Cover Story
Boundaries of Algorithmic Computing 7

P=NP?
Cover Story
Algorithmic Computing – A Perspective 10

Research Front
Stable Marriage – Algorithm and Variants 23

Security Corner
An Overview of Next Generation Firewalls (NGFW) 35

Article
Defining and Describing Multilayer Approach for Safe Social Networking 30

Security Corner
A Case Study of Vaayda Bazaar 37
GURU NANAK INSTITUTIONS
TECHNICAL CAMPUS

is now the most ENERGY EFFICIENT GREEN CAMPUS of The State

The GNI Campus won "The Excellent Innovation Institute in A.P. Award" at the A.P. Education Awards 2014 supported by Department of MNRE GOI, Department of MSME GOI, AICTE, JNTUA, CMAI, Association of Indian Universities, NIELIT, Electronics India. The campus with an investment of 1.5 Crores has set up a 110KW solar plant, that taps sufficient energy to run many electrical facilities of GNI Campus.

11 CENTERS OF EXCELLENCE @ GNI

Your edge in ENGINEERING is here.

Our state-of-the art Innovation Centre has Research Centres for Robotics, Big Data, Solar Power Engineering, Machine Vision, Software Incubation, Entrepreneurship, Arch GIS, Cloud Computing, Infosys, Center for NDT and Skill Matters under its ceiling. These Research Centres facilitate students to carry out their research meticulously as well as further their learning process by working on live projects for a better understanding of their subject.

COURSES OFFERED

Engineering:
- B.Tech: ECE, CSE, Mechanical, EEE, Civil, IT, Aeronautical
- M.Tech: CSE, DECS, DSCE, CAD/CAM, SE, IT, VLSI Design, Embedded Systems

Management:
- MBA, PGDM, BBM, E-PGDM, MCA

Pharmacy:
- Pharm. D, Pharm. D (Post Baccalaureate), B. Pharm, M. Pharm (Pharmaceutics, Pharmacology, Pharmaceutical Analysis & Quality Assurance, Pharmaceutical Management and Regulatory Affairs)

Dental:
- BDS, MDS (in all 9 Specialties)

EAMCET CODES

Guru Nanak Institutions Technical Campus
GURU

Guru Nanak Institute of Technology
GNIT

Campus: Ibrahimpetham, R.R. District, Hyderabad - 501506, Telangana State.
Phone: 08414-202120/21, Fax: 08414-225344.
City Office: B2, 2nd Floor, Above Datta, Vikramtunga Colony, Kanchana Road, Secunderabad - 500 009. Phone: 040-6632 3294, 6517 6117
Email: admissions@gniindia.org

HELPLINE: +91 80082 95550 / 51

Follow us on: /gurunanakinsitutionsindia /GNInstitutions /GNInstitutions
Contents

Volume No. 38 • Issue No. 9 • December 2014

Editorial Board

Chief Editor
Dr. R M Sonar

Editors
Dr. Debasish Jana
Dr. Achuthsankar Nair

Resident Editor
Mrs. Jayshree Dhere

Published by
Executive Secretary
Mr. Suchit Gogwekar
For Computer Society of India

Design, Print and Dispatch by
CyberMedia Services Limited

Cover Story
Boundaries of Algorithmic Computing
Prof. David M Keil

Algorithmic Computing – A Perspective
N.S. Narayanassignam

Technical Trends
Algorithms to Restructure the Websites for Efficient Browsing
Harpreet Singh and Parminder Kaur

Algorithm – AIM (Analysis in Minutes)
B. Raj Kumar and M. Chandrakumar Peter

Algorithimic Computing: A Detailed Oriented Thinking about Procedures
Prof (Dr.) D G Jha and Ms. Kimaya Ambekar

Recommendation Engines – A Generic Architecture
Ms. Seema Rawat, Mr. Praveen Kumar, Prof. Sunil Kumar Khatri and Dr. Balvinder Shukla

Research Front
Stable Marriage – Algorithm and Variants
Dr. Meghana Nasre

Generating Random Numbers and their Applications in Computing
Srabani Mukhopadhyaya

Articles
Challenges in Using Aadhar as Unique Identity Number for Delivery of e-Government Services
Rajesh Sharma

Defining and Describing Multilayer Approach for Safe Social Networking
Nandakumar Edamana

Practitioner Workbench
Programming.Tips() »
Fun with Bitwise Operators in C Programming
Amitava Nag

Programming.Learn("R") »
Shine with Shiny of R !!!
Umesh P and Silpa Bhaskaran

Security Corner
Information Security »
An Overview of Next Generation Firewalls (NGFW)
Samriti Gupta, Balvir Kumar and P. K. Khosla

Case Studies in IT Governance, IT Risk and Information Security »
A Case Study of Vaayda Bazaar
Dr. Vishnu Kanhere

PLUS

Brain Teaser
Dr. Debasish Jana

Happenings@ICT
H R Mohan

CSI Reports

CSI Elections 2015-2016/2017

CSI News

Published by Suchit Gogwekar for Computer Society of India at Unit No. 3, 4th Floor, Samruddhi Venture Park, MIDC, Andheri (E), Mumbai-400 093.
Tel.: 022-2926 1700 • Fax: 022-2830 2133 • Email: hq@csi-india.org Printed at GP Offset Pvt. Ltd., Mumbai 400 059.
Know Your CSI

Executive Committee (2013-14/15)

President
Mr. H R Mohan
president@csi-india.org

Vice-President
Prof. Bipin V Mehta
vp@csi-india.org

Hon. Secretary
Mr. Sanjay Mohapatra
secretary@csi-india.org

Hon. Treasurer
Mr. Ranga Rajagopalan
treasurer@csi-india.org

Nomination Committee (2014-2015)

Prof. P. Kalyanaraman
Mr. Sanjeev Kumar
Mr. Subimal Kundu

Regional Vice-Presidents

Region - I
Mr. R K Vyas
Delhi, Punjab, Haryana, Himachal Pradesh, Jammu & Kashmir, Uttar Pradesh, Uttarakhand and other areas in Northern India.
rvp1@csi-india.org

Region - V
Mr. Raju L kanchibhotla
Karnataka and Andhra Pradesh
rvp5@csi-india.org

Division Chairpersons

Division-I : Hardware (2013-15)
Prof. M N Hoda
div1@csi-india.org

Division-IV : Communications (2014-16)
Dr. Durgesh Kumar Mishra
div4@csi-india.org

Division-V : Education and Research (2013-15)
Dr. Anirban Basu
div5@csi-india.org

Division-III : Applications (2013-15)
Dr. A K Nayak
div3@csi-india.org

Important links on CSI website

About CSI
http://www.csi-india.org/about-csi

Structure and Organisation
http://www.csi-india.org/web/guest/structureandorganisation

Executive Committee
http://www.csi-india.org/web/guest/executive-committee

Nomination Committee
http://www.csi-india.org/web/guest/nominations-committee

Statutory Committees
http://www.csi-india.org/web/guest/statutory-committees

Who’s Who
http://www.csi-india.org/web/guest/who’s-who

CSI Fellows
http://www.csi-india.org/web/guest/csi-fellows

National, Regional & State

Student Coordinators Collaborations
http://www.csi-india.org/web/guest/collaborations

Distinguished Speakers
http://www.csi-india.org/web/guest/distinguished-speakers

Divisions
http://www.csi-india.org/web/guest/divisions

Regions
http://www.csi-india.org/web/guest/regions

Chapters
http://www.csi-india.org/web/guest/chapters

Policy Guidelines
http://www.csi-india.org/web/guest/policy-guidelines

Student Branches
http://www.csi-india.org/web/guest/student-branches

Membership Services
http://www.csi-india.org/web/guest/membership-service

Upcoming Events
http://www.csi-india.org/web/guest/upcoming-events

Publications
http://www.csi-india.org/web/guest/publications

Student’s Corner
http://www.csi-india.org/web/education-directorate/student-s-corner

CSI Awards
http://www.csi-india.org/web/guest/csi-awards

CSI Certification
http://www.csi-india.org/web/guest/csi-certification

Upcoming Webinars
http://www.csi-india.org/web/guest/upcoming-webinars

About Membership
http://www.csi-india.org/web/guest/about-membership

Why join CSI
http://www.csi-india.org/web/guest/why-join-csi

Membership Benefits
http://www.csi-india.org/web/guest/membership-benefits

BABA Scheme
http://www.csi-india.org/web/guest/membership-schemes-baba-scheme

Special Interest Groups
http://www.csi-india.org/web/guest/special-interest-groups

Membership Subscription Fees
http://www.csi-india.org/web/guest/membership-fee

Membership and Grades
http://www.csi-india.org/web/guest/membership-grades

Institutional Membership

Become a member
http://www.csi-india.org/web/guest/become-a-member

Upgrading and Renewing Membership
http://www.csi-india.org/web/guest/upgrading-member

Download Forms
http://www.csi-india.org/web/guest/download-forms

Membership Eligibility
http://www.csi-india.org/web/guest/membership-eligibility

Code of Ethics
http://www.csi-india.org/web/guest/code-of-ethics

From the President Desk
http://www.csi-india.org/web/guest/president-s-desk

CSI Communications (PDF Version)
http://www.csi-india.org/web/guest/csi-communications-pdf-version

CSI Communications (HTML Version)
http://www.csi-india.org/web/guest/csi-communications-html-version

CSI Journal of Computing
http://www.csi-india.org/web/guest/csi-journal-of-computing

CSI Newsletter
http://www.csi-india.org/web/guest/csi-newsletter

CSI Chapters SBS News
http://www.csi-india.org/web/guest/csi-chapters-sbs-news

Education Directorate
http://www.csi-india.org/web/education-directorate/home

National Students Coordinator
http://www.csi-india.org/web/national-students-coordinator/home

Awards and Honors
http://www.csi-india.org/web/guest/awards-and-honors

eGovernance Awards
http://www.csi-india.org/web/guest/e-governanceawards

IT Excellence Awards
http://www.csi-india.org/web/guest/it-excellenceawards

YITE Awards
http://www.csi-india.org/web/guest/yite-awards

CSI Service Awards
http://www.csi-india.org/web/guest/csi-service-awards

Academic Excellence Awards
http://www.csi-india.org/web/guest/academic-excellence-awards

Contact us
http://www.csi-india.org/web/guest/contact-us

Important Contact Details

For queries, correspondence regarding Membership, contact helpdesk@csi-india.org

CSI Communications | December 2014 | 4

www.csi-india.org
Dear Members,

I am happy to share the good news that Prof. Mahabala Distinguished Chair in Computational Brain Research has been established on 28th Nov 2014 by Mr. Kris Gopalakrishnan, co-Founder of Infosys at Indian Institute of Technology (IIT) Madras where Prof. Mahabala had served in the faculty of Computer Science and Engineering for over two decades. He has been adjudged by the students as “the Best Teacher” between 1981-82. Prof. H.N. Ramakrishna,a visiting faculty, also presented the CSI Nihiliant eGovernance Award during the convention. Apart from the tutorials on state of the art technologies, special sessions on “IT enablement of Public & Govt. Sector” and “Intravenous management for Human Excellence” by Swami Bhoomananda Tirtha will be of interest to the delegates.

In addition to three keynote addresses on “Digital India - Opportunities and Challenges Ahead” by Dr. Avinash Chander, Scientific Advisor to Defense Minister & DG, DRDO; “Digital Literacy for Smart India” by Mr. P. Sudhakar, CMD, ECIL; “Role of IT in Defence Systems” by Dr. V.G. Sekaran, DGM, DRDO, the six main convention sessions namely “Cloud Computing Technologies & Strategies for Business”, “Cyber Security & Information Warfare”, “Enterprise Networks & Intelligent Data Centers”, “Smart Cities & IoT”, “Technology Imperatives for Education & Healthcare” and “Mobile Computing & Social Networking” will feature addresses by eminent speakers from industry and academia. Contributed Paper Presentations will take place simultaneously.

In the CSI-2014 convention and Golden Jubilee celebrations, we will be honouring four of our distinguished fellows of CSI with Life Time Achievement Awards. We congratulate the following four LTA awardees: Dr. C.R. Chakravarthy, who has served CSI for over three and a half decades in various capacities and of late who is synonymous with the event “- IT for Defence”; Professor D.K. Dutta Majumder, a founding member of CSI and a recipient of the Norbert Wiener Award; Brig. S.V. Choudhary, an Indian Army Senior Officer who lead the CSI during 1992-94; and Prof. DVR Vithal, a recipient of the CSTI Lifetime Achievement Award during CSI-2012 in Kolkata. We are proud of him. This is the best feeling of saying thank you to a person who has contributed so much to the field of Computer Science and Technology.

I am happy to announce that Mr. H.C. Sridhar, Manager of CSI BC for having completed 25 years of service in CSI, similar to CSI ED staff Mr. S. Natarajan, Manager(Finance) and M. Gnanasekaran, Manager (Administration) who had similarly good appointments at the CSI.

It is concerning to read newspaper reports about stressed out IT professionals who feel stigmatized by those in their professional circles as they seek psychiatric help. Many turn into mental wrecks because they do not know they could get help or are reluctant to seek medical referral for fear of a stigma. The stress levels, meanwhile, are on the increase right from the college days to the transition to the work place, resulting in a lot of other health-related problems. Recently, I had the opportunity to visit Art of Living Centre in Bangalore and Gayatri Tirth Shantikunj in Haridwar both to encourage your colleagues and contacts to become Life Members of CSI, taking advantage of the limited time discount offer in membership fee which will end by Dec 2014.

I look forward to seeing you at Hyderabad in Dec 2014.

With best regards

H.R. Mohan
President
Computer Society of India
Dear Fellow CSI Members,

The theme for this issue is Algorithmic Computing. By *algorithm*, we conceptualize a sequence of actions to compute a solution to a functional problem. Some problems are tractable that can be solved computationally in polynomial time while there remain several intractable problems that are believed not to have a polynomial time algorithm. For intractable problems, sometimes, we devise a solution for a simpler or restricted version of the problem or try to find an answer that is highly probable to be right, or approximately correct. The Turing machine remains as the basis of all studies in computability and efficient algorithms, thus serving as foundation of mathematical computation. While algorithmic computing relies on mechanical automatic transformation of input to output, computing with intelligent machines may have to consider environmental interactions too, and this could be imagined as interactive computing.

Our Cover Story section is enriched with two lucid and thought-provoking contributions. Prof. David M Keil of Framingham State University, Massachusetts, USA has elaborated on Boundaries of Algorithmic Computing. Prof. Keil emphasizes on models of algorithmic computing through finite automata with equivalence among propositional logic, logic circuits, lookup tables and loopless transition systems and interactive computing through extensions of Turing machine, random-access machine and mu-recursive function. Prof. N S Narayanaswamy of Indian Institute of Technology Madras has presented Algorithmic Computing – A Perspective. In his article, Prof. Narayanaswamy talks about algorithmic computing as a phrase that stands for the design of a Halting Turing machine with emphasis on logical proof of algorithmic behavior deduced in a mathematical logic framework through axioms and inference rules. In the process, he touches upon the upper and lower bounds of efficient algorithms with examples of some well-known algorithms and role of reductions among tractable and intractable problems from a mathematical standpoint.

The Turing machine remains as the basis of all studies in computability and efficient algorithms, thus serving as foundation of mathematical computation. While algorithmic computing relies on mechanical automatic transformation of input to output, computing with intelligent machines may have to consider environmental interactions too, and this could be imagined as interactive computing.

Technical Trends section of this month has four articles. The first one is by Dr. Harpreet Singh of DAV University Jalandhar and Dr. Parminder Kaur of Guru Nanak Dev University Amritsar on Algorithms to Restructure the Websites for Efficient Browsing, elaborating website graph structure improvement for better browsing experience. The second one is by B Raj Kumar and M Chandrakumar Peter of Periyar Maniammai University, Vallam, Thanjavur on Algorithm – AIM (Analysis in Minutes), presenting a collection of time and space complexities of several common searching and sorting algorithms. The third one is by Prof. D G Jha and Ms. Kimaya Ambekar of K J Somaiya Institute of Management Studies and Research, Mumbai on Algorithmic Computing: A Detailed Oriented Thinking about Procedures to present fundamental building blocks of programming to engage algorithmic techniques. The fourth one is by Ms. Seema Rawat, Mr. Praveen Kumar, Prof. Sunil Kumar Khatri and Dr. Balvinder Shukla of Amity University, Noida on Recommendation Engines – A Generic Architecture that helps in intelligent choice predictions for prospective buyer on the web.

Our Research Front section is enriched with two important contributions. First one is titled Stable Marriage – Algorithm and Variants by Dr. Meghana Nasre of Indian Institute of Technology Madras, elaborating techniques of finding a stable match between two sets of elements under preferences. Second one is by Dr. Srbani Mukhopadhyay of Kolkata Campus of Birla Institute of Technology Mesra titled Generating Random Numbers and their Applications in Computing, which presents practical applications of randomization and probabilistic techniques.

Our Article section is having two contributions on varied topics. The first one is by Mr. Rajesh Sharma of Telecommunication Engineering Centre, New Delhi on Challenges in Using Aadhar as Unique Identity Number for Delivery of e-Government Services and the second one is by Mr. Nandakumar Edamana, a software developer studying B.Sc. Computer Science in a college run by Institute of Human Resource Development, Kerala on Defining and Describing Multilayer Approach for Safe Social Networking.

In our regular Practitioner Workbench column’s Programming. Tips() section, Mr. Amitava Nig of Academy of Technology, West Bengal explains Fun with Bitwise Operators in C Programming. Umesh P and Silpa Bhaskaran continue their write-ups on app development as Shine with Shiny of R under Programming.

...algorithmic computing as a phrase that stands for the design of a Halting Turing machine with emphasis on logical proof of algorithmic behavior deduced in a mathematical logic framework through axioms and inference rules.

Under Information Security section in Security Corner we have an interesting anecdote on An Overview of Next Generation Firewalls (NGFW) by Ms. Samriti Gupta, Mr. Balvinder Kumar and Mr. P K Khosla of Terminal Ballistics Research Laboratory Chandigarh, DRDO. Dr. Vishnu Kanhere of CSI-SIG on Humane Computing searches answer to Algorithmic Computing – Problem or Solution through A Case Study of Vaayda Bazaar under Case Studies in IT Governance, IT Risk and Information Security subsection of Security Corner.

Dr. Debasish Jana, Editor, CSI Communications presents crossword for those who want to test their knowledge in Algorithmic Computing under Brain Teaser column. Mr. H R Mohan, President, CSI and Former AVP (Systems), The Hindu, Chennai brings us the ICT News Briefs at a glance under various sectors in November 2014 under regular column Happenings@ICT. We have other regular features like CSI Announcements, CSI Reports and Chapter and Student Branch News.

Please send your feedback, comments and views about CSI Communications magazine to csic@csi-india.org

With warm regards,
Rajendra M Sonar, Achuthsankar S Nair, Debasish Jana and Jayshree Dhere
Editors
Boundaries of Algorithmic Computing

Computing began with devices to drive looms, tabulate census data, and convert data from punch cards into print-outs. The old computing paradigm of batch computing, typified by COBOL programs that produced print-outs from punch cards, was algorithmic. An algorithm by definition transforms a finite input into a finite output in finite time (Fig. 1).

An algorithm always computes a function that maps from inputs to outputs. Output is strictly dependent on the most recent input.

Today, most computing that involves users follows an interactive paradigm, in which input and output follow each other repeatedly, often many times per second, and in which most inputs depend on prior outputs (Fig. 2).

At each step of an interactive computation, an algorithm is executed that computes a function. Unlike the function computed by a batch program, this function maps, not from external input to output, but rather from a pair consisting of external input and state of the interactive computing agent, to a pair that consists of external output and state of the agent. Thus, when we have a conversation and you say, “How are you?” my response will not depend only on your question, but also on my state. When we click on a screen button using a touch pad, the result on our screen is not computed as a function of our click only, but also as a function of the state of the device we are using.

Input to an interactive computation is a stream (x, in Fig. 3), and output (y) is a stream. The behavior of an interactive computing system is characterized not by a function from possible inputs to possible outputs, but rather as a stream of pairs of inputs and outputs.

Furthermore, most user-based computation today is not only interactive, but is actually multi-stream interactive - a second paradigm away from strictly algorithmic computing. When we use our mobile phones, when we log on to a social network, or when a robotic device operates, multiple streams of inputs and outputs are flowing as part of the computation.

In Fig. 4, we see how multiple computing agents may each interact concurrently with multiple others.

In multi-stream interaction, much of the interaction may be indirect. In Fig. 5, computing agent A interacts directly with agent X and not with agent B (we may call E, consisting of X and B, the environment of A). But A and B may interact indirectly. This indirect interaction via the environment is the main reason for the rise of social networks and much other online software.

Thus, we have two paradigm shifts. Both were identified in the 1990s by Peter Wegner, one of the authors of the original computer-science curriculum adopted by the Association for Computer Machinery, Curriculum 68.

In the field of software development, design notations have evolved with paradigms of computing and software. For decades, the flowchart and the module hierarchy were the most widely used notations. In the 1990s, with the rise of object-oriented technology, a new notation evolved that incorporated the interactive paradigm. Thus the Unified Modeling Language (UML) incorporates use-case diagrams, interaction diagrams, and class diagrams, among many others. Object-oriented technology incorporates the interaction paradigm with the notion of messages passed to objects. It is not an accident that, when computational challenges evolved from batch computing to graphical user interfaces, a revolution of object-oriented analysis and design occurred to accommodate the change.

In the field of theoretical computer science, change has not taken the same course; it has not followed the pattern of software-development technology. Today, textbooks still claim that the Turing machine (the standard model of algorithmic computing) captures all computing, such as all the operation of a personal computer. User interfaces, disk storage, cloud storage, and social networks are not captured by the Turing machine.

The computational project of building cars that drive themselves, now well under way, is solved by interaction and not by algorithms alone. No effective algorithmic procedure can take a car from a university building to a cinema. A map can help, but the travel task can only be accomplished by interaction with the environment along the way.

Ten years ago, Dina Goldin and others proved that a model of interaction, the
Persistent Turing Machine, solves problems not solved by the iterated computations of a Turing machine. Other researchers, such as Farhad Arbab, Jan Van Leeuwen, Jiri Wiedermann, Robin Milner, and researchers in open computational systems and environments for multi-agent systems, have worked to model interactive computation. It seems probable that this research will be taken forward, perhaps by readers of this article. The body of theoretical work developed by Wegner, Goldin, and others in particular invites elaboration and extension.

The boundaries of algorithmic computing, as treated by scholars, may be extended in two directions, and computing, as treated by scholars, may be extended in two directions, and The traditional understanding of computing extends from finite automata, through stack machines, to Turing machines. It is known that Turing machines are of equivalent computing power, or expressiveness, to random-access machines. Turing machines operate with symbols on tape, whereas RAMs operate via a simple assembler-like language that accesses memory locations by symbolic names.

Finite automata (also called “finite state machines”) are transition systems that accept or reject their inputs, depending on the state in which an input leaves the automaton. An example is in Fig. 6. It accepts strings such as “11000” and rejects strings such as “001”. The languages accepted by finite automata are themselves considered an alternative way to model computation. Each model of computation is associated with a set of languages. For the finite automaton in Fig. 6, the language specification could be as follows: 1*0(0* | 11*0)*. What precedes a star may be repeated zero or more times, and the vertical bar (for OR) denotes options.

