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Announcement

Announcement of Current Year Award

Awards Committee of the Prof. R. Narasimhan Memorial Lecture Award has selected Dr. Koushik Sen, University of California, Berkeley, as the recipient of the Prof. R. Narasimhan Memorial Lecture Award for the current year. This is the second award under this Endowment. The first one was awarded to Dr. Sanjit Seshia of UC, Berkeley.

This award has been made possible because of an endowment received from the Bharat Family Trust, USA. Professor R. Narasimhan was a senior academic staff member of TIFR and a Distinguished Computing Scientist who has contributed immensely to the founding and setting up of Computer Science in India. He was attached to the Computer Group of the Tata Institute of Fundamental Research, Mumbai.

Dr. Sen obtained his B.Tech degree in computer science from the Indian Institute of Technology, Kanpur, M.S. from the University of Illinois at Urbana Champaign and Ph.D also from the same institute. He has several awards and honors to his credit, a few of which are mentioned below:

- Second Prize at the First International Workshop on Live Programming held in conjunction with the 35th International Conference on Software Engineering for the tool CodeHint
- Alfred P. Sloan Foundation Fellow, Computer Science 2011
- IFIP TC2 Manfred Paul Best Paper Award for the paper titled DETERMIN: Inferring Likely Deterministic Specifications of Multithreaded Programs
- 2009 Haifa Verification Conference Award for the work on “DART: Directed Automated Random Testing”
- ACM SIGSOFT Distinguished Paper Award for the paper titled “Asserting and Checking Determinism for Multithreaded Programs”
- ACM SIGSOFT Distinguished Paper Award for the paper titled “Eff effective Static Deadlock Detection.”
- David J. Kuck Outstanding Ph.D. Thesis Award

Currently he is an Associate Professor in the Electrical Engineering and Computer Sciences Department, University of California Berkeley, CA, USA

Prof. R. Narasimhan Memorial Lecture Award Details

17th April was Prof. Narasimhan’s birthday. His family has made available to the Tata Institute of Fundamental Research, the Institute where he spent his working life, a handsome endowment for an annual memorial award to bring a world-class invited speaker to international conference in Computer Science and Technology in India. For details, please visit


- Some salient aspects about the award are as follows –
- One award will be given annually in the field Computer Science and Technology and will recognize advances in hardware, software, theoretical aspects of computing, or applications of computing.
- The award will recognize the achievement of younger professionals only and hence will be restricted to professionals up to the age of 40.
- Recipients of the award should hold a degree from an Indian University, excluding honorary degrees.
- The award will be in the form of a scroll, with a trophy or plaque (rather than in monetary form), and an invitation to give a public talk titled the "Professor R. Narasimhan Memorial Lecture" on the topic for which the recipient is being recognized. In cases wherein the recipient cannot attend the conference in person, arrangements will be made for the recipient to present the lecture through video conference.
- The award will cover the expenses of the recipient to travel to the chosen conference in India and present the talk.

Obviously, only established international conferences with high standards will qualify for these awards. Peer reviewing and published proceedings are essential.
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Dear Members

I am happy to start this month message with two pleasantries. First, let us congratulate Dr. S. Ramadorai, our Fellow, Padmaabhushan awardee and the Adviser to the Prime Minister of India in the National Council on Skill Development, Government of India was felicitated with the Lifetime Achievement Award, the highest in CSI during the inaugural function of the Round Table Seminar of ‘Next Generation Networks’ which was organised by CSI jointly with Indo-French Centre for Advanced Research on April 5, 2014 at New Delhi. He has been awarded for his significant contributions to the IT Industry as well as several other positions.

Secondly, I am delighted to report that Mr. S. Ramadorai, our Fellow, Padmaabhushan awardee and the Adviser to the Prime Minister of India in the National Council on Skill Development, Government of India was felicitated with the Lifetime Achievement Award, the highest in CSI during the inaugural function of the Round Table Seminar of ‘Next Generation Networks’ which was organised by CSI jointly with Indo-French Centre for Advanced Research on April 5, 2014 at New Delhi. He has been awarded for his significant contributions to the IT Industry as well as several other positions.

The CSI-2014, the flagship event of CSI on the theme, “Emerging ICT for Bridging Future” is being hosted by the CSI Hyderabad Chapter this year in December in association with Jawaharlal Nehru Technological University, Hyderabad and Defence Research & Development Organisation, Hyderabad. Dr. J. A. Chowdary, a seasoned IT professional is the Organising Committee Chair of this, one of the CSI@50 Conventions being held during the Golden Jubilee period of CSI. A team including Dr. A. Govardhan of JNTU, Mr. Gautam Mahapatra of DRDO and Mr. Mr Raju L. Kanchibhotla, our RVP-S with eminent members drawn from various organisations and institutions has already started working on this crowning event of the year. I am sure that CSI-2014 will be rich in content and memorable. The call for papers & participation appears elsewhere in this issue.

I am happy to inform that in the execon meeting recently held at Delhi, detailed discussions were held regarding the series of Golden Jubilee events to be held across the country. In line with the curtain raiser event held at Delhi last year, in major chapters of CSI, associating the nearby chapters, we will be organizing events which will trace the history of CSI and also focus on its future, involving the fellows, past presidents, senior members, industry and academic experts as resource persons. CSI Bangalore has announced that it will hold the first of this kind of meeting in June 2014 and Chennai is planning to have one in the first week of July.

A formal review of the Special Interest Groups (SIGs) was done at the execom based on the inputs received from the conveners. Out of 27 existing SIGs, 20 were active and have organized some events during the period under consideration and it is concluded that the rest of them have met the objectives of its formation and being wound up. There has been suggestions to combine few SIGs such as SIG-SE and SIG-DS as one and merge SIG-DATA with SIG-BIG DATA, a newly proposed SIG. Additionally, requests received to form two more SIGs, SIG-Formal Methods and SIG-Indic Computing have been approved. Recently, one more request has been made to form a SIG on Technology Enhanced Learning. In the context of growing adoption of eLearning, wide spread launch & enrollments in MOOCs and need by the professionals and faculty to get updated through structured online courses, it is considered that this SIG-TEL will be of immense use and is being recommended for approval. The conveners of the all new SIGs proposed are very enthusiastic and we wish them all the very best and the final beneficiaries are our members.

At the execon, one of the many activities discussed to be initiated as a Golden Jubilee activity is the formation of CSI Student Clubs at the schools. The penetration of Internet and mobiles has resulted in a large no. of children at school level turning into tech savvy and at the same time needing proper guidance. With this as the main objective and to nurture their creativity, safeguard them from cyber security related problems, promote safe surfing and steer and teach them to use the Internet productively, the clubs are proposed. These young minds are capable of creating Intellectual Property which alone will facilitate our Country to retain its supremacy in the IT field since the IT services market is shrinking. Formal guidelines to start these clubs and extend support through the chapters / student branches with our senior and superannuated members as mentors will be made available shortly. Our target is to have at least 500+ school clubs in this year – at par with the no. of student branches.

For our request to share material for the CSI History project, we have received some inputs though not to the extent we expected. These are available for viewing at http://tiny.cc/tpl84ex We are renewing our request to all our members and readers to provide us with whatever information they have related to CSI. Please send them in the digital form to csi.history@gmail.com and the physical items to the Education Directorate, CSI, CIT Campus, 4th Cross Road, Taramani, Chennai - 600113. Be a part of capturing CSI History.

Dr. T.V. Gopal, the immediate past chairman of Division II on Software has left a mark of his own by organizing a no. of high profile events during 2013-14. Our other division chairs have also been equally vibrant in terms of events organized by their divisions which are captured and viewable at http://goo.gl/EnUqXE

The growing need for IP addresses with no spare IP addresses available in the APNIC region in which India is a part, is forcing us to migrate from IPv4 to IPv6. In this context, ERNET has been organizing the IPv6 Road Shows across the country and CSI is partnering with them. In one of such Roadshows held at IIT Madras, has resulted in foreclosing the registrations within four days of its announcement since over 300 – much higher than the auditorium capacity have registered. We thank our past president Prof. S.V. Raghavan for linking CSI with ERNET in this initiative. It may be of interest to note that through Education Directorate and CSI Bangalore, we have recently launched the IPv6 training initiative with the support of Matrabyte.

CSI is now fairly active in Social Media with its recently launched Facebook site. Our readers may get to know the latest happenings at CSI through this avenue. Thanks to Ms. Nourine Bhimani assistant manager at CSI HQ, Mumbai.

We are now enjoying the Digital version of our monthly CSI Communications (CSIC) due to the initiatives of Mr. Ranga Rajagopal and the team at Cyber Media, the publishing partners of CSIC. The App for CSIC for on Android and iOS was also recently launched making CSIC accessible anywhere, anytime by anyone.

While I have a lot more to share in this column, due space constraints, I end this month’s message now and catch up with you next month.

With regards

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

Graph Theory is the theme for this issue. Many real-world scenarios can be conveniently represented by a graph consisting of several points (vertices or nodes) and lines (edges or arcs) joining pairs of some, none or all of the vertices. The nodes could be represented by people and edges by friends in social networking purview or several other interesting applications in life. This is the backbone of the motivation of study of graphs with strong mathematical abstractions spawning to discern Graph Theory as a topic of interest.

We start our cover story with a precise and comprehensible eye opener article on Graph Theory: From Konigsberg Bridges to Web-like Complex Networks a Computer Science Perspective authored by Prof. Narasingh Deo and Prof. Sumit Kumar Jha of University of Central Florida, Orlando, USA. It’s indeed a very lucid presentation for our enthusiastic community drawing analogy from a philosophical origin of ancient Indian tradition of family genealogies to Eulerian formal introduction of Graph Theory and then sailing through complexity of real world networks and finally concluding with a message of social changes in India through graph theory based expert recommendation systems as a way forward. The second cover story by Dr. C Shoba Bindu and Ms. K Dhanasree of JNTUA College of Engineering, Anantapur is on Graph Theory: Applications in Various Fields, showing an assortment of many major applications.

Technical Trends section of this month is by Prof. Krishna Kumar L and Ms. Jimy Joy on Graph Theory Behind Theoretical Neuroscience and Brain Parcellation to explain application of graph theory used as an analytical method.

Our Research Front section is enriched with two important contributions. First one is titled Graph Theory Applications in Images: A New Trend Analysis of Image Visualization in Medical Images by J Emmanuel Robin, Dr. N Kannan and G Prabu of Jayaram College of Engineering and Technology, Tamil Nadu, emphasizing upon the application of graph theory in medical image visualization. Second one is titled Rigidity of Graphs highlighting a special aspect of the geometric representation of graphs by Srabani Mukhopadhyya of Birla Institute of Technology, Mesra, Kolkata Campus and Buddhadeb Sau of Jadavpur University, Kolkata.

In Practitioner Workbench’s Software Engineering,Tips() subsection, we have two very special contributions. The first one comes from Great Guru of Software Engineering, Father of Use Cases, Prof. Ivar Jacobson alongwith Pan-Wei Ng, Ian Spence and Paul E McMahon on Major-League SEMAT— Why Should an Executive Care?, where authors accentuate how SEMAT can provide the foundation towards better application software development in a faster, cheaper and happier way. Second article by Shihong Huang, Ivar Jacobson, Panwei Ng, Arne J Berre and Mira Kajko-Mattsson of SEMAT team is on Essence – A Foundation for Software Development Games highlighting the outcome of the global SEMAT initiative that has been recently adopted as a standard by the OMG. In fact, Essence will be presented in a forthcoming tutorial at ICSE 2014 at Hyderabad by the team at Hyderabad on June 3, 2014.

In our regular Practitioner Workbench column Programming.Tips() section, Madhurima and Nitasha Hasteer of Amity University, India, who is recently inducted into Internet Hall of Fame. Mrs. Jayshree A Dhere, Resident Editor presents a very thought provoking interview with Dr. Srinivasan Ramani, pride treasure of India, who is recently inducted into Internet Hall of Fame.

Dr. Debasish Jana, Editor, CSI Communications presents crossword for those who want to test their knowledge in Graph Theory under Brain Teaser column. H R Mohan, President, CSI, AVP (Systems), The Hindu, Chennai brings us the ICT News Briefs at a glance under various sectors in April 2014 under regular column Happenings@ICT.

With warm regards,

Rajendra M Sonar, Achuthsankar S Nair, Debasish Jana and Jayshree Dhare
Editors
Graph Theory: From Konigsberg Bridges to Web-like Complex Networks
A Computer Science Perspective

Early History: The official birthday of graph theory is considered to be August 26, 1736 — the day Euler presented his historic paper proving the infeasibility of traversing Konigsberg’s seven bridges, each exactly once. In an informal sense, however, concepts from graph theory were used implicitly several centuries earlier, for example, in building family trees. The Pandas of Hardwar and other places of Hindu pilgrimage have been devising family trees of up to 20 generations since the 12th century[4].

Early growth of graph theory was slow. After Euler’s paper, it took 200 years for the first book on graph theory to appear: Denes Konig’s book on Theory of Finite and Infinite Graphs, published in 1936 in German, spurred a world-wide interest in the subject.

During the intervening 200 years, from 1736 to 1936, a number of remarkable results were discovered; but they were isolated and sporadic. Most notable and influential among these were: Kirchhoff developed theory of trees [1847] for analyzing electrical networks; Arthur Cayley [1857] used trees in enumerating isomers of saturated hydrocarbons; Mobius presented the 4-color problem in one of his lectures in 1840; and William Hamilton invented the puzzle of finding a cyclic route along the edges of a regular dodecahedron passing through each of its 20 vertices exactly once.

In the 1940s and 50s graph theory grew out of its origin in recreational puzzles and games, and gained popularity as a tool for modeling and solving problems of significant size in operations research and circuit analysis.

After the Computer: The second half of the 20th century witnessed the true flowering of graph theory—an impressive accumulation of research papers, textbooks, and its inclusion in curricula across several disciplines. Graph theory is taught as a full-fledged stand-alone course in Mathematics, Computer Science, Industrial Engineering, Electrical Engineering and Management Science. This rise of graph theory from an obscure corner of topology into a significant player in ushering the Information Age, is primarily because of the symbiotic relationship between the Computer and Graph Theory.

On the one hand, it was recognized that graph theory, unlike, say, differential equations, starts becoming indispensable in solving practical problems only when the graphs involved are fairly large. A problem that can be modeled as a graph small enough to be solved by hand, can usually be solved by means other than graph theory. To handle large graphs arising in real-life applications, one needs a computer and a good algorithm. On the other hand, graph theory has turned out to be a multifaceted, extremely valuable, tool in design, building, manufacturing, and testing of computer hardware and software. From the back-plane wiring of the early mainframe machines, to layered layout of the printed-circuit-boards, to packing of a billion transistors in a microprocessor chip, to supercomputer interconnections, have been employing graph theory.

Computational Graph Theory: In the history of graph theory the second half of the 20th century may be dubbed as the era of algorithmic or computational graph theory. During this period a large number of fast, efficient graph-theoretic algorithms were designed, developed, implemented, and published. Many were used to solve large real-life problems. The P-NP classification was developed and problems were categorized. Some computational graph problems, such as, the graph-isomorphism problem continue to defy classification.

Consider the planarity problem[2,3]: Determine if a given graph G with n nodes is planar. Before 1963, the best available algorithm for this problem required time proportional to O(n^6). It was based on Kuratowski’s [1930] characterization of a planar graph. Faster planarity algorithms developed during the next ten years brought the time-complexity down successively from O(n^6) to O(n^3) to O(n^2) to O(n log n) to O(n). The last one, for the Hopcroft-Tarjan algorithm, achieves the best possible speed, the lower bound for the planarity problem (See Fig. 1).

Large Graphs: As pointed out in an earlier section, the very first book on graph theory [König 1936] dealt with both finite and infinite graphs. Properties of infinite graphs were studied early on. Some of these include elementary family of graphs with infinite number of nodes and /or edges (e.g., paths, cycles, ladders, stars, wheels, complete graphs, grids, Boolean hypercube graphs, circulant graphs, and the like). Other, more involved, families are fairly large. A problem that can be solved by hand, can usually be solved by means other than graph theory. To handle large graphs arising in real-life applications, one needs a computer and a good algorithm. On the other hand, graph theory has turned out to be a multifaceted, extremely valuable, tool in design, building, manufacturing, and testing of computer hardware and software. From the back-plane wiring of the early mainframe machines, to layered layout of the printed-circuit-boards, to packing of a billion transistors in a microprocessor chip, to supercomputer interconnections, have been employing graph theory.