A simpler two-state FA is in Fig. 7. It accepts the language 10*.Finite automata are in turn built from simpler devices, equivalent to the propositional logic. These may take the form of lookup tables, logic circuits, or loopless transition systems. Their sets of possible inputs are finite, whereas there is no bound on the length of the input of a finite automaton. A truth table is a lookup table that is equivalent to any logic circuit or loopless transition system.

The following three models of computation are equivalent. The logic circuit (Fig. 7a) computes a boolean (true/false or 0/1) function from three boolean inputs. The truth table (Fig. 7b) shows equivalent results and is used in computation by a lookup process. The loopless transition system (Fig. 7c) accepts strings that take it, symbol by symbol, into a circled state following the labels on the transition arrows. Each also corresponds to the sentence ((a ∨ b) ∧ ¬(a ∧ b)) in propositional logic.

The languages (sets of (a, b) input sequences) accepted by the above described models are all finite. An instance of the logic circuit, truth table, or loopless transition system accepts only a finite number of strings.

Just as finite automata may be constructed from logic circuits or lookup tables, the more powerful model of computation known as the stack machine is constructed from finite automata. A stack machine is a finite automaton with pushdown stack storage attached.

The languages accepted by finite automata are called regular and those accepted by stack machines are called context-free. All regular languages are context-free, but not all context-free languages are regular. All the languages accepted by logic circuits are regular.

Finite automata are in turn built from simpler devices .... may take the form of lookup tables, logic circuits, or loopless transition systems.

In turn, Turing machines are equivalent to two-stack stack machines, or, alternatively, to finite automata with tape storage attached. The Turing machines and the random-access machines accept a set of languages called recursive or recursively definable, and compute a set of functions on natural numbers called mu-recursive.

Recursion and induction, well-known in mathematics, are very deeply connected with computation and its limits. By induction, we can prove that an algorithm computes the function we say it computes. By use of recursive function definitions, we may analyze the time performance of algorithms. Thus the mathematics of set theory, induction, and recursion theory is part of the professional toolkit of software developers.

By showing that a function is not recursively definable, we may show that it is not algorithmically computable, hence it is a problem that is not worth the slightest investment in solving for all cases. A program-checking program that could tell, from source code, whether a given program goes into an infinite loop on some input, would have great value to a software development enterprise. But that problem has unfortunately been proven to be unsolvable computationally. You may potentially save investors the waste of very large amounts of money by showing

---

**Fig. 6: Finite automaton**

---

**Fig. 7: Automaton that accepts the language 10**

---

**Fig. 7a: Logic circuit**

**Fig. 7b: Truth table**

**Fig. 7c: Loopless transition system**
The boundaries of algorithmic computation have been broken in computing practice, twice over, by standard desktop user interfaces and by multi-stream interactive devices such as smart phones and robotic systems. Much of the corresponding theoretical work has yet to be done, and the corresponding significant results are yet to be established as part of the shared knowledge of computer science.

References
Algorithmic Computing – A Perspective

What can be computed is formalized in the framework of a subject called Formal Languages and Automata Theory\(^1\), which is part of every undergraduate Computer Science curriculum. All those decision problems that can be solved by a Turing Machine are those that can be computed. Algorithms are special kinds of Turing Machines that halt on all inputs. The field of Design and Analysis of Algorithms has been a central topic in the field of Computing for nearly half a century now. Prior to that, starting with Pythagoras, procedures to compute certain values, and procedures to compute one more entity with a given property were known for nearly two thousand years. In particular, given a Pythagorean triple \((3^2 + 4^2 = 5^2\) Pythagoras came up with a method to compute another Pythagorean triple, and this could be thought of as among the earliest recorded algorithmic methods. Pythagoras himself is supposed have learned of the possibility of creating formulae for different mathematical objects from the Egyptians and Babylonians\(^2\). In the world of Algorithms, one endeavours to optimize the resources used during the execution of an Algorithm. The aim of this article to present to the reader the different landmark algorithms, the techniques used, and a few glimpses into the bottomless pit of problems which have algorithms (Halting Turing Machines), and we desire efficient algorithms.

Algorithms are special kinds of Turing Machines that halt on all inputs

An Algorithm is a set of statements that precisely defines a sequence of operations on each input, and one that eventually halts on each input. The word "algorithm" is believed to stem from the name of a Latin Translation of a book by Al Khwarizmi, who was a Persian mathematician, astronomer, and Geographer. A book by him titled On the Calculation with Hindu Numerals when translated into Latin became Algoritmi de numero Indorum (meaning Al-Khwarizmi on the Hindu art of Reckoning) (see Wikipedia article on Algorithms). Algorithms are represented using many notations- an undergraduate student of Computer Science will be familiar with the fact that a halting Turing Machine represents an algorithm, for his/her study of Data Structures and Algorithms will know that a C program or psuedocode can be used to describe algorithms. Those of us who have written assembly programs in our study of Microprocessors will also recognize that assembly code represents algorithms.

Pythagoras himself is supposed have learned of the possibility of creating formulae for different mathematical objects from the Egyptians and Babylonians

... a mathematical proof, or a logical proof ....... can definitely be verified by a person with sight, but can also be verified by a machine that can perform inferences in a framework of logic

Correctness, Halting, and Efficiency

The correctness of an algorithm is sacrosanct, it must be logically proved. It is important to distinguish between a logical proof and a scientific proof\(^3\). For example, Software Developers usually deploy testing as a way of believing that an implementation is indeed correct. In a scientific proof, a statement is believed to be acceptable as true, if it can be verified independent of the properties of the verifier. Most of us who have studied science in school will recognize that repeatability of an experiment is a very important parameter for the experiment to the recognized as a valid one. A scientific proof is similar. On the other hand, a logical proof is one where the behaviour of the algorithm is inferred in a framework of mathematical logic (one that a finite number of axioms and inference rules to derive new statements). While many students of the subject will be familiar with this idea, it is useful to give a small example. Let us consider the statement that the sum of three angles, in degree, of a triangle is 180. A scientific proof of this statement will consist of many triangles, methods for drawing them, using a compass and ruler, the values of the 3 angles, and then the sum. On these examples, any person who can have sight can measure and verify the truth of the claim. This is what constitutes a scientific proof. On the other hand, a mathematical proof, or a logical proof is based on the Euclid’s axioms of geometry that can definitely be verified by a person with sight, but can also be verified by a machine that can perform inferences in a framework of logic. So, the correctness of an algorithm is acceptable only in a framework of logic. That is why as students of algorithms, we write logical proofs. A simple proof illustrating the inferences made in a logical framework can be seen by analyzing the popular sorting algorithm called Insertion Sort\(^2\). The logical statement that plays a central role in the correctness analysis of insertion sort is - If insertion sort is run an input consisting of n keys, then after the i-th iteration where i lies in the range 1 and n, the first i elements are in sorted order. This logical statement is then proved using the principle of Mathematical Induction. Let us illustrate the importance and ubiquity of logical proofs in algorithms by another example that each of will be familiar with. Let us recall the Minimum Spanning Tree Problem for which two popular algorithms are the Prim’s Algorithm and the Kruskal’s algorithm\(^2\). In both the algorithms the main logical statement that is proved is - if the current data that has been computed is guaranteed to be part of a final optimum solution, then among all the edges that can be added to the current data without violating any of the constraints, the any one of the edges of least cost can be used to extend the data, and is also guaranteed to be part of a final optimum solution. Using any of the acceptable edges of least cost is referred to as Greedy Choice, and the proof of correctness is by the principle of Mathematical Induction, and from the Theory of Matroids. There are many more mathematical concepts that play a very important role in the correctness of Algorithms: The Ellipsoid method and the Simplex Method for Linear Programming\(^5\), The Ford-Fulkerson and Edmonds-Karp Algorithms for computing a maximum network flow\(^2\), and the Miller-Rabin test\(^2\) and the Agrawal-Kayal-Saxena algorithm\(^4\) for primality testing. The first of the above examples, Linear programming is an analysis of optimization algorithms on convex polyhedra, the second one, about Network Flows is a problem that is extremely important in Transportation networks and other
mathematical proofs in algorithms, and the last one on Primality testing involves advanced Algebra, and also involves an All Indian Team. Termination of an Algorithm or Halting is traditionally the part of the correctness proof. In our two examples on the correctness of Insertion Sort and Minimum Spanning Tree algorithms, note that the logical statements involve in-built termination conditions. In the Sorting case, the range of values of i, lying between l and n, guarantees termination. In the Minimum Spanning Tree example, from the subject to Graph Theory, we can prove that in a finite number of iteration the set of edges that can be added without violating any of the constraints will become empty, at which point, the algorithm stops. This is an appropriate place to stop this discussion on correctness and halting, and this is in the interests of using the space limit for this article efficiently.

The most inefficient algorithm is to enumerate each candidate solution or almost all candidate solutions and select a solution when we find one. While this may seem an exaggeration, there are many problems that still only admit such correct algorithms. Indeed, before the Agrawal-Kayal-Saxena algorithm for primality testing in 2002, such an algorithm was the efficient algorithm that most of us knew. Let us visit this as a complete example (for many of us this was our first programming exercise): take a positive integer n as input (remember, n is represented using log(n) bits), and test if it is a prime number. The algorithm that was immediately implemented was to test if any integer between 2 and square-root of n was a factor. If a factor was found, then n was reported as composite, else it was reported as prime. How efficient is this algorithm? The input is the number n, and we only perform square-root of n division operations. It looks efficient. Actually, it is an exponential-time algorithm in the input size, which is log(n) bits to represent n. So the Agrawal-Kayal-Saxena algorithm for primality testing runs in time which is \(O(\log^5 n)\) algebraic operations, and this is exponentially smaller than square-root of n operations. Again, as in correctness, efficiency requires mathematical handles from a variety of fields. Using simpler combinatorial techniques, we have known efficient algorithms for finding shortest paths in graphs, finding minimum spanning trees, for sorting a given set of keys. Sorting a given set of n keys is even more interesting, as we know that a comparison based sorting algorithm cannot use lesser than n log(n) comparison operations. This is a lower limit on the efficiency, an inherent problem specific limit. While design of efficient algorithms have been enticing and exciting, the goal of proving lower bounds on efficiency have been daunting. Our mathematical understanding of algorithms is just evolving. Are there problems for which we cannot do any better than just do an exhaustive, therefore inefficient, enumeration to solve a problem? Many. Let us start with the simplest, and one that a fresh reader is likely to be unaware of: A society of n men and women have given symmetric marriage preferences for each other. A symmetric preference is one in which a pair have agreed to be married, if necessary. How many pairings are there in the society? There is no efficient algorithm known to solve this problem, yet. Further, it is believed that this problem cannot be solved in time which is a polynomial in n. This problem is identical to computing the Permanent of a square matrix, and research on this problem is being spearheaded by Indian research groups headed by Agrawal of the primality testing fame. Permanent is a fascinating function that looks very similar to its very famous cousin, so to speak, the Determinant of a square matrix. To get the definition of the permanent from the definition of the determinant that we have all studied in our school days, replace all the negative signs in the determinant formula with a positive sign. Remember that the signs of the matrix entries are not the ones that you are asked to change, it is the negative signs in the determinant formula. Now that you have got the definition of the permanent easily by changing the definition of the determinant, it is a well-known fact that the determinant of a matrix can be very efficiently calculated by the famous Gaussian-Elimination algorithm using invariant properties of the determinant that, again, we studied in school. However, the permanent function so easily obtained by modifying the determinant function, remains an elusive problem for algorithm designers, and is believed to be inherently hard for efficient algorithms. There are many more problems for which we do not efficient algorithms, and the only inefficient algorithms that we know are ones that involve exhaustive enumeration of candidate solutions. Let us list a few: Boolean Satisfiability, Travelling Salesman Problem, and the Graph Colouring Problem[6]. They and many other problems that they can be reduced to (see[4] for more about reductions) seem to be waiting for the Indian Ingenuity that introduced zero or shoonya to Mathematics. You are all welcome, there is so much to be explored.

References
Algorithms to Restructure the Websites for Efficient Browsing

Introduction
With the expansion of internet, the size of the websites is growing at a faster rate and the number of Internet users is also increasing exponentially. Many firms and government agencies are providing services through applications such as e-commerce and e-government respectively. This has created a problem for the website designers to develop such a structure of the website so that users do not get disoriented and get satisfied with the website contents. Efficient browsing refers to navigating to the relevant web page quickly with less effort. It is a normal tendency of the web users that they tend to leave a website if it takes long to reach to the target page. It has also been observed that the browsing behaviours of users change frequently. Hence algorithms to rearrange the structure of websites are needed.

Web Graph Structure
The structure of a website can be considered as a directed graph where nodes represent webpages and edges represent the hyperlinks between webpages. Figure 1 represents such a structure.

![Hyperlink graph example](image)

The websites are divided into two categories: Informational or Static websites and Dynamic websites. Informational websites refers to the websites whose contents remain unchanged for a long period of time. Examples consist the websites of hotels, universities and hospitals. Dynamic website refers to the websites whose contents change regularly. E-commerce websites are examples of these websites where information about new products and schemes is added regularly and information about old products is removed.

The methods to reorganise the graph structure are further classified into following three approaches:

- **Mathematical Programming Techniques**: In these approaches, the problem is formed as 0-1 programming problem with some constraints to be satisfied. These approaches use tools (Lin, 2006) to solve the models.
- **Heuristic Methods**: These methods are based on heuristics such as combining two nodes, removal or addition of links etc. These approaches do not produce the optimal solution and also take less time.
- **Meta-Heuristic Techniques**: Mostly, metaheuristics are derived from some natural process such as food foraging process of ants. These approaches use predefined strategy to find the near optimal solutions.

The websites which reorganize their graph structure according to the behaviour of the users are known as adaptive websites. This restructuring can be performed in two ways: Customization and Transformation. In Customization, web pages are generated which include links to another pages according to behaviour of a particular user. Transformation approaches include reorganizing the graph structure of a website to improve the browsing experience for all the users. Both these approaches use web log data at the web servers to get the browsing behaviour of users. Here, browsing behaviour of users refers to the webpage navigation patterns of web users. The website graph structure improvement models follow certain constraints. Some of the constraints are:

- **Connectivity constraint**: This constraint defines that every other webpage should be reachable from the home page.
- **Depth constraint**: It specifies that there should be limit on maximum number of links to be followed to reach a particular page.
- **Outdegree limit**: There should be a constraint on the number of hyperlinks out of a webpage.
- **Link constraint**: There are some links which should not be removed to maintain the service logics specified by website design.

Algorithms for Website Restructuring
This section briefly discusses the various categories of methods for website graph structure improvement. Figure 2 shows the basic web graph reorganization model. The navigation behaviour of users and the current web graph structure are fed to the model as input and the algorithm generates the improved graph structure as output.

Heuristic Methods
A very successful heuristic method is developed by Fu et al. (2002). The webpages are classified into two categories: index pages and content pages based on the page access information. The general scheme of reorganization is to reduce the navigation time by reducing the number of intermediary index pages a user has to browse to reach the destination webpage. To accomplish this, frequently accessed pages are positioned higher up in the link structure, i.e. nearer to the home page and pages that are not accessed frequently are placed lower in the website link structure. Starting from the home page, the webpages are examined sequentially. For every page, the predecessor and successor nodes are considered, where a predecessor is any page that has a link to it and successor nodes are pages that are pointed by the current page. There are different cases depending on the number of predecessor and successor nodes and for each case,
different actions may be taken according to the frequency and category of the pages involved.

Mathematical Programming Methods
Lin (2006) has successfully applied the 0-1 programming model to optimize the web graph structure. Every link in the website link structure has an access frequency \( f_{ij} \), obtained by using the web usage mining process (Lin, 2006) on the web logs stored at web servers. The access frequency \( f_{ij} \) corresponds to the number of users moving from webpage \( i \) to webpage \( j \). The goal of optimizing the web graph structure is to maximize the frequency summation of all the links with certain constraints.

The objective function of model is described below.

\[
\max \sum_{(i,j) \in E} f_{ij} x_{ij} \]

The parameter \( x_{ij} \) denotes the presence of link \( (i,j) \). If \( x_{ij} = 1 \), it means that a hyperlink exists from page \( i \) to \( j \). If \( x_{ij} = 0 \), it denotes that page \( j \) cannot be accessed directly from \( i \).

If the web graph structure of a website is changed significantly then the old users may find it difficult to browse the website. To address this issue, Chen and Ryu (2013) have developed a mathematical programming model that assists the user navigation on a website. Here the changes made to the web graph structure are minimized. In this model, the out-degree is taken as a cost term in the objective function and webpages that have more links than the specified threshold are penalized, hence the out-degree of a page may be more than the threshold if the cost of adding more links can be justified. This model minimizes the structural changes to the web link structure of a website and also reduces the information overload to users. The model can be used to optimize very large sized websites because this model operates with the database of user sessions to identify the number of links to be added and it does not remove the links which are already present in the web structure.

Metaheuristic Techniques
Metaheuristic methods have been found to be very effective in improving the graph structure of websites with in less time. This section briefly discusses such metaheuristic algorithms. Lin and Tseng (2010) have developed a model based on ant colony system (Dorigo, Maniezzo, and Colomni, 1996) for website reorganization. The model works in two stages. In the first stage, the ant colony method is applied to find a spanning tree which follows the depth and outdegree constraints. Here ants move along the edges and keep on depositing the pheromone on the edges. One by one, edges are added to the spanning tree. When the construction of the spanning tree is completed then second stage starts. In the second stage, the edges with largest weights are continuously added to complete the graph structure that satisfies the depth and outdegree constraint.

Saremi, Abedin, and Kermani (2008) have developed a method in which the Website Structure Optimization problem is modeled as quadratic assignment (QAP) (Loiola et al., 2007) type problem. Ant colony meta-heuristic technique (Dorigo, Maniezzo, and Colomni, 1996) is employed to solve the problem. The QAP is formulated as facility location problem (Loiola et al., 2007). The facilities location problem is about finding the better or best location of facilities when the distances between locations and the demand flows among the facilities is given. It can also be defined as the problem of finding a minimum cost allocation of facilities into locations. The web pages are considered as facilities and the connectivity (Saremi, Abedin, and Kermani, 2008) between pages is taken as the flow between the facilities. The shortest distance between two pages is taken as the distance between locations. The problem is to allocate different web pages to the possible locations in a website based on the connectivity and distance between web pages. The cost of two web pages is taken as a product of their distance and connectivity, so the most efficient structure is the one with the least possible overall cost.

Yin and Guo (2013) have developed a metaheuristic based on Tabu search (Yin and Guo, 2013) approach for obtaining an optimal website structure. This method also models Graph Structure improvement problem as quadratic assignment problem type problem. The model is developed with the objective of making the frequently used paths shorter. A 0-1 binary matrix represents a candidate solution. In this method, the original structure is used as the initial solution. The structure is altered by two operations of link insertion and deletion. A combination of a link deletion and a link insertion leads to a neighboring solution. The algorithm begins from an initial solution \( S \) which can be generated by some heuristic method. A set \( N(S) \) of the neighboring solutions of the current solution is considered and the move that improves most the objective function value \( f \) is selected. If there are no improving moves, tabu search chooses the move that least degrades the goal function. This procedure is repeated until a stopping condition is reached.

Wang, Wang and Ip (2006) worked in the area of dynamic websites and developed a method to optimize the link structure for E-supermarket websites. Hopfield networks are a special case of Artificial Neural Networks and have been a successful method for combinatorial optimization problems. The basic elements of neural network are neurons and their connections. Hopfield networks are constructed from artificial neurons. These artificial neurons have \( N \) inputs and a weight \( w \) is associated with every input. Four kind of neutral units have been used in the technique. One kind of neutral unit represents the presence or absence of a link in the web structure. Other three kinds of neutral units represent the three constraints related to indegree, outdegree and total number of links respectively. Authors observed that Hopfield network technique is suitable for web graph of less than one hundred nodes. Recently an extension of the approach developed by Lin and Tseng (2010) has been developed by Singh and Kaur (2014). The method is divided into two stages. First, the ant colony based model (Lin and Tseng, 2014) is applied to reorganize the link structure and then this resultant graph structure is used in the second stage. In the second stage, the local search (Singh and Kaur, 2014) procedure is applied to further improve the solution. This method takes more time than the Ant Colony based procedure but it certainly generates a better link structure than the Ant Colony based method. The local search procedure improves the solution step by step by removing the links with low weight and adding links with higher weights.
Conclusions
In this paper, a newly emerged problem of website graph structure improvement has been discussed. Few main algorithms for solving this problem and improving the navigation efficiency have also been briefly explained along with future research directions. Optimizing the structure with the metaheuristic based approaches takes less time and can improve the large sized structures. Mathematical programming model which works with web user sessions also seems a very promising method with very large sized website link structures. A lot of experiments are needed to be performed with real and large web log data sets to discover more issues and problems related to the above mentioned approaches. Very less amount of research work has been done in this area and it offers a tremendous scope for research.

References

About the Authors
Harpreet Singh is an Assistant Professor in the department of Computer Science & Engg. at DAV University Jalandhar. He is also pursuing Ph.D. from Guru Nanak Dev University Amritsar in the field of Software Engineering. His research interests include Data Mining and Web Engineering.

Parminder Kaur is an Assistant Professor in the department of Computer Science & Engg. at Guru Nanak Dev University Amritsar, India. She completed her Ph.D. from Guru Nanak Dev University Amritsar in the year 2011. Her research interests include Component-based Software Engineering, Web Engineering and Software Security.
Algorithm - AIM (Analysis in Minutes)

Algorithm is an interpretable, finite set of instructions for dealing with contingencies and accompanying task that has recognizable end-points, end-state or result for inputs given. It is a tool for solving problems related to computational design. An algorithm is said to be correct if for every correct input, it halts with the correct output. Algorithms often have steps that repeat or require decisions until the task is completed. Different algorithms can be written for the same task, i.e., using different set of instructions, take more or less time, space or effort. Analyzing an algorithm means the resources that an algorithm needs. Resources can be memory requirements, communication bandwidth, logic gates computation time etc. Analysis consists of two phases

(i) Priori analysis
The bounds of algorithm computing time are obtained by formulating a function based on theory. It is independent of programming languages and machines structures. The stress is laid on the frequency of execution of statements

(ii) Posteriori analysis
The actual amount of space and time taken by the algorithms are recorded during execution. It is dependent on the programming languages used and machine structures

Notation for asymptotic growth

<table>
<thead>
<tr>
<th>letter</th>
<th>bound and lower, tight</th>
<th>growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>(theta) Θ</td>
<td>upper and lower, tight</td>
<td>equal</td>
</tr>
<tr>
<td>(big oh) O</td>
<td>upper, tightness unknown</td>
<td>less than or equal</td>
</tr>
<tr>
<td>(small oh) o</td>
<td>upper, not tight</td>
<td>less than</td>
</tr>
<tr>
<td>(big omega) Ω</td>
<td>lower, tightness unknown</td>
<td>greater than or equal</td>
</tr>
<tr>
<td>(small omega) ω</td>
<td>lower, not tight</td>
<td>greater than</td>
</tr>
</tbody>
</table>

- Big O is the upper bound. Upper bound is specified using the notation Omega. Big O as well as Omega is represented using Theta. Representation of Theta can also be called as tight bound (it must be both the upper and lower bound). For example, an algorithm taking Omega (n log n) takes at least n log n time but has no upper limit. An algorithm taking Theta (n log n) is far preferential since it takes AT LEAST n log n (Omega n log n) and NO MORE THAN n log n (Big O n log n).
- f(x) = Θ (g(n)) means f (the running time of the algorithm) grows exactly like g when n. When input gets larger, the growth rate also gets higher (i.e asymptotically proportional to g(n)).
- Same thing. Here the growth rate is no faster than g (n). Big-Oh is the most useful because represents the worst-case behavior.