Kuratowski

GOLDSTEIN / SHIREY 1963/1969 k n^4 1.67 min
LEMPLE, EVEN, & CEDERBAUM 1967 k n^2 100 ms
MONDSHEIN 1970 k n^2 100 ms
HOPCRAFT & TARJAN 1970 k n log n 1 ms
HOPCRAFT & TARJAN 1974 k n 0.1 ms
n = 1000 vertices k = 1 μsec

Fig. 1: Progress of Planarity Algorithms
of infinite graphs were defined and studied from a combinatorial point of view, including Pascal graphs, Rencontres graphs, Stirling graphs, etc. Typically, these families of graphs have well-defined regular structures, which allow us to derive many of their properties analytically and in closed-form.

**Classical Random Graphs:** A random graph $G_{n,m}$ introduced by Erdős and Rényi and independently by Gilbert, in 1959, is generated as follows: start with $n$ isolated nodes and add undirected edges between $m$ pairs of nodes (out of $n\times(n-1)/2$) with uniform probability, one by one. This classical model of the random graph is referred to as the Erdős-Rényi static random graph, because the number of nodes remains fixed during the process of edge additions. Various asymptotic properties of random graphs have been derived and reported in the literature.

**Dynamic Random Graphs of Web-like Networks:** Toward the very end of the 20th century, a new and exciting type of random graphs emerged directly from modeling the WWW and the Internet. Empirical studies showed statistical similarity between these two and numerous other complex, real-life networks such as the network of phone calls, power-distribution networks, citation networks, science-collaboration networks, movie-actor collaboration networks, neural networks, and other social, technological, and life-sciences networks. Viewed as large (often with billions of nodes), dynamic (with birth and death of nodes taking place), random graphs, they differ significantly from the classic Erdős-Rényi random graphs. These graphs are sparse, exhibit small-world properties and follow power-law degree distribution, and give rise to formation of communities (locally dense subgraphs in a globally sparse graph).

Because of their importance, ubiquity, and their ability to be characterized by a small set of statistical parameters, these networks (referred to as Complex Networks) have spawned a truly cross-disciplinary science of networks in the past 15 years. Hundreds of studies have been conducted and papers published exploring properties of complex networks—such as, their size, diameter, degree distribution, pairwise-distance distribution, cliques, communities, clustering coefficient, and the like. Several growth models of these evolving networks have been proposed and studied([1]).

**From Dynamic Random Graph to Real-World Networks:** Over the last two decades, there has been a shift in the focus of graph theory research: from establishing theorems and properties of arbitrary graphs to the algorithmic study of families of related real-world networks. Such real-world or complex networks are classified based on their provenance and studied together as a family. Graphs of Internet nodes connected through network routes, biochemical entities interacting via chemical reactions, and email addresses communicating through electronic messages are prototypical examples of such complex networks. Because of the similarity in their origin, complex networks from a given real-world domain often share a number of preserved topological properties. For example, many social networks are scale-free, i.e. their degree distribution follows a heavy-tailed Pareto distribution that remains invariant across multiple networks of varying sizes. In 1998, Watts and Strogatz proposed a mathematical model that described the evolution of scale-free complex networks and the small diameter of such graphs. Their results explained the complex networks dynamics that gives rise to the “small world” phenomenon such as the six degrees of separation among human beings first observed in 1961. Since these results were published, other researchers have developed mechanistic models involving addition or deletion of nodes and edges that explain the observed topological properties of several classes of real-world networks. However, the development of stochastic models that describe the evolution of complex networks while preserving the statistical distribution of a given set of topological properties is still an area of active study. In future, we envision a tight integration between the theory of stochastic systems and complex networks that will enable the development of non-algebraic truly computational models capable of explaining, predicting, and controlling complex natural phenomenon as well as engineered systems.

**Big Networks for Big Data:** Modern computer-aided data acquisition and storage systems are creating more than quintillion ($10^{20}$) bytes of new data every day. Only a small fraction of this voluminous data, for example metadata, is currently being exploited. Graph theory provides a natural framework for analyzing such mammoth data stores by fusing together different data sources into one informational complex network. Over the next couple of decades, the future of algorithmic graph theory will be inspired by such big data problems. Several directions for future research remain open. In many practical scenarios, nodes in a system are connected through multiple relationships and their interrelationships are best studied by combining information from these multiple interrelationships into a single relation. This has been traditionally achieved by mashing together information using algebraic methods to produce a single network with nodes and at most one edge between a pair of nodes. Such an ad hoc way of combining data is known to create problems in predictive data analytics, and we believe that a truly graph-theoretic framework of information fusion will become an active area of interest in the near future. For example, how can one compute a single collection of communities on a set of nodes from multiple weighted graphs containing these nodes? An example would be the identification of known acquaintances of an individual from multiple social networks, email metadata, phone records and video surveillance records — each of which will produce its own graph.

**3D Layout and Visualization:** Expert analysts who use computer systems often need to visualize the analysis performed by the machine as a final sanity check on the computations performed and on the validity of the assumptions that went into the design of such a computer system. Many such visualization systems produce graphs as their primary output. Traditionally, there has been a lot of work in visualizing two-dimensional layouts of graphs. However, with the availability of three-dimensional visualization hardware, the problem of producing low-distortion and low-clutter three-dimensional layouts of graphs will be an area of active interest. Depending on the context, low distortion
and low clutter may have different interpretations such as reduced average change in distances between nodes, minimum maximum change in the inter-node distances, or least change in the distance between the centers of communities in a large sparse network. Three-dimensional graph theory will also be a subject of focus by researchers in VLSI and nanoelectronics as 3D chips become more abundant and two-dimensional routing problems that were solved using planar graph theory need to be optimized for 3D VLSI circuits. While any graph can be embedded in three dimensions, practical problems of optimal VLSI layout and low-distortion visualization will provide a rich source of problems to graph theory over the next decade.

**Graph Theory and Social Change in India:** The Right to Information (RTI) Act of 2005 has given Indian citizens the legal right to obtain information on the decision making process of the executive that they elect. Since its inception, the RTI act has been used to unravel potentially questionable decisions by the executive and this has led to well publicized PILs or public interest litigations. However, its current use to expose possible corruption has focused only on a small amount of textual or quantitative data directly hinting at possible questionable decision-making practices. As a number of similar PILs become popularly known, future cases of corruption may not leave such tangible evidence behind. Instead, RTI activists will have to rely on an electronic trail of breadcrumbs and use heterogeneous data from multiple sources to detect and establish malfeasance to the satisfaction of a court of law. Graph theory and research into complex networks will be particularly crucial for allowing computers to run sanity checks on gigabytes of information obtained electronically using RTI requests – official phone calls of decision makers, movement of currency, commodity and stock prices, clearance of projects, visits and meetings with stake holders, and textual data in government files. One can envision a private group of individuals establishing a publicly accessible computer farm that uses complex networks to make sense of the deluge of data coming from routinely filed RTI requests and the use of stochastic models to automatically detect causal relationships and rare behaviors that need the attention of an expert RTI activist.

According to the Telecom Regulatory Authority of India (TRAI), India is home to about 900 million telephone connections\(^1\) with a rural phone density i.e. number of phones per person of about 43%. Despite this penetration of mobile phones into rural India, a large fraction of its 1.25 billion population still remains disconnected not only from the world at large but also from its own political landscape. The development of graph theory based expert recommendation systems for the identification of experts that need the attention of an expert RTI activist.

References


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Graph Theory: Applications in Various Fields

Graph theory has a history dating back more than 250 years. The era of graph theory started when a famous mathematician, Leonhard Euler had a problem of crossing the seven bridges of Königsberg. Ever since he was a child he had a quest for a walk linking seven bridges in Königsberg. This was today called as the first problem of graph theory. Since then, graph theory, the study of graphs with nodes and inter-connections of nodes has evolved and proved with its tremendous use in various fields. It has crept itself into the hands of many famous mathematicians making them easy to solve every complicated real world problem. Its method of representing every problem using pictures or graphs had made itself a pioneer in finding solutions for many unsolved problems.

Leonhard Paul Euler (1707-1783) was a famous Swiss mathematician. More than a mathematician many of the books also quoted him as a traveler as he was very fond of travelling to various places. He constantly travelled between Russia and Germany. While travelling he came across the famous bridge by name Königsberg and its problem which is faced by the people travelling across the bridge. Euler solved the first problem using graph theory and thereby led to the foundation of very vast and important field of graph theory. He created first graph to simulate the problem of the bridge, which was then considered as one of the toughest problems.

**Problem:**
The 'Königsberg Bridge' is located in the city of Königsberg, formerly in Germany but, now known as Kaliningrad and part of Russia, which was built on the river Preger. The city had seven bridges, which connected two islands with the mainland via seven bridges. People staying there always tried for a walk across these seven bridges exactly once and come back to the land where they have started. This remained every time as impossible and remained as a famous unsolved problem then. Many mathematicians have tried to solve this but were unsuccessful until 1736. Fig. 1 shows the picture of the map of Königsberg during Euler’s time representing the actual layout of the seven bridges on the river Preger.

In, 1736 Euler out of many attempts came out with the solution in terms of some visual diagrams. This has led to the basic structure of a graph. Euler formulated the bridge problem in terms of visual pictures called graphs. He removed all unnecessary features of the city connecting seven bridges and abstracted it using dots and lines. He used dots to represent the land masses and lines to represent the bridges connecting the land masses. He then used the graph structure proved that it was not possible to walk across the seven bridges exactly once. The resulting picture might have looked somewhat similar to Fig. 2.

This rough sketch of the 'Königsberg Bridge' problem that has used dots and connections has led to the advent of graph theory, where he later defined dots as vertices and connections as edges. Since then, the theory of graphs spread in all varied fields. With these varied field extensions, the theory of graphs is not maintaining any standard notations to represent its objects. As how the various applications of these fields vary, the notations of objects are also varying.

Thus, for example, if we consider a communications network as a graph, then the systems taking part in this network are named as nodes rather than vertices or points. In the field of chemistry these vertices are given the notation of molecules. In case of software development process these vertices are given the notations of modules.

**BASIC Concepts of Graph Theory**

Graph theory can be defined as the study of graphs.

Graphs are mathematical structures used to model pair-wise relations among objects from a certain collection. A graph G consists of a vertex set V(G) and an edge set E(G), where each edge is an unordered pair of vertices. A loop is a self edge with in vertex itself.

For example, Fig. 3 shows a graph G = (V(G), E(G)) defined as follows:

\[ V(G) = \{a, b, c, d\} \]

\[ E(G) = \{(a, b), (a, c), (b, c), (b, d), (c, d)\} \]

The graph in Fig. 3 is a simple graph since it does not contain loops or multiple edges.

If more than one edge joins a pair of vertices then the graph is called multigraph. If there is no specific direction of the edges then the graph formed is called a non directed graph. If here is a specific direction mentioned on the edges then the graph is called directed graph or diagraph. A tree is an acyclic connected graph. Fig. 4 is a non directed multi-graph with loops and multiple edges.
Graph Theory in Computer Science

Graph theory is playing an increasingly important role in the field of computer science. Any software that has to be developed, any program that has to be tested is making themselves easy using graphs. Its importance is derived from the fact that flow of control and flow of data for any program can be expressed in terms of directed graphs. Graph theory is also used in microchip designing, circuitry, scheduling problems in operating system, file management in database management system, data flow control between networks to networks. The theory of graphs had made the field of computers to develop its own graph theoretical algorithms. These algorithms are used in formulating solutions to many of computer science applications.

Some algorithms are as follows:
1. Shortest path algorithm in a network
2. Kruskal's - minimum spanning tree
3. Euler's- graph planarity
5. Algorithms to find the connectedness
6. Algorithms to find the cycles in a graph
7. Algorithms for searching an element in a data structure (DFS, BFS) and so on.

Graph Theory in Chemistry

Many of the chemical phenomena in chemistry are modeled using graph theory. All structural formulas of covalently bonded compounds are graphs and are called as molecular graphs. It is used to study the nature of molecules in chemistry. A model of molecules can be represented by graphs where vertices represent atoms and edges represent bonds between them. Graph theory has aided chemistry to represent many chemical compounds in symbolic formulæ. Graph enumeration methods such as Polya's are used to enumerate certain specific classes of chemical compounds. It is used for classification of organic compounds. In biochemistry to resolve the conflicts between two chemical compounds some series of atom samples need to be removed. This can be represented in the form of graphs, where the atom series in the sample are represented as vertices. If there is a conflict between two series then an edge is drawn. Then to resolve the conflict, the conflicting vertices can be removed. For computerized chemical identifications many graph enumeration techniques are used. Possible distinct chemical structures can be generated from a given chemical formula and the valence rules for any new substance can be derived. A computer language named DENDRAL was developed for automatic identification of the chemical compounds.

Graph Theory in OR

Operations research, major field of statistical mathematics is widely using Graph theoretical concepts such as the shortest spanning tree in a weighted graph, the traveling salesman problem, obtaining an optimal match of jobs and men and finding the shortest path between two vertices in a graph. It can also be applied in activity networks, modeling transport networks and game theory. In the network activity graphs can used to model network of pipelines through which goods and commodities can be shipped from one place to another. This operational research network is called transport network. To minimize the cost of transport graph theory aims at finding the shortest paths in the transport network. The most accepted and successful applications of graphs in OR is the planning and scheduling of large complex projects. PERT (Project Evaluation Review Technique) and CPM (Critical Path Method) are the well known algorithms. Using PERT/CPM complex projects can be designed and evaluated in minimal time duration.

Graph Theory in Day to Day Applications

In a modern information retrieval system each document carries a number of index terms. Each index term is represented as vertex and if two index terms v1, v2 are closely related then they are joined with an edge (v1, v2). The simple, undirected large graph then produced is called the similarity graph. Components of this graph produce a very natural classification of documents in the system for retrieval. One specifies some relevant index terms and the maximal complete sub graph that includes the corresponding vertices will give the complete list of index terms which specify the needed documents.

How Google Work Does:

When Google search engine connects all the Google databases to retrieve the user data, a giant network is formed. Google sees this network as a directed graph. Each webpage is represented as a node, and an edge is used to join two pages, if...
Graph Theory in other Areas

Linguistics is another field where graphs are majorly used. They are used to represent natural language parsing diagrams. The vertices represent words and word strings and the edges represent certain syntactical relationships between them. Socio-graphs, a type of digraphs, have been used to represent relationships among individuals in a society. To maintain population statistics, family trees are used. Graph theory has also been used in economics, logistic cybernetics, artificial intelligence, pattern recognition, genetics and reliability theory and in many other computer science fields.

Conclusion

Graph theory has its sprawling applications in various fields. It is now viewed as one of the subject of interest that is used for many of real time problem solving. As a theory of graphs it is showing its easiness to represent each real time problem using a visual graph to find the solution. Many of the fields like computer science, business, microbiology, medical etc are able to solve existing complicated problems using graphs.

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Mathematics plays vital role in various fields of Engineering. One among the important areas in mathematics is graph theory which is used in structural models. The structural arrangements of various objects or technologies pave way to new inventions and modifications in the existing environment. Theoretical neuroscience includes various streams like neuromathematics, neurophysics, neurostatistics and neuroinformatics. It uses quantitative tools to understand further how the brain works. It is used to understand how a neural system produces a given behaviour and why a neural system performs the way it does, using tools from information theory. Graph theory is an analytical method used in theoretical neuroscience.

**Graph Theory Analysis in Detail**

Graph is a set of nodes and links. The elementary part of a functional network analysis is the node. Links can be either directed or undirected paths. In a brain functional network, nodes can represent neurons, cortical areas or brain regions and links can represent correlations between these nodes. Thus, links depict activity patterns between nodes and functional connectivity among nodes[1].

Graph theory is a valuable framework to study the organization of functional and anatomical connections in the brain [2]. This paper introduces the important concepts of Network Theory and their application in the areas of brain connectivity research. Brain connectivity is generally divided into three types; structural, functional, and effective connectivity. Anatomical connections between brain regions are exhibited using Structural connectivity. Functional connectivity represents the temporal correlation in the activity of two brain regions. Effective connectivity refers to the directed causal influences that one brain region produces in another brain region.

**Brain Parcellation**

The brain parcellation is based on a database of 14 normal T1-MR brain scans which were manually segmented by neuroanatomically trained operators.[3] The following processing steps consists of the parcellation of an individual T1-MR brain scan:

1) A non-local means algorithm to reduce the noise in MR image.
2) Gray Matter (GM), White Matter (WM) and the Cerebrospinal Fluid (CSF) segmentation.
3) Splitting the left and right hemispheres. Both hemispheres are processed separately. Three anatomical points are considered.
4) Definition of a fourth anatomical point located between the caudates
5) Selecting the N most comparable brain hemispheres in the knowledge base using the measures specified by the user.
6) Using a hierarchical approach, every single knowledge base hemisphere that is selected is elastically matched to the subject hemisphere. A set of N structure definitions in the geometry of the subject hemisphere is thus obtained.
7) From the N structure definitions, derive a maximum probability atlas.
8) Parcellating the gray matter structure into cortical regions with the help of an atlas.

Anatomical connections are usually used to constrain the function of a brain region. Even if the 3D volume of the subject and the atlas overlap perfectly, there are chances that the size of the regions be different. A new evaluation metric can be used to measure the overlap between a parcellation and an atlas, regardless of the kind of atlas. It works with different numbers of clusters and detects the usefulness of the parcellation. Different pre-processing and clustering approaches will be tried, and additional feature generation and selection methods will be applied[4].

**Graph Theoretical Analysis and Brain Parcellation**

Various steps of Graph theoretical analysis and brain parcellation as shown in Fig. 1 are:

- Defining the network nodes. The nodes could be specified as electroencephalography electrodes, or as anatomically defined regions of MRI imaging data.
- Estimating a continuous measure of association between nodes. The association could be the spectral
coherence or Granger causality measures.

- Generating an association matrix by compiling all pair wise associations between nodes.
- Applying a threshold to each element of the generated matrix to obtain a binary adjacency matrix or undirected graph.
- Calculating the network parameters of interest in this graphical model of a brain network.
- Compare the parameters of interest to the equivalent parameters of a population of random networks.

Each step includes a crucial decision to be made that may influence the final results and thus they must be wisely chosen. In step 1, parcellation schemes may use prior anatomical criteria or functional connectivity profiles of different regions. There are so many parcellation schemes that can affect the network measures. In previous studies of magneto encephalography and electroencephalographs, network nodes are equivalent to individual electrodes or sensors. Even though, some reconstruction algorithms will pinpoint the brain location of each source by optimizing the covariance between sensors.

In step 2, estimation of a range of different coupling metrics, including measures of both functional and effective connectivity is performed. An important decision at step 3 is the choice of threshold used to generate an adjacency matrix from the association matrix, since different thresholds are capable of generating graphs of different sparsity and thus the network properties are often discovered over a vivid range of credible thresholds. In step 4, a large number of network parameters are quantified and compared with the distribution of equivalent parameters.

Till date most graph theoretical network studies have used symmetrical measures of statistical association to construct undirected graphs. This could be generalized to consider asymmetrical measures also to construct directed graphs. Thresholding can also be avoided by analysing weighted graphs that contain more information than the simpler unweighted and undirected graphs.

Conclusion
Graph theory application can provide very valuable insights in the structural and functional organization of neural networks in the future. The major difficulty arises from the fact that graph measures depend on the increasing number of nodes and edges while considering the brain. Despite all these difficulties, it is noticeable that graph theory can be very beneficial if one knows the exact application of each and every structure in the graph theory. Likewise, the distribution of nodal values for a particular graph measure can be very insightful.

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Graph Theory Applications in Images: A New Trend Analysis of Image Visualization Mapping in Medical Images

Introduction
Graph theory is one of the emerging trend-setting fields in computer science. In the mathematical language, graph is a set of elements and a set of pair wise relationships between the elements. A graph in the context is made up of “vertices” or “nodes” and lines called edges to connect them. A graph may be undirected - meaning that there is no distinction between two vertices associated with each edge or its edges may be directed from one vertex to the other.

Graphs can be used in many types of physical and biological information systems. Graphs are used in the computer science field exceptionally well e.g. graphs are used in networking, communication, data organization and in flow of computation.

Graphs are used in the variety of two categories as directed and undirected graphs. In Image processing, graphs play a vital role for developing the structure and connection between the edges and transformation between the vertices. In particular in the arena of medical imaging field graphs are playing the came in analysis and diagnosis of the medical reports.

Characteristics of Graphs
Graph based image processing methods typically operate on pixel adjacency graphs, i.e., graphs whose vertex set is the set of image elements, and whose edge set is given by an adjacency relation on the image elements.

Commonly, the edge set is denoted as all vertices v, w such that
\[ d(v, w) \leq p \] (1)

This is called the Euclidean adjacency relation.

When we discuss about the images we need to adjacency matrix.

The adjacency matrix representation of graph G = (V, E) is a \(|V| \times |V|\) matrix W where Wij = {wij if ej ∈ E, 0 otherwise}

For undirected graphs the matrix Wij is symmetric.

Representation and Visualization of Image as a Grid Graph
The image to be segmented is represented as a graph G (V, E). To do so, each pixel is treated as a vertex of the graph. Edges are defined based on 8-connectivity of the neighborhood vertices. An edge (vi, vj) ∈ E corresponds to a pair of neighboring vertices. The graph G, thus obtained is an undirected weighted non-planar graph.

Clearly, an image of size N × N contains N2 vertices, (N−1)N vertical edges, N(N−1) horizontal edges and 2(N−1)2 diagonal edges. Thus, in total there are (N−1)N +N(N−1)+2(N−1)2 = 4N2−6N+2 edges. Let M = 4N2−6N+2. The graph thus formed is visualized as a grid and hence called as grid graph.

A sample grid graph of size 8×8 is shown in Fig. 2.

Medical Image Visualization in Images
During the past three decades, there has been significant increase of different devices like CT, MRI, and X-Ray etc. One of the best medical non invasive procedure is called dermoscopy or dermatoscopy. Dermatoscopy (also known as dermoscopy or epiluminescence microscopy) is the examination of skin lesions with a dermatoscope.

This traditionally consists of a magnifier (typically x10), a non-polarized light source, a transparent plate and a liquid medium between the instrument and the skin, and allows inspection of skin lesions unobstructed by skin surface reflections. Modern dermatoscopes dispense with the use of liquid medium and instead use polarized light to cancel out skin surface reflections. When the images or video clips are digitally captured or processed, the instrument can be referred to as a “digital epiluminescence dermatoscope”. This instrument is useful to dermatologists in distinguishing benign from malignant (cancerous) lesions, especially in the diagnosis of melanoma.

Fundus photography (also called fundography) is the creation of a photograph of the interior surface of the eye, including the retina, optic disc, macula, and posterior pole (i.e. the fundus). fundus photography generally needs a considerably larger instrument, but has the advantage of availing the image to be examined by a specialist at another location and/or time, as well as providing photo documentation for future reference.
Modern fundus photographs generally recreate considerably larger areas of the fundus than what can be seen at any one time with handheld ophthalmoscopes.

DNA microarrays are an experimental technology which consists in arrays of thousands of discrete DNA sequences that are printed on glass microscope slides.

Visualization Mapping Graph Theory
Adjacency Matrix in Dermoscopy Images
Visualization of the images analysis adjacency matrix is divided into two groups.

In the first group three images are analyzed and two temporary vectors $v$ and $e$ are produced. They contain information on the objects and connections attached to each joint: $v_i$ is the label of object attached to $i$-th joint, while $e_i$ stands for the label of connection attached to that joint.

In the second group the graph adjacency matrix $a$ is computed. First, matrix elements are set to 0.

The analysis of each joint result in the increment of an appropriate element of matrix $a$. Since the graph - by definition - is undirected, the adjacency matrix is symmetric, so the increment is performed twice. Since the increment is performed following appropriate joints, finally an element of the matrix contains the total number of connections (edges) between two objects (nodes).

With the help of visualization, we can easily traverse through each and every vertex and edge, in terms of adjacency matrix representation it is nothing but rows and columns. These processes are executed in MATLAB simulink tool the outputs of the results are shown below.

Conclusion
In this article a method for extraction from binary images, structures of the foreground, that resemble graph structures, was presented. Such foreground configurations consist of thick objects connected with thin and elongated connections. The objects and connections are detected using morphological image processing, (connections). In particular in this context dermoscopy images are analyzed and results are clearly displayed. Depending on the structuring element used, various image regions can be classified as objects. Apart from object and connections, also their joints are detected. In the next step, based on the labeling of all these three images, the graph adjacency matrix is computed, which describes the structure of resulting graph.

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Fig-4: A fundus photography image
Fig-5: A DNA microarray image
Fig-6: Skin based Binary Image
Fig-7: Graph based adjacency matrix with vertex and edges(nodes)

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Rigidity of Graphs

Graph Theory has found applications in varied domains ranging from transportation problems, VLSI design to social networks. Geometric representation of graphs, where nodes are physical locations on the plane or higher dimensional spaces, is getting special attention. These are natural representations of objects like road, railway or airlines networks. An obvious representation of natural objects is getting special attention. These are the graphs, where nodes are physical locations and edges denote the links between two nodes. In this article, we discuss about a special aspect of the geometric representation of graphs – Rigidity of Graphs.

Basic Concepts

Let \( G(V, E) \) be an undirected graph (without self loop and parallel edges) with vertex set \( V \) containing \( n \) vertices and edge set \( E \) containing \( e \) edges. To discuss the rigidity of a graph we first understand what is bar framework embedding of a graph in the Euclidean plane \( \mathbb{R}^2 \).

A bar-joint framework embedding of \( G \) into \( \mathbb{R}^2 \) means to each vertex \( v_i \) of \( G \) we assign a position \( p_i \) in \( \mathbb{R}^2 \) such that if there exist an edge between \( v_i \) and \( v_j \) in \( G \), then \( p_i \neq p_j \). Thus, it is possible that two distinct vertices \( v_i \) and \( v_j \) (\( i \neq j \)) can share common points in \( \mathbb{R}^2 \), when they are not connected in \( G \). Let \( p = (p_1, p_2, ..., p_n) \in \mathbb{R}^2 \times \mathbb{R}^2 \times ... \times \mathbb{R}^{2n} \) be a composite vector which is referred to as configuration. Then bar-joint framework of \( G \) is \((G, p)\) ([JJ05]).

The frameworks shown in Fig. 1(b) and (c) are two different frameworks of the same graph \( G \). Laman [L70] studied the bar-framework realization of graphs in \( \mathbb{R}^2 \).

Informally speaking, a bar-joint framework of a graph \( G = (V, E) \) can be viewed as a rod-hinged body. The edges of \( G \) are thought of as strong and rigid bars which connect two flexible joints (vertices). These bars represent the distance constraints between two joints as they cannot get shorter or longer or break. On the other hand, joints are freely rotatable. If we want to continuously move this framework in the plane, the distance between a pair of joints which are connected by a bar would remain fixed throughout the motion. Now, the question is will the distances between non-connected pairs of joints remain same or the shape of the structure will be deformed? A deformation can be described as a motion of the framework (whole or part) in \( \mathbb{R}^2 \), in which the lengths of the bars in the framework remain unchanged but changes take place only in the distances between some (at least one) pair of unconnected joints. A framework is rigid if it has no deformation. Otherwise, it is called flexible. Thus, through translation, rotation and flip a framework can not be deformed. These notions are introduced formally as follows [COS, JJ05].

In \( \mathbb{R}^2 \), two frameworks \((G, p)\) and \((G, q)\) are said to be equivalent if \( \|p(v) - p(u)\| = \|q(v) - q(u)\| \) holds for all edges \((v, u)\) of \( G \), \( \in E \), where \( || \) denotes the Euclidean norm in \( \mathbb{R}^2 \).

Two frameworks \((G, p)\) and \((G, q)\) are congruent if \( \|p(v) - p(u)\| = \|q(v) - q(u)\| \) holds for all pairs \((v, u)\) of \( G \) in \( \mathbb{R}^2 \). A framework \((G, p)\) is globally rigid if every other framework \((G, q)\) which is equivalent to \((G, p)\) is congruent to \((G, p)\). A graph \( G \) is said to be globally rigid if its every possible framework is globally rigid.

The framework \((G, p)\) is rigid if for any \( \epsilon > 0 \), if \((G, q)\) is equivalent to \((G, p)\) and \( \|p(v) - q(v)\| < \epsilon \) for all \( v \in V \), then \((G, q)\) is congruent to \((G, p)\). A graph \( G \) is said to be rigid if its every possible framework is rigid.

The framework shown in Fig. 2(a) is flexible, whereas the framework in Fig. 2(b) is rigid in \( \mathbb{R}^2 \). However, if we allow the motion of the rigid body in 3-D space, Fig. 2(b) will not be rigid in \( \mathbb{R}^3 \).

The frameworks shown in Fig. 1(c) and Fig. 3(a) are equivalent but not congruent. Fig. 3(a) is obtained from Fig. 1(c) by reflecting a part (marked by dotted lines) of it with respect to the line passing through tree collinear points. The same are the frameworks shown in Fig. 2(b) and Fig. 3(b). Hence, frameworks in Fig. 1(c) and Fig. 2(b) are not globally rigid. Fig. 1(b) is rigid as well as globally rigid.

Insight of Rigidity

A configuration is called generic or in general position if the coordinates of the points in a configuration are algebraically independent. In \( \mathbb{R}^2 \), if no three points are collinear, the configuration is generic. The framework shown in Fig. 1(b) is generic in \( \mathbb{R}^2 \) whereas, that in Fig. 1(c) is not generic. If the vertices of every realization of a rigid graph are in general position, the graph is called generically rigid.

Laman’s Theorem

An edge-weighted graph \( G = (V, E, w) \) is generically rigid in \( \mathbb{R}^2 \) if and only if there is a subset \( E' \subseteq E \) consisting of \( 2n - 3 \) edges such that, for any nonempty subset \( E'' \subseteq E' \), \( |E''| \leq n' \) where \( n' \) is the number of nodes of \( G \) which are incident with edges in \( E'' \).

Rigidity Testing

In \( \mathbb{R}^2 \), based on variants of Laman’s theorem, Hendrickson [H92] proposed an \( O(n^2) \) algorithm for generic rigidity testing.

An edge-weighted graph \( G = (V, E, w) \) is called redundantly rigid, if the deletion of any edge from \( G \) results in a graph which is also rigid.
For $R^2$, Jackson and Jordan [JJ05] proved a necessary and sufficient condition for a graph to be generically globally rigid as follows:

An edge-weighted graph $G = (V, E, w)$, $n \geq 4$, is generically globally rigid in $R^2$ if and only if it is 3-connected and redundantly rigid in $R^2$.

In view of the above result, generically globally rigid graphs can be identified in two steps:

Step 1: 3-connectivity can be tested in polynomial time [HT73, MR92].

Step 2: Redundant rigidity testing can efficiently be done by an algorithm proposed by Hendrickson [H92].

**Laman Graphs**

A graph $G$ is said to be minimally rigid if $G$ is rigid and $G - e$ is not rigid, for all $e \in E$. These graphs are usually known as Laman graphs.

- A graph $G$ is rigid if and only if $G$ has a Laman subgraph.

**Popular Families of Rigid and Globally Rigid Graphs**

A bilateration ordering is a sequence $\pi = (u_1, u_2, ..., u_n)$ of nodes, where $u_i, u_j, u_k$ form $K_3$ and every $u_i, i > 3$ is adjacent to two distinct nodes $u_j$ and $u_k$ for some $j, k < i$ (i.e., two nodes before $u_i$ in $\pi$).

A graph $G = (V, E)$ is said to contain a bilateration graph if it has a bilateration ordering.

- Bilateration graphs are rigid graphs in $R^2$.

A graph is a trilateration graph if it has an ordering of vertices $\pi = (u_1, u_2, ..., u_n)$, where $u_1, u_2, u_3$ form $K_3$ and every $u_i, i > 3$ has at least three neighbours before $u_i$ in $\pi$.

Trilateration graph can be identified in distributed environment.

A graph $G$ is a wheel extension graph if it has an ordering of vertices $\pi = (u_1, u_2, ..., u_n)$, where $u_1, u_2, u_3$ form $K_3$ and each $u_i$ lies in a wheel graph [H69] containing at least three vertices before $u_i$ in $\pi$.

- Trilateration and wheel extension graphs are generically globally rigid graphs in $R^2$.

**Applications**

Graph rigidity has several practical applications. New domains from different disciplines of science and technologies are regularly being added to them.

In a reconfigurable sensor network, the mobile devices may need to maintain a specific formation in order to gather data. For example, a useful formation for reconfigurable sensor networks is a regularly spaced polygon. Pattern formation is an important problem in the area of multi-robot networks also. In this problem, when a swarm of robots are deployed over certain area to achieve a task collectively, they may need to form a target pattern to achieve their goal. There is an interesting relationship between the concept of graph rigidity and pattern formation problem [SM02].

**References**


In today’s ever more competitive world, boards of directors and executives demand that CIOs and their teams deliver “more with less.” Studies show, without any real surprise, that there is no one-size-fits-all method to suit all software initiatives, and that a practice-based approach with some light but effective degree of order and governance is the goal of most software-development departments.