In short, if algorithm is __ then its performance is __

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Time Complexity</th>
<th>Worst Case Auxiliary Space Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bubble Sort</td>
<td>O(n)</td>
<td>O(n^2)</td>
</tr>
<tr>
<td>Bucket Sort</td>
<td>O(n+k)</td>
<td>O(n+k)</td>
</tr>
<tr>
<td>Heap sort</td>
<td>O(n log(n))</td>
<td>O(n log(n))</td>
</tr>
<tr>
<td>Insertion Sort</td>
<td>O(n)</td>
<td>O(n^2)</td>
</tr>
<tr>
<td>Merge sort</td>
<td>O(n log(n))</td>
<td>O(n log(n))</td>
</tr>
<tr>
<td>Quick sort</td>
<td>O(n log(n))</td>
<td>O(n log(n))</td>
</tr>
<tr>
<td>Radix Sort</td>
<td>O(nk)</td>
<td>O(nk)</td>
</tr>
<tr>
<td>Select Sort</td>
<td>O(n^2)</td>
<td>O(n^2)</td>
</tr>
</tbody>
</table>

Searching
A search is an algorithm for finding an item among a collection of items.

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Complexity with respect to Time</th>
<th>Complexity with respect to Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binary search</td>
<td>O(log(n))</td>
<td>O(log(n))</td>
</tr>
<tr>
<td>Breadth First Search (BFS)</td>
<td>-</td>
<td>O(</td>
</tr>
<tr>
<td>Depth First Search (DFS)</td>
<td>-</td>
<td>O(</td>
</tr>
<tr>
<td>Linear (Brute Force)</td>
<td>O(n)</td>
<td>O(n)</td>
</tr>
<tr>
<td>Shortest path by Bellman-Ford</td>
<td>O(</td>
<td>V</td>
</tr>
<tr>
<td>Shortest path by Dijkstra, using a Min-heap as priority queue</td>
<td>O(</td>
<td>V</td>
</tr>
<tr>
<td>Shortest path by Dijkstra, using an unsorted array as priority queue</td>
<td>O(</td>
<td>V</td>
</tr>
</tbody>
</table>

Conclusion
The above sections cover the time and space complexities of various searching and sorting algorithms used in Computer Science. Knowing the best, average, and worst case complexities for various algorithms will help designers to design the data storage and accessing system to the best possible combination.
Algorithmic Computing: A Detailed Oriented Thinking about Procedures

Introduction
The exponential changes in the science of numbers and the use of operation of computers referred to generally as computing techniques have made mankind scale to newer and greater heights. Be it tracking of investments or trading in the equity market or publishing a newsletter or, for that matter architecting a building design or a more sophisticated simulation technique of practising landing of F14 on the deck of an aircraft carrier - this amazing wonder-machine called computer helps perform all these different tasks that affect our lives in more than one way. Needless to say, for all these large volume of processed data is required at the right time in the right format for the managers of business activities to take right decisions. The processing task begins with getting the data into the system (recording), placing the same at the apt place in an efficient manner (storing), assuring the user that the task of storing has been performed (retrieval), facilitating the classification and arrangements of details in specific group and in specific order (grouping and ordering), allowing the user to conditionally retrieve the details (querying), generating formatted outputs in the form of detailed, condensed, summarised, abstract reports and communicate the relevant and required data to all the stakeholders in secured manner (network).

The ever evolving computing techniques, therefore, created such an impact that the computers potential and utility are now explored and used in all walks of life. However, the very basis for the computing technique to perform all of the above tasks is instruction i.e., computer works and works only on instructions. It responds to only those changes that have been anticipated before. The languages used for communicating the instructions to the computers are referred as programming languages.

The programming languages are characterised by set of reserved words referred to as commands, the commands plus the associated parameter(s) make an instruction, set of instructions in a logical sequence make a program, collection of related programmes make an application and the applications along with its associated kit such as manual (operational and user), installation guide are referred to as (software) package.

Algorithm is a procedural technique that helps formulate rules and create sequences of instruction in a logical order which can then be converted into a program using commands of a programming language. Its’ a step-by-step technique used for writing programs that help computer perform the desired task. The very basic algorithm techniques for the beginners are list below.

The Classification of Algorithm Techniques

a) Straight line logic
The instructions are basically classified into three straight steps:
- Input/Assignment instruction
- Computation instruction
- Output instruction
For instance, in order to compute area of circle with radius 4.42 cm, the algorithm would be:
1. Start
2. Assume <variable>Radius (R) = 4.42, <constant> PI (P) = 3.14
3. Compute <variable> Area (A) = PI * R*R
4. Output A
5. Stop

b) Optional Else
This is ideally used to set the default value and instructions may look like:
- Input/Assignment instruction
- Set the default value instruction
- Change the default value as per the stated condition instruction
- Compute instruction (if required)
- Output instruction
Example: Compute HRA as 33% of basic salary or Rs 12000/- whichever is lower.
Algorithm:
1. Start
2. Input <variable> Basic Salary (BS)
3. Compute <variable> HRA = .33 * BS
4. IF HRA > 12000 Then HRA = 12000
5. Output HRA
6. Stop

c) Simple Branching
The instructions are planned when either of the two computational tasks is required to be performed and the algorithm steps may include:
- Input/Assignment instruction
- Conditional instructions
- Compute instruction (if required)
- Output instruction
Example: For employees in grade A the spl. Allowance is 15% while for every other employee the spl. Allowance is 10% of basic salary.
Algorithm:
1. Start
2. Input <variable> Grade (GR), Basic Salary (BS)
3. IF GR = ‘A’ Then <variable> SA = .15 * BS Else SA = .10 * BS
4. Output SA
5. Stop

d) Nested branching
At times it becomes essential to nest a conditional statement within the other at the time of program execution. In such a scenario the algorithm step would look like:
- Input/Assignment instruction
- Condition instruction 1
  - Conditional instruction 2:::
  - Conditional instruction n
- Compute instruction (if required)
- Output Instruction
Example: To determine whether the number entered as value for...
the variable is positive, negative or zero

Algorithm:
1. Start
2. Input <variable> Number (N)
3. IF N > 0 Then <variable> Remark (R) = ‘POSITIVE’ Go to Step 5
4. IF N < 0 Then R = ‘NEGATIVE’ Else R = ‘ZERO’
5. Output R
6. Stop

e) Finite loops
In order to perform a task (iteration) for predetermined specified number of time, the finite loops algorithm concept can be used

- Set the counter as 1
- Perform the task
- Increase the counter by 1
- Conditional instruction to check the counter value and exit if it crosses the specified final value for the counter

Example: For the 50 students in the class scores of 3 tests are to be read, total, average are required to be generated and printed, the algorithm would be:
1. Start
2. Set the <variable> Counter (COUNT) = 1
3. Input (Read) scores of 3 Tests <variables> T1, T2, T3
4. Compute <variable> Total (T) = T1+T2+T3
5. Compute <variable> Average (A) = T/3
6. Output COUNT, T1, T2, T3, T, A
7. Increase COUNT by 1 (COUNT = COUNT + 1)
8. IF COUNT <= 50 Then Go to Step 3
9. Stop

Example: Reading the marks scored in 3 tests from a data file, computing total and average for the entire students in a class, the above algorithm can be modified as:
1. Start
2. Read current record from the data file
3. Read <values> Roll Number, scores of 3 Tests into <variables>RN, T1, T2, T3
4. Compute <variable> Total (T) = T1+T2+T3
5. Compute <variable> Average (A) = T/3
6. Output RN, T1, T2, T3, T, A
7. Skip to Next record
8. IF NOT END OF FILE [eof()] Then Go to Step 2
9. Stop

f) Series generation
It is similar to finite loops, but at times algorithms are needed to generate numbers that satisfy certain pre set rules. This can be best explained using two examples:

i. Generate all the integers between 1 and 100 (both inclusive)
1. Start
2. Assign (variable> SV = 1, EV = 100
3. Output SV
4. Add SV to SUM (SUM = SUM + SV)
5. Increase SV by 1 (SV = SV + 1)
6. IF SV <= EV Then Go to step 3
7. Output SUM
8. Stop

CASE: Sort v/s Index concept for getting data arranged into specific order (input to algorithmic computing)
One of the most common task needed by the function user is to get classification and arrangements of details in specific group and in specific order (grouping and ordering). A typical DBMS application provides with two techniques – SORT and INDEX.

THE CONCEPT OF SORT
Assume a data file that keeps the following details about the customers of a retail stores:

<table>
<thead>
<tr>
<th>Recno()</th>
<th>CustCode</th>
<th>CustName</th>
<th>CustType</th>
<th>CustBirthDet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C104</td>
<td>Manoj</td>
<td>A</td>
<td>7 Dec</td>
</tr>
<tr>
<td>2</td>
<td>C102</td>
<td>Anil</td>
<td>C</td>
<td>2 Jan</td>
</tr>
<tr>
<td>3</td>
<td>C105</td>
<td>Nimi</td>
<td>B</td>
<td>8 Sept</td>
</tr>
<tr>
<td>4</td>
<td>C103</td>
<td>Onkar</td>
<td>A</td>
<td>6 Feb</td>
</tr>
<tr>
<td>5</td>
<td>C101</td>
<td>Juhi</td>
<td>B</td>
<td>5 Aug</td>
</tr>
</tbody>
</table>

Name of Data File: CustData (original source file)
Note: A DBMS application creates a column Recno() by default (application generated column) and increments it by 1 every time a record is appended.

Whenever, ordering of data is done using a SORT option, it creates a new destination data file identical to the source file. The destination file however contains the detail in specified order.

For instance: A SORT option can be specified as-
USE CustData
SORT on CustCode to CustCodeData
- The original source file CustData have five records
- The new destination file CustCodeData will also contain five records
- Both the data files are two separate entities i.e., any change made to any one file will not get reflectted onto other

i.e., the new destination file CustCodeData will have:

<table>
<thead>
<tr>
<th>Recno()</th>
<th>CustCode</th>
<th>CustName</th>
<th>CustType</th>
<th>CustBirthDet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C101</td>
<td>Juhi</td>
<td>B</td>
<td>5 Aug</td>
</tr>
<tr>
<td>2</td>
<td>C102</td>
<td>Anil</td>
<td>C</td>
<td>2 Jan</td>
</tr>
<tr>
<td>3</td>
<td>C103</td>
<td>Onkar</td>
<td>A</td>
<td>6 Feb</td>
</tr>
<tr>
<td>4</td>
<td>C104</td>
<td>Manoj</td>
<td>A</td>
<td>7 Dec</td>
</tr>
<tr>
<td>5</td>
<td>C105</td>
<td>Nimi</td>
<td>B</td>
<td>8 Sept</td>
</tr>
</tbody>
</table>

Another instance,
USE CustData
SORT on CustName to CustNameData
The new destination file CustNameData will have

Observation:
- The column Recno() do not take part in process of sorting for instance the value for Recno() for CustCode
(C103) is 4, 3, 5 in the three different data files.

- It causes redundancy as the data itself gets copied onto destination file.
- Each of these data file are separate entities and any manipulation (such as append, edit and delete) performed one data file does not get reflected on other related data files causing inconsistency.
- The minimum disk space required for sorting process is space equivalent to the source file i.e., in case, the disk space equivalent to the source file is not available, the sorting process cannot take place.
- All these get corrected in INDEX concept.

THE CONCEPT OF INDEX

Assume a data file that keeps the following details about the customers of a retail stores:

<table>
<thead>
<tr>
<th>Recno()</th>
<th>CustCode</th>
<th>CustName</th>
<th>CustType</th>
<th>CustBirthDet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C104</td>
<td>Manoj</td>
<td>A</td>
<td>7 Dec</td>
</tr>
<tr>
<td>2</td>
<td>C102</td>
<td>Anil</td>
<td>C</td>
<td>2 Jan</td>
</tr>
<tr>
<td>3</td>
<td>C105</td>
<td>Nimi</td>
<td>B</td>
<td>8 Sept</td>
</tr>
<tr>
<td>4</td>
<td>C103</td>
<td>Onkar</td>
<td>A</td>
<td>6 Feb</td>
</tr>
<tr>
<td>5</td>
<td>C101</td>
<td>Juhi</td>
<td>B</td>
<td>5 Aug</td>
</tr>
</tbody>
</table>

Name of Data File: CustData (original source file)
Note: A DBMS application creates a column Recno() by default and increments it by 1 every time a record is added.
Whenever ordering of data is done using an INDEX option, it creates a new destination index file. Here the value of column Recno() gets effectively used

For instance: An INDEX option can be specified as-
USE CustData
INDEX on CustCode to CustCodeINDEX

The Working:
The source data file CustData is:

<table>
<thead>
<tr>
<th>Recno()</th>
<th>CustCode</th>
<th>CustName</th>
<th>CustType</th>
<th>CustBirthDet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C104</td>
<td>Manoj</td>
<td>A</td>
<td>7 Dec</td>
</tr>
<tr>
<td>2</td>
<td>C102</td>
<td>Anil</td>
<td>C</td>
<td>2 Jan</td>
</tr>
<tr>
<td>3</td>
<td>C105</td>
<td>Nimi</td>
<td>B</td>
<td>8 Sept</td>
</tr>
<tr>
<td>4</td>
<td>C103</td>
<td>Onkar</td>
<td>A</td>
<td>6 Feb</td>
</tr>
<tr>
<td>5</td>
<td>C101</td>
<td>Juhi</td>
<td>B</td>
<td>5 Aug</td>
</tr>
</tbody>
</table>

The INDEX command creates a file CustCodeINDEX with referential Recno() i.e.,

5, 2, 4, 1, 3

For retrieval the source file (referred to as underlying base data file) along with it Index needs to be specified; SAY
USE CustData INDEX CustCodeINDEX
The retrieved record will be in the order of CustCode (observe the Recno() column)

<table>
<thead>
<tr>
<th>Recno()</th>
<th>CustCode</th>
<th>CustName</th>
<th>CustType</th>
<th>CustBirthDet</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>C101</td>
<td>Juhi</td>
<td>B</td>
<td>5 Aug</td>
</tr>
<tr>
<td>2</td>
<td>C102</td>
<td>Anil</td>
<td>C</td>
<td>2 Jan</td>
</tr>
<tr>
<td>4</td>
<td>C103</td>
<td>Onkar</td>
<td>A</td>
<td>6 Feb</td>
</tr>
<tr>
<td>1</td>
<td>C104</td>
<td>Manoj</td>
<td>A</td>
<td>7 Dec</td>
</tr>
<tr>
<td>3</td>
<td>C105</td>
<td>Nimi</td>
<td>B</td>
<td>8 Sept</td>
</tr>
</tbody>
</table>

Observation:
- The record number generated while entering the record in the data file remains’ the same in the index file, only the order of retrieval changes.
- Every time an INDEX command gets used only referencing changes, the underlying base table remains the same.
- Since, all the manipulation (Append, Edit, Delete) happens using underlying base table it minimises the data redundancy.
- For index updation the command REINDEX update the referencing INDEX file.

Another Instance:
USE CustData
SORT on CustName to CustNameINDEX
The INDEX command creates a file CustNameINDEX with referential Recno() i.e.,

2, 5, 1, 3, 4

For retrieval the source file (referred to as underlying base data file) along with it Index needs to be specified; SAY
USE CustData INDEX CustNameINDEX
The retrieved record will be in the order of CustCode (observe the Recno() column)

<table>
<thead>
<tr>
<th>Recno()</th>
<th>CustCode</th>
<th>CustName</th>
<th>CustType</th>
<th>CustBirthDet</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>C102</td>
<td>Anil</td>
<td>C</td>
<td>2 Jan</td>
</tr>
<tr>
<td>5</td>
<td>C101</td>
<td>Juhi</td>
<td>B</td>
<td>5 Aug</td>
</tr>
<tr>
<td>1</td>
<td>C104</td>
<td>Manoj</td>
<td>A</td>
<td>7 Dec</td>
</tr>
<tr>
<td>3</td>
<td>C105</td>
<td>Nimi</td>
<td>B</td>
<td>8 Sept</td>
</tr>
<tr>
<td>4</td>
<td>C103</td>
<td>Onkar</td>
<td>A</td>
<td>6 Feb</td>
</tr>
</tbody>
</table>
Evolution of Computing Paradigms

The main mantra associated with any computing technique is creating applications that enable an increase in efficiency of a business process. It makes sense here to briefly look at various computing paradigms/disrupting technologies that has seen exponential changes in the field of computing and data processing. Features, pluses (+) and improvement scopes (-) of various disruptive computing models are listed below:

| Personalised computing | Smarter and personalized applications that adapt according to users behaviour and preferences are now being designed and developed. |[24] The personalised computing model act as a tool with easy-to-use interface that enable managers to create environment that suits them the best. The following features characterises personalised computing:

- Installation and maintenance of software is managed locally (+)
- Customisable according to users’ need and specification(+)
- Utilisation is very low (-)
- Exponentially very high up-front cost(-)

| Reconfigurable computing | John Villasenor and William H. Mangione-Smith explains’ configurable computers as “Computers that modify their hardware circuits as they operate (are) opening a new era in computer design. Because they can filter data rapidly, they excel at pattern recognition, image processing and encryption.”[7] The following features characterises reconfigurable computing:

- Field Programmable Gate Arrays (FPGA) forms the main component (+)
- Hardware is reprogrammable(+)
- Programming time is slower (-)
- Power consumption is invariably high (-)
**Autonomic Computing**

Autonomic computing, a concept introduced by IBM in 2001, refers to IT systems being able to manage themselves dynamically adapting to changes in the computing environment, business policies and objectives. Autonomic functionality is characterized by four key areas, self-configuring, self-healing, self-optimizing, and self-protecting. The following features characterizes autonomic computing:

- Inspired by Human Autonomic Nervous System (ANS)
- Motivation: rapidly growing complexities of integrating, managing and operating computer systems
- Increased complexity

**Mobile Computing**

James Bucki states “Mobile computing is a generic term used to refer to a variety of devices that allow people to access data and information from wherever they are. It uses cell phone (apart from PC) connections to make phone calls as well as connecting to the Internet”. It is widely regarded as technology on move since 1990s. The following features characterizes mobile computing:

- No physical connectivity is required
- Intermittent (discontinuous) connectivity
- Limited bandwidth
- Dependent on mobile device maturity

**Utility Computing**

Marios Alexandrou in online-article states “Utility computing refers to the ability of companies to access computing services, business processes, and applications from a utility-like service over a network. The idea is to charge organisations as per the service that they use. While the company offering utility computing services can benefit from economies of scale by using the same infrastructure to service multiple clients, the concept of utility computing was conceptualised in 1960s; however it could materialised only in 1990s. The following features characterizes utility computing:

- Provide community service for computing resources to business (processing power, bandwidth, data storage and enterprise software services)

**Distributive Computing**

A distributed system uses software to coordinate tasks that are performed on multiple computers simultaneously. The computers interact to achieve a common goal, and they interact by sending each other an apt message. It is used to solve complex computational problems that cannot be completed within a reasonable amount of time on a single computer. The time necessary to complete all the calculations is reduced by harnessing the power of multiple computers. The following features characterizes distributive computing:

- Multiple autonomous computers connected through a communication network (though large complex programs are processed by multiple computers, distributive computing gives the illusion of one system)
- Provides transparency of resources
- The system has distributed memory where each process gets its private memory
- Information is exchanged using communication models such as memory passing interface (MPI)

**Virtualisation**

Virtualization refers to technologies designed to provide a layer of abstraction between computer hardware systems and the software running on them. It enables:

- Creation of virtual version of things such as an O/S, a server, a storage device or a network resource
- For instance, logical partitioning of hard discs drive to create in effect two separate hard disc drives is a virtualisation of storage device

**Cloud Computing**

A model for delivering information technology services in which resources are retrieved from the internet through web-based tools and applications, rather than a direct connection to a server is referred to as cloud computing. Data and software packages are stored in servers. However, cloud computing structure allows access to information as long as an electronic device has access to the web. This type of system allows employees to work remotely.

---

**Conclusion**

The concept of developing and designing algorithms forms the basis of any application creation. Every computing task requires step-by-step instructions in a logical sequence, and algorithm makes it easier to comprehend the requirements and work backwards. The basic algorithmic structure provides the clarity about the algorithmic concepts, while the case presents the two alternative logics that can be used for the purpose of arranging and retrieving the collected data using SORT and INDEX. Also, the ever evolving computing techniques that defines the current generation digital firms is identified for future discussion.

**References**


Prof (Dr.) D G Jha is currently working as Professor and Area Chairperson - IT at K J Somaiya Institute of Management Studies and Research. He has over 25 years of experience and has authored a text book in the area of computing concepts and Management Information System. He is a Ph.D from University of Mumbai. He is also the programme coordinator of MCA. His area of interests are computing concepts, DBMS, Information systems, and HRIS.

Ms. Kimaya Ambekar is Academic Associate - IT at K J Somaiya Institute of Management Studies and Research, Vidyavihar, Mumbai. She is a Masters in Computer Applications graduate from University of Mumbai and has two years of academic experience. Her areas of interests are Cloud computing, security, C# framework.
Recommendation Engines - A Generic Architecture

Abstract: Have you ever imagined what makes web portal giant so easily predict your choice and recommend you products that a majority of time you are bound to purchase/refer/pay attention to? Well, these suggestions come from highly advanced systems having their own intelligence that run on your online footprint as inputs and predict your next purchase even before you go online. In technical terms, these systems are referred to as “Recommendation Engines” and it’s a booming term in the domain of IT Algorithms. Many international organizations have filed patents against their recommendation engine algorithms while many others are in the development pipeline.

Introduction
A Recommendation Engine, in actual definition can be referred to as a system that can run on clustered / non clustered environment taking user online footprint as one of its input set and generating a probable footprint for the user thereby providing its users a prediction closer to reality.

Recommendation Engines require a large dataset and a fast computing system that can perform analytics on the same within fraction of seconds. With the rise in the Big Data technologies both the above components required for recommendation engine to execute at its full potential are now easily available in the tech market.

Big giants of the internet like Amazon, Flipkart, IMDB, Google and many others get a majority of their sales from such highly intelligent engines. There have been many instances where matrimonial sites start showing up in primary ads section of whatever one surfs online. These suggestions are a result of someone accessing such sites - uploading/creating profiles or showing interest in them. For example, the DVD rental provider, Netflix displays predicted ratings for every displayed movie in order to help the user decide which movie to rent. The online book retailer Amazon provides average user ratings for displayed books, and a list of other books that are bought by users who buy a specific book. Microsoft provides many free download for users, such as bug fixes, products and so forth. When a user downloads some software, the system presents a list of additional items that are downloaded together. All these systems are typically categorized as recommender systems, even though they provide diverse services.

Recommendation Engines, in simpler terms are programs that are data intensive and involve complex pattern matching on a set of predefined parameters and they become efficient with the increase in the size of the content being fed to them.