SEMAT (Software Engineering Method and Theory) is a collaborative initiative whose mission is to provide software engineering with a foundation, based on a kernel of practice-independent elements, supported by a language that allows best practices to be described as light or as detailed a way as needed. These can then be selected by teams for the context of their endeavor, thus ensuring the organization neither falls into a practice free-for-all nor constrains its business into a process straitjacket.

Executives have reason to care about SEMAT. The initiative supports the goals of “more with less” by delivering value at the team and organizational levels. Initiatives will always remain at a theoretical level unless and until proven through experimentation, and the case for SEMAT is strongly supported through real-life case studies.

**CIO Priorities**

According to Gartner’s “Top 10 CIO Business and Technology Priorities in 2013,” CIO imperatives are split between business enablement and efficiency, reflecting the importance of the CIO’s contribution in both these areas of the organization. This is obviously a tough challenge—and the phrase “getting more with less” is often heard in conversations with IT executives and their leadership teams. What can be done to gain a real effect, and how can the software functions of major-league IT organizations react?

In support of this challenge, respondents to a survey conducted at the 2013 Gartner AADI (Application Architecture, Development, and Integration) Summit pointed out that trying to do more with less by attempting to standardize around a single development process was not the answer. The results reflect that no “silver bullet” universal method has been found (no surprise there!) and that a software endeavor needs to use the most effective practices for its particular context. The respondents went on to suggest that at a foundational level, ensuring an ability to measure the effectiveness of endeavors end to end was a key requirement across all applications development.

The survey acknowledged that while the agile movement has helped accelerate development, respondents and their CIO leadership are still looking for some degree of rigor, structure, and governance in order to align better with business, behave more predictably, measure and address risk, and finally, deliver business value better, faster, and cheaper with happier stakeholders—the BFCH metrics.

Of course, “being agile” can be said to be a goal for any software endeavor, or any software organization (after all, who would not want to be agile?). It is not necessarily the case, however, that the same set of agile practices can be applied universally across all programs and teams. Indeed, in some endeavors, particular agile techniques or practices may not be possible. Take, for example, the case of a bank’s portfolio of programs. At any time there is huge diversity across many dimensions: pure development projects require a different approach from maintenance projects; highly regulated software initiatives such as financial clearing may require more rigorous requirements documentation than new consumer-driven, graphical front-end development; and simple standalone apps may require a radically faster cadence than architectural changes such as the replacement of the enterprise application server. This, therefore, gives rise to the need for multiple practice alternatives within a single organization.

The conclusions of the AADI Summit survey—that a standard one-size-fits-all process should not be a 2013 priority and that some order and governance are necessary to prevent what could become a practice free-for-all if left unchecked—certainly make sense when considering the reality of a large organization’s application-development landscape, as in the bank example.

The SEMAT initiative supports the findings of the AADI Summit survey, as well as the more general CIO goal of “more with less” through delivery of value at both the organizational and team levels.

**Introducing Semat**

Since 2010, experts from industry and academia have collaborated under the SEMAT banner in an explicit attempt to “refound software engineering based on a solid theory, proven principles, and best practices.” As a first step on this journey they have created Essence, a kernel and language for the improvement of...
software-development methods, which is soon to be ratified as a standard by OMG (Object Management Group). It will be clear that the standard is an underpinning of the various practices available in the industry—agile or not.

The SEMAT initiative and the Essence kernel enable organizations to establish an environment where they can make use of the right practices for the right endeavors and right contexts. The practices are built on an independent, solid foundation (the kernel) that incorporates a lightweight yet appropriate level of order and measurement for the business. This approach represents a first of its kind in software engineering.

The Essence kernel includes “things we always have” and “things we always do” when developing software. It is universal to all software-development endeavors—agile or pre-agile. SEMAT has adopted several fundamentally new ideas. One of them is called the alpha concept, which allows teams to focus on the doing rather than on the describing. Teams can measure the progress and health of their endeavors in a practice- or method-independent way. At any moment the team can identify where it is now and where it is going next. It makes the team results-focused instead of document-driven or activity-centric. The alpha concept supports several other ideas—for example, the idea of a method being a composition of practices built on top of the universal kernel. Thanks to the alpha concept, SEMAT has been able to create a robust, extensible, intuitive kernel.

More complete descriptions of SEMAT are available in previous writings [2][3].

The Value of Semat for Large Organizations

It is a fact that the software world has a huge number of methods—perhaps more than 100,000 have been developed, although many have not been used more than once. Some are known by brands such as RUP (Rational Unified Process), Scrum, and XP (Extreme Programming), but most are homegrown with ideas picked up from textbooks or other resources, with zero opportunity for reuse outside of the single context for which they were built. The development of SEMAT has demonstrated that underneath all of these methods is a common ground, or a kernel, of “things we always have” and “things we always do” when developing software. These things form the essence of software engineering and are now included in Essence.[5]

As discussed earlier, large organizations have a diverse range of projects carried out by a diverse range of people. Without an accepted kernel to share, coordinating development endeavors is unnecessarily complicated, because teams must spend scarce time and attention on deciding how to work at the start of every project. This results in significant wasted effort, project delays, frustrated developers, and dissatisfied customers. All of these factors have the potential to compromise that all-important CIO priority of achieving “more with less.” The inefficiencies occur both at the project/team (endeavor) level and the organizational level. To quantify this, consider the value it could bring to an organization if the development team did not need to come up with a specific new way of working, but instead could start from a common ground and then add existing well-proven (possibly agile or lean) ideas published in a library of practices.

The Essence kernel has benefits at both the team and organizational levels. To make this discussion something readers can identify with, let’s introduce two characters: Smith, a project leader, and Dave, an executive in a large company that has been trying to improve the way it develops software. The company had invested in and achieved a CMMI (Capability, Maturity, Model Integration) rating, then adopted the Unified Process, and, in some teams, successfully applied agile methods.

Grass-Roots Level—Ensuring the Team’s Success

At the team level, the objective is to ensure the success of the endeavor, which Smith is responsible for. Success means delivering what his customers really want in the given time frame and budget, and with the right quality. Success also means that his team is motivated and collaborating effectively—fundamentally, a happy team. This requires four skills: using the right method for the right job; measuring project progress and health; effective collaboration; and decision-making based on a middle ground.

Using the right method for the job at hand. The battle-seasoned Smith understands (as did the Gartner AADI survey respondents) that there is no one-size-fits-all, future-proofed software development method. As mentioned, Smith’s organization had adopted CMMI, the Unified Process, and agile methods. Smith is not against any of these approaches and, in fact, thinks there is something good in each one of them. The problem is that, in the past, his organization at any point in time mandated just one way of running development.

Although Smith’s colleague who runs small enhancements found Scrum to be useful, Smith found Scrum by itself to be inadequate for the large-scale enterprise development he is running. Smith was also mindful that his organization’s previous CMMI- and Unified Process-based approaches were also inadequate. In each project, Smith still had to make significant adjustments to the mandated way of working to achieve a suitable approach. In effect, he was adding to the 100,000-methods problem by creating his own variant. Making and establishing such adjustments was no small feat, as Smith had to communicate them to his teammates, each of whom had different backgrounds and opinions.

Smith wanted a better approach for his teammates to come quickly to agreement on how they should work on each project.

The lightweight kernel and its support for systematically combining practices to create a variety of “just enough” methods, all based on the same common kernel, allows organizations to provide development teams with the right methods to undertake each job at hand, supporting each organization’s specific culture, standards, and mandated practices.

Ability to measure project progress and health accurately. If Smith has learned anything, it is that software development is a complex endeavor, and the progress and health of a project have to be considered from multiple perspectives—for example, stakeholders’ satisfaction; requirements
The problem, however, is that Smith’s company does not have governance procedures that holistically help each team evaluate progress and health. In fact, no commonly accepted framework has previously been able to do this.

Each alpha (i.e., opportunity, stakeholders, requirements, software system, team, work, and way of working) covers a dimension, and the states defined for each alpha provide an indication of progress and health. For example, Essence identifies states of the software system as being architecture selected, demonstrable, usable, ready, operational, and retired. Each of these states provides an indication of how far the development of the software system has come, and what a team should do next to move the progress and health of the software system forward. Modern approaches do exist that recommend a similar way of thinking but only in a single dimension (e.g., Kanban focuses on the work alpha). Essence, on the other hand, is more comprehensive and holistic, since it is multidimensional (i.e., it focuses on all the alphas), and thus gives a more accurate picture of progress and health. What’s more, Essence does this in a lightweight manner, unlike previous attempts such as within CMMI and the Unified Process.

**Ability to get team members to collaborate effectively.** Each time Smith begins a project, he has to assemble a team with members from different parts of the organization, and possibly even from different contractor organizations. The team members need to agree on how they should collaborate. For example, they need to agree on which practices to use. Because they have different backgrounds and experiences, this often turns out to be nontrivial. Preparing team members can be as complex as a reengineering effort. As evidence, in the literature published over the past 20 years on the causes of failed projects, poor communication among team members frequently ranks very high[6].

Individuals from different organizations have a common base from which to start. This helps the team communicate more effectively and therefore become productive more rapidly, even when their native or favorite ways of working are significantly different.

**Decision-making based on a middle ground.** The basis for decision-making should be quick health checks rather than inflexible processes—or nothing at all. An integral part of Smith’s job is deciding with his teammates where to place their efforts to achieve progress and deal with project risks. Some requirements might be vague and need further exploration with customer representatives; some technical issues might need investigation; some defects might need attention. Previously, however, Smith had to work within prescribed governance procedures that required the production of specific documents at specific milestones within the project and specific activities to be conducted in a specific order. This was a heavyweight, ineffective approach that did not help Smith and his teammates make relevant decisions. With Essence, however, the focus is on the results generated and dealing with risks within the project’s context.

**Essence provides a framework that enables faster, more effective, more autonomous decision-making and can help organizations evolve their current governance practices to meet the needs of present-day challenges.** One example of how Essence accomplishes this is through the alphas, alpha states, and checklists that keep the team focused on what is most important at any point in the project, based on the current project context. That provides an independent check of how well the team is doing at achieving the intended result. This check can be applied regardless of the method and practices the team is using. Today we understand far better the importance of each project’s context when it comes to managing cost and performance effectively. This is where Essence can be a great differentiator from previous approaches, because it helps ask the right question at the right time based on the current state and the target goal state.

To summarize, the use of the SEMAT kernel provides many benefits at the team level. Visualize a library of interchangeable practices, written using a language that can be as light or as formal as the situation requires, and built around the immutable fact that all software endeavors are successful based on the progression of certain key elements. The team can select from that library based on the needs of the endeavor and compose their way of working rather than create it. They can build the optimum way for their situation. They can measure the progress and health of their project using standard metrics that are independent of those practices and methods—again invention and distraction that the team can avoid. New members of the team need not learn everything from scratch. All of these factors contribute positively to improving time-to-effectiveness for the team. Reducing such wasted time and energy, in addition to helping the team achieve its goals, clearly has cumulative benefits for the organization at large, thus helping attain the CIO’s goal of “more with less.”

**Organizational Level—Growth and Competitiveness Mean “More with Less”**

As discussed at the beginning of this article, at the organizational level the objective is business growth. In our scenario this is what Dave is responsible for. He knows that his business will grow only if his customers are happy and keep coming back, providing more business opportunities for the organization. He knows that speed to market and relevance are improved through having a highly motivated and driven team. He also knows he needs to run a tight ship. Therefore, Dave wants to introduce mechanisms to nurture a continuously learning and inspiring culture. Not only does Dave want his teams to learn from one another, he also wants them to learn from others in the industry. This requires some changes.

**A common vocabulary and body of knowledge.** One would have thought that Dave’s team would share a vocabulary because they work for the same company, but this is not the case. Many teams within his organization use different terminology, and often the same word can carry different meanings. In order for one team to learn successful practices from another team, it has to cross this unnecessary language barrier. Essence tears down this language barrier by enabling practices to be
described using a single vocabulary—the kernel. In addition, Essence provides a structure to organize practices such that they can be discovered, assessed, and applied quickly.

Teams can also contribute what they have learned back to these practices, thus building a structured library of knowledge—namely, practices. This also provides a learning roadmap for individuals in the organization. The more practices from the library they can master, the more competent they become. The benefits of a common practice library reach beyond single projects. For example, it can substantially help with the communications problems documented on many failed IT projects[6].

**Empowering teams to change their way of working safely.** This must be done not just in minor steps, but also in major ways. Dave wants to encourage his teams to be innovative, but at the same time he worries that they may venture into chaos. As such, his approach has tended to err toward the conservative, and the flexibility given to team leaders like Smith was rather limited. With Essence and the layering of practices on top of the kernel, however, organizations have a proven framework from which they can safely change their way of working. This allows Dave to focus on mandating a minimum number of specific practices—those that he needs the teams to practice in a consistent manner. At the same time he can also empower the teams to innovate in the other areas of the method, adding and replacing practices as and when it is appropriate.

Teams get a controlled and intuitive way to replace an existing practice or add a new one. This empowers teams to right-size their methods safely and in major ways, if appropriate.

**Continual performance improvement/true learning organization.** As mentioned previously, Dave’s organization had adopted CMMI, the Unified Process, and, lately, agile practices, each providing a different emphasis. When embracing a new approach, however, his organization unfortunately threw away many of the good practices they had learned in the past, along with the parts they wanted to free themselves from. This was a great loss for the organization. In fact, it led to significant and costly reinvention. For example, when they introduced agile practices they had to reinvent the way architectural work was accomplished. By adopting the Essence kernel and working with practices rather than monolithic methods, Dave’s organization became a true learning organization—continually growing and improving the set of practices they use and improving their development capability.

Teams can easily understand what is working and where they need to tune their practices—dropping or refining the unsuccessful ones and adding appropriate new ones to address the changing needs of their development organization.

The result is a software-development department that is not only allowed but encouraged to explore the possibilities presented by new techniques and practices in the industry. Successful practices (the good ideas) can be slotted into the lightweight Essence framework and incorporated quickly into the organization’s way of working. Such freedom is highly motivating in a knowledge-worker environment—and motivation is key to attracting and retaining the best employees in the industry, and therefore to heightened effectiveness in the software organization.

Organizations benefit from SEMAT, too, and not simply because of the roll-up benefits from teams. The practice-based approach to ways of working, or methods, means that the organization invests at this level and has a greater chance of reuse, rather than creating bespoke descriptions of project-specific methods. Resource groups master practices rather than methods, arming them with the ability to move more easily among teams and giving the CIO greater flexibility in the workforce. This more efficient management of practices, combined with higher adaptability and effectiveness of people, supports the “more with less” requirement imposed by the business.

**Semat Success Stories**

**Offshore Development**

Building on the foundation provided by the Essence kernel, a major global reinsurace company has established a family of collaboration models that cover the whole spectrum of software-
and application-development work. Four collaboration models have been built on the same kernel from the same set of 12 practices. The models are (1) exploratory, (2) standard, (3) maintenance, and (4) support. Each defines a lightweight governance process suitable for the kind of work being undertaken and provides enough practices for the teams to get started.

This has many organizational, as well as local, benefits, including:

- **The unification of the people working in the service organization.** The application-development group is organized into a number of independent services. Teams are formed by drawing on the members of the various services as they are needed. The use of the kernel provides the common ground that allows these teams to come together quickly and ensure that they all speak the same language.

- **The enabling of flexible sourcing policies.** Adopting a kernel-based approach also allows the various services to flex their capacity safely by drawing on external resources and suppliers. The use of the kernel allows everyone to get up to speed quickly with the way-of-working and easily understand his or her roles and responsibilities.

- **Increased agility and improved project performance.** By focusing on the practices that join up the services and the teamwork needed to develop good software, the organization has been able to DEVELOPMENT 8 empower the teams and the services that they draw on to continuously inspect and adapt, and safely embrace agile and lean thinking in their day-to-day work.

- **Global collaboration.** The company's application-development teams are located all over the world. By providing a standard, lightweight way of working, greater global collaboration and in some cases global-sourcing models have been achieved.

### Standard Application Life-Cycle Management Tooling

A number of companies have used the Essence approach to help establish practice-independent tooling and application life-cycle management frameworks, including:

- A major systems integrator assembled an open source, low-cost tooling environment to support distributed teams working around the Essence kernel, as well as its support for practice composition and execution. The environment runs as an organizational service and has been successfully used on a variety of projects. The flexibility inherent in Essence has allowed the same tooling and practices to be used in support of both agile and waterfall ways of working.

- A major UK government department introduced a kernel-based agile tool set to enable disciplined agility and the tracking of project progress and health in a practice-independent fashion. This allowed teams to adopt the agile practices of their choice within a consistent, effective, lightweight governance framework. It also helped the teams stay on track and avoid some of the pitfalls that can occur when transitioning to an agile way of working.

In both cases the common ground provided by the kernel and the results focus of the alphas enabled the widespread adoption of the tooling without compromising the teams' autonomy and empowerment.

### Becoming Better, Faster, Cheaper, and Happier

The effectiveness of a method should be measured in how much better, faster, cheaper software you develop and how much happier your customers and employees are. Better methods results in improvements in all these factors. Better software means increased competitiveness for your products. Faster is critical to getting products on the market. Cheaper often comes as a side effect of faster, but also from automation. And happier customers come from many sources, one being the creation of better user experiences.

Better, faster, cheaper, and happier are all elements of the CIO’s priorities. SEMAT provides the foundation that allows a large organization's application-development department to improve all these elements, resulting in a more effective team of motivated professionals truly contributing to the competitiveness of the organization.

Organizations do not need to wait to benefit from the Essence kernel. Teams and departments can start benefiting today. The primary value that Essence brings is preventing the costly reinvention and unnecessary relearning of what is already known.

Essence can help your organization get to where you know you need to go, and it will help you get there faster and cheaper, so you are ready for whatever the future brings.

### References


**Essence – A Foundation for Software Development Games**

*Abstract*— To be successful in software development, software teams must have the knowledge to systematically evaluate the progress and health of their projects, and detect and resolve risks early. How do teams acquire and apply such knowledge? How do teams adapt this knowledge to different development contexts? Essence is the result of the global SEMAT initiative that has taken place for a few years and has been adopted as a standard by the OMG in April 2014. Essence provides an innovative and novel user experience based on cards and game boards that are used to assess the progress and health of software development. Through the cards and the boards, developers can enact various development games, such as planning their sprints/iterations, agreeing on lifecycle models, and evaluating health and progress of their projects. Essence is an effective approach both in real software development and in software engineering education. Moreover, Essence provides the foundation for software engineering research and has been demonstrated as a framework for presenting case studies. This paper describes how Essence—the software engineering kernel and language—addresses these challenges and summarizes the tutorial given at ICSE 2014.

*Index Terms*—Essence, SEMAT, software engineering, kernel, practices, methods, agile, separate of concerns

**Introduction**

Although software development endeavors vary with respect to their complexity, domain, novelty, and distribution, they all share a common ground of timeless principles and approaches underlying the ways of working. Such common ground is often hidden in the existing methods and it takes different forms that often practitioners, teams and academics are not aware of. Even large organizations that invest significant resources into defining their methods have difficulties to uncover the common ground[8].

A common ground could provide an excellent and stable foundation aiding developers in a couple of ways: (1) in understanding the core and timeless concepts and principles of software engineering, and (2) in reusing them across various software engineering endeavors. To uncover such common ground and its elements, the initiative SEMAT – Software Engineering Method and Theory – has been launched[4][5][6]. So far, it has succeeded to identify a common kernel of software engineering elements. Recently, this kernel has been endorsed to become an OMG standard[3].

The kernel[3][2] captures the essence of software engineering. Together with the language supporting the kernel, it constitutes what is called the Essence. The kernel includes a stripped-down, light-weight set of elements that are universal to all software engineering endeavors. Through the states defined for its elements, the Essence kernel constitutes an important instrument for reasoning about the progress and health of a software development endeavor. For a team, the kernel provides a conceptual basis and a roadmap for defining and evaluating the quality of its method. It also helps them understand where they are, point out what they should do next and, suggest what they should improve and where.

This tutorial introduces the Essence ideas and approach and demonstrates its practical applications. The goal is to help the audience to gain understanding of the basic concepts of the kernel and demonstrate how to use them in practice. The remainder of this paper is structured as follows. Section II briefly introduces the basics of Essence. Section III motivates why Essence is a paradigm shift. Section IV presents the contents of the tutorial. Finally, Section V summarizes the tutorial and points out the benefits of attending it.

**Basics of Essence – Alpha and States**

Essence provides a common ground for understanding and describing the commonalities and diversities of software engineering practices. Its kernel identifies a core set of elements called alphas, where each alpha represents a key dimension of the endeavor that needs to be progressed. As shown in Fig. 1 the alphas are *Opportunity, Stakeholders, Requirements, Software System, Team, and Work and Way of Working*. They are separated into three different areas of concerns, which are *Customer, Solution and Endavor*.

Each alpha has a series of state progressions where each state is described with a detailed checklist specifying the criteria that need to be satisfied in order to progress to a particular state. In this way, Essence helps development teams understand the progress of each alpha and identify risks and challenges for that alpha. For example, as illustrated in Fig. 2, the set of states of requirements are *Conceived, Bounded, Coherent, Acceptable, Addressed, and Fulfilled*. While working on the requirements, the teams should progress these states in the above-listed order. If, for some reason they do not, they may encounter various risks. For example, if teams attempt to make requirements Coherent before getting them Bounded (i.e. understanding the boundaries), then they may risk wasting their effort on the unbounded requirements, and thereby, waste their time and resources on changing the boundaries during later phases of the development effort.

The kernel is actionable and extensible. The team can act on it and do something concrete with it. The team can also extend the kernel with further practices when needed. As illustrated in Fig. 3, both the
method-independent approach. Essence does this through a novel state-based, what needs to be done, but it also helps them in mapping out development teams in their ongoing work. Essence puts its focus on supporting the essence of our ways of working. It shifts the focus from describing to doing. Traditionally, method frameworks such as RUP, SPEM, SME have focused on assisting method engineers in creating method descriptions. However, the adoption of these descriptions among software professionals has been very low. This is because these method descriptions are not effective enough in supporting development teams in their development efforts.

Being of a superlight narrative nature, Essence puts its focus on supporting the development teams in their ongoing work. It does not only assist them in mapping out what needs to be done, but it also helps them to achieve concrete and measurable results. It does this through a novel state-based, method-independent approach. Essence helps the teams to evaluate progress and health in a holistic manner in the most basic dimensions of a project such as, for instance, requirements, software system, team and other dimensions.

Distinctive features of Essence
Besides what have been discussed above, Essence also differs from traditional methods. It focuses on three distinctive features: (1) it relies on the separation of concerns, (2) it focuses on the agile principle, and (3) it considers the states of software engineering endeavors. Below, we briefly describe these three features.

Essence heavily relies on the “separation of concerns” principle. It separates the kernel from practice, governance and lifecycle specifics. It allows a method to be assembled from distinct and precise practices. This makes it easier for students and professionals to learn and grasp the fundamentals of software development and to grow in their understanding practice by practice. For teams and organizations, this permits safe and evolutionary approach to improve their ways of working.

Essence relies on the agile principle while working with methods. So far, the job of describing methods has been left to process engineers, resulting in a false dichotomy of describers and doers. With Essence, professionals are equipped and empowered to refine and improve their methods, that is, describers become doers and vice versa.

Special attention has been put to the design of Essence syntax. Essence focuses on the states of software engineering endeavors that are always relevant irrespective of the methods being used. All the Essence alphas include the states indicating their health and progress. In addition, the states are made concrete through a deck of state cards. The cards can be used in a variety of ways in different activities ranging from planning work, to assigning work, to defining work procedures, and to finalizing the work.

The above-described features cannot be achieved by simply extending previous and existing works. It takes a fundamental change in the way we work with methods and processes.

Essence works hand-in-hand with agile
No other process or method initiative has drawn such attention from the developer community as agile. The agile movement has provided a new way of looking at how we conduct the day-to-day activities of software development, how we build our teams and how we organize our work. Agile has led to the empowerment of the developers and the prominence of agile practices (such as Scrum and Test Driven Development) as the modern developer’s practices of choice.

Essence and the SEMAT community provide a new way of approaching the domain of software engineering, a new way of understanding the progress and health of our development efforts, and a new way of combining practices into effective ways-of-working. This adds to the power of agility by adding a light however still a systematic and disciplined way of dealing with knowledge and putting this knowledge into practice[7].

The Tutorial Contents
This tutorial targets practitioners, as the SEMAT kernel is primarily focused on identifying the core and timeless concepts and principles underlying their ways of working. The tutorial also targets academics—both instructors and researchers who wish to systematically describe software engineering instead of presenting individual methods. This tutorial is structured in five parts:

1. Introduction and Background of the Essence Kernel: Discussing currently perceived problems and suggestions for remedying them by using Essence.
2. Illustration of Using the Kernel: Presenting the kernel, the alphas and alpha states and illustrating how they can be used in practice. This section includes hands on exercises practicing the use of the kernel and its elements. It provides hands-on experience on the kernel usage where the audience will get an opportunity to evaluate development endeavors in both agile and traditional contexts. Using tools, it will demonstrate how to do a project in iterations or sprints and how to continuously measure its progress. The details include: a) understanding the context; b) determining the current state; c) planning with Essence; and d) agreeing on the Lifecycle.
3. The Essence Kernel and Language: Describing the constitution of Essence Kernel, Alphas and Alpha states, and briefly introducing the language used to describe the Kernel.
4. Case Studies: Demonstrating some representative case studies of applying Essence in different areas, including:

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Fig. 2: Requirements alphas and states

kernel alphas and their states can be represented as a deck of cards. These cards may be used for monitoring the progress and health of software development endeavors. The monitoring may also be supported by spider graphs illustrating the common progress of all alphas.

Essence Represents a Paradigm Shift
This section explains why Essence is a paradigm shift, lists Essence’s distinctive features, and finally, it discusses why it works hand-in-hand with the current agile trends.

Why a Paradigm Shift?
Essence is an innovative approach to managing software engineering endeavors. It is a paradigm shift implying a change in the approach of our ways of working. It shifts the focus from describing to doing. Traditionally, method frameworks such as RUP, SPEM, SME have focused on assisting method engineers in creating method descriptions. However, the adoption of these descriptions among software professionals has been very low. This is because these method descriptions are not effective enough in supporting development teams in their development efforts.

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Fig. 3: Essence Pays Attention to Concrete Syntax

Special attention has been put to the design of Essence syntax. Essence focuses on the states of software engineering endeavors that are always relevant irrespective of the methods being used. All the Essence alphas include the states indicating their health and progress. In addition, the states are made concrete through a deck of state cards. The cards can be used in a variety of ways in different activities ranging from planning work, to assigning work, to defining work procedures, and to finalizing the work.

The above-described features cannot be achieved by simply extending previous and existing works. It takes a fundamental change in the way we work with methods and processes.

Essence works hand-in-hand with agile
No other process or method initiative has drawn such attention from the developer community as agile. The agile movement has provided a new way of looking at how we conduct the day-to-day activities of software development, how we build our teams and how we organize our work. Agile has led to the empowerment of the developers and the prominence of agile practices (such as Scrum and Test Driven Development) as the modern developer’s practices of choice.

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3. The Essence Kernel and Language: Describing the constitution of Essence Kernel, Alphas and Alpha states, and briefly introducing the language used to describe the Kernel.
4. Case Studies: Demonstrating some representative case studies of applying Essence in different areas, including:
a) Agile development  
b) Agile organizations and practices  
c) Essence Tooling.  

5. Ongoing and Future Work with Essence and SEMAT: Presenting the ongoing work within the SEMAT community, including education[9], research[10] and certification process. Future directions of applying Essence are also presented.  

Summary  
Essence presents a paradigm shift in software engineering from describing to doing. The tutorial presents and explains Essence and its structure and demonstrates how Essence can be effectively used in practice. The kernel captures the common ground of software engineering, it is agile and lightweight easy to use. The tutorial’s target groups are the practitioners in the industry and instructors and researchers in the academia. It focuses on supporting the usage of methods rather then defining them. The alpha and alpha states make it tangible to monitor the progress and health of software development. These are the critical features that separate Essence from previous and existing efforts in this space. Since the ideas are new and substantially different from what have been done in the past, the tutorial is very hands-on and interactive. Its participants will gain good understanding of how to use Essence and, hopefully, they will get motivated for adopting it in their daily work.  

References  
[6] SEMAT Website: www.semat.org  
About the Authors

Paul McMahon (pmcmahon@acm.org) is an independent consultant focusing on coaching project managers, team leaders, and software professionals in the practical use of lean and agile techniques in constrained environments. He is a Certified ScrumMaster and a Certified Lean Six Sigma Black Belt. He has been a leader in the SEMAT initiative since its inception.

Announcement of Tutorial on Essence – A Foundation for Software Development Games

Collocated with the 36th International Conference on Software Engineering
(Hyderabad International Convention Centre, Hyderabad, India)

This tutorial is on the new OMG standard “Essence — the software engineering kernel and language”

Target Audience
Managers, leaders, team members, and agile change agents who want to be empowered to take advantage of software teams of different kinds to become better, faster, cheaper and happier

Essence of Software development in a deck of cards

Presenter
Shihong Huang Associate Professor, Florida Atlantic University, USA
Ivar Jacobson Chairman, Ivar Jacobson International, Switzerland
Pan-Wei Ng Asia Pacific CTO, Ivar Jacobson International, China
Mira Kajko-Mattsson Associate Professor, Royal Institute of Technology, Sweden
Arne J. Berre Chief scientist, SINTEF Oslo, Norway

Tutorial Description
To become successful in software development, software teams must have the knowledge to systematically evaluate the progress and health of their projects, and detect and resolve risks early. How do teams acquire and apply such knowledge? How do teams adapt this knowledge to different development contexts? This tutorial demonstrates how Essence, the software engineering kernel and language, addresses these challenges.

Essence is the result of the global SEMAT initiative, (see www.semat.org), that has taken place for a few years and now recently been adopted as a standard by the OMG (http://www.omg.org/spec/Essence/). Essence provides an innovative and novel user experience based on cards and game boards that are used to assess the progress and health of software development. Through gamification with cards and game boards developers can enact various development games, such as planning sprints/iterations, agreeing on lifecycle models, evaluating health and progress of a project. Participants will gain hands-on experience with the cards and games in this highly interactive and engaging tutorial.

This tutorial also introduces some real world case studies in which Essence cards and games are applied. We also demonstrate how to use Essence as a foundation for reporting and evaluating software engineering research.

Tutorial Outline
1. Introduction and Background of the Essence Kernel
2. Illustration of Using the Kernel
   a. Understanding the Context
   b. Determine the Current State
   c. Planning with Essence
   d. Agreeing the Lifecycle
3. The Essence Kernel and Language
4. Case Studies
   a. Agile development
   b. Agile organizations and practices
   c. Essence Tooling
5. Ongoing and Future Work with Essence and SEMAT

Registration
Indian Delegates Registration Link  (Special offer for Indian/local participants) http://events.kwconferences.com/ ei/ICSE2014/registrations.htm
“Databases are the hidden workhorses of many organisation’s IT systems, holding critical business intelligence and carrying out hundreds of thousands of transactions each day.” As published in an article in computerweekly.com.

There are many options of databases suppliers which includes IBM, Microsoft, Fujitsu, Hitachi, NCR Teradata, SAS Institute, Sybase, Hewlett-Packard and Oracle. “Oracle has shown cumulative growth in revenue year by year” said a Gartner report (Source: Global Software Top 100- Edition 2011, written by Michel van Kooten). “Oracle Corp” founded by Larry Ellison, Bob Miner and Ed Oates is now the world second largest business software company after Microsoft.

The oracle 8i started with many improvements in the available databases. It has shown an improvement in the performance by decreasing the overhead that was associated with the context switches between the PL/SQL and SQL engines. The concept of collections was introduced PL/SQL for array processing. We were able to encrypt and decrypt data using the DBMS_OBFUSCATION_TOOLKIT package and many more features were included. Then the oracle 9i with added advantages was introduced. Oracle9i release 2 allowed users to index-by string values using Associative arrays (earlier known as collection). It added the access to web services directly from PL/SQL using a simple Consuming Web Services API. A provision for storing XML documents in tables and query them using SQL was also included.

In Oracle 10g, the DBMS_ASSERT package was introduced that incorporated a number of functions that were used to cleanse user input and helped to shield against SQL injection. The DBMS_OBFUSCATION_TOOLKIT package was replaced with DBMS_CRYPTO. The Oracle 11g had shown the improvement in the performance of PL/SQL functions across the whole database instance by cross-session PL/SQL function result cache. The edition based redefinition feature in Oracle 11g helped in upgrading database components online. The Oracle 11g had also shown enhancements in triggers.