Approaches Adopted
The Recommendation Engines that have been developed so far run primarily on the following approaches:

1. Content Based: This approach relies on creating a plethora of parameters to describe a product ‘P’. Considering a smart phone as an example the possible parameters could be screen size, image quality, Wi-Fi protocols, brand names, operating systems etc. The larger the parameter set the better and easier it is to match patterns with user profile and his online footprint. The parameters can then be assigned weights and hence a relative priority is set for each of the parameter. All these parameters are then used to create a user profile and each time a prospective user checks out another product, his profile gets updated. Hence we see that the system learns about the user preferences and selection patterns by his online footprint. Popular platforms that use such an approach are IMDB and Pandora.

2. Collaborative: This approach relies upon direct learning about the user which may require active or passive participation. Active methodology involves directly probing the user about his preferences through feedbacks and responses based on what the user has purchased / surfing experience. The ratings that a user gives in most websites against products/items are not mere ratings but an option to save his priorities against his own profile that the engine maintains. Cookie sniffing is one of the most common parts of this and comes under the passive methodology. Thus this approach expects the user to collaborate with the recommendation engine in creating a profile of his preferences. Popular organizations that use such an approach are Pandora, MySpace and Facebook.

3. Hybrid Filtering: The collaborative approach fails when the recommendation engine gets a “cold start” about the user - that is, when the user is very new and his preferences are not available in the system to study and predict. The best way in such case is to start creating the user footprint based on content based approach. But the content based approach relies heavily on the parameters of the catalog items and is less mature. In such scenarios it is best suggested to use the Hybrid Approach – Content based filtering for cold start like scenarios and Collaborative for advanced / frequent users.
Algorithms

The performance of a recommendation engine can be evaluated by testing how well its collective intelligence behaves when fed with large data sets about user preferences, after all it is “machine learning” that the system relies heavily upon. Data mining algorithms are used to generate the user profile while clustering algorithms are used to shortlist the recommendations. The common algorithms include:

- n-Dimensional Euclidean Distance
- k-means algorithm
- Bayes Theorem
- Singular Value Decomposition
- K-nearest Neighbor Algorithm

How a clustering algorithm works:

Assume that your system has all the available parameters against a user preference – everything that the user has surfed/looked at so far. This could be single product cluster or a cluster of multiple of products. A clustering algorithm simply finds the means from the un-clustered data (left graph) that could be a single mean point or a set of associated means. These can be found at the center of each of the cluster (right graph). From these means, the distance to all the data points are calculated and then based on which points are closest, a small cluster is formed. This data set would indicate which products are viewed more frequently by the user or are high in the user’s surfing footprint. And hence we get a set of products that can be showed to any user –whether the system has his profile maintained or for a fairly new user.

Combined Architecture

Hence a generic architecture of a recommendation engine, in terms of processes involved can be summed up as:

1. Data Collection: This component collects all the data about a user in an active or passive way. The active methods include taking user feedback, storing user preferences, his past surfing records etc. The passive methods are more intrusive and include cookie sniping, social engineering, and anonymous tracking. The type and variety of the data could include
   a. Personal details about the user such as age, location, favorite colors, nationality etc.
   b. Social details such as friends of the user, family and neighborhood details and how well the linking of their preferences can be done with the preference information captured about the user.
   c. Online footprint details such as what the user surfs a majority of the times, what does he purchase, what is the average spend of each of such purchase, the prime categories of such purchases etc.

2. Data Filtering: This process involves removing or segregating the available data into information chunks. It processes an available data set and gives it a weight depending on how relevant that information can be for building the user profile. For example, based on the location, age bucket, nationality of the user we can measure his online activity and link each of them to his profile. If a user surfs all the product categories then age cannot be used as a determining parameter and hence should be assigned a lower weight in this phase. Apart from the user specific information, this phase also requires to engineer the available social information such as the friend’s location, their age, their online activity details into chunks of information set for the next set of processes. Sometimes what the friends of a user are using (say a smart phone) could be closer to what the user would need next, if he does not own one. This phase performs best when the available data is big, or in correct terms – “Big Data” has been captured about the user.

3. Profiling: Every recommendation engine has its own data structure of storing user information that in the end represents a user profile. In a majority of engines, a graph structure used. Some directly use a graph data base for storing such information

4. Pattern Matching: Once the profile has been built the same is put to use by the pattern matcher. Advanced clustering algorithms are used in this phase. The pattern matcher picks up quantum of information from the profile and starts building a recommendation list. For example if the last browsing records of the user indicates the user has purchased a smart phone, the pattern matcher would pick up the accessories that other user’s bought after such a purchase and would put this in the recommendation engine basket with an assigned priority. A Forrester study on third party recommendation engines indicates that:
   a. 15% of users admit to buying recommended products.
   b. 62% of the users that notice recommendations on websites follow them as it helps them find a suitable product or accessory.
   c. Vendors have also claimed that recommendation can increase the online sales by 2% to 20%.

Limitation of Recommendation Engines

A recommendation engine in its core runs primarily on abstract / un-confirmed data and hence is bound to make mistakes. Some of its limitations are:

1. The algorithms run on static form of data – just because the user showed interest on something today does not mean we can categorize and predict all his activity with respect to his actions prevalent currently. Hence probability and trend analysis of such engines needs to mature and take this dynamic aspect of the data into account as well.
2. A profile that matches another profile may not leave the same online footprint. Just because a set of users in the given age bucket say ‘x’ from a location, say ‘I’ liked a product does not mean a new user with the same profile may like one and is going to perform the same actions. The engines at present have no space to accommodate exceptional cases and neither do they assume the existence of any such scenarios.
Conclusion
In the past decade there has been a vast amount of research in the field of recommender systems, mostly focusing on designing new algorithms for recommendations. An application designer who wishes to add a recommendation system to her application has a large variety of algorithms at her disposal, and must make a decision about the most appropriate algorithm for her goals. Typically, such decisions are based on experiments, comparing the performance of a number of candidate recommenders.

References

About the Authors
Ms. Seema Rawat is working as Assistant Professor at Amity School of Engineering & Technology. She is M.Tech in Computer Science and B.Tech in Information Technology. She is pursuing her Ph.D in Computer Science from Swami Vivekanand University. She has 8.6 years of experience in academics. She has a number of international and national publications to her credit. She is a member of IEEE, IACSIT and IAENG. Her primary research area includes Cloud Computing, Data mining and Artificial Intelligence.

Mr. Praveen Kumar is working as Assistant Professor at Amity School of Engineering & Technology. He is M.Tech in Computer Science & Engineering. He is pursuing her Ph.D in Computer Science from NIMS University. He has more than 8 years of experience in academics. He has a number of international and national publications to his credit. He is a lifetime member of IETE, ACM, and IET. His primary research area includes Big Data Analytics, Cloud Computing and Data mining.

Prof. Sunil Kumar Khatri is Director in Amity Institute of Information Technology, Amity University, Noida. He has been conferred “IT Innovation & Excellence Award for Contribution in the field of IT and Computer Science Education” in 2012 and “Exceptional Leadership and Dedication in Research” in the year 2009. He has edited four books, six special issues of international journals and published several papers in international and national journals and proceedings. His areas of research are Software Reliability, Data Mining and Warehousing and Network Security.”

Dr. Balvinder Shukla Vice Chancellor Amity University Noida is Ph.D from Queens University U.K. She is M.Tech from I.I.T kharagpur and has 27 years of rich experience in academia, industry, Research and Administration. To her credit she has presented many papers in seminars, conferences at national and international level. She has organized over 150 seminars, conferences and management developments programmes. She is on advisory board of many companies and is member of several professional bodies is closely associated with many CSR projects. Dr. Shukla is chair Person of more than 20 committees within Amity and outside.
Stable Marriage - Algorithm and Variants

Introduction
The task of assigning agents to one another or resources to agents is something that we routinely encounter in our day-to-day life. For instance, consider the task of assigning students to colleges, or jobs to machines, and roommates to one another. In many of these cases, participants are allowed to specify preferences over other participating agents or resources. The goal then is to compute an assignment that is optimal with respect to these preferences. These problems are motivated by important real world applications like the National Residency Matching Program (NRMP)\(^1\), the Canadian Resident Matching Service (CaRMS)\(^2\), and Netflix DVD rental program\(^3\), to name a few. The scale of the participants involved in these applications necessitates efficient algorithms that compute optimal matchings respecting the specified preferences.

Problems of this kind are broadly classified under the umbrella of “matchings under preferences”. Here the term matching is derived from the fact that the assignment can be viewed as a matching in a suitably defined graph. The history of this area dates back to the seminal paper by Gale and Shapley\(^4\) titled “College Admissions and Stability of marriage”, in which they defined the stable marriage problem, it is not immediately clear that a stable matching always exists. However, Gale and Shapley proved that the prize is awarded for ‘the theory of stable allocations and the practice of market design’. Our article attempts to present the celebrated Gale and Shapley stable marriage algorithm and also present some optimality notions in a variant called the one-sided preference list model. Our focus here is on the algorithmic aspects of computing such optimal allocations.

Our focus here is on the algorithmic aspects of computing such optimal allocations.

At a very high level, the problems of matchings under preferences can be classified into three broad categories:

(i) Stable marriage problem: here agents are usually referred to as men and women and both men and women specify preferences over the members of the opposite gender.

(ii) Stable roommate problem: here the agents are of a single type and every agent has a preference ordering of a subset of the agents.

(iii) House allocation problem: here agents on one side (say people) specify preferences on objects belonging to another set (say houses). The houses in turn have no preferences and therefore these kind of problems are termed as problems with one-sided preferences as opposed to the stable marriage which has two-sided preference lists.

It is convenient to model the problem as a graph \(G = (V, E)\) where vertices correspond to the participating agents or objects and there exists an edge between two vertices if both of them are mutually acceptable to each other. In addition, the preferences can be conveniently represented by weights on the edges. The assignment problem then, is to compute a matching \(M\) in \(G\) which satisfies the desired notion of optimality. A matching in a graph is a set of edges such that no two edges share an end point. It can be easily observed that the graph derived from an instance of the stable marriage problem or the house allocation problem is in fact a bipartite graph.

A matching in a graph is a set of edges such that no two edges share an end point.

Stable Marriage

Gale and Shapley in 1962 introduced the marriage problem where the participants are \(n\) men and \(n\) women. Each participant ranks the members of the opposite gender by assigning a unique number from 1 to \(n\). This ranking of the members of the opposite side by a participant is called his/her preference list. If a man \(m\) assigns rank \(i\) to woman \(w\), and rank \(j\) to woman \(w'\), where \(i < j\), we say that \(m\) prefers \(w\) to \(w'\). Consider any pairing \(M\) and let there be a man \(m\) and a woman \(w\) not paired with each other in \(M\). In addition, if both \(m\) and \(w\) prefer each other to their current partners in \(M\), in the pairing, it is very likely that they will break their current engagements and pair off with each other. Such pairs are undesirable for the stability of a pairing. Thus, the goal is to come up with a pairing of men and women such that there is no unstable pair. Formally, a pair \((m, w)\) is said to be unstable with respect to a pairing \(M\) if both \(m\) and \(w\) prefer each other to their current partners in \(M\).

To illustrate these definitions, we consider a toy instance of the stable marriage problem with three men \(\{m_1, m_2, m_3\}\), and three women \(\{w_1, w_2, w_3\}\). The preference lists are as shown in Fig. 1 and can be read as follows: \(m_2\) prefers \(w_1\) to \(w_2\) and in turn \(m_3\) prefers \(w_2\) to \(w_1\), and so on. The instance admits several maximum matchings – the following two matchings \(M = \{(m_1, w_1), (m_2, w_2), (m_3, w_3)\}\) and \(M' = \{(m_1, w_3), (m_2, w_1), (m_3, w_2)\}\) are stable for the instance. It is easy to verify that the matching \(M' = \{(m_1, w_3), (m_2, w_1), (m_3, w_2)\}\) is unstable since the pair \((m_2, w_1)\) is an unstable pair with respect to \(M'\).

Fig. 1: A stable marriage instance

Given an instance of the stable marriage problem, it is not immediately clear that a stable matching always exists. However, Gale and Shapley proved that every instance of the stable marriage problem with strict and complete
preference lists admits a stable matching and also gave an algorithm that computes one such matching in $O(n^2)$ time. Recall that $n$ denotes the number of men or the number of women in the instance.

The algorithm: The Gale and Shapley algorithm (shown as Algorithm II.1) is iterative and involves a series of proposals by one side, say the men. To begin with, all men and women are unengaged. In every iteration, an unengaged man $m$ proposes to the most preferred woman $w$ to whom he has not yet proposed. The woman $w$ accepts the proposal from $m$ if either $w$ is unengaged or $w$ is engaged to a $m'$ and $w$ prefers $m$ to $m'$. In the latter case, $w$ breaks her engagement with $m'$ and gets engaged to $m$. It can be shown that this proposal algorithm halts in $O(n^2)$ iterations, after which all men and women are engaged and the resulting matching is in fact stable.

**Algorithm II.1 Stable marriage algorithm**

1: Set all men and women as unengaged.
2: while there exists an unengaged man $m$ do
3: $m$ proposes to the most preferred woman $w$ to whom he has not yet proposed.
4: $w$ accepts if either she is unengaged or she is engaged to $m'$ and $w$ prefers $m$ to $m'$.
5: end while

The Gale and Shapley algorithm is deceptively simple and it is almost surprising that it terminates to output a stable matching. Although we do not delve into the proof of correctness (refer\(^4\) for details), we note some interesting properties of the algorithm and the matching that it outputs.

**Properties of the stable matching:**
First, observe that the algorithm does not specify the order in which men are considered in the white loop. Furthermore, as seen in the example instance, there can be multiple stable matchings in a given instance. Yet, the men-proposing stable marriage algorithm always outputs a unique matching which is called the men optimal stable matching. In a men optimal stable matching, every man is guaranteed to be assigned to the best possible women amongst all the women he can get in different stable matchings of the instance. In the above example, $M$ is a men optimal stable matching. Since the two sides men and women are symmetric, it is natural to expect that the algorithm can be run when women propose men. Such an algorithm outputs a women optimal stable matching; in the example instance matching $M'$ is indeed a women optimal stable matching. In fact, there is an underlying lattice structure for the set of all stable matchings for an instance which has been exploited to generate stable matchings with additional criteria. We refer the reader to\(^5\) for a detailed exposition.

Numerous generalizations of the stable marriage problem motivated from real world applications have been studied. These include allowing incomplete preferences, ties in preferences, hospitals resident problems, strategic issues related to the stable marriage, and more recently the study of stable matchings under social stability. This list is by no means exhaustive and pointers to detailed treatment of many of them can be found in\(^1\)\(^6\). We now move on to a restricted version of the stable marriage problem - that is, the question of finding “good” matchings in the house allocation problem.

**One Sided Preferences**
The one-sided model is motivated by several important applications like assigning graduates to training programs, families to government owned housing, and mail based DVD rental systems like Netflix. In this model, members of only one side say the agents, specify preferences over objects, say houses. Unlike the two-sided model, where stability is accepted as a desirable notion of optimality, there is no clear consensus about an optimal matching in the one-sided world.

Fig. 2 shows an instance of the house allocation problem with 3 agents and 3 houses. A possible allocation or a matching in the instance is $M = \{(a_1, h_1); (a_2, h_2); (a_3, h_3)\}$ which leaves $a_3$ unassigned to any house. Such an allocation is clearly not acceptable if the size of the matching is only of concern. This is because, there exists matching $M' = \{(a_1, h_1); (a_2, h_2); (a_3, h_3)\}$ which has larger size than the size of $M$. However, we note that assigning a house to $a_3$ is indeed at the cost of demoting $a_3$ to a less preferred house. This brings us to the definition of pareto-optimality which is the weakest desirable property that any matching should satisfy. More formally, we say that a matching $M$ is pareto-optimal if no group of agents can improve their allocation without hurting someone. In our example, both $M$ and $M'$ are pareto-optimal however, the matching $M'$ is also maximum cardinality pareto-optimal.

....a matching $M$ is pareto-optimal if no group of agents can improve their allocation without hurting someone.

In fact, stronger notions of optimality like rankmaximality, fairness, and popularity are studied. We discuss these below.

**Rank-maximality**
A matching is rank-maximal if it matches maximum number of agents to their rank-1 houses, subject to this, maximum number of agents to their rank-2 houses, and so on. This very natural criteria was introduced and studied by Irving\(^7\) under the name of greedy matchings. A rank-maximal matching can be computed by assigning suitable weights to the edges and transforming the problem into a maximum weight bipartite matching problem. However, this approach has the issue of assigning large weights on edges and thus the resulting algorithm has to

A rank-maximal matching can be computed by assigning suitable weights to the edges and transforming the problem into a maximum weight bipartite matching problem.

Fig. 2: A house allocation instance
deal with arithmetic on large numbers. A simple combinatorial algorithm was presented by Irving et al.\cite{8} which avoids this issue of arithmetic with large numbers. The efficiency of the algorithm stems from an elegant use of the Gallai Edmonds decomposition which is well-known in matching theory.

**Fairness**

Rank-maximal matchings aim to assign as many agents as possible to their highly preferred houses. Fair matchings work the other way around by assigning least number of agents to their less preferred houses. More formally, a matching \( M \) is fair if it leaves the least number of agents unmatched (and therefore is a maximum cardinality matching), subject to this, the least number of agents are assigned to their last choice houses, and so on. Fair matchings can again be computed by assigning suitable weights on edges and transforming the problem into a minimum weight bipartite matching problem.

**Fair matchings can again be computed by assigning suitable weights on edges and transforming the problem into a minimum weight bipartite matching problem.**

In the instance in Fig. 2, the matching \( M' \) is both rank-maximal as well as fair for the instance. However, as expected, there are several instances where rank-maximal matchings and fair matchings are different and one may be desirable over the other.

**Popularity**

Popularity is another appealing notion of optimality which can be defined informally as follows. A matching \( M \) is popular if no majority of agents wants to switch to any other matching in the instance. An agent wishes to switch from matching \( M \) to another matching \( M' \) if he gets a better preferred house in \( M' \). Popular matchings have another attractive feature that they rely only on the relative ranks of the houses as opposed to rank-maximal and fair matchings which depend on absolute ranks. This makes popularity useful even when the absolute preferences of agents are not known or cannot be revealed.

Although natural and appealing, popular matchings have a downside that there are instances in which no popular matching exists. In fact, the instance shown in Fig. 2 does not admit any popular matching. On the positive side, when popular matchings exist, they can be considered stable since no group of agents can force migration to any other matching. Abraham et al.\cite{9} have presented efficient algorithms that determine if an instance admits a popular matching and computes one if it exists.

As remarked earlier, there is no clear consensus on the notion of optimality in the one-sided world. It is upto the application to chose the right notion as per their requirements. It will be interesting to study how these notions compare with respect to different parameters like average rank of the agents, effect of length of preference lists, and on the prior knowledge if any, about the distribution from which preferences of agents are drawn. Findings of such a study (either experimental or theoretical) may serve as a guideline to chose a particular notion of optimality.

... there is no clear consensus on the notion of optimality in the one-sided world. It is upto the application to chose the right notion as per their requirements.

**Discussion**

We have presented here a bird’s eye-view of the stable marriage problem and some of its variants related to matchings in one sided preference model. A topic as rich as this and of immense practical importance has been dealt in detail in several research papers and books two of which we cite here\cite{5},\cite{6}. Both of these books provide lucid and accessible treatment of intriguing issues related to the stable marriage problem and also point out important open problems in this area. We hope that the quest to resolve some of these will enhance our understanding of the beautiful structure underlying these problems.

**References**

Generating Random Numbers and their Applications in Computing

Randomization and Probabilistic techniques have significant applications in almost every branch of modern science ranging from genetics, evolutionary biology to modern economics. We have learned to accept randomness as an essential feature in modeling and analyzing nature. In modern computer science also probabilistic methods and randomness play a very important role in a wide range of applications including combinatorial optimization, computational biology or even in communication networks too. For the last few decades, we have witnessed a tremendous growth in the use of randomness and probabilistic theory in the field of computing.

**Randomness in Algorithmic Computing and Analysis**

There is a class of algorithms, known as randomized algorithms, which incorporate randomness in their execution. In actual practice, these algorithms use a random value, generated by random number generator, to decide the next step at different stages of their execution. For example, in randomized quicksort, at every recursive step, the pivot element is selected randomly to impose randomness in the input instances. Worst case complexity analysis of the quicksort shows that there are a few input instances for which quicksort takes longer amount of time compared to its average execution time. Therefore, in repeated applications of this algorithm, it is desirable to impose randomness in the input instances to prevent excessive occurrence of unfavorable instances. In these kinds of randomized algorithms, the execution time varies with the set of random values used in their execution without affecting the result.

Complexity theory classifies some of the computational problems as difficult

randomized algorithms .... use a random value, generated by random number generator, to decide the next step at different stages of their execution.

problems (in scientific terms these are NP-complete, NP-hard). Some of these problems, though hard to compute for a set of pathological input instances, are actually not so difficult to compute for most of the cases. Probabilistic theory analyzes and explains this phenomenon. Actually, if the inputs are drawn randomly from a probability distribution on the set of all inputs, it is likely to get an instance which is easy to solve. Instances which are hard to solve appear with relatively small probability. For example, there are several NP-hard graph problems. The question whether these problems are hard to solve for most of the instances or for a relatively small fraction of graphs can be answered by using random graph models.

Another reason behind popularity of randomized algorithms is its efficiency and simplicity. In many applications, randomized solutions are more efficient than the best known deterministic solution. There are several NP-hard/ NP-complete problems, whose efficient randomized solutions can be designed at the cost of marginal degradation of accuracy. However, in these cases, the randomized algorithm can be tuned in such a way that the probability of getting an inaccurate answer can be made less than a prefixed level. Primality testing is one such problem.

**Random Number Generators**

For implementation of randomized algorithms, generation of random numbers is essential. Moreover, a simulation of any process which involves an inherent random component, make use of random numbers. In this article we are trying to indicate a few methods for drawing random values from a uniform probability distribution over the range [0,1]. It may be noted that if we can generate uniform random variates, it is possible to get samples from most of the common distributions using suitable transformations.

On first thought the idea of an algorithm for generating random numbers sounds like an oxymoron. If something is computed deterministically, as it would be in the case of the output of a deterministic algorithm, how can it be random! Strictly speaking, it is not possible to generate random numbers using an algorithm. However, it is possible to generate a sequence of numbers which have the desirable properties of a random sequence. Two most important properties among these are (i) generated numbers should appear to be uniformly distributed over the range [0,1] and (ii) there should not be any correlation among these numbers. Apart from these desirable properties of the generated random numbers, the random number generating algorithms are expected to possess some features from the application point of view. Some of these can be listed as (i) the generators must be time and space effective (as is the case for any algorithm), (ii) the generator must be able to reproduce the identical stream of random numbers (this is not only useful for debugging but also required for comparison of two processes in case of simulation) (iii) the generator must be able to produce multiple sequences.

**Early Methods**

In earlier days the random numbers were generated by hand, such as throwing dice, drawing cards from well-shuffled pack, drawing numbered balls from stirred urn, etc.\(^{(1)}\). Similar methods like picking up numbers ‘randomly’ from telephone directory or from expansion of $\pi$, etc. are still followed in informal situations.

**Mechanical and Electrical Devices**

Later, in the early twentieth century, when statisticians joined gamblers for their academic interest, some mechanical devices were designed for faster generation of random numbers. Some
of these devices are still found in many lotteries. One such instrument was a rapidly spinning disk, which was first used by Kendall and Babington-Smith in 1938[2]. Later electric circuits based on randomly pulsating vacuum tubes were used to generate random numbers at much faster rates. The Electronic Random Number Indicator Equipment (ERNIE) was used by British General Post Office[3]. A recent device based on counting gamma rays is described in a paper by Miyatake et al[4].

**Midsquare Method**

During 1940 to 1950, researchers started designing numeric or arithmetic methods to generate random numbers. These methods are essentially sequential and each new random number is generated as a function of its predecessors. First and the most famous such arithmetic generator, proposed by Von Neumann, was the midsquare method[5]. This method starts with a seed value \(X_0\) of four digits. In \(X_0^2\) the middle four digits are taken with a decimal point to the left of it as \(X_1\). Following the same procedure \(X_2\) is generated from \(X_1^2\). This method is continued till the desired number of random numbers are generated.

**Linear Congruential Generators**

The most widely used random number generators in recent years is Linear Congruential Generators (LCGs). This technique was introduced by Lehmer in 1951[6]. This method also starts with a seed value \(X_0\) of four digits. In \(X_0^2\) the middle four digits are taken with a decimal point to the left of it as \(X_1\). Following the same procedure \(X_2\) is generated from \(X_1^2\). This method is continued till the desired number of random numbers are generated.

**Testing Random Number Generators**

We have already mentioned that a deterministic algorithm cannot generate truly random numbers. For example, if we look at the formula used in LCGs, by mathematical induction it can be proved that for \(i = 1, 2, 3, \ldots\)

\[ X_i = (aX_{i-1} + c) \mod m \]

\( U_i = X_i / m \)

\( \mod (m) \wedge U_i = X_i / m \) That is, the random numbers can be generated deterministically if the seed is known. These pseudo random numbers are generated with an expectation that they would appear to be independently and identically distributed over [0,1]. At this stage, these random number generators would undergo several tests which will ensure how good the generator is in a sense that a good random number generator produce random values which represent a true IID \( U(0,1) \) random variate. To name a few, chi-square test, serial tests, run test are well known, widely used empirical tests. However, which of these tests are best to use is a difficult question to answer. It can only be said that the test should be selected carefully so that it is consistent with the use of the random numbers generated.

While we have seen a great deal of applications of randomization in computing, one can safely predict that this is only the beginning. More innovative applications in the future would require pseudo random numbers which are closer to the actual ones. It would lead to more sophisticated algorithms as well as hardware techniques for generation of random numbers.

**References**

Challenges in Using Aadhar as Unique Identity Number for Delivery of e-Government Services

The Unique Identification Authority of India (UIDAI), which functions under the Planning Commission of India has been entrusted with the responsibility of issuing cards to the citizens of India. Aadhaar is a 12-digit unique identification number issued by the Indian government to every individual resident of India.

The Aadhaar project was initiated as an attempt towards having a single, unique identification document or number that would capture all the details, including demographic and biometric information, of every resident Indian individual. It was felt necessary because of the fact that currently there are a plethora of identity documents in India including passports, permanent account numbers (PANs), driving licenses and ration cards but there is no Single Identity Number (SIN) that can be used for uniquely identifying the citizens. Further, there was a vast segment of citizens who did not have any identification documents to claim the benefits of government schemes. It was targeted to provide 600 million such cards to the citizens over a period of 4 years from the year of inception, i.e., 2009. Over time it will cover the entire population of the country which is presently about 1200 million but likely to increase further by the time the project nears completion. The cost of the project has been estimated to be as high as Rs 45000 crores by its critics while the government maintains that it may not cross Rs 18000 crores.

It was envisaged that the project can be used for extending benefits of such schemes directly by money transfer to the bank accounts of eligible citizens. Another important application of Unique Identity Number is that it can be used as the primary key for linking databases maintained by various government departments such as Income Tax, Passport Offices, Regional Transport Offices etc. Seamless connectivity achieved by linking of databases with proper semantic standards will enable these departments to share documents online and substantially reduce the hassles of paperwork required for providing citizen services. However, there are several challenges that need to be addressed for obtaining maximum benefit of such a mammoth and expensive project. Some of these challenges are listed below along with recommended steps that can be taken for removing such hurdles in technical, organizational and legal domains:

**Storage and computational challenge:** The project will require storage and processing of huge amount of data. The scope of the project roughly translates to capturing 12 billion fingerprints, 1.2 billion photographs, and 2.4 billion iris scans. The file size for each enrolment is approximately 5 Mb. For 1.2 billion people, the file size would be measured in petabytes. Moreover, the captured data exhibits the three characteristics of Big Data namely - Volume, Variety and Velocity. Updating of dynamic data of citizens such as address, occupation, marital status etc in a secure and immediate way is another important challenge that needs to be addressed. In the absence of availability of such processes, the data stored may become old and unreliable.

The solution to this important issue is not a trivial task and may require following action on the part of UID:

- Establish a mechanism by which citizens can log a request for change in dynamic information contents. The request should be routed for physical verification in a time bound manner to the appropriate authority in district administration. This will require use of technology as well as suitable process for fixing of responsibility with monetary penalties to the concerned officers (as has been implemented for time bound response to RTI applications)
- Ensure that scalability of the data centres and data warehouses that are designed for storage of the huge data.
- Ensure that sufficient computational power is available at the data centres because the transactions with requirement of verification of data will multiply as interoperability features in e-government services get activated which is likely to be mandated by the government in the new NeGP shortly. Failing to ensure such capacity may result in frequent failure of the system as seen in the case of IRCTC in recent times.

**Security and privacy issues with the data:** The data is being collected by the UID with the help of private agencies. There is strong apprehension expressed by various quarters that they may misuse the data and pass it on for commercial gains or for tracking individuals. Moreover, there is threat of hacking of the data for snooping as well as possibility of destroying the centralized data with cyber attacks that have become common in recent times. Citizen forums have become active and are protesting against such possibilities.

The possible solution to such problems are as follows:

- **Policy of data disclosure:** Several countries have implemented strict laws against misuse of such sensitive personal information that includes obtaining permission of owner of data before using it, obtaining consent of citizens before divulging to third parties.
- **Encryption of data:** Austria has put in place a system in 2004 in which a source identification number sPIN is generated from citizen data for each sector. This encryption mechanism ensures that use of data outside the intended sector is impossible. Perhaps similar mechanism may be put in place in India for ensuring data security to win trust of citizens.
- **Securing of data against cyber attacks:** This can be achieved by using distributed data storage, securing the storage area physically as well as logically, use of effective firewalls, restricting access to data and so on.

**Organizational and Legal issues:** There are several organizational issues as various departments feel threatened by loss of their control over the processes which are presently in their domain. These apprehensions relate not only to giving up power and less avenues for corruption but are also directed to prevent close monitoring of their activities which are possible once the systems interoperability is achieved by this
It is necessary to overcome these organizational and legal issues as follows:

- By making the public aware of the benefits that will accrue to them by implementation of such projects. The best way is to demonstrate the benefits of direct transfer of subsidies to them. This was tried by the government but was opposed by citizens as the UID number was made mandatory without provision of UID numbers to them. Instead of such arm twisting, it is better to keep both options open for some time and let people themselves judge the benefit of UID. Once voice is raised from their side, the resistance of government departments will eventually end and UID will be adopted by the citizens willingly.

- Legal issues regarding use of UID number in legal proceedings can be sorted out with proper legislations by the government. At present this issue is the most critical that is being faced by this project as Supreme Court has prohibited government from making UID number mandatory. Government has to clearly explain to the courts how such a move will adversely affect the e-government interoperability capabilities for delivery of government services.

Developing innovative applications for use of the data collected: The fourth critical challenge is to use the huge data that is collected for some innovative applications instead of letting it lie for just a handful of services. Once the innovative applications are useful to a large section of population, the acceptance will take off dramatically. One such use that comes to mind is that of grievances redressal. At present people complain for government services by letters, emails etc which are difficult to verify by the redressal authorities. If UID number is used, authenticity of such complaints can be easily ascertained and acted upon.

The progress on providing Aadhar is expected to pick up momentum with the decision of the government for continuing the project. Since the unique identity for all citizens is now a reality, the UIDAI must quickly move to address the complex issues related to technology, security, privacy, organizational and legal complications in order to promote its voluntary acceptance among the citizens and make Aadhar as a facilitator for effective delivery of e-Government services.
Defining and Describing Multilayer Approach for Safe Social Networking

Abstract: Social media is becoming an important part of modern life. But most social networking systems (such as social networking websites) are threatening users' privacy, security and health. They are designed in a way to make the users addicts. They present a lot of features which are enabled by default, and make a big part of the data given by the user public without explicit notice. Moreover, many 'useless' features (i.e., features which cannot be used for any creative/reproductive work) of social media are wasting a lot of human resource and energy. But dividing the features of a social networking system into different modules (in the user-level), which are enabled only on the user's request can make the system safe, private, and non-addictive.

Definition

Simple: Generally speaking, Multilayer Approach for Safe Social Networking (MASS) is a social networking system that is safe, private and non-addictive.

Real: The term 'Multilayer Social Networking' means dividing a social networking system (such as a social networking website) into different 'global' and 'local' layers. A 'layer' means a subset of the features provided by the system. A user of the system must go through global layers while the local ones can be skipped as (s)he wishes. Only necessary features like authentication should be made global so that the user gets maximum control to turn off (or not to use) the features (s)he doesn't like. When there are global layers for security, privacy, non-addictiveness and other ethical aspects in a Multilayer Social Networking system, the system is said to be a Multilayer Approach for Safe Social Networking (MASS) based system.

Description

Background

Social networking systems are becoming the primary mode of communication and meeting in this IT era. They can be used to organize people, share news and ideas, and run socially important campaigns, irrespective of the location of the involved. They are preferred over traditional communication methods because of their swift nature and flexibility (even sound and video can be sent easily, to thousands at a time).

All major social networking websites come with a variety of features such as groups, discussion, microblogging, instant messaging, sharing, etc. (although the names can vary). Many users join a social networking website to use only certain features of it, but they soon start to use a lot of things they didn’t really want. There are two cases:

1. The user likes to use certain features only. But these features/notifications are turned on automatically and some private data is made public without the knowledge/consent of the user. (S)he is annoyed by frequently received messages related with those features.

2. The user starts a social media account just for fun. Being eager to explore, (s)he starts to use all features of that social networking system. In an everything-enabled-by-default social networking system, the user can easily do this, so there is no chance for hesitation/double-thinking.

It is clear that case 1 is a major privacy/security issue, and case 2 is the cause for social media addiction and related health risks. The terms of service of most websites will be justifying these problems to make them legal, while they remain unethical. Hence a new social networking strategy is needed in which the user gets maximum control over the features and which respects ethics.

Global and Local Layers

The idea towards the solution was to divide the features provided by the social networking system into subsets, so that the user can choose the subsets (s)he needs, without involving with the other ones. However, while making this idea practical, developers would find that many API (Application Programming Interface) features like authentication should be made globally. So the idea arose that the global features like authentication can be made 'global layers' which are spread everywhere in the system, while all other features like involving in groups and uploading images (which are not necessary) should strictly be made 'local layers' so that the user can control them.

The word ‘necessary’ should be taken in a programming point of view, otherwise the system owners can fool the public by declaring everything as necessary and telling “everything will be useful for you in this social networking system.”

Forbidden Layers

These are truly server-side layers, which the user cannot access directly. In MASS, API source files and user’s private data are kept in forbidden layers. Any upload from a user should be kept in forbidden layers until the user asks to make it public (many contemporary websites don’t do this). For example, in the case of a regular Apache web server, the contents of forbidden layers (including the uploads) are kept outside the 'public_html' directory. It can be external servers also (with similar privacy and security policies).

Fig. 1: General arrangement of a multilayer social networking system. Note that LL1 is not related with FL1, LL2 is not related with FL2, etc.

Nested Layers

A 'nested local layer' is a local layer which comes under another local layer ('hosting local layer'). Let GL1 be a global layer. Local layers LL1 and LL2 come under this. Now a user has to pass through GL1 in order to reach LL1 or LL2. Let NL1 and NL2 be two local layers which come under LL2. Now LL2 is called a 'hosting local layer' and NL1 and NL2 are called 'nested local layers.'
Here a user has to pass through GL1 and LL2 in order to reach NL1 or NL2.

Generally speaking, hosting a single layer under a local layer makes no sense since they can be combined as a single local layer. However, the former can be applied when there is a chance for more nested layers in the future.

Extended Definition
Although the term suggests covered systems to have divided into layers without linking to each other, MASS means more. The overall idea is introduced to protect the user’s privacy, tastes and health. Multi-layer Social Networking seems to be implemented already to an extend in many services (we don’t know what happens in their servers) although a clear definition was not available. But it is doubtless that Multi-layer Social Networking alone can’t provide safe social networking. a MASS-based system should always contain some ‘ethical’ global layers to do this.

Global Layer for Security and Privacy
Privacy layer is a must and should always be implemented as a global one. ‘Implementing a privacy layer’ doesn’t only mean the creation of some API functions to ensure privacy, but the absence of surveillance/’data mining’ mechanisms also (creating secret profiles by watching a user’s actions rather than by asking him/her questions is also surveillance). That means, half of a privacy layer can be implemented by simply removing the surveillance traps. In other words, a social networking system which doesn’t steal/share users’ private data has already implemented the privacy layer partly. However, software daemons which watch users’ actions to detect terrorism is allowed. But data from them which are not related with terrorism shouldn’t be recorded. Detailed view is given under subtitle Privacy vs Safety.

While the first half of the privacy layer is the absence of surveillance mechanisms, the second half is the presence of mechanisms which prevent the leak of users’ private data. A system can make its privacy-killing tricks legal by showing them in its privacy policy and forcing the user to agree that, but it no longer becomes a MASS-based system since the term is related to ethics too. Privacy issues cannot be solved without the help of the server/service provider, hence the privacy layer is a must in a MASS-based system.

Security layer should contain function which prevents a user from attacking the server and other users. It also contains the act of maintaining file permissions, which keeps the users’ data private. The user must be offered with the option not to list their data/profile in search engines. This and related features can be combined into an ‘anonymity layer,’ if needed.

Actions against the server’s privacy are harmful to other users’ privacy. Also, the server shouldn’t harm the users’ data and client devices. Privacy layer should also consider this ‘reverse’ issue. Hence the Security and Privacy layers are two-way systems.

Some features like Secure Socket Layer come under both security and privacy layers. So it is better to combine these two layers into a single one. Authentication (log in system in websites) also comes under this layer. Irreversible techniques such as hashing should be used to store the passwords.

Global Layer for Health Care
Health layer consists of features or limitations which can prevent users from social media addiction and related health risks. This layer may include features like:

• Dark themes (visual styles) like ‘High Contrast Inverse’ which offer less strain for the eyes.
• Alarms to prevent the user from being a social media addict.
• Limits on the number of likes/comments that a user can put per day.
• Readable text styles with optimum font size and spacing.

Users’ requests should be filtered using the health layer. However, the health layer can be made less strict since the user can take care of his/her heath by himself/herself (security and privacy can only be established with the help of the service provider; but health care does not require the co-operation of the a server in most cases). But features asking for the co-operation of the service provider (such as precautions for non-addiction) cannot be ignored at any excuse.

Layer for Client-side Encryption and Decryption
This can be a global layer or a hosting layer of local layers which handle private informations of a user. Its availability is necessary. Messaging and private data storage features can make use of it. But it is sometimes dangerous, so the user should get the freedom to skip this.

This layer helps the user to encrypt the data with a password before sending to the server. Being encrypted, the service providers cannot read the data. If the data is a message, only the intended recipient who knows the password can decrypt it. Very simple algorithms are enough to do this job, given the encrypted text can be decrypted only with the correct password. Client-side programs are usually written in JavaScript, so the source code is publicly-viewable. It is not a problem since the password from the user is (should be) unpredictable. Also, users can verify their data is not sent to the server before the encryption, if the source code is available.

However, client-side encryption is not possible for the data which has to be read by the server. For example, user’s publicly viewable posts and uploads shouldn’t be encrypted in this way. Also, there is a risk of data loss if the password is forgotten.

Newsletter Service
Newsletter services which follow MASS or which are included in a MASS-based system should be compatible with the following:

1. The publisher can request anybody to join the newsletter, but (s)he cannot add people’s id (username, email,...) directly to the recipients’ list.
2. The publisher cannot view the recipients’ list; otherwise (s)he can take a copy of the list, run other unsolicited newsletters, and send newsletters to unsubscribed people.
3. The user has to confirm his/her subscription in order to receive issues and has the freedom to unsubscribe at any time.

Account Deletion and Data Deletion
The user has the freedom to delete the account whenever (s)he wants. Access to this feature should not be hidden...
somewhere, but easily accessible. All data related with a particular service should be deleted from the server/backup facilities once the user removes himself/herself from it. In the case of account deletion, everything related with the user should be removed.

Removal of already shared data will not be possible always. If so, a clear message about this should be shown in all share dialogs. For example, a ‘share this picture publicly’ dialog shows a message ‘You cannot undo this sharing even after account deletion. Share with care.’

General Characteristics

Previous sections provided a detailed view of MASS. Here are the general characteristics of a social networking service which has implemented MASS:

- The user can choose which features are to be enabled and not.
- A feature doesn’t trigger another one automatically (e.g.: a profile page is not created automatically when one tries to start a blog page).
- User’s public news feed/timeline should not include anything without explicit approval from him/her. For example, ‘Example has changed his profile photo’ is shown to nobody until Example commands to do so. This may become a tiring job sometimes. So a feature can be added which helps the user to list things which can appear in his/her timeline without further approval. A ‘starred (trusted)’ contact list can also be created for this.
- Each feature (e.g.; group discussion, microblogging) is clearly distinguished from one another so that the user can control them separately.
- System-wide security and privacy feature which ensures the absence of surveillance traps.
- Client-side (end-to-end) encryption for private data and messages.
- Profile about a user’s tastes, if necessary, is created by asking him/her questions directly. Watching or recording the user’s actions for this purpose is not allowed.
- Non-addiction features.
- The user gets the freedom to delete the account whenever (s)he wants. Access to this feature should not be hidden somewhere, but easily accessible.
- No unsolicited newsletters and notifications.

Pros and Cons

Pros

1. The user gets maximum security and privacy.
2. Social media addiction can be controlled to an extend.
3. Human resource is not wasted and can be used for good purposes.
4. Eco-friendliness: switching off unwanted features helps to prevent the wastage of electrical, electronic, and computational resources-this is good for economy and environment.
5. Unsolicited newsletters and Spam messages can be controlled.
6. User can ‘escape’ from social networking at any time.

Cons

1. The user has to switch on features manually, and in order make this easier, the developer has to write extra code.
2. Client-side encryption feature asks for additional coding.
3. Strict security and privacy makes censoring complicated.

Cons one and two are developer’s issues and should be taken as duty. Solution for the third one is discussed under subtitled Privacy vs Safety.

Implementation

Layout of an Example System

Figure 3 shows the structure of an example MASS-based system. Security and privacy feature is made global. A user has to pass through this layer in order to create a new account or browse visible-for-public pages. (S)he has to pass through an additional layer for authentication in order to do microblogging or podcasting since both can be done only by a registered user. If the podcasted media should be available for non-registered users (like in YouTube), they have to be moved into a layer which is not nested under the authentication layer.

Developer View Point

Although the theory of MASS-based systems gives a clear picture of properly divided subsets, the coding need not be this much distinguishable. Putting each layer into its own subfolder/source file will not be possible always. The division is done via invoking the functions properly. That means, the idea of layers is made practical in a theoretical way rather than physical.
Privacy vs Safety
Strict privacy and freedom sometimes make it difficult to apply community guidelines and parental features. MASS can have exceptions for minors making their parents able to watch them (upon the basis of prior request). Only non-private activities can be monitored since the private ones might be encrypted. Anti-social or anti-national activities can be banned on the base of manual reports.

If software daemons are running to watch unethical moves, only users who work for terrorism should be noted for manual actions. Users who do unethical things like spreading malware can be detected while passing through the security layer and they can be banned without manual actions. (Manual action means other human beings know ‘this’ person does ‘that’.) However, nothing from the daemons should be recorded or transmitted except reports related with terrorism.

MASS at Present
Although the term MASS is being defined here for the first time, some aspects of it have been implemented already. For example, almost all sites validate requests using filters and pass them through anti-malware features. This is an example for global layers. But most of these are done considering the facts like the service provider’s security and commercial success, where MASS is introduced to protect the privacy, security and tastes of both parties in a healthy way.

Many features are turned on by default in most social networking websites. Users face difficulties when they find no way to turn them off. Annoying notifications is also a part of this issue.

Unsolicited Newsletters
Many newsletter and mailing list services allows the admin to add people to the recipients’ list directly. They may get the opportunity to unsubscribe, but the problem is, subscription doesn’t need any confirmation. This happens in the field of e-mail marketing mainly. Moreover, The admin or a member can access the recipients’ list which is a major privacy issue. In MASS, even admin cannot view the entire recipients’ list.

Forbidden Layers
Almost all websites keep restricted data outside the ‘public_html’ folder, which is the basic idea of forbidden layers. But MASS asks for more. Any user upload should be stored in a forbidden layer (intermediate steps can use public_html directory if needed, given the data is erased soon), until the user makes it public. API source code should also be kept in forbidden layers. These actions will prove useful when things like server misconfiguration or bad permissions occur.

Cross-website Case
Some companies provide their social networking facilities in different domains/websites, which sometimes resembles Multilayer Social Networking. For example, blogging and podcasting services from Google are distributed into two different websites: Blogger.com and YouTube.com. Google doesn’t force a user to use both linked. MASS supports cross-website social networking, but it requires each website to be compliant with the idea.

Conclusion
Even though social media is very useful, most social networking services are threatening users’ security, privacy and health. They waste a lot of human resource/energy which can be used in productive ways. So a new social networking strategy is needed and MASS is introduced to fill that gap (at least to start such a standardisation). The ultimate goal of MASS is to make a social networking service secure, private and healthy. Prevention of wastage of human energy is also a goal of MASS.

Some characteristics of MASS can already be found in existing social networking services, but of course, they are not designed in a way to be truly compliant with MASS. Even though MASS makes social media non-addictive, it will not discourage people from using such services. Instead, a social networking service which has implemented MASS will become trustworthy and encourage more people to join it and start utilizing it for good purposes.

Nandakumar Edamana is a first year B.Sc. Computer Science student at College of Applied Science, Vattamkulam, run by Institute of Human Resource Development, Kerala. Being a free software (free as in freedom) user, developer and activist, he has created a handful of software packages, which are available at nandakumar.co.in. Sammatty Election Engine, one of the packages developed by Nandakumar, became a popular choice among thousands of schools in Kerala. He is a frequent contributor to mainstream print media also.
The commonly used “bitwise operators” in C are: “~”, “&”, “|”, “^”, “<<” and “>>”. These operators have enormous power. Bitwise operators work on each bit(1 or 0) of data. Thus bitwise operators make processing faster. The following examples (program to check whether a number is power of 2 or not) show that how bitwise operators reduce computational cost of a program.