And now the Oracle 12c brings major enhancements and additions in the areas of database administration, data guard and performance tuning. The “c” in Oracle 12c stands for “cloud”. The Oracle 12c is a “Container Database” because it can hold bunch of other databases but keep their data discrete. It allows sharing underlying hardware resources like memory or filing storage between the separate databases. With the help of this the problem of multitenancy is addressed. It has also shown high improvement in performance as it consumes one-sixth amount of hardware and runs five times better than other existing databases. The Redaction policy of Oracle 12c is a remarkable feature for masking of data using a package called DBMS_REDACT and has replaced the FGAC (fine-grained access control) and VPD (Virtual Private Database) packages used in old versions. In Oracle 12c a column can be included in the B-tree index as well as a Bit Map index. There is also a reduction in undo table space and reduced redo log space used for temporary undo. The DDL logging facility allows automatically recording of the DDL statements in xml/log file (subjected to if ENABLE_DDL_LOGGING is set to True).

“Pluggable databases allow us to consolidate hundreds of databases onto a RAC environment that guarantee the separation that drove us to put them on separate servers previously.”

Martin Power, Logical Technology

Fig. 1 shows the comparison of Oracle Database 12c pluggable databases versus separate databases in terms of memory requirements and scalability. (Source an article “An Inside Look at the Development of Oracle ® Database 12c Extensive collaboration between Intel and Oracle leads to innovation and optimization” from www.intel.ia)

The users have the choice of directly upgrading from Oracle 11g and 10g to Oracle 12c database Multitenant Architecture. Oracle Multitenant architecture retains data isolation and security of independent databases which are plugged into a multitenant container by managing the meta-data and all the security access privileges from the previous standalone databases. The application users keep possession of their access benefits from a stand-alone database to a pluggable database. But these benefits will not enable admittance to other pluggable databases in the container. Obviously the servers are virtualized in this case and the scalability is elastic.

Consider an example, if we remember the query for retrieval of some number of rows in an ordered set of data while limiting the number of rows either from top or bottom. Many database engines provide complicated methods for paging data between one or more ordered sets, For example, in MySQL database engine, the use of “LIMIT” clause was done for paging data through a result set (subject to it is an ordered set). But the problem is easily solved with the introduction of row limiting clause in Oracle 12c database. The syntax for using row limiting clause is given below.

Table 1 shows the syntax of row limiting clause.
The OFFSET part is an optional clause shown in square brackets. The purpose of this clause is to tell how many number of rows to be ignored from the starting of the result set. The beginning for the FETCH clause is OFFSET+1. If the OFFSET clause is there, the FETCH clause can be missed. The number of rows can also be limit by providing percentage of rows. The use of WITH TIES clause is to return result by considering the situation when there is a match of multiple rows

Consider a table “STUDENT” with columns as “Roll_No”, “Stud_name”, “Address” and “marks” (We are not stating here column values). For example consider the query below that retrieves top five (5) marks from STUDENT table.

```
SELECT Roll_no, Stud_name, marks FROM STUDENT ORDER BY marks DESC FETCH FIRST 5 ROWS ONLY;
```

Table 2 shows the example of row limiting clause using FETCH clause.

Table 3 shows the example of row limiting clause using FETCH clause by providing percent of rows.

The query below can be used to fetch the result to five (5) percent from the top marks in the STUDENT table.

```
SELECT Roll_no, Stud_name, marks FROM STUDENT ORDER BY marks DESC FETCH FIRST 5 PERCENT ROWS ONLY;
```

There are many more noteworthy features introduced in Oracle 12C and means different to different people and it all depends on which areas we are interested in. Some of the remarkable features of Oracle 12c are mentioned below:

- “Expanded Interactive Reports”
- “End User Data Upload”
- “New PL/SQL Package UTL_CALL_STACK”
- “Modernized Application Builder”
- “Time Stamp and Time Zone Support”
- “Unicode 6.1 Support”
- “Improved Charting Engine”
- “Implicit Result Sets”
- “JDBC Support”
- “Identity Columns”
- “Support for .NET and Microsoft Development Community”
- “Business Intelligence and Data Warehousing”

**Conclusion**

All Oracle Database 12c variants are fully reconcilable with each other. It has a communal set of application development tools and programming interfaces. Initially one can start with the Standard Edition and can easily upgrade to the Enterprise Edition.

**References**

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**About the Authors**

Madhurima did her Master’s Degree in Information Technology from Guru Gobind Singh Indraprastha University, New Delhi. She is at present doing her Ph.D in Information Technology from Sri Venkateshwara University. She has 7.6 years of working experience in academic field. She has number of international and national publications to her credit. She has published one book with the title “Computer Networks” with Laxmi Publications. Her M.Tech work has been published as a book titled “Video Object Tracking” by LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany. She is a member of Computer Society of India. Her primary research area includes image segmentation, object tracking and object oriented testing, ajax and databases.

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**Programming.Learn("R") »**

**Graphics in R**

R has versatile graphic capabilities for data representation. Built-in functions in R help us to make plots as per the requirement. Powerful plotting commands make R an important tool for statistical applications. The plotting commands can be categorized as high-level commands, low-level commands and interactive graphics.

**High-level commands**

High-level commands endue creating new plots with fundamental information like axes, title, labels etc.

**plot ( )**: This is the most frequently used plotting command in R. It is a generic function which create plots of type equivalent to that of the first argument. In the example given below vector data is plotted which is given as the (first) argument to the plot ( ) function.

```r
> x<-1:10
> plot(x)
```

The other high level plotting commands in R enable to create variety of plots according to the requirement. R provides various high level plotting functions to create variety of plots including boxplot, pie chart, barplot, and histogram.

**Low-level commands**

Low-level commands enhance existing plots with features like extra points, labels etc. These commands require coordinate positions also, to indicate the position where we have to insert the new plotting elements. Some of the low-level plotting commands are listed in the below table:

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>points (x, y)</td>
<td>Add points to the current plot</td>
</tr>
<tr>
<td>lines (x, y)</td>
<td>Add connecting lines to the current plot</td>
</tr>
<tr>
<td>text (x, y, labels, ...)</td>
<td>Add text to the plot at point x and y. labels is a vector in which labels[i] is plotted at the point (x[i], y[i])</td>
</tr>
<tr>
<td>abline (a, b)</td>
<td>Adds a line of slope b and intercept a to the current plot.</td>
</tr>
<tr>
<td>polygon (x, y, ...)</td>
<td>Draws a polygon defined by the vertices (x, y)</td>
</tr>
<tr>
<td>legend (x, y, legend, ...)</td>
<td>Adds a legend to the current plot at the specified position.</td>
</tr>
<tr>
<td>title (main, sub)</td>
<td>Adds a title main to the top of the current plot in a large font and (optionally) a sub-title sub at the bottom in a smaller font.</td>
</tr>
<tr>
<td>axis (side, ...)</td>
<td>Adds an axis to the current plot on the side given by the first argument</td>
</tr>
</tbody>
</table>

As another example, see the function identify( ). Identify ( ) reads the position of the graphics pointer when the mouse button is pressed. It then searches for the x and y coordinates closest to the pointer. If this coordinate is close enough to the pointer, its index will be returned otherwise warning is given. Syntax is, identify(x, y, labels). See the example given below and the resultant plot after identifying the coordinates.

```r
> x <- c(1.6907, 1.7242, 1.7552, 1.7842, 1.8113, 1.8369, 1.8610, 1.8839)
> y <- c( 6, 13, 18, 28, 52, 53, 61, 60)
> plot(x,y)
> identify(x,y)
warning: no point within 0.25 inches
```

**Interactive graphics**

The interactive graphics facility in R allows the user to extract or add required information to a plot. For example, consider the locator ( ) function. The function locator( ) reads the position of the graphics cursor when the mouse button is pressed. This continues until n locations are selected. Here type argument has to chose any one of the values from “n”, “p”, “l” or “o”. If “p” or “o” the points are plotted; if “l” or “o” they are joined by lines. Syntax is locator (n, type, ...).
CIO Perspective

Managing Technology>>

The SMAC Effect Towards Adaptive Supply Chain Management

Abstract: Social, Mobile, Analytics and Cloud technologies integrated together into a stack is touted as the next wave in enterprise computing. IDC estimates that the worldwide spending on ICT spending will reach the US$5 trillion mark by 2020 with 80% of this driven by this intersection of SMAC technologies. Each of these technologies is complementary in nature and delivers a force-multiplier effect when fused together. The resultant e-enterprise promises to be agile, collaborative, connective, distributed, lean, flexible, responsive, robust, scalable, transparent and visible. This paper discusses the potential benefits of the SMAC stack in terms of improved customer engagement, enterprise workflow, collaboration and decision-making as also involvement of all stakeholders. Successful SMAC stack implementations by progressive companies like Cognizant and Netflix are described. Tools such as Google Apps, Apple I-Tunes and Oracle Social Network, which are based on this stack, are studied. This intersection of these cutting-edge technologies can render supply chains to be more adaptive and robust and improve various supply chain activities like inventory management, customer relationship management and collaboration between various stakeholders.

Keywords: Supply Chain Management (SCM), SMAC, stack, Social, Mobile, Cloud, Analytics

Introduction

Information and Communication Technology (ICT) usage, applications and deployments along the supply chain has become a determinant of competitive advantage for enterprises. For enterprises, ICT usage serves as a performance enabler in the face of volatility in the business environment due to competition, pricing pressures, liberalization and globalization. Many tools like Supply Chain Management (SCM) software packages, RFID, EDI, bar-codes, inventory management systems are widely deployed with some technologies like DSS and software agents making good inroads in supply chain management processes.

The Information Technology landscape is replete with several buzzwords and game-changing technologies. SMAC - Social, Mobile, Analytics and Cloud is touted as the next big thing. IDC estimates that the worldwide spending on ICT spending will reach the US$5 trillion mark by 2020 with 80% of this driven by the intersection of social media, mobility, analytics, and cloud technologies. This potent disruptive combination is fast becoming a reality with tremendous potential to transform supply chains to value chains and emerge as the future model of the e-enterprise. One of the major advantages of SMAC is that each of these game-changing technologies complements and enables each other to deliver a force-multiplier effect and enables another to maximize their effect. The resultant e-enterprise promises to be agile, collaborative, connective, distributed, lean, flexible, responsive, robust, scalable, transparent and visible.

This assumes huge significance considering the predictions that by 2020, there would be 100 billion intelligent devices connected to the Information Superhighway from the present 10 billion devices, as also an increase of more than fifty fold on the amount of enterprise data.

SMAC Stack

Hitherto organizations have been using the power of social media, mobile and android technologies, business analytics and cloud computing independently to drive their business. SMAC stack is dubbed as the next generation architecture which intermingles and intersects these cutting-edge technologies for organizational transformation. Combining these to create a new product-service combo brings about greater synergies and a force-multiplier effect. One big advantage is that organizations can easily adapt to this stack because they are not grappling by legacy applications or platforms and can leverage the new generation, social behavior platforms and media.

It makes perfect business sense to transform their enterprise IT departments to adopt the SMAC approach to get better operational synergies. Often these departments have legacy applications running on myriad hardware, software, storage, and communications & networking platforms. With the recent trend of proliferation of Bring Your Own Device (BYOD), mobile and cloud technologies can seamlessly integrate these heterogeneous platforms and devices. Social media can facilitate real-time communication and collaboration. Analytics would be the icing on the cake, mining the enterprise Big Data available through several channels. Tying various business processes to an integrated SMAC stack will be the key. Mobile transactions using platforms like PayPal and cashless payments through smart phones will also open new vistas towards the SMAC stack. The advent to mobile apps for all kind of applications is another healthy trend. The number of app downloads are expected to touch 183 billion annually by 2015.

Social media offer seamless collaboration, sharing and dissemination of knowledge for the enterprise. This technology recognizes the fact that people are the most valuable asset of any organization and this is the best way to unlock their value is through the use of these platforms. Business analytics and dashboards enhance SCM and CRM activities. And the cloud powers the transformative combination of social, mobile, and business analytics.

Some interesting statistics are given below:

- Number of users of social media like Twitter, Facebook and Linked in have topped over a billion and a half
- Forrester Research estimates that the cloud computing industry will be worth US $241 billion by 2020
- Number of mobile phone users are around 4.5 billion, many of them
using smart phones or making a gradual shift to them
• Big retailers are spending between 20-25 percent of their advertising budget on social media channels with nearly 90 percent of top global banks using social networking
• Big data analytics is estimated to be US $50 billion by 2016.

An early adopter of this stack is Netflix, the leading entertainment and video distribution company, which has over 36 million subscribers, who watch 4 billion hours of programs every quarter. Netflix through its premium, Cinematch engine uses analytics of consumer preferences to recommend movies. These movies are hosted on the Amazon Web services cloud and consumers can access them on various devices like tablets, phablets, smart phones or event the good old television. Your preferences and choices with regard to the movies can be shared in social media. Here we see the SMAC effect build a synergistic eco-system, where each technologies complements or supplements each other and brings value to the customer, who gets a personalized experience of watching movies.

Oracle Social Network is a cloud-based enterprise social network & collaboration tool with various features for real-time dialogue & updates, transactional information, business updates, analytics, content, workflow etc. This tool removes the artificial separation between enterprise, collaborative and social media applications. It removes any gaps in collaborative activities, using stream-based conversations between stakeholders and applications along the workflow.

Oracle Social Network has 4 building blocks namely:
• Conversations for dialogue and deliberations amongst stakeholders using the social paradigm resulting in quick decision making in consensus
• Social objects are for interactions between stakeholders and workflow processes within enterprise applications
• Content consists of tools for knowledge management including conversations, documents, videos, images etc
• Activity Streams is concerned with analytics and gets summaries and updates from the above mentioned objects

Another example from the Apple i-constellation is iTunes, which analyses user experiences to facilitate faster, downloads of the popular things. Apple had their own internal social media for iTunes dubbed Ping, but it was recently discontinued in favor of popular social media platforms like Facebook and Twitter.

Google Apps is yet another example of SMAC stack with various services like Calendar, E-mails, Storage, Document Management, Collaboration groups, news feed, sites, wallet and sites. Also the ubiquitous Wikipedia to some extent is based on this stack. When we try to buy books on Amazon, we encounter several recommendation based on analytics and reviews. Amazon, which is on the cloud, can be accessed as an App on any smart phone.

The possibilities are endless and limitless with the advent of Internet of things to create a future generation of social machines, devices and consumer products.

**Boundary less Organization**

The Integrated SMAC stack unbundles various tightly coupled links in a value chain to create a boundary less organization. This stack will impact enterprises in the following areas to have:
• Better interactions with the customer
• Better workflow, collaboration and decision-making amongst all stakeholders
• Better involvement of employees by capturing all their inputs and suggestions
• Better technologies and web-enabled devices integrated together

Cognizant using its Cognizant 2.0 platform has improved its efficiency of client delivery by 17%. This platform combines the project and knowledge management activities with a user-friendly interface. Some of the features of this platform that have enhanced internal collaboration and communication include:
• Blogs, Micro-blogs (like twitter), discussion forums and wikis
• Activity stream that aggregates notifications
• lspace, a platform for crowd sourcing and ideas
• Integrated learning management system.

**SMAC for Supply Chain Management (SCM)**

The SMAC effect and fusing of these cutting-edge technologies can be leveraged to render supply chains to be more adaptive, resilient and responsive. It can impact strategies for supply chain planning and execution. Social and Mobile Technologies are providing new insights into customer needs & preferences and buying patterns as facilitating improved communication and collaboration among stakeholders. Customers are now exposed to a wealth of information emanating from various sources. At the enterprise computing level, analytics is fundamentally changing the enterprise architecture by bringing our actionable intelligence about the enterprise from multifarious sources. The Cloud brings supply chain transparency, flexibility, visibility and lesser costs in terms of Total Cost of Ownership (TCO).

Mobile apps and Social media can provide better understanding about customer preferences and to a large extent, be able to personalize product and service offerings. In addition to this, decisions like ‘buy or build, outsourcing, types of sales and distribution channels, market segmentation etc can be influenced by social profiles.

The success of Amazon Prime is an example of the SMAC technologies enabling a competitive and adaptive supply chain. Amazon currently ships more of its orders through its two-day Prime offering more than its free Super-Saver Shipping scheme. In this case, social media interactions have improved the sales and distribution channels as well as inventory & warehouse management practices of Amazon.
Using SMAC, Inventory Management can be efficiently led towards Zero Inventory, JIT or Vendor Managed Inventory (VMI) with real-time actionable intelligence from various sources like Point of Sale, Warehouse etc. and stakeholders like retailers, customers, logistic providers etc. Integration of front-end Point of Sale with back-end operations like order management can also been achieved.