Function 1:
```c
int isPowerOfTwoWB(int n)
{
    int flag=0,c;
    while(n>1)
    {
        c=n%2;
        if(c==1)
            {
                flag=1;
                break;
            }
        n=n/2;
    }
    n=n/2;
    return flag;
}
```
If \( n = 1024 \), then while loop will be executed \( 10 \) (\( \log_2(1024) \)) times. Thus time complexity of isPowerOfTwoWB is \( O(\log n) \). On the other hand, the following function (isPowerOfTwoB) written using bit wise “&” (AND) operator gives same result with reduced complexity \( O(1) \).

```c
int isPowerOfTwoB(int n)
{
    return n&(n-1);
}
```

```
int main()
{
    int n,m;
    printf("\t Enter a number to check whether it is power of 2: ");
    scanf("%d",&n);
    m = isPowerOfTwoB(n);
    if(m==0)
        printf("\n	 %d is power of 2",n);
    else
        printf("\n	 %d not power of 2",n);
    return 0;
}
```
Output:
Enter a number to check whether it is power of 2: 16
16 is power of 2.
Enter a number to check whether it is power of 2: 24
24 not power of 2.

Another funny C program to obtain binary equivalent of a decimal number using bitwise operator is given below:

```c
int main()
{
    int i,n,m,x;
    printf("\t Enter A Number");
    scanf("%d",&n);
    printf("\ The binary equivalent of %d is ",n); 
    for(i=15;i>=0;i--)
    { 
        m=1<<i;
        x=n&m;
        if(x==0)
            printf("0");
        else
            printf("1");
    }
    printf("\n");
    return 0;
}
```
Output:
Enter A Number 12
The binary equivalent of 12 is 000000000001100
Enter A Number 31
The binary equivalent of 31 is 000000000011111
Programming.Learn("R") »
Shine with Shiny of R !!!

In this session, let us jump into web app development by using R. Shiny is a wonderful RStudio package, using which you can showcase and share statistical analyses and results performed in R on the web interactively. You can work on Shiny and produce shining results, even if you don’t have prior knowledge in HTML, CSS, or JavaScript.

As always, to start Shiny, you have to install and load it in the R environment. For this you can use,

```r
> install.packages("shiny")
> library(shiny)
```

A typical Shiny app has two components - a user-interface script and a server script. The user-interface (ui) script controls the layout and appearance of app. Server script contains the instructions for building or manipulating your data in your app.

A typical user-interface script starts with a ShinyUI with attributes.

Let us have a look into a simple user-interface script (save this as `ui.R` in a folder - say, myapp)

```r
shinyUI(pageWithSidebar(
  headerPanel("Know Your Body Mass Index"),
  sidebarPanel(
    numericInput('id1', 'Enter Your Weight in Kg (id1)', 0, min = 0, max = 10, step = 1),
    numericInput('id2', 'Enter Your Height in Meter (id2)', 0, min = 0, max = 10, step = 1),
    submitButton('Submit')
  ),
  mainPanel(
    h4('You entered Your Height as'),
   verbatimTextOutput("oid1"),
    h4('You entered Your Weight as'),
   verbatimTextOutput("oid2"),
    h4('Your Body mass Index is'),
   verbatimTextOutput("oid3")
  )
))
```

Now let us see the server script (save this as `server.R` in the same folder - myapp)

```r
shinyServer(
  function(input, output) {
    output$oid1 <- renderPrint({input$id1})
    output$oid2 <- renderPrint({input$id2})
    output$oid3 <- renderPrint({input$id1/(input$id2*input$id2)})
  }
)
```

Now run the app by typing `shiny::runApp(path to the files ui.R and server.R)`

For example, `shiny::runApp('C:/Users/DCB/Desktop/myapp')`

Now let’s have a closer look into the code. The first line in the user interface script `shinyUI (pageWithSidebar())` sets the UI for the Shiny page.

---

Table 1: Text styles and their usage in Shiny

<table>
<thead>
<tr>
<th>Shiny function</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>A paragraph of text</td>
</tr>
<tr>
<td>h1</td>
<td>A first level header</td>
</tr>
<tr>
<td>h2</td>
<td>A second level header</td>
</tr>
<tr>
<td>h3</td>
<td>A third level header</td>
</tr>
<tr>
<td>h4</td>
<td>A fourth level header</td>
</tr>
<tr>
<td>h5</td>
<td>A fifth level header</td>
</tr>
<tr>
<td>h6</td>
<td>A sixth level header</td>
</tr>
<tr>
<td>a</td>
<td>A hyper link</td>
</tr>
<tr>
<td>br</td>
<td>A line break (e.g. a blank line)</td>
</tr>
<tr>
<td>div</td>
<td>A division of text with a uniform style</td>
</tr>
<tr>
<td>span</td>
<td>An in-line division of text with a uniform style</td>
</tr>
<tr>
<td>pre</td>
<td>Text ‘as is’ in a fixed width font</td>
</tr>
<tr>
<td>code</td>
<td>A formatted block of code</td>
</tr>
<tr>
<td>img</td>
<td>An image</td>
</tr>
<tr>
<td>strong</td>
<td>Bold text</td>
</tr>
<tr>
<td>em</td>
<td>Italicized text</td>
</tr>
</tbody>
</table>

HTML

Directly passes a character string as HTML code.

---

Fig. 1: View of an app developed using Shiny

Here we have used `sidebarLayout` to create a basic layout for your Shiny app. There are more advanced layouts according to your needs. You can read more on Shiny Application Layout Guide. Also here we have used three panels - headerPanel, sidebarPanel and mainPanel for the layout. In the sidebar panel we have created two numericInput which is the input control for entering values and a submit button. In the main panel we have created label with style h4 (the style that used to create text in html).

Here Shiny uses html styles to manipulate text styles. Table 1 (from Shiny web site) shows different text styles and their usage.

---

You can try more experiments in Shiny for which tutorial is available in the Shiny web page. Please have a look at http://shiny.rstudio.com/ tutorial and try more exciting Shiny scripts. We are sure that you can shine in web world by using Shiny.
Just as antivirus software has been a cornerstone of PC security since the early days of the Internet, firewalls have been the cornerstone of network security. The previous generation of firewalls includes packet filtering, application proxies, stateful packet inspection firewall categories. This generation of firewalls addressed security in a world where malware was not a major issue and web pages were just documents to be read. Ports, IP addresses, and protocols were the key factors to be managed. Network security used to be relatively simple; everything was more or less black and white (either clearly bad or clearly good). Problems with this approach today include the fact that applications have become increasingly “gray”, now classifying types of applications as good or bad are not a straightforward exercise.

As the Internet evolved, the ability to deliver dynamic content from the server and client browsers introduced a wealth of applications we now call Web 2.0. Port-based firewalls are helpless in providing security as today, applications from reputed to nefarious all run over TCP port 80 as well as encrypted SSL (TCP port 443). Additionally, for want of easy availability and cost savings to the business, many client-server applications like Salesforce.com and Google’s Office Suite are moving to the web to become web-based services. Such critical business applications have today become indistinguishable from the less important applications in a business network that also utilize HTTP for the purpose of network communications.

These scenarios lead to a situation where Enterprises, need a deeper awareness of and control over individual applications along with deeper inspection capabilities by the firewall that allow administrators to create very granular allow/deny rules for controlling use of websites and applications in the network. This is also necessary because in addition to introducing security threats, some non-productive applications drain bandwidth and productivity, and compete with mission-critical applications for precious network bandwidth. Importantly, enterprises need tools to guarantee bandwidth for critical business relevant applications and need application intelligence and control to protect both inbound and outbound flows of traffic, while ensuring the velocity and security to provide a productive work environment.

Next-generation firewalls (NGFW) represent the next major step in the development of firewall technology in this direction. A next-gen firewall is designed to combine the functionality of a firewall and an IPS, while adding detailed application awareness into the mix. NGFWs bring additional context to the firewall’s decision-making process by providing it with the capability of understanding the details of the Web application traffic passing through it, taking action to block traffic that might exploit Web application vulnerabilities. Next-generation firewalls combine the capabilities of traditional firewalls - including packet filtering, network address translation (NAT), URL blocking and virtual private networks (VPNs) - with Quality of Service (QoS) functionality and features not traditionally found in firewall products. These include intrusion prevention, SSL and SSH inspection, deep-packet inspection and reputation-based malware detection as well as application awareness. The application-specific capabilities are meant to thwart the growing number of application attacks taking place on layers 4-7 of the OSI network stack.

A next-generation firewall inspects the payload of packets and matches signatures for nefarious activities such as known vulnerabilities, exploit attacks, viruses and malware all on the fly. There are some indirect benefits of this also; since the contents of packets are inspected, exporting all sorts of statistical information is also possible, meaning administrators can now easily mine the traffic analytics to perform capacity planning, troubleshoot problems or monitor what individual employees are doing throughout the day.

Most of things mentioned above about NGFW, make them sounds similar to UTM (Unified Threat Management). But next generation firewalls are different from unified threat management (UTM). UTM products are basically stateful inspection firewalls with some additional security functionality. These products often consolidate firewall, intrusion prevention, content filtering, antivirus and other security functionality into a single box. While this approach is not often appropriate for a large enterprise, a UTM device is effective product for smaller or midsize enterprises seeking to limit security expenditures. Significant functional requirements for an effective next-generation firewall over UTM include the ability to:

- Support multi-gigabit, in-line deployments with negligible performance degradation.
- Provide real-time protection against a wide array of threats, including those operating at the application layer.
- Integrate, not just combine, traditional firewall and network intrusion prevention capabilities.
- Support multi-gigabit, in-line deployments with negligible performance degradation.

The last point mentioned is quite significant, as this distinguish NGFW from the cadre of normal firewalls. For
traditional security products, especially those with bolted-on capabilities, each high-level security function is performed independently. This multi-pass approach requires low-level packet processing routines to be repeated numerous times. System resources are used inefficiently and significant latency is introduced. In contrast, a NGFW that uses single-pass architecture eliminates repetitive handling of packets, reducing the burden placed on hardware and minimizing latency.

Next-generation firewalls produce numerous benefits over traditional network security infrastructures and solutions. These include

Visibility and control: The enhanced visibility and control provided by NGFWs enable enterprises to focus on business relevant elements such as applications, users, and content for policy controls, instead of having to rely on nebulous and misleading attributes like ports and protocols, and to better and more thoroughly manage risks and achieve compliance, while providing threat prevention for allowed applications.

Safe enablement: Achieve comprehensive coverage — by, providing a consistent set of protection and enablement capabilities for all users, regardless of their location.

Simplification: Reduce complexity of the network security and its administration — by obviating the need for numerous stand-alone products. This consolidation reduces hard capital costs, as well as ongoing “hard” operational expenses, such as support, maintenance, and software subscriptions, power and HVAC, and “soft” operational expenses, such as training and management.

IT and business alignment: Enable IT to confidently say “yes” to the applications needed to best support the business — by giving them the ability to identify and granularly control applications while protecting against a broad array of threats.

NGFW are quite effective than previous generation firewalls, but there some things to keep in mind to evaluate and embrace a next-generation firewall. As a baseline, there must have a thorough understanding of organization’s needs and should have performed extensive testing before deciding to implement NGFW. There are few things that should be looked into before deploying NGFW, like ease of the use managing interface, vendor specific application identification support, performance characteristics in real environment as sometimes the performance of NGFW changes drastically by the amount of traffic or switching some application inspection functionality.

Due to the various elements that need to be considered, and also because of the relative newness of the technology, NGFWs are not yet widely adopted by organizations. According to a survey, less than 5% of Internet connections today are secured using NGFWs. But the capabilities that they have, there future is bright in cyber market and it is hoped that by the end of 2014, their usage will rise to 35% of the installed base, with 60% of new purchases being NGFWs.

References

About the Authors

Samriti Gupta is working as Scientist C in Terminal Ballistics Research Laboratory Chandigarh, DRDO. She has done M.E. in Computer Science & Engineering. She has more than 6 years of scientific research experience. She is Associate Member of Aeronautical Society of India and recipient of team award of DRDO, Agni Excellence Award for Strategic Contribution. Her research interests include Cyber Security, Information Security, Embedded Systems etc.

Balvir Kumar is working as Scientist E in Terminal Ballistics Research Laboratory Chandigarh, DRDO. He is M.Tech from IIT, Madras in Computer Science & Engineering. He has more than 14 years of research experience. He has been the recipient of DRDO Young Scientist award of the year 2012. He has been working in the area of Embedded Systems, Computer Architecture, Networking etc.

P. K. Khosla is working as Scientist G in Terminal Ballistics Research Laboratory Chandigarh, DRDO. He has completed M.Tech with university gold medal. He has more than 27 years of research experience in various domains including Telemetry Systems, Embedded Systems, Networking and supersonic track testing. He has been a recipient of number of technical awards and has the credit of publication of research papers in various journals and international conferences.
Algorithmic Computing – Problem or Solution?

Algorithm, simply put is the technique used to get a job done. It is a method to solve a problem that consists of exactly defined instructions. Some tasks are one-off problems. One thinks through the solution, applies it and then just moves on. Most jobs, tasks and problems are apparently similar and are faced and dealt with again and again. It is for these that you need a solution, an approach that needs to work every time without having to think through the tasks and solutions.

This makes life easier for all concerned - be it a practicing professional, an entrepreneur, an employee or a common person going about his day to day life. Use of algorithmic computing has enabled today’s advanced decision support systems, core banking solutions, auto-pilot mechanism in aircrafts, case management software for doctors and lawyers, and the smart washing machine and smart television set both of which remember your personal choices and preferences – e.g. decide the duration of wash and spin cycle based on the clothes loaded etc. Modern digital cameras use algorithmic programming to ensure that pictures are sharp and focused and use optimum effects.

There are problems too. Systems often act dumb and lack common sense, which an ordinary human being of average intelligence also displays and thus the individual is able to deal with situations better than say a computer program. One still comes across massive utility bills charged on inoperative / low use accounts which are attributable to program malfunction.

No doubt, algorithmic programming is here to stay and makes programs and computers better, faster, more efficient, more effective, and most important is that it takes away the load of repetitive tasks and problems from humans to systems. In fact the prowess of computing systems in terms of speed, reasoning and responses has been such that computers / systems are often regarded as a panacea for business and industry problems and tasks. CRM software, decision support systems, Algo-trading software for dealers and brokers on the stock market are a few examples of systems designed using algorithmic programming.

To elaborate, an automated (Robotic) trading system also referred to as Algo trading, automatic trading, algorithmic trading or automatic trade executor, allows traders to enter and exit the trade without human intervention based on simple or complex conditions. Most of the Robotic Trading systems require charting software with real time data, trade executor plug-in and brokers trading terminal. The first thing in Robotic Trading is to create a trading strategy. The strategy can be moving average crossover, pivot level break, opening range breakout (ORB) or oscillator related strategies. Based on this high volume, multiple automated trades are placed. Based on the exit strategy, it will book profit or exit when stop loss hits. The system utilizes highly advanced mathematical formula to generate the trading decisions in equity and derivative markets. Algo trading or robotic trading is generally used by institutional traders who have heavy volume trading to automate their work, but now even small traders have started using robotic trading software.

What can go wrong or what issues could arise using such systems more frequently and on a larger scale? Is it really safe to depend on systems for important business, welfare / social / health and personal decisions? These are significant issues especially in the context of Governance, and Security. Businesses and society need to consider these issues before progressively adopting and relying on these systems, but we have gone so far ahead that in reality there is no turning back; it is a point of no return. It is necessary to look into these aspects more closely.

Given this background the current Case in Information Systems is being presented. The facts of the case are based on information available in media reports online and real life incidents. Although every case may cover multiple aspects it will have a predominant focus on some aspect which it aims to highlight.

A case study cannot and does not have one right answer. In fact answer given with enough understanding and application of mind can seldom be wrong. The case gives a situation, often a problem and seeks responses from the reader. The approach is to study the case, develop the situation, fill in the facts and suggest a solution. Depending on the approach and perspective the solutions will differ but they all lead to a likely feasible solution. Ideally a case study solution is left to the imagination of the reader, as the possibilities are immense. Readers’ inputs and solutions on the case are invited and may be shared. A possible solution from the author’s personal viewpoint is also presented.

A Case Study of Vaayda Bazaar

Ramesh, the CEO of Vaayda Bazaar has decided it’s high time to introduce Algo trading in the company. After his recent US trip where he has seen these systems work at lightning speed placing spliced orders and reaping in arbitrage profits he is convinced that in these days of thin margins and online trading platforms adopting Algo trading is the way forward for the company.

He calls a meeting of his management team and shares his viewpoint. He emphasizes that adopting Algo trading will enable Vaayda Bazaar to:

- Earn profit from Arbitrage opportunities between multiple exchanges
- Curtail broker front-running and impact costs
- Allow purchases to be spread over number of smaller trades preventing prices from being driven up
- Enhance liquidity and also
- Enable large orders otherwise blocked by the exchanges

Prabhudas, who heads market operations is an old timer. He and the chief accountant Kantilal are not enthusiastic. The CIO Kunal is bullish and is all set to implement the system. In fact he anticipates a fair reduction in staffing costs which can substantially fund the acquisition of the system. It is amidst these conflicting opinions in the top management team that a go ahead is given and a time frame of 6 months is given to implement and roll out the system in the company.

Prabhudas is concerned and he has pointed out two significant reports. The first is about the 2010 US flash crash that happened in May 2010:

A computer-driven sale worth $4.1 billion by a single trader helped trigger the May flash crash, setting off liquidity shocks that ricocheted between U.S. futures and stock markets, regulators concluded in a report. The report by the U.S. Securities and Exchange Commission and the...
Commodity Futures Trading Commission did not name the trader. Reuters, citing internal documents prepared by exchange operator CME Group Inc, in May identified the trader as money manager Waddell & Reed Financial Inc. The long-awaited report focused on the relationship between two hugely popular securities – E-Mini Standard & Poor’s 500 futures and S&P 500 “SPDR” exchange-traded funds – and detailed how high-frequency algorithmic trading can sap liquidity and rock the marketplace. “The interaction between automated execution programs and algorithmic trading strategies can quickly erode liquidity and result in disorderly markets,” the report said. The “flash crash” sent the Dow Jones industrial average plunging some 700 points in minutes on May 6, exposing flaws in the electronic marketplace dominated by high-speed trading. The Dow was down nearly 1,000 points at its lowest point on that day.

The second one was the NSE October 2012 crash that wiped nearly $60bn off Indian stock index. India’s main share index plunged 16% within minutes on Friday in a so-called “flash crash” – the latest in a series of market glitches that have shaken confidence in global financial markets. India’s National Stock Exchange (NSE) was forced to halt trading for 15 minutes, after a brokerage placed 59 wrong orders, triggering a sell-off that wiped nearly $60bn off the value of the country’s biggest companies. The orders were cancelled and stocks recovered, with India’s Nifty index closing down 0.8% on the day. NSE blamed Friday’s crash on human error but experts said that was highly unlikely. “There is no human being in the world that can take down the stock market by 16%. This is typical spin.” They said the error was exacerbated by high-frequency trading, which involves using software to post orders for microseconds at a time to exploit tiny differences in share prices. It is now widely accepted that high-frequency trading fuelled the flash crash of May 2010, which saw the Dow Jones industrial average plunge by 998 points in 20 minutes, raising fears of a worldwide stock market collapse.

Kunal points out that computers do exactly as they have been programmed to do, and there will be large errors only if they aren’t monitored properly. According to him all these were human errors and blaming the Algo systems was just witch-hunting.

Ramesh who had already made up his mind, pointed out that at this stage the debate was only academic and inputs provided by Prabhudas were exceptions to the rule and could be used beneficially as inputs to improve the system.

To reassure the old guard, Ramesh decides to call in Sulabha an experienced analyst who had implemented similar systems to help them move to Algo trading. Sulabha has been called and she has suggested a way forward.

Solution
The Situation
High frequency trading using automated software programs is dominating world stock markets today. It accounts for up to 50% of the trade volume and has become acceptable and is used across all major exchanges. It enables firms both large and small to use automated strategies to churn through large volumes of orders in fractions of seconds. Some firms can trade in microseconds. After introduction of online trading 10 to 15 years back, this is the next big change across markets.

It has increased volumes, lowered arbitrage, made markets more liquid and has taken some of the emotion out of the markets making it more rational. Clearly, it provides an advantage to the firms that use it, and is here to stay.

Given its size and scale of operations Vaayda Bazaar has to introduce Algo trading and automate its systems. The key challenge is identifying what can go wrong which can then be dealt with effectively.

• The first issue is of bugs in the software - programming errors, errors in logic, in the strategies built into the system.
• The second issue is of human errors in programming as well as in feeding in, selection and use of the strategies in given situations.
• The third issue which is of greater concern is of unauthorized changes / alterations to the program which can cause huge losses to the firm. These could be motivated by fraud or malice and may be internal or external.
• The fourth is the possibility of rogue traders or elements using the systems setting off a market crash.
• Finally, the most disturbing of all is the occurrence of what Nassim Nicholas Taleb, a finance professor and former Wall Street trader had described as the “Black Swan effect”. An event or occurrence that deviates beyond what is normally expected of a situation and that would be extremely difficult to predict.

The Consequences
The company has to be alive to these issues when implementing and using automated algorithmic trading. The company its management and employees cannot individually and collectively ignore these issues. Doing so can not only result in losses but even wipe out the existence of the company, in a single day.

The Strategy
The right strategy for the company will be to deal with each of these issues:

1) Bugs in the software – governance and control on software acquisition, development, deployment and use needs to be put in place and rigorously monitored. UAT, and regular periodic testing, mock drills in simulated conditions and audit post changes with a proper change management procedure needs to be put in place.

2) Human errors – Human errors need to be restricted at the programming level through robust software development and in data entry and use through appropriate controls to prevent these errors. Further, putting in place risk management controls in the form of inbuilt checks like quantity and value limits, price range checks, client level, broker level and overall exposure and credit limits, will minimize the impact of human errors.

3) Unauthorized changes / alterations and Rogue elements – Information security governance framework using proper policies, best practices, procedures, controls and monitoring needs to be implemented and maintained to secure the system.

4) Black Swan – Dealing with the black swan is the biggest challenge as algorithmic programs cannot deal with them, simply because they are not designed for them. In fact just like people they are blind to uncertainty and unaware of the massive role of the rare event in historical affairs. They only deal with and are based on events that have occurred and have been encountered in the past, that too in the recent past.

Black swan events are typically random and unexpected. For example, the previously successful hedge fund Long Term Capital Management (LTCM) was driven into the ground as a result of the ripple effect caused by the Russian government’s debt
default. The Russian government’s default represents a black swan event because none of LTCM’s computer models could have predicted this event and its subsequent effects.

The best way to deal with such eventualities would be to put in place risk management systems which are monitored and provide for human intervention at a very senior level by people who have experience and understanding of the market. This may not prevent losses but will at least ensure that the program which is blind to the rare event can be stopped in time preventing a complete wipe off. This will enable the company to survive another day.

In modern times with transaction speed being in micro seconds the fuse wire of decisions is really short – leaving no choice to the risk manager who has to be always alert and on the lookout.

The company will do well to put in place these measures initially and keep identifying newer threats and issues as they emerge and follow best practices to make itself Algo trading ready.

An effective solution is generally expected to proceed on these lines.

**About the Author**

Dr. Vishnu Kanhere

Dr. Vishnu Kanhere is an expert in taxation, fraud examination, information systems security and system audit and has done his PhD in Software Valuation. He is a practicing Chartered Accountant, a qualified Cost Accountant and a Certified Fraud Examiner. He has over 30 years of experience in consulting, assurance and taxation for listed companies, leading players from industry and authorities, multinational and private organizations. A renowned faculty at several management institutes, government academies and corporate training programs, he has been a key speaker at national and international conferences and seminars on a wide range of topics and has several books and publications to his credit. He has also contributed to the National Standards Development on Software Systems as a member of the Sectional Committee LITD17 on Information Security and Biometrics of the Bureau of Indian Standards, GOI. He is former Chairman of CSI, Mumbai Chapter and has been a member of Balanced Score Card focus group and CGEIT-QAT of ISACA, USA. He is currently Convener of SIG on Humane Computing of CSI and Topic Leader – Cyber Crime of ISACA(USA). He can be contacted at email id vkanhere@gmail.com.
Brain Teaser

Crossword »

Test your Knowledge on Algorithmic Computing

Solution to the crossword with name of first all correct solution provider(s) will appear in the next issue. Send your answers to CSI Communications at email address csic@csi-india.org with subject: Crossword Solution - CSIC December 2014

CLUES

ACROSS

2. A technique that converts a data string into a numeric string output of fixed length (4, 9)
3. Type of a problem that can be solved in polynomial time (9)
6. Tree traversal technique that processes all subtrees recursively and finally processes the root (9)
8. A nonempty, proper subset of vertices of a graph (3)
9. A path in a graph where edges may be repeated (4)
11. A collection of items (4)
13. The maximum of the distances between all possible pairs of vertices of a graph (8)
14. An edge of a connected graph whose removal would make the graph unconnected (6)
15. A technique used in discrete and combinatorial optimization problems (6, 3, 5)
16. An array data structure that stores bits compactly (3, 6)
18. The computer scientist who formulated the dining philosophers problem (6, 8)
23. Transition systems that accept or reject their inputs, depending on the state (6, 8)
24. The number of edges connected to a vertex of a graph (6)
26. The measure of execution time of an algorithm in terms of input size (4, 10)
27. A type of pseudo-random number generator technique (6, 12)
29. Tree traversal technique that processes the root first and then all subtrees recursively (8)
30. A technique that finds the position of an element within a sorted array (6, 6)
31. A lookup table that is equivalent to any logic circuit or loopless transition system (5, 5)
32. A rearrangement of elements of a sequence, where none is lost, added, or changed (11)

DOWN

1. A queue where request with highest priority is processed first (8, 5)
4. A strategy for searching in a graph (7, 5)
5. The boolean and function (11)
7. An arrangement of characters and symbols expressing a pattern (7, 10)
8. Choosing a subset of m elements out of n elements, where m ≤ n (11)
10. A type of technique that always takes the best immediate solution while finding an answer (6)
12. A sorting technique (6, 4)
13. The study of mathematical structures that are fundamentally discrete rather than continuous (8, 11)
17. A greedy technique in graph theory that finds a minimum spanning tree for a connected weighted graph is known as ___’s algorithm (7)
19. A node in a tree without any children (4)
20. The beginning characters of a string (6)
21. Division into many distinct classifications (11)
22. A theoretical computing machine invented by Alan Turing to serve as an ideal model for mathematical computation (6, 7)
23. A set of strings of symbols that may be constrained by rules those are specific to it (6, 8)
24. The boolean or function (11)
25. A closed, bounded N-dimensional figure whose faces are hyperplanes (8)
28. A set of statements that defines a sequence of operations on each input, and one that eventually halts on each input (9)

Did you ever visit Alan Turing Memorial in England?

Alan Mathison Turing (1912-1954), universally recognized as the father of modern Computer Science, formalized the concepts of algorithm and computation with the Turing machine, which has been considered a model or a general purpose computer. A statue of this icon of computing resides in Sackville Park in Manchester, England and the Turing memorial plaque in the park is shown here that reads a Bertrand Russell quote that “Mathematics, rightly viewed, possesses not only truth, but supreme beauty — a beauty cold and austere, like that of sculpture.” (More details can be found in http://en.wikipedia.org/wiki/Alan_Turing and http://en.wikipedia.org/wiki/Alan_Turing_Memorial

We are overwhelmed by the responses and solutions received from our enthusiastic readers

Congratulations!

NEAR ALL correct answers to November 2014 month’s crossword received from the following readers:

Er. Aruna Devi (Surabhi Softwares, Mysore), Dr. Suresh Kumar (CSE, Faculty of engineering and Technology, Manav Rachna International University, Faridabad) and S Christina Mary and S Jeyalakshmi (MSPVL Polytechnic College, Pavoorchatram, Tamil Nadu)
ICT News Briefs in November 2014

The following are the ICT news and headlines of interest in November 2014. They have been compiled from various news & Internet sources including the dailies - The Hindu, Business Line, and Economic Times.

Voices & Views

- The IT-BPM industry contributed 8.1% of country’s GDP last year and garnered $86 billion in terms of revenue exports. It has given direct and indirect employment to 3.1 million and 10 million as indirect employment.

- “Indians have it in their DNA to build the next WhatsApp for the world.” - Neeraj Arora, Vice-President of WhatsApp.

- About 53 per cent of children in India have been cyber bullied - Study by Telenor & BCG.

- There are 30 IT software product companies in India with a combined valuation of a whopping $6.2 billion or Rs. 37,500 crore.

- Indian Gaming market is worth close to $890 million and casual gaming revenue is set to quadruple from $65 million to $244 million by 2015.

- Healthcare providers will spend $1.1 billion on IT in 2014 - Gartner.

- Jack Ma-promoted Alibaba, the world’s largest e-commerce company by value and volume, mopped up a whopping $8 billion (Rs. 48,000 crore).

- India’s online retailing is expected to reach Rs. 50,000 crore by 2020.

- Out of the 48 million SMBs in India, only 5-6% businesses have a website whereas 40% of the SMB owners have a smartphone.

- Bangalore will become the world’s largest IT cluster by 2020. Bangalore contributed $45 billion, or 38% of India’s total IT exports, including domestic consumption, last fiscal. - IT Secretary, Karnataka Government.

- The IT industry must change to the entrepreneurial mindset of ‘Believing is Seeing’ where they believe in an opportunity and see it, after which everybody else sees it – CEO, Infosys.

- Vote on Jio Technology Start-ups, India is home to the third-largest start-up base in the world - NASSCOM.

- 108 billion work emails are sent daily, requiring one to check inbox an average of 36 times an hour. Only 14% of the emails are of critical importance – IT Industry Analysts.

- The market for the Internet of things is projected to hit $71 trillion by 2020 - IDC.

- The online shopper base which was at 8 million in 2012 grew to 35 million by 2014. It is expected to grow to 100 million by 2016. Over 50 million new buyers to come from Tier 1 and Tier 2 cities - Google.

- Total ban on porn websites not possible as servers are located outside India. There are around 40 million such websites around the world – IAMAI.

Govt, Policy, Telecom, Compliance

- IT Ministry to expand the incubator infrastructure for start-up firms offered by the STPI from four lakh sq ft at present to 10 lakh sq ft. It plans to start a ‘trade net portal’ to provide B2B services to the IT industry.

- India, Australia likely to ink social security pact which will benefit IT professionals going for short visits.

- Over 1.25 crore pensioners in the country will no longer be required to submit physical proof of being alive every November, thanks to an Aadhaar-based digital certification system soon.

- Next round of auction could force operators out of business in some circles - Vodafone India head.

- A special Defence Interest Zone to be created near international border for war time and counter-terrorism operations.

- Masking phone numbers will need security clearance.

- BSNL-Inmarsat satellite telecom services set to take off at a cost of $8 million with Ghaziabad as the location for the satellite gateway.

- DoT has identified 45 cities and 705 tourist locations for Wi-Fi services in public areas.

- To help IT firms, India will seek more visa concessions from US.

- A super-regulator for broadcasting, IT and telecom through a new Communication Bill will repeal four existing Acts, including the Indian Telegraph Act 1885 and the Telecom Regulatory Authority of India Act 1997.

IT Manpower, Staffing & Top Moves

- 8 years, 800 million handsets later, Nokia shuts Chennai plant. Last 800 employees took VRS.

- EMC has tied up with 27 engineering colleges in Pune to train students in the field of information storage management.

- Infosys probing harassment charges by a group of female employees against top executive.

- Karnataka alone created 73,000 new jobs in IT, last fiscal year and employs 10 lakh people directly and 30 lakh indirectly. This number is expected to double to 80 lakh direct and indirect jobs by 2020.

- Gujarat Govt aims at 1 million IT jobs by 2020.

- Syntel initiates a corporate recruitment drive to reach out to all eligible candidates from more than 2,800 AICTE approved engineering colleges.

- Wipro selects 14 students from Karnataka govt colleges under ‘Earn-cum-Learn’ plan.

Company News: Tie-ups, Joint Ventures, New Initiatives

- e-toll collection (ETC) in 350 national highways by December. ETC could save Rs. 34,000 crore - Nitin Gadkari.

- Google launches the Indian Language Internet Alliance (ILIA) to promote Indic language content online.

- Silicon Valley start-up develops intelligent sound system for iPhones.

- The Silicon Valley chapter of TiE to launch ‘Billion Dollar Babies’ to identify promising tech start-ups that have the potential to reach a billion dollars in valuation.

- India is home to some 3,100 start-ups. Nascom to take 150 of the most promising tech start-ups to Silicon Valley in 2015 to showcase their work and talent.

- Cognizant pips Infosys, Wipro in revenue growth in Sep 2014 quarter.

- WhatsApp, the messenger service firm acquired by Facebook, is not to enforce its $1 a year fee in India.

- Bharti Airtel launches a free WiFi service in two West Bengal Government-run AC buses in Kolkata.

- India, Russia look to establish smart cities.

- Singapore keen to develop AP capital including development of a new smart satellite city.

- Ramco Systems has developed ERP software suitable for use on wearable devices such as Google Glass and smart watches.

- ICAR - Indian Council for Agricultural Research, brings in IT tools to forecast commodity prices.

- Bangalore to host maiden CeBIT in which 50 start-ups to get special display.

- American ‘Tower keen to develop ‘villages of the future’.

- BIAL becomes the first e-freight compliant airport in India. It eliminates the generation of up to 30 documents an average airfreight shipment generates.

- NIIT, eBay join hands for e-commerce certification programme.

- IBM extends its Global Entrepreneur Program to Indian start-ups.

- SanDisk in talks with Indian phone-makers to enhance memory of devices.

- Intel, unveils its “Sensing Platform”, with an eye on the $7 trillion Indian healthcare market.

- Zomato, the popular food and discovery service to launch a mobile payment app.

- IBM launches email service - IBM Verse.

- Microsoft, partners to launch e-learning platform soon.

- Microsoft Devices bets on services, apps to drive smartphone market.

- Cisco tests ‘Make in India’ waters with $5 billion proposal.

- Mobile operators offer credit facilities for pre-paid users to help them make important calls even after their talk-time is exhausted fully.
CSI Communications | December 2014 | 45

CSI Reports

From CSI SIG and Divisions »
Please check detailed news at:
http://www.csi-india.org/web/guest/csic-reports

**SPEAKER(S)**
SIG-FM (Special Interest Group on Formal Methods) & CSI Bangalore Chapter
Dr. Kalyan Krishnamani, Prof. Deepak D’Souza, Prof. Aditya Kanade, Dr. Sriram Rajamani, Prof. Madhavan Mukund, Prof. Shyamsundar, Prof. Meenakshi D’Souza, Dr. Yogananda, R Venky, N Ranjana, Dr. Prahlad Sampath, Dr. Manoj Dixit, Dr. Sudarasan, Dr. Raoul Jetley, Shailashree Patil, BS Reddy and Ravi Prakash

**TOPIC AND GIST**
**15-17 October 2014:** National Workshop/Conference on “Formal Methods (NCFM-2014)”

Event was first of its kind. Advances in technologies, safety and security are key issues and there is need to use effective and reliable approaches to design, develop and qualify complex, high assurance system software within time-schedule and budget. Formal methods are proving effective in meeting these criteria. FMSE (Formal Methods Software Engineering) strives to promote research and development for improvement of formal methods and tools for industrial applications. Workshop had various sessions such as - Deductive verification of C programs, Refinement-Based Verification, Proofs of functional correctness of data-structure implementations with illustrations, Race detection for Android applications, Probabilistic Programming, Statistical Model Checking by Prof. Mukund, Formal Methods and Web Security, Architectural semantics of AADL using Event-B, Certifying Safety Critical Control Systems – An industry perspective, Formal Verification at Nvidia, Should we use formal methods in Flight Controls?, Challenges in Static analysis and testing in Industry, Validation Methods - AGNI Perspective, Formal methods at MathWorks, Formal Methods for Assurance of Safety Critical Systems: A case study, Industry perspective on use of formal methods & program analysis for embedded systems, Case Study by MCSRDC-HAL, Development of Large scale airborne embedded application for a fighter aircraft, Unleash the unknown: A true black box approach.

**8 November 2014:** Seminar on the topic “Art & Science of Love and its Management in Human Life”

On this occasion, a talk was delivered by Dr. Fakir Charan Parida on the above topic. Dr. Parida is a notable person in Nuclear Science domain. Presently, he is serving as Scientific Officer in Radiological Safety Division at Indira Gandhi Center for Atomic Research, Kalpakkam (Tamil Nadu). Dr. Parida, in his talk, highlighted different types and aspects of love. The nice design & contents of his talk were unique & enlightening in nature.

**Inaugural session**

Hi-Tech Institute of Technology, Bhubaneswar, Odisha in association with Computer Society of India (CSI)

Dr. Fakir Charan Parida, Prof. Dr. Anirman Basu, Prof. Dr. AK Nayak and Sanjay Mohapatra

**Honouring the guest**
Kind Attention: Prospective Contributors of CSI Communications

Please note that Cover Themes for forthcoming issues are planned as follows:

- January 2015 – IT Infrastructure
- February 2015 – Quantum Computing
- March 2015 – Machine Translation

Articles may be submitted in the categories such as: Cover Story, Research Front, Technical Trends and Article. Please send your contributions before 20th of a month prior to the issue month for which you are contributing. The articles may be long (2500-3000 words maximum) or short (1000-1500 words) and authored in as original text. Plagiarism is strictly prohibited.

Please note that CSI Communications is a magazine for membership at large and not a research journal for publishing full-fledged research papers. Therefore, we expect articles written at the level of general audience of varied member categories. Equations and mathematical expressions within articles are not recommended and, if absolutely necessary, should be minimum. Include a brief biography of four to six lines for each author with high resolution author picture.

Please send your articles in MS-Word and/or PDF format to the CSI Communications Editorial Board via email id csic@csi-india.org.

(Issued on behalf of Editorial Board of CSI Communications)
Following is the final election slate by the Nominations Committee (2014-2015) for the various offices of the Computer Society of India for 2015-2016/2017

CSI Elections 2015-2016/2017

For the Term 2015 - 2016  (April 1, 2015 – March 31, 2016)

Vice President cum President Elect
- Dr. Anirban Basu
- Dr. D D Sarma
- Prof. (Dr.) Kamlesh Kumar Saini
- Mr. S. Ramanathan

National Nomination Committee
- Prof.(Dr.) Anil K Sani
- Mr. C.G. Sahasrabudhe
- Mr. Rajeev Kumar Singh
- Mr. Satish Babu
- Mr. Suresh Tiwari
- Mr. Tarun Kumar Dey
- Prof. (Dr.) U.K. Singh

For the Term 2015-2017  (April 1, 2015 – March 31, 2017)

Hon. Treasurer
- Prof. R K Vyas
- Mr. Soman S. P

Regional Vice President (Region I)
- Mr. Brijendra Singh
- Mr. Shiv Kumar

Regional Vice President (Region III)
- Prof. R P Soni
- Dr. Vinip Tyagi

Regional Vice President (Region V)
- Mr. I L Narasimha Rao
- Mr. Shiv Kumar

Regional Vice President (Region VII)
- Mr. K Govinda
- Dr. M.A. Malik Mohamed

Divisional Chair Person Div. I (Systems)
- Mr. B S Bindhu Madhava
- Prof. M N Hoda

Divisional Chair Person Div. III (Applications)
- Ms. Mini Ulanat
- Mr. Ravi Kiran Mankikar

Divisional Chair Person Div. V (Education & Research)
- Prof. Dipti Prasad Mukherjee
- Mr. Iqbal Ahmed
- Dr. P. Sakhivela
- Dr. R. Rajkumar
- Dr. Rabi Narayan Satpathy
- Dr. Suresh Chandra Satapathy

For the Term 2015-2017

Kolkata Chapter – Treasurer
- Dr. Ambar Dutta
- Mr. Sourav Chakraborty

Kolkata Chapter - Management Committee
- Dr. Ajanta Das
- Mr. Sumanta Bhattacharya
- Dr. Abhi Mukherjee
- Dr. Sanjoy Kumar Saha
- Mr. Devapriva Chatterjee
- Dr. Tanushayam Chattopadhyay
- Prof. (Dr.) Amitava Dass
- Mr. Taral Deb
- Mr. Raktakorni Sarnobat
- Mr. Sandip Kumar Ghosh
- Mr. Mirinmoy Chatterjee
- Prof. Subho Chaudhuri

For the Term 2015-2016

Bangalore Chapter – Treasurer
- Mr. Satish B.G.
- Mr. R. K. Senthil Kumar

Bangalore Chapter – Management Committee
- Dr. Anirudh Sen
- Mr. Himanshu Gupta
- Mr. Dinakaran Pillai
- Mr. Yogamanda Jeppu
- Mr. Dattatreya S Veelal
- Mr. Mohan Ramanathan
- Mr. Arbindkumar R
- Dr. Manjun Nanda
- Dr. Prabhad Rao
- Dr. CKB Nair
- Dr. K. Satyaranayan Reddy
- Mr. Ravi K. S

Code of Conduct:
Information on CD may be used for personal contacts and ethical canvassing about one’s own candidate only. The information should not be used for disturbing the privacy and disclosing the details to others or to use any derogatory/unethical remarks about the other contesting candidates.

You can use SMS/ Email or Telephone for canvassing but avoid repeated messages / calls to respect privacy of the members.

Thanking you and with season’ greetings

Appeal to Members

You may be aware that the election for the various positions of the Executive Committee and three members of Nomination Committee for the term 2015-16/2017 as the case may be, will be through electronic ballot.

- To exercise your ballot you are requested to login to http://www.directvote.net/csi using your CSI Membership Number and password. Please view your Region and Balloting options for the elective offices for the term 2015-2016/2017.
- In case you have not received your password, please write to helpdesk@csi-india.org or before January 10, 2015 and we will email your login password.
- Please exercise your vote for the posts of Vice President cum President elect, Nomination Committee (3 members), Hon. Treasurer, RVP-I, RVP-III, RVP-V, RVP-VII and Div-I, Div-III, Div-V. Members belonging to Kolkata and Bangalore chapters will be allowed to vote for positions in their respective chapters only. In case of RVP’s members belonging to a particular region would only vote for that region’s RVP
- The ballot also includes some amendments to the constitution (proposed by ExecCom) to be approved. You are requested to exercise your voting for these also.
- The balloting for this election will start on 16th Dec, 2014 at 18.00 hrs (IST) and will end at 18.00 hrs on 16th Jan, 2015. You are requested to exercise your voting right electronically before the closure of the election site. If you have any queries on internet balloting, please email to support@directvote.net for clarifications.

Nominations Committee 2014-2015

Mr. Sanjeev Kumar  (Chairman)
Prof. P Kalyanaraman  (Member)
Mr. Subimal Kundu  (Member)
Rewards & Recognitions: A reason for Double Delight

There is nothing more satisfying than getting recognized for all of your efforts in front of your peers from different organisations. Recognitions received by organisations are for its ability to adapt the constantly evolving innovative norms. Such recognitions for organisations brings in double delight - one for the organisation itself as winning one only emphasizes that they have taken correct steps in the right direction and also positions itself as an enterprise that's always at the threshold of future growth.

It's not only the organisation that gets all cheers, the people on the project also get rewarded for their explicit role in staging a successfully chalked out plan. The delight of the 'people' on the project forms the grounds for the second part of the delight.

That's the precise reason why we see so many awards and recognition programs across various functions in different industries all around the world. Most reputed amongst them are those that are felicitated by industry associations and media houses – both being neutral bodies. Associations are much more attractive because of participation from senior industry professionals as adjudicators of the categories and the selection process. Furthermore, the status of being a non-profit organisation adds to the credibility.

I have been pre-dominantly associated with Information Technology industry and it's easier for me to talk on how awards for technology implementation from associations have always been regarded as 'THE RECOGNITION' to be received. Amidst a clutter of year-on-year awards in India, 'CSI Excellence in IT Awards' stands out and we have seen how technology teams in the enterprise burns mid-night oil to ensure that their nominations is well structured and its increase the probability of being selected by the esteemed jury comprising. The jury for the awards comprises of Academicians and Technology leaders from the industry. The next edition for awards has been already announced and as I understand, the nominations are fast trickling in. By the time the nominations close by end of December 2014, the number of entries for various industry categories would surely be a massive chunk which may well mean loads of work for Deloitte who in the capacity of 'Strategic Process Validator' would scrutinise each of these papers before arriving at a shortlisted list of nominees. More information is available on www.csiawards.in.

Technology companies offering solutions to the Indian enterprise would do well to associate with such awards program in order to get the best mileage from the reach, visibility & one-on-one networking opportunities presented.

I would be interested to hear about your opinion on how a recognition bestowed on you or your organisation have changed things for you.

Author: Salil Warior, Director, i3R Global
i3RGlobal - Event partners with CSI Excellence in IT Awards 2014
20th February 2015
Mumbai

Recognising & Benchmarking Excellence in IT

CSI EXCELLENCE IN IT AWARDS
Nominate your organisation for the ‘Best IT implementation’!!!