Cloud technologies integrate all partners in this increasingly global extended supply chain into an online community with real-time information on all elements in the supply chain. Supply Chain management processes and areas where cloud-based solutions are available include demand forecasting, demand planning, e-procurement, distribution, inventory, warehouse and transportation systems. Mobile apps, which are readily available for news feeds, stock prices etc will effect SCM by automating workflows, managing content discovery and build knowledge iteratively over time as employees and customers use an application.

Conclusion

The integrated stack of Social, Mobile, Analytics and Cloud (SMAC) promises to be the next big game-changer in enterprise computing. Enterprises are increasingly adopting this combo, as they become more robust and agile with better knowledge exchange both within the organization and with their partners and customers. Enterprises like Netflix and Cognizant have deployed this stack to spectacular results. Popular tools using this like Google Apps, Apple i-Tunes and Oracle Social Network are also showcased. The intersection of these cutting-edge technologies can render supply chains to be more adaptive and robust and improve various supply chain activities like inventory management, customer relationship management and collaboration between various stakeholders.

References


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Role of Public Key Infrastructure in Big Data Security

Abstract: In recent times Big Data is one of the biggest buzzword in the IT industry. It is used to describe the massive amount of data produced by various applications and systems. Databases are so large that it becomes very difficult to manage and analyze them. Normally data is stored in petabytes, exabytes or even zetabytes. For accurate analysis and decision making it is essential to protect big data against modification and theft. Hence there is a need for big data security. This article discusses the significance of public key infrastructure (PKI) and how it can be used to ensure security for big data.

Introduction
The term Big Data is used almost everywhere these days, from news articles to professional magazines, from tweets to YouTube videos and blog discussions. The term was coined by Roger Magoulas from O’Reilly media in 2005. It refers to a wide range of large data sets almost impossible to manage and process using traditional data management tools not only due to their size, but also due to their complexity. Big Data exists in the finance and business processes where enormous amount of stock exchange, banking, online and onsite purchasing data flows through computerized systems every day and are then captured and stored for inventory monitoring, customer behavior and market behavior. It can also be seen in the life sciences where large data sets such as genome sequencing, clinical data and patient data are analyzed and are used to advance breakthroughs in science. Other areas of research where Big Data is of central importance are astronomy, oceanography, and engineering among many others. The leap in computational and storage power enables the collection, storage and analysis of these Big Data sets and even companies introducing innovative technological solutions to Big Data analytics are flourishing.

Big Data Challenges
Big Data management is the organization, administration and governance of large volumes of both structured and unstructured data. The challenges associated with Big Data management are capture, storage, search, sharing, transfer, analysis, and visualization. Data management principles such as physical and logical independence, declarative querying and cost-based optimization have led, during the last 35 years, to a multi-billion dollar industry. More importantly, these technical advances have enabled the first round of business intelligence applications and laid the foundation for managing and analyzing the Big Data today. The many novel challenges and opportunities associated with Big Data necessitate rethinking many aspects of these data management platforms, while retaining other desirable aspects. It is believed that appropriate investment in Big Data will lead to a new wave of fundamental technological advances that will be embodied in the next generations of Big Data management and analysis platforms, products, and systems. Fortunately, existing computational techniques can be applied, either as it is or with some extensions, to at least some aspects of the Big Data problem. For example, relational databases rely on the notion of logical data independence: users can think about what they want to compute, while the system (with skilled engineers designing those systems) determines how to compute it efficiently. Similarly, the SQL standard and the relational data model provide a uniform, powerful language to express many query needs and, in principle, allows customers to choose between vendors, thereby increasing competition. The challenge ahead of us is to combine these healthy features of prior systems as we devise novel solutions to the many new challenges of Big Data.

In a broad range of application areas, data is being collected at unprecedented scale. Decisions that previously were based on guesswork, or on painstakingly constructed models of reality, can now be made based on the data itself. Such Big Data analysis now drives nearly every aspect of our modern society, including mobile services, retail, manufacturing, financial services, life sciences, and physical sciences. TCS surveyed 1,217 companies in nine countries in four regions of the world (US, Europe, Asia-Pacific and Latin America) in late December 2012 and January 2013. About half of the firms surveyed are using Big Data, and many of them projected big returns for 2012. Companies that do more business on the Internet spend more on Big Data and project greater ROI (Return On Investment). Similarly, a recent survey by Gartner Inc. found that Big data investments in 2013 continue to rise, with 64 percent of organizations investing or planning to invest in big data technology compared to 58 percent in 2012. Dr. Satya Ramaswamy, Tata Consultancy Services vice president, and Doug Laney, Gartner vice president of research, information innovation and business analytics, have shared their insights on big data and what architects can do to overcome the challenges. It is imperative to solve the problems related to big data. It is going to revolutionize not only business, but also research and education to a certain extent.

Characteristics of Big Data
Three characteristics define the big data are 3Vs. That is Volume, Variety and Velocity.

• Volume –refers to the amount of data.
• Velocity – refers to the speed at which data is being processed.
• Variety –refers to the various types of data.

Gartner analyst Doug Laney introduced the 3Vs concept in a 2001 Meta Group research publication. More recently, additional Vs have been proposed including variability -- the increase in the range of values typical of a large data set and value, which addresses the need for valuation of enterprise data. Fig.11, shows the increasing expansion of 3Vs.

Big Data Technologies and Tools
The Big Data phenomenon is intrinsically related to the open source software revolution. Large companies such as Facebook, Yahoo!, Twitter, LinkedIn etc.
To utilize such data effectively, it is the data has been increasing exponentially. Logging data are just a few examples where data, user-generated content and machine information, social graphs, geo location Google+ and others. Personal user through third parties such as Facebook, it is possible to access and capture data through the NoSQL database. GB batch MB GB TB PB Periodic Near Real Time Real Time Table Data base Photo Web social Audio Video unstructured Mobile Data Velocity Data Variety Data Volume.

HADOOP (High Availability Distributed Object-Oriented Platform)
High-availability distributed object-oriented platform or “Hadoop” is a software framework which analyses structured and unstructured data and distributes applications on different servers. Hadoop is used in maintaining, scaling, error handling, self-healing and securing large scale of data. These data can be structured or unstructured. Hadoop allows writing applications that rapidly process large amounts of data in parallel on large clusters of computer nodes. A Map Reduce job divides the input dataset into independent subsets that are processed by map tasks in parallel. This step of mapping is then followed by a step of reducing tasks. These reduced tasks use the output of the maps to obtain the final result of the job.

Architecture of Hadoop is shown in Fig. 2.1 below. Description of the various components is available in the literature.

**NoSQL Database**
It is possible to access and capture data through third parties such as Facebook, Google+ and others. Personal user information, social graphs, geo location data, user-generated content and machine logging data are just a few examples where the data has been increasing exponentially. To utilize such data effectively, it is required to process huge amount of data for which SQL databases were never designed. The evolution of NoSQL databases is to handle these huge data properly. The term NoSQL was coined by Carlo Strozzi in the year 1998. He used this term to name his Open Source, Light Weight, and Database which did not have an SQL interface.

As the term says NoSQL, means not only SQL or Non-SQL database. NoSQL is not based on table formats and that’s the reason we don’t use SQL for data access. A traditional database deals with structured data while a relational database deals with the vertical as well as horizontal storage system. NoSQL deals with the unstructured, unpredictable kind of data according to the system requirement.

**NoSQL pros/cons**
**Advantages:** High scalability, Distributed Computing, Lower cost, Schema flexibility, semi-structure data, No complicated Relationships.
**Disadvantages:** No standardization, Limited query capabilities (so far), Lack of Data consistency.

**Public Key Infrastructure (PKI) for Big Data Security**
Organizations in both public and private sectors have become increasingly dependent on electronic data processing. Vast amount of digital data are now gathered and stored in large computer databases and transmitted between computers and terminal devices linked together by complex communication networks. Without appropriate safeguards these data are susceptible to interception during transmission or it may be physically removed or copied while in storage.

As Big Data becomes a potential game-changer for businesses, the security risks become even greater. Cyber Security is one of the issues found in Big Data management as today all the transactions are made online. PKI can be used to avoid cyber security issues as PKI uses secure digital authentication and signing. The infrastructure also allows forwarding data by using an encrypting key pair: a public encryption key and a private decryption key. In Estonia, this technology is used in relation with electronic identity (ID card, mobile ID, and digital ID).

The secure online transmission of information in e-commerce is the primary objective of the public key infrastructure. The scalable and distributed characteristics of PKI are suitable for a distributed environment that exists in case of Big Data. It provides a means for the following:

**Authentication** – Mechanisms to strongly authenticate user identities.

**Confidentiality** – Ability to enable strong encryption that can protect the privacy of information transferred during a transaction.

**Integrity** – Capability to ensure that transactions have not been modified by an unauthorized party.

**Key Recovery** – Capability for authorized users to obtain cryptographic keys needed to recover information protected with encryption keys that may have been lost or damaged.

**Non-Repudiation** – Ability to validate that specific users were involved in a transaction.

Password authentication is not sufficient for authenticating the persons or devices who are handling huge amount of data. Digital certificates can be used in securing transactions on the internet other than user id and passwords. When dealing with data not only authentication but non-repudiation and time stamping is also important. The exact time of the

<table>
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<th>Transaction top level interfaces</th>
<th>ETL Tools</th>
<th>BI Reporting</th>
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<td>PIG</td>
<td>Hive</td>
<td>Sqoop</td>
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**Processing**

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<th>Map-Reduce</th>
<th>HBASE Database with Real time access</th>
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The base is a self-healing clustered storage system.

![Fig. 2.1 Hadoop Architecture](image-url)
transaction can be important. For instance, a transaction may have to be submitted by a certain time to be valid. The solution for having trusted transactions is to combine digital signatures with time-stamps. Non-repudiation is a concept, or a way, to ensure that the sender or receiver of a data/information cannot deny either sending or receiving data in future. Time stamping is one of the important audit checks for non-repudiation. The time stamp is an audit trail that provides information of the time the data is sent by the sender and the time the data is received by the receiver.

Devices that generate and store information (in super markets (big bazar), banks, and google) can encrypt data using a public key. Authorized users or applications can use the private key to decrypt the data. Using PKI digital certificates proper authentication of the devices can be achieved, in addition to secure data transmission. PKI not only provides authentication and authorization but also defines the level of the trust relationship between the user and certification authority.

Authentication using PKI

Establishing user identity is of primary concern in distributed environments; otherwise, there can be little confidence in limiting privileges by user. Passwords are the most common authentication method in use, but for particularly sensitive data, you need to employ stronger authentication services. Popular authentication methods used with PKI include:

- Secure Sockets Layer (SSL) Authentication and X.509v3 Digital Certificates.
- Entrust/PKI Authentication
- The SSL protocol has gained the confidence of users, and it is perhaps the most widely-deployed and well-understood encryption protocol in use today.

PKI uses concept of encryption, decryption, digital certificate and digital signature for authenticating clients. It has the following components:

Certificate Authority (CA): A trusted third party, which is independent and issues digital certificates.

Registration Authority (RA): RA is an entity that is trusted by the CA to register or vouch for the identity of users to a CA.

Key Management: PKI generates public and private keys for secure communication and manages the keys.

Digital Certificates: Digital certificates are issued by CA that identifies users and machines.

PKI Repositories: A repository is a database of active digital certificates for a CA system. It uses LDAP protocol which provides the list of all issued and revoked certificates.

Archives: An Archive is a database of information to be used in settling future disputes. It stores previously issued certificates.

The benefits in using a PKI for remote authentication can be attractive. The complexity of pre-establishing shared keys between processes is eliminated, as is the security risk of transmitting sensitive authenticating information (such as a password or a thumbprint) over a network. Rather, public-key technology is used to achieve the authentication using sophisticated challenge-response protocols and signed messages.

Authentication (both entity authentication and data origin authentication), integrity, and confidentiality are the core security services provided by a PKI. These services enable entities to prove that they are who they claim to be, to be assured that important data has not been altered in any way, and to be convinced that data sent to another entity can be read only by that entity. Organizations can derive tremendous benefits from these services by using them to ensure, for example, that highly sensitive information only gets into the hands of those with an explicit “need-to-know”. A number of companies such as VeriSign, Baltimore Technologies, Microsoft, Entrust Technologies, and Thawte are specialized in PKI products. A lot of organizations are using PKI for their security needs.

Why PKI

In conventional DBMS data is stored and maintained by the DBA. DBMS security is mostly confined to access control and flow control. But during big data analysis, data is coming from different external resources. It’s necessary to ensure that data is not compromised during transmission from the source to the Big data server. Providing authenticated data and ensuring data integrity become the main concerns. The PKI mechanism is useful in this context. It provides secure web access. It is a security mechanism for securing data, identifying users & establishing chain of trust.

PKI combines many components - digital certificates, asymmetrical cryptography (public key cryptography), certification authorities and applications for the entire network of security architecture. PKI is used for secure issue of digital certificates to individual users and servers, management of the keys and certificates, renewal and cancellation of certificates, integration into applications and training, services and support associated therewith.

1. Data is coming from different external sources i.e data is distributed. How server trust that data is trusted one? Now there is a need for the trust relationship between the data source and the Big data server which is provided by the PKI. In this scheme, Source data is encrypted by the private key along with digital certificates so that server can check whether the data is modified or altered in the transit.

2. These certificates are issued and signed (CA’s private key) by the CA that is one of the most trusted and reliable party.

3. There is a big data analyzer to verify and identify the identity of the each sender of data (Authentication and Authorization).

4. Digital certificates are very difficult to spoof.

5. As PKI uses digital signatures data/records in electronic form get legal recognition. Also Indian IT Act 2000 specifies that authentication must be done by digital signatures. TCS, Customs & Central Excise are some of the licensed CAs in India.

6. PKI is also cost effective over the long run.

PKI is used in government, financial, e-commerce and health care sectors. It is already being used by Indian (NASA, DoD), Australian and Canadian governments for e-Governance applications for authentication and integrity purpose.

Conclusion

In the modern digital era wide range of large data sets are easily available. This enormous data must be genuine for a fruitful analysis to be carried out. PKI based authentication can be employed to ensure that the Big Data is genuine. The scalable and distributed characteristics of PKI are most suitable for the Big Data environment. Therefore PKI can be used for Big Data Security.

References

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Case Studies in IT Governance, IT Risk and Information Security

Introduction to Case Study Series: Information Systems have come a long way from the time when the first computer was invented. The journey was a long and arduous one from 1822 (Charles Babbage – Difference Engine), 1936 (Konrad), 1936 (Turing) to the first commercial computer 701 by IBM in 1953. From the days of computing and electronic data processing we have now moved to the age of information systems. With ICT, which has revolutionized the world, today information systems have grown beyond being mere tools or a medium and have become all pervasive.

Computers have not just become a part of our lives but have in fact become a way of life. With this pervasive use of computing it has become equally essential to manage ICT and information systems as it is necessary to manage our society, government, business and culture.

Managing information systems encompasses a wide range of topics and covers a plethora of disciplines. Issues have to be handled at the strategic, operational and activity level covering people, processes and technology. Thus, managing information systems deals with Governance, optimizing value, controls, managing risks, compliance, security, continuity, development and life cycle of information systems, training and human relations, social and cultural aspects, cost-benefit and even project management.

Covering these multifarious aspects one by one with a detailed technical exposition would not only make it an arduous and lengthy task but would also be less interesting and likely to be skipped over.

Case studies have always proved to be an excellent tool to put across complex subjects having a wide scope. From the days of Panchatantra to the modern day cases they have proved time and again their benefit, utility and appeal to the novice and the expert to the casual as well as the serious follower of the subject. They can be addressed at different levels each according to one’s own choice.

It is with these thoughts in mind that the current Case in Information Systems is being presented. 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 Omega Films

Omega Films is an upcoming media and entertainment company that has successfully produced television serials and has now also moved into making popular regional and Hindi films. It has had reasonable success with its first film Mumbai Masala and has lined up a few projects for the next two years.

As a part of using ICT to popularize movies and entertainment programs it has, up to now outsourced this activity to a professional company. Omega Films has plans to diversify into media, print, publication and gaming industry. It has also attempted putting out some merchandise and a few activity games based on its released films for sale. It has recently launched a website highlighting and showcasing its activities as well as providing a blog-space and facility of down loads of clips, tunes, songs and provided online activities and games.

Mr. Mohandas Moga the Chief Operating Officer of Omega Films walks into his office in the newly constructed Alpine Towers. Mr. Moga sits at his desk back from his two week vacation to Bangkok, a well deserved break after the success of their last film. Mr. Moga is a middle aged man in his early fifties, large and portly but with a benevolent smile always on his face. Mr. Moga glances at the grand view of Mumbai right up to the sea from his office window and is about to open his briefcase, when the telephone on his table rings and he briskly straightens himself and smoothens his graying hair and gets up. Mr. Ankoosh the CEO and MD has called him for a meeting.