Computer Society of India, India’s largest IT association will recognise & felicitate the winners across various industries in India

To nominate and more details visit www.csiawards.in

For partnership enquiries, contact Salil Warior on +91 9987580188 / email: salil.warior@i3global.com

Initiative by

Produced by

CSI Communications | December 2014 | 49
CSI News

From CSI Chapters

Please check detailed news at:
http://www.csi-india.org/web/guest/csic-chapters-sbs-news

<table>
<thead>
<tr>
<th>SPEAKER(S)</th>
<th>TOPIC AND GIST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GHAZIABAD (REGION I)</strong></td>
<td>15 November 2014: Region I - Regional Student Convention 2014 on theme “Digital India-Role of Gen-Y”</td>
</tr>
<tr>
<td>Prof. RK Khandal, Puneet Garg, Dr. Kavita Saxena, RK Vyas, Dr. DK Iobiyal, Saurabh Agrawal, Vijay Rastogi, Anilji Garg, Dr. Arun Sharma, Dr. Rabins Porwal, Lt. Gen Ashok Agrawal and Mr. Rajesh Dogra</td>
<td></td>
</tr>
<tr>
<td></td>
<td>More than 250 students from 20 colleges from various states of region 1 participated. Events such as Paperix (Paper presentation), Innovasie (Software Design, Working Model &amp; Circuitronics), Quiz-O’-Caf@c (Technical Quiz), Posterino (Poster Paper Presentation), Bugbusters (Programming &amp; Code debugging), Animaatio (Web Design &amp; CAD Design), E-Warz (Gaming) &amp; Axon (Documentary) were held. They were judged by representatives from Industry and Academia. Valedictory program Chief Guest was Lt Gen Agarwal and Guest of Honour was Rajesh Dogra. Refer to links - <a href="http://epaper.livehindustan.com/story.aspx?id=7188&amp;boxid=63738164&amp;ed_date=2014-11-15&amp;ed_code=2&amp;ed_page=18">http://epaper.livehindustan.com/story.aspx?id=7188&amp;boxid=63738164&amp;ed_date=2014-11-15&amp;ed_code=2&amp;ed_page=18</a> <a href="http://epaper.livehindustan.com/story.aspx?id=7897&amp;boxid=70527726&amp;ed_date=2014-11-16&amp;ed_code=2&amp;ed_page=2">http://epaper.livehindustan.com/story.aspx?id=7897&amp;boxid=70527726&amp;ed_date=2014-11-16&amp;ed_code=2&amp;ed_page=2</a></td>
</tr>
</tbody>
</table>

| NOIDA (REGION I)                  | 24 November 2014: Seminar on “E-Governance Initiatives of GOI and Implications on Corporate Governance” |
| Anuj Agrawal, Tanmoy Chakrabarty and Gopal Krishna Agarwal, Economic Cell, BJP |
|                                  | Anuj Agrawal mentioned in inaugural talk that governance can be improved only with help of IT enabled citizen centric services. Keynote speaker Mr. Tanmoy said that with digitization and e-governance we can remove petty corruption. With automated processes in government services nobody will have to visit government offices and bribery in government offices will be eliminated. Gopal Krishna Agarwal said that new BJP government is different in its approach towards citizen problem solving. PMO is entertaining queries and complaints online and helping to find solutions. Government wants to automate services so that people can get benefit of all Government schemes. Preparation of road map for digital Noida is to be presented to Noida authorities and constructive suggestions are being given to MSME task force of Central Government for all-round development of MSME sector. |

| RAIPUR (REGION III)               | 7-8 November 2014: Workshop on “Android”                                                          |
| Dr. Sanjay Kumar and Mr. Sisodia | First participants were told about basics of Android Operating System and later architecture & applications of Android followed by extensive hands on session for writing small applications like sms application, sms broadcast application to a group, event handling programming like mouse and button clicks etc. were explained. Participants were given Android Software Kit which contained Android SDK, Eclipse IDE, Java JDK and some notes. Certificates were distributed to participants. Practical based test on Android was also conducted in which 1st winner was Gurdeep Singh, 2nd was Devendra Ausar, 3rd was Jayshri Veram and 4th was Nidhi Jaswani. |

**A Group photograph during Android Workshop**
<table>
<thead>
<tr>
<th>SPEAKER(S)</th>
<th>TOPIC AND GIST</th>
</tr>
</thead>
</table>
| **BANGALORE (REGION V)**   | 18 October 2014: Workshop on “Design Patterns”  
Mrs. Bhanumathi and Mr. Shamsundar Dhage  
Mr. Dhage spoke on Introduction to the “Design Patterns”. Topics covered were - 1) Need and applicability of design patterns in current advanced software development 2) Categories of Design patterns and different design solutions under each category 3) Understanding of various design patterns with case studies and examples 4) Exercise: Identifying and application of design pattern for given problem statements 5) Creational Patterns: to create objects in a manner suitable to the situation. |
| **VISAKHAPATNAM (REGION V)** | 29 September 2014: Felicitation to Prof. SV Raghavan and technical talk on “Emerging opportunities in ICT”  
Y Madhusudana Rao, Prof. GSN Raju, Prof. SV Raghavan, Prof. PS Avadhani, KVSS Rajeswara Rao and TNS Rao  
Chapter took honor in felicitating Prof. Raghavan by Prof. GSN Raju and Prof. PS Avadhani. Subsequently technical talk was presented by Prof. Raghavan on Emerging opportunities in ICT. In his talk he explained evaluation of big data from not only enterprises but also from non-business organizations. Present uses of Big Data in research of micro biology, nanotechnology and searching techniques out of big data were also explained. |
| **PUNE (REGION VI)**       | 10 October 2014: Conference series on “Advances in Cloud Computing (ACC)”  
Conference was inaugurated by HR Mohan. Harry Viet & Ronald van Grunsven from Amsterdam, Netherlands delivered plenary keynote and covered IOT in pest control - “The use of poisons in controlling pests, results in huge damage to nature and welfare of humans and animals”. Mr. Suresh delivered tutorial on “Saving lives through IoT”, Atul Gore covered “Notes from the (greasy) field - IoT Platform Components”. Interesting talk on “IoT and Automobiles - Practical Applications” was presented by Divyesh Desai. Anand Agrawal covered “IoT - SAP Perspective”. There was Panel Discussion on “The present and the future of IOT”. Yogesh Kulkarni, Dr. Rajesh Ingie, Prafulla Wadaskar were panelists and discussion was moderated by Monish Darda. |
| **CHENNAI (REGION VII)**   | 21 November 2014: Professional Development Program on “Internet of Things (IoT)”  
Dr. San Murugesan, Dr. Arpan Pal and Mr. H.R. Mohan  
Program was organized jointly with IEEE Computer Society, Madras Chapter on “Internet of Things (IoT): Technology, Applications, and Impact - How you can capitalize on the next big thing in IT”. The PDP was inaugurated by HR Mohan who in his address highlighted that IoT is the next wave in the era of Internet and its growth is largely fuels due to the advances in Internet, mobile, embedded devices and sensor technologies.  

"Mr. HR Mohan inauguaring PDP at CSI Education Directorate Chennai"
From Student Branches

<table>
<thead>
<tr>
<th>SPEAKER(S)</th>
<th>TOPIC AND GIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIVANDRUM (REGION VII)</td>
<td></td>
</tr>
<tr>
<td>[Image]</td>
<td>In 4 technical sessions, topics covered were (1) Introduction to Big Data (Distributed Computing, Hadoop1.x Ecosystem, Deploying a Hadoop cluster), (2) Hadoop Programming Examples (MapReduce, Hive SQL, PIG Scripts, (3) Data Sciences for Big Data (Introduction to data science Concepts, Examples, (4) Big Data Architecture and Industry use cases (How industry uses big data, How Facebook and twitter use Big Data and a Concluding session. There were 52 participants from organizations such as CDAC, VSSC, NeST, Envestnet, Triassic Solutions, Tata Elxsi, Allianz Cornhill, InApp, SCT College of Engineering, TCS, CTS, FlyTXT and MBCE.]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(REGION-I)</th>
<th>(REGION-I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECOND CSI J&amp;K STATE STUDENT CONVENTION BY MIET</td>
<td>AMITY UNIVERSITY UTTAR PRADESH, NOIDA</td>
</tr>
<tr>
<td>26-09-14: Prof Vyas, RVP addressing the convention at MIET, Prof. M.N. Hoda Division I, Sameru Sharma, Dean Engineering University of Jammu and Principal GCET were present.</td>
<td>25-09-14: Glimpse of CONFLUENCE 2014 - Dr. K.M. Soni, Ms. Nitasha Hasteer, Dr. Abhay Bansal, Dr. Shri Kant Sharma, Dr. Ravi Prakash, Dr. Balvinder Shukla, Dr. Raj Kumar Buyya along with other distinguished guests.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(REGION-I)</th>
<th>(REGION-IV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.D. GOENKA UNIVERSITY, GURGAON</td>
<td>GANDHI INSTITUTE FOR TECHNOLOGY, BHUBANESWAR</td>
</tr>
<tr>
<td>16-10-14: Prof. (Dr.) D.P. Kothari, Former Vice Chancellor, VIT University, Director v/c IIT Delhi, Principal, VNIT Nagpur talking about the current scenario and future scope of renewable energy in India.</td>
<td>20-09-14: New student branch was inaugurated by Dr. Anirban Basu, Division Chairman. Mr. Sanjay Mohapatra, Secretary is handing over the Academic membership certificate.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(REGION-V)</th>
<th>(REGION-V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GURU NANAK INSTITUTIONS TECHNICAL CAMPUS (GNITC), HYDERABAD</td>
<td>CMR TECHNICAL CAMPUS, HYDERABAD</td>
</tr>
<tr>
<td>15-11-14: Dr. D. V. Ramana, Sr. Consultant, HP Global Soft Ltd. &amp; Sr. CSI Member delivered a talk on “Big Data Management, Technologies and Applications” to the student branch.</td>
<td>13-11-2014: Workshop on “USAGE OF INFORMATICA TOOL IN DATAWARE HOUSING AND DATA MINING” by Mr. Sreehari Tippana, Wipro Technologies, Hyderabad.</td>
</tr>
</tbody>
</table>
(REGION-V)

VITS COLLEGE OF ENGINEERING, VISAKHAPATNAM

22-09-14: Resource person Shri Gampa Nageshwer Rao Addressing the audience.

SUMATHI REDDY INSTITUTE OF TECHNOLOGY FOR WOMEN, WARANGAL

26-09-14: Dr. K. Rajanikanth inaugurated the CSI Student branch with Dr. N. Sambasiva Rao, Principal, Dr. B. Ramasubba Reddy, CSE HOD and Mr. M. Ranjith Kumar CSI SBC.

(REGION-V)

SRINIVASA INSTITUTE OF ENGINEERING & TECHNOLOGY, CHEYYERU

21-11-14: Two Days Workshop on C-Programming by Mr. K. Devarajulu

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, ANANTAPUR

16-10-14: CSI-ED conducted a free workshop for faculty members on BOSS MOOL, jointly with CDAC, IIT Madras, and JNTU-A. The workshop was inaugurated by Prof. Lal Kishore, Vice Chancellor, JNTU-A.

(REGION-VII)

AVS ENGINEERING COLLEGE, SALEM

25-09-14: Workshop on “Entrepreneur in you and Multimedia & Plug in development”, Principal Dr. G.Tholkappia Arasu, Prof. SP. Malarvizhi, Dean of CSE (SBC) with student office bearers.

SRI RAMAKRISHNA ENGINEERING COLLEGE, COIMBATORE

28-07-14: Dr. M. Sundaresan, Chairman, CSI Coimbatore Chapter inaugurated the INTERACT 2014

(REGION-VII)

SKR ENGINEERING COLLEGE, CHENNAI

6-11-2014: FDP Workshop on “WIRELESS SENSOR NETWORKS”

EINSTEIN COLLEGE OF ENGINEERING, TIRUNELVELI

07-11-2014: Motivational talk on “Key skills for Industry expectation” by Mr. A. Muruganantham, Senior manager, Hexaware Technologies
### NATIONAL ENGINEERING COLLEGE, KOVILPATTI

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-10-14</td>
<td>National level Technical Symposium Souvenir released by Chief Guest Dr. R. Natarajan, Chairman, Division (II). Mr. Jerart Julus- SBC, Dr. Manimegalai, Dr. Chockalingam-Director, Mr. Nirmal Lakshman-Student President</td>
</tr>
</tbody>
</table>

### SAstra UNIVERSITY, THANJAVUR

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-10-14</td>
<td>Prof. J. Naren, SBC with Students of Final Year at the Workshop on Python Programming</td>
</tr>
</tbody>
</table>

### RAJALAKSHMI ENGINEERING COLLEGE, CHENNAI

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>14th &amp; 15th November, 2014</td>
<td>Regional Conference on “Innovations in Engineering Education and Research”</td>
</tr>
</tbody>
</table>

Please send your student branch news to Education Director at director.edu@csi-india.org. News sent to any other email id will not be considered. Please send only 1 photo per event, not more.
Application for Travel Grants for Researchers

Research Committee of Computer Society of India has decided to partly fund CSI Life Members to the extent of Rs. 25000/ for travelling abroad to present research papers at conferences.

CSI Life Members who have been invited to present papers abroad and have received partial or no funding are eligible to apply for the same. They have to apply within December 31, 2014 to div5@csi-india.org and furnish:

1. Name of the Applicant, Organization Details and Bio Data of Applicant
2. CSI Life Membership Number
3. Name of the International Conference with details of the organizers
4. Conference Venue and Date
5. Copy of the Research Paper
6. Copy of the Invitation Letter received from the organizers
7. Details of funding received from/applied to for funding to any other agency
8. Justification for requesting support (in 100 words).
9. Two References (including one from head of the organization)

Dr Anirban Basu
Chairman,
CSI Division V (Education and Research)
<table>
<thead>
<tr>
<th>Date</th>
<th>Event Details &amp; Organizers</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>December 2014 events</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:csi2014@csihyderabad.org">csi2014@csihyderabad.org</a></td>
</tr>
<tr>
<td>12-14 Dec 2014</td>
<td>Special session on “Cyber Security and Digital Forensics” during Computer Society of India Annual Convention - 2014 by CSI Special Interest Group on Cyber Forensics, JNTU Hyderabad</td>
<td>Dr. Vipin Tyagi</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:dr.vipin.tyagi@gmail.com">dr.vipin.tyagi@gmail.com</a></td>
</tr>
<tr>
<td>16-20 Dec 2014</td>
<td><strong>ICISS-2014: International Conference on Information Systems Security.</strong> At Institute for Development &amp; Research in Banking Technology (IDRBT), Hyderabad, India. Co-sponsored by CSI Division IV and CSI SIG-IS.</td>
<td><a href="mailto:iciss2014@idrbt.ac.in">iciss2014@idrbt.ac.in</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:cseait@gmail.com">cseait@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:ichcpa2014@gmail.com">ichcpa2014@gmail.com</a></td>
</tr>
<tr>
<td><strong>January 2015 events</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4 Jan 2015</td>
<td><strong>49th Annual Student Convention</strong>, Organised by Computer Society of India, Hyderabad Chapter in association with GNIT, Hyderabad. Theme: “Campus to Corporate” Venue: GNIT, Ibrahimpatnam, Rangareddy District Telangana.</td>
<td>Dr. DD Sarma, Shri Raju Kanchibhotla</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shri Chandra Sekhar Dasaka</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="http://www.csihyderabad.org/csi-2014">http://www.csihyderabad.org/csi-2014</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="http://www.csihyderabad.org/csi-2014">http://www.csihyderabad.org/csi-2014</a></td>
</tr>
<tr>
<td>17-18 Jan 2015</td>
<td><strong>5th National Conference on Indian Language Computing (NCILC-2015)</strong> organized by Department of Computer Application, Cochin University of Science &amp; Technology, Kochi, Kerala and CSI Division-III (Applications)</td>
<td>Prof. (Dr.) A.K. Nayak</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:aknayak@iibm.in">aknayak@iibm.in</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:mullayilkannan@gmail.com">mullayilkannan@gmail.com</a></td>
</tr>
<tr>
<td>23-24 Jan 2015</td>
<td><strong>Regional Student (Region-3)</strong> organised by AESICS-CSI Student Branch, School of Computer Studies, Ahmedabad University, Ahmedabad. Theme: “ICT for Make In India”</td>
<td>Prof. (Dr.) Aditya Patel</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:aditya.patel@ahduni.edu.in">aditya.patel@ahduni.edu.in</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prof. (Dr.) Sandeep Vasant</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:sandeep.vasant@ahduni.edu.in">sandeep.vasant@ahduni.edu.in</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prof. (Dr.) Kuntal Patel</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:kuntal.patel@ahduni.edu.in">kuntal.patel@ahduni.edu.in</a></td>
</tr>
<tr>
<td>23-25 Jan 2015</td>
<td><strong>National Workshop On Structural Equation Modeling Data Mining &amp; Neural Networks</strong></td>
<td><a href="mailto:giagadeesh@vit.ac.in">giagadeesh@vit.ac.in</a>, <a href="mailto:kgovinda@vit.ac.in">kgovinda@vit.ac.in</a></td>
</tr>
<tr>
<td><strong>February 2015</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 Feb 2015</td>
<td><strong>First National Conference on Computational Technologies-2015 (NCCT’15)</strong> organised by CSI, Siliguri Chapter, Dept of Computer Science and Application, University of North Bengal and CSI Div-V.</td>
<td>Prof. Ardhendu Mandal</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:am.csa.nbu@gmail.com">am.csa.nbu@gmail.com</a></td>
</tr>
<tr>
<td>Event Details</td>
<td>Contact Information</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>26 Feb - 6 March Annual Symposium on Information Technology Research, Innovation and Entrepreneurship Development award (ITRIED)</td>
<td><a href="mailto:gjagadeesh@vit.ac.in">gjagadeesh@vit.ac.in</a> <a href="mailto:kgovinda@vit.ac.in">kgovinda@vit.ac.in</a></td>
<td></td>
</tr>
<tr>
<td>March 2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-13 Mar 2015 9th INDIACom; 2015 2nd International Conference on “Computing for Sustainable Global Development” Organized by Bharati Vidyapeeth’s Institute of Computer Applications and Management (BVICAM), New Delhi</td>
<td>Prof. M.N.Hoda <a href="mailto:conference@bvicam.ac.in">conference@bvicam.ac.in</a> <a href="mailto:indiacom2015@gmail.com">indiacom2015@gmail.com</a></td>
<td></td>
</tr>
<tr>
<td>21-22 Mar 2015 International Conference on ICT in Healthcare organized by Sri Aurobindo Institute of Technology, Indore in association with CSI Indore, Udaipur Chapter and CSI Division III and Division IV Communication. <a href="http://www.csi-udaipur.org/icthc-2015/">http://www.csi-udaipur.org/icthc-2015/</a></td>
<td>Prof. Durgesh Kumar Mishra <a href="mailto:drdurgeshmishra@gmail.com">drdurgeshmishra@gmail.com</a> Prof. AK Nayak <a href="mailto:aknayak@iibm.in">aknayak@iibm.in</a> Prof. Amit Joshi <a href="mailto:amitjoshiudr@gmail.com">amitjoshiudr@gmail.com</a></td>
<td></td>
</tr>
<tr>
<td>May 2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-17 May 2015 International Conference on Emerging Trend in Network and Computer Communication (ETNCC2015) at Department of Computer Science, School of Computing and Informatics Polytechnic of Namibia in Association with Computer Society of India Division IV and SIG-WC <a href="http://etncc2015.org/">http://etncc2015.org/</a></td>
<td>Prof. Dharm Singh <a href="mailto:dsingh@polytechnic.edu.na">dsingh@polytechnic.edu.na</a></td>
<td></td>
</tr>
</tbody>
</table>
Student Essay Contest
Harnessing the Power of ICT for our New Initiatives

Computer Society of India, Chennai Chapter, in association with the IEEE Computer Society, Madras and IEEE Professional Communication Society, is pleased to announce an Essay Contest on the role of Information & Communication Technology (ICT) in India for school and college students. The contest will be in two streams:

• Stream 1: Open to School Students (from 8th Standard to Plus 2)
• Stream 2: Open to College Students (UG students of all disciplines)

Now ICT has ubiquitous presence in India and other parts of the world, and it is being applied in various fields such as Manufacturing, Banking & Finance, Telecom, Healthcare, Hospitality, Transportation, Education, Agriculture, Environment, eGovernance, eCommerce, and Defence for quality and productivity improvements. India is a major force in the global IT landscape. ICT is a key driver of our economic development and accounts for about 6.5% of our GDP and provides employments to over 3 million people. The Government of India has recently launched three major initiatives – Digital India, Make in India, and Clean India, in which ICT can – and should – play significant roles. Through this contest, we seek your thoughts, innovative ideas and solutions on how ICT could support and help these initiatives. We propose to share ideas from the young minds to PMO and DeitY.

An eligible participant is required to submit his/her essay on any one of the following topics by 31st Dec 2014:

1. ICT for Digital India
2. ICT for Make in India
3. ICT for Clean India

Submissions will be assessed by a panel of experts on criteria such as originality, novelty, applicability, potential value of the proposed idea(s) and clarity and style of presentation.

The contest winners in EACH stream will be awarded the following prizes & certificates:

One 1st Prize: Rs. 10000
• Two 2nd Prizes: Rs. 5000 of each
• Four 3rd Prizes: Rs. 2500 of each
• Ten Consolation Prizes: Amazon gift voucher of Rs. 1000 each
• Certificate of Merit: For 25 short listed essays over and the above prize winning essays

For more details & complete brochure, please visit the website: http://goo.gl/FziCmK

For clarifications / queries if any, please email us at essay.csi@gmail.com


Please feel free to share this information to all your contacts and encourage participation in this contest.
Computer Society of India
National Headquarters
Education Directorate, Chennai

Invites Project Proposals from Faculty Members and Students
Under the Scheme of R&D Funding for the Year 2014-2015

As India’s largest and one of the world’s earliest IT professional organizations, the Computer Society of India has always aimed at promoting education and research activities, especially in the advanced technological domains and emerging research fields. It is also committed to take the benefits of technological progress to the masses across India in particular to unrepresented territories. In order to promote research and innovation meeting the grass-root level ICT needs and emphasize the importance of joint research by faculty-students, the CSI has been providing R&D funding for last several years.

The CSI Student Branches and member institutions are requested to motivate the young faculty members and students (including undergraduate and postgraduate) to benefit from this scheme. The proposals (based on the ongoing or new projects for the academic year 2014-2015) with the following aims/objectives, expected outcome, indicative thrust areas for research funding may be submitted to: The Director (Education), Computer Society of India, Education Directorate, CIT Campus, IV Cross Road, Taramani, Chennai 600113.

Last date for Receipt of Proposals: 31st January 2015.

Aims and Objectives

• To provide financial support for research by faculty members, especially for developing innovative techniques and systems to improve teaching-learning and institutional management processes.
• To provide financial support to students for developing new systems catering to the needs of socially relevant sectors and/or involving proof of concepts related to emerging technologies
• To facilitate interaction/collaboration among academicians, practitioners and students
• To develop confidence and core competence among faculty/students through research projects
• To foster an ambience of ‘Learning by Doing’ and explore opportunities of industry funding and mentoring for inculcating professionalism and best practices among students and faculty
• To recognize innovation and present excellence awards for path-breaking projects through CSI YITP awards and industry associations, Govt. Agencies and professional societies.

Expected Outcome

• Identification of thrust areas, capability assessment, gap analysis, recommendations and future education and research directions
• Integration of research methodologies into the university teaching-learning process and evolving a quality control mechanism for academic programmes and curricula
• Strengthening of industry-institutes interaction through commercialization of technologies and products developed by students and faculty
• Publication of research studies (ICT penetration, technological innovation, diffusion & adaptation), state-of-the-art reports and case studies of education/research initiatives
• Identification of potential new and innovative projects of young faculty, researchers and students for possible business incubation

Indicative Thrust Areas for Research funding

The financial assistance up to Rs 50,000/- for hardware projects and up to Rs 30,000/- for software projects would be provided to cover items like equipment, books/journals, field work, questionnaire, computation work and report writing. The indicative thrust areas for funding include (but not limited):

- Technology- OS, Programming Languages, DBMS, Computer & Communication Networks, Software Engineering, Multimedia & Internet Technologies, Hardware & Embedded Systems
- Inter-disciplinary Applications- CAD/CAM/CAE, ERP/SCM, EDA, Geo-informatics, Bioinformatics, Industrial Automation, CTI and Convergence.

Last date for Receipt of Proposals: 31st January 2015

Further details and application form can be downloaded from the link of “Student’s Corner - CSI Education Directorate” at www.csi-india.org

Director (Education)
Computer Society of India
Education Directorate
CIT Campus, IV Cross Road
Taramani, Chennai-600113