When he enters the conference room he finds the mood somber. The usually chirpy Sumitra, the young creative head barely manages a faint smile. The Production Controller and his team, who are always upbeat, are looking downcast. Everyone in the room is so quiet, that the sound when he pulls a chair to sit down seems very loud. He looks around at the staff gathered in the room. Certainly the mood looks serious he thinks to himself.

Ankoosh pushes a print out towards him and booms – “what do you make of it?” It is an email sent to Omega Films demanding a million rupees to be transferred to an account within three days failing which their new website will be defaced and their company maligned in social media.

“I think we should approach the police, the authorities”, he says tentatively. “All that is thankfully past”, says the MD. “Look at the date of the email. It came in the next day after you left and thankfully the matter has been sorted out. It turned out to be an April fool’s Day prank by our good friend Soma from Noodle Films.”

“But we all have had a harrowing time thinking of the consequences and racking our brains to deal with the situation. This meeting is to brainstorm and list some of the likely threats we can face in the future and mind you, next time it could be very real and ugly. Thank God it was Soma and his practical joke.” No one dared to smile as Ankoosh went...
In a creative business like films, securing knowledge and information is very vital. It is very easy to steal an 'idea'. There are plenty of examples where theft of ideas, central theme, concept, even scenes, characters and climax has taken place.

on. “The other thing that I want from you is what we should do to prepare ourselves against these threats.”

It is at this moment that hot tea and biscuits are served. The mood relaxes a bit. There is light banter about how lucky Moga has been to be enjoying on a holiday. The meeting ends soon with a grim reminder from Ankoosh to come up with likely threats and strategies to deal with them.

Mr. Mohandas Moga returns to his office, slumps in his chair and closes his eyes. IT has always been a bug bear for this man who has been brought up in the old school and is most comfortable on the sets of a film. To him IT is something which is taken care of by the technicians who handle the special effects and digital processing or by the IT department which deal with the computers and laptops. He himself has little to do with it he mulls over and presses the intercom and calls in Roma his secretary.

Roma walks in looking bright and fresh, with her mid length hair tied back with a bow.

By then Moga has realized that this is not his cup of tea and he needs help. “Roma, please open my email and send a request to Mr. Gopal to contact me as soon as possible. He is wiz with computers and a good friend. I can only think of him for help.” “Do you have his id”, asks Roma. Moga looks in his pocket diary but cannot find it easily. “I think I have his id”, Roma walks in looking bright and fresh, with her mid length hair tied back with a bow.

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What a relief muses Moga. Now the email will go and Gopal will be on his way.

And then Mr. Gopal helps Mr. Moga to identify possible threats and strategies.

Solution:
The situation:
The events and details of the case seem to indicate that in general there is a very low level of awareness regarding securing information systems. Policies and procedures governing use of information systems also appear to be either absent or weak. Most of the staff despite handling important projects and sensitive information and data like story idea, unreleased film content and songs and other sensitive information seem to oblivious of the possibility of their misuse or theft. Apart from being low on governance, the conduct of the secretary shows that she had no qualms in openly accessing the MD’s email using a password she had got from his secretary. The organization culture also appears to be lacking in work ethic. The organization appears vulnerable to threats and ill prepared to face unforeseen events.

Threats: The first obvious threat is of the kind enacted in the case. The website which is the window, the showcase and the portal of the company with the external world and also its own employees is likely to be attacked, hacked or defaced causing severe damage to the Company both in terms of money and reputation.

In such a situation the biggest and most valuable asset of Omega Films at risk is the Intellectual Property Rights. They are exposed to the threat of hacking, misuse, theft, wrongful exploitation. The threat could come from an external hacker, or more likely from a disgruntled or an opportunistic employee, who may choose to attack, subvert and compromise the valuable asset.

In a creative business like films, securing knowledge and information is very vital. It is very easy to steal an ‘idea’. There are plenty of examples where theft of ideas, central theme, concept, even scenes, characters and climax has taken place.

Strategic information may be targeted through social engineering, phishing attacks, eavesdropping or even unauthorized physical access. People – staff, artists etc. can be subverted and poached causing damage. Sensitive information regarding market price, artist contracts, dates and schedules, contact information, details and terms of important deals may also be compromised. Piracy of films and television content, songs and programs will lead to substantial loss of revenue. Vandalism or destruction of film content and masters by disasters or unforeseen events can destroy intellectual property.

Other equally severe threats could include breach of privacy, release of content violating laws of the land or intellectual property rights leading to compliance issues, third party claims and legal issues.

The strategy: The strategy should focus on strong governance, business ethics, proactive systems, improving business functionality, protecting the intellectual property and assets of the company, training and protecting the people, building a culture of resilience and compliance.

This should cover strategy formulation, direction, management, systems lifecycle of acquisition, deployment and phase out, change management, operations and support activities including vital HR and communication aspects.

The road map for implementing information security could be as follows -

(1) To put in place benchmarked information systems security policies that are robust, appropriate and tailored to be implementable within the organization.

(2) This should be followed up by HR policies to be put in place like non-disclosure agreements, ethical value systems, procedures and protocols.

(3) There should be a model of advocacy/ awareness about information security followed by adequate training in security.

(4) This should be followed up with setting up a permanent security framework – comprising of a plan, do, check and act cycle of implementation followed by monitoring and improvement, setting up of initiatives like help desk, incident response procedure as well as FAQs, induction of relevant technology and continual education to keep the staff abreast.

(5) The check i.e. monitoring phase can be implemented by carrying out internal audits as well as security audits by external independent system auditors.

(6) The act phase is a continual process of closing gaps and carrying out improvements to the information security management system.

The protection of the website - the window, the showcase and the portal of the company with the external world and also its own employees is likely to be attacked, hacked or defaced causing severe damage to the Company both in terms of money and reputation.

This should cover strategy formulation, direction, management, systems lifecycle of acquisition, deployment and phase out, change management, operations and support activities including vital HR and communication aspects.
be taken care of in the above, as the website would be robust and secured against known OWASP vulnerabilities and with a monitoring system in place any compromise will be promptly reported and effectively dealt with. Regular backups will ensure that defaced websites are taken down and quickly restored to normalcy.

An effective solution is generally expected to proceed on these lines. With the increasing dependence of all concerned on information systems and technology the need, importance and relevance of Information Security Governance is well acknowledged and accepted. If not through knowledge sharing and board briefings, then definitely when events like the one portrayed in the case study occur. The question that still plagues organizations at all levels is not whether, why or what to secure? It is when, how, to what extent and at what cost to secure business and its information systems?

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
Did you hear about Paley Graph?

Paley graph of order \( q \) (a prime power) is a graph on \( q \) nodes with two nodes adjacent if their difference is a square in the finite field \( \mathbb{F}_q \). A prime power is an integer power of a prime number, e.g., \( 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, 19, 23, 25, 27, 29 \) etc. This graph is undirected when \( q \) becomes \( 1 \) (modulo \( 4 \)). Simple Paley graphs therefore exist for orders \( 2, 3, 5, 7, 11, 13, 17, 19, 23, 25, 27, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97, 101, 103, 107, 109, 113, 127, 131, 137, 139, 149, 151, 157, 163, 167, 173, 179, 181, 191, 193, 197, 199, 211, 223, 227, 229, 233, 239, 241, 251, 257, 263, 269 \).

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

Congratulations

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

Mr. Amit Dhawan (CISAS, DRDO, Delhi), Dr. Madhu S Nair (Dept. of Computer Science, University of Kerala, Kariavattom, Thiruvananthapuram, Kerala), Ms. Nazish Khan (Department of Computer Science and Engineering, Anjuman College of Engineering and Technology, Nagpur, Maharashtra)
It’s pleasure to welcome the receipt of a book on Java Programming written by K Rajkumar of Bishop Heber College in Tiruchirappalli. We provide here a brief review of the book for interested readers. The book comes in the form of an introductory text on Java Programming and is suitable for semester-long, undergraduate course in Java. It has five parts starting with a part on Java Basics wherein fundamental concepts such as data types, variables, literals, console I/O features, conditional and looping statements, arrays and methods are explained with examples. Second part introduces classes and methods along with concepts of inheritance and polymorphism. This part also proposes to teach abstract classes, interfaces, enums, packages and exception handling methods.

Third part deals with data structures used for storing objects such as sequence containers viz. vector, string tokenizer and stack, map containers viz. hashtable and also discusses set containers. Sorting and searching methods are also introduced. Fourth part talks about Java threads and introduces concept of multithreading along with thread synchronization. It also introduces file processing concepts. Last and fifth part discusses GUI (i.e. graphical user interface) development in Java. It introduces 2D graphics to generate lines, arcs etc. And also talks about creating GUI applications using JFrame and applets using JApplet. The text highlights use of swing-based GUI design rather than that of AWT classes.

Preface to the book provides guidelines to trainers for customizing the syllabus as per requirements and provides three different sample tracks - one for beginners, other for intermediate level learners and third for those having good knowledge of one programming language.

At the end of every chapter of the book, summary is provided which is useful for quick revision of learnt concepts. A list of keywords introduced in the chapter is also provided. Interesting part is that there three types of questions at the end of each chapter - multiple choice questions (with answer key at the end), short answer questions and exercises wherein programmer is asked to write simple programs using the concepts learnt. There are three appendices at the end out of which first two appendices provide a list of Java Keywords (Reserved Words) and a list of Selected Java 7 packages respectively. The third appendix provides the syllabus for the examination of Oracle Certified Associate (OCA) Java SE 7 Programmer-1 (Exam No. 1Z0-803). There is a back index at the end of the book which helps to quickly arrive at the desired concept and its explanation. So the book is a good text book for beginners and for those who intend to have a quick glimpse of Java programming without going into the details of advanced topics such as networking concepts, socket programming (Java.net) and JDBC concepts (Java.sql), remote method invocation (RMI), JavaBeans etc.
Your Question, Our Answer

“The only true wisdom is in knowing you know nothing.”

Dr. Debasish Jana
Editor, CSI Communications

On C++: A scenario of segmentation fault
From: Nagma Khan, Third Year Student, Bachelor of Instrumentation and Electronics Engineering, Jadavpur University, Kolkata

Q Hello Sir / Madam
Can you please help me find the problem in the following program?

```cpp
#include <iostream>
#include <cstring>
using namespace std;

class String {
    char* ps;
    public:
        String(const char *s) {
            int ln = strlen(s);
            char *ps = new char[ln];
            strcpy(ps, s);
            cout << "String object created" << endl;
        }
        ~String() {
            if (ps != NULL) {
                delete [] ps;
            }
        }
        int get_length() {
            int i = strlen(ps);
            return i;
        }
        void display() {
            cout << "displaying string" << endl;
            cout << ps << endl;
        }
};

int main() {
    String s1 = "abcd";
    cout << s1.get_length() << endl;
    s1.display();
    return 0;
}
```

The output is as follows:

String object created
Getting length of string
Segmentation fault (core dumped)

With the Segmentation fault coming, project executable has stopped working. I am using Dev-C++ 4.9.9.2 compiler. Is it due to some pointer allocation error?

A One statement was faulty, within String constructor,

```cpp
ps = new char[ln + 1];
```

This is a faulty statement, ps was re-declared as local, also, +1 needed for accommodating the string terminator. The corrected statement should be as below:

```cpp
ps = new char[ln + 1];
```

The corrected program is given below.

```cpp
#include <iostream>
#include <cstring>
using namespace std;

class String {
    char* ps;
    public:
        String() {
            ps = (char *) NULL;
        }
        String(const char *s) {
            int ln = strlen(s);
            char *ps = new char[ln + 1];
            strcpy(ps, s);
            cout << "String object created" << endl;
        }
        ~String() {
            if (ps != NULL) {
                delete [] ps;
            }
        }
        int get_length() {
            int i = strlen(ps);
            return i;
        }
        void display() {
            cout << "displaying string" << endl;
            cout << ps << endl;
        }
};

int main() {
    String s1 = "abcd";
    cout << s1.get_length() << endl;
    s1.display();
    return 0;
}
```

The problem was that the pointer member of the object instance was not getting initialized at all, this was hidden out by the local declaration of variable having same name, so other member function crashed when it was trying to access that pointer which was not initialized.

Do you have something to ask? Send your questions to CSI Communications with subject line 'Ask an Expert' at email address csic@csi-india.org
ICT News Briefs in April 2014

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

Voices & Views
- Indian vendors imported a total of 15.06 million smartphones in the 4th quarter compared to 5.35 million units in the same period of 2012 – IDC.
- Worldwide software revenue totaled $407.3 billion in 2013, a 4.8% increase over 2012, driven by trends such as “big data” – Gartner.
- Food portals see 150% jump in orders.
- Currently, the value of the global product development service (PDS) market is $13.2 billion and expected to reach $16 billion in two years.
- Online fashion nearly doubled in value from $278 million in 2012 to $559 million in 2013.
- Average broadband speed in India has increased by 31% to 1.5 Mbps but is still the lowest in the Asia-Pacific region.
- India was Asia’s No. 1 phishing target in 2013, resulting in an estimated loss of more than $22.5 million – Study by RSA.
- DoT decides to maintain status quo on security clearance.

Govt, Policy, Telecom, Compliance
- India’s broadband penetration is only 2%, while mobile is a vast 72% (with 893 million subscribers) and rising.
- Telecom towers must be powered by renewable tech such as solar energy, wind energy, biomass energy, fuel cells, hybrid power systems and battery technologies.
- There are about 5.85 lakh telecom towers in India, which develops more than 10% of the apps – Microsoft.
- Nokia unveils its first dual-SIM Lumia phone.

Company News: Tie-ups, Joint Ventures, New Initiatives
- Cognizant has come out with a new approach called ‘code halos’ that it believes will open up more multi-million dollar business opportunities.
- IBM to manage Airtel’s infrastructure and application services in a deal valued at about $700 million.
- Nokia unveils its first dual SIM Lumia phone.

IT Manpower, Staffing & Top Moves
- Telecom Sector Skill Council (TSSC) in partnership with World Trade Center Bangalore, Cisco, ITI, and UTL, organized the skills conclave to promote skills development for the telecom sector. Plans to training to 80,000 youth across India over the next 18 months.
- NTT DoCoMo to exit Tata Tele. Entitled to get at least Rs. 7,250 crore for the entire stake, which is 50% of its total acquisition price.
- Infosys, Orange offer TV apps with customised content.
Interview with Dr. Srinivasan Ramani

Dr. Srinivasan Ramani has brought a rare honour to the country by being inducted into the Internet Society’s Internet Hall of Fame (see box on next page). On this occasion, it is a great pleasure and my privilege to present his interview here for CSI readers. Useful links are also provided for interested readers to get more information about Internet Hall of Fame, Dr. Ramani’s views on getting the most out of mobile revolution and detailed C-DAC news of Dr. Ramani’s induction into Internet Hall of Fame.

Q1: Sir, first of all, our heartiest congratulations to you for induction into the Internet Hall of Fame in recognition of your contribution in creating first Indian link to the Internet. Your efforts brought India on the Internet map of the world for the first time as early as in 1987. Your achievement has made the entire Indian IT fraternity extremely proud. Please tell us in brief about your contribution.

Ans. I have been involved with computer networking since 1973. I was one of the first few hundred users of ARPANET and its email during 1971-73 when I was at the Carnegie Mellon University. I felt that these were technologies of great importance to India and other developing countries. So, when I returned to the Tata Institute of Fundamental Research (TIFR) in 1973, I started network related R & D and assembled a team. My colleagues Anant Joshi and Vinod Kumar, among others, worked with me to create computer networking software to connect a TDC-316 computer over telecom lines to a bigger computer. The TDC-316 worked as a remote station and was located at VJTI, Mumbai and played a significant role in educational activities there. We belonged to the National Centre for Software Development and Computing Techniques at TIFR, set up by Prof. R Narasimhan. Later our networking team went on to create an experimental packet switching network over satellite channels to demonstrate connectivity between Delhi, Mumbai and Ahmedabad. I wrote a paper jointly with Dr. R Miller in 1980 proposing a new type of computer communication satellite for computer messaging. A final version published in 1982 attracted the attention of the International Center for Development Research set up by Canada. They funded groups that demonstrated the concept and its applications by launching two satellites.

Another dimension of our work started in 1985-86 when we started using a large UNIX computer to run email and support UUCP connections. By this time, we were at the National Centre for Software Technology (NCST), Mumbai, under the aegis of the Dept. of Electronics, Govt. of India. I had presented a paper at a seminar called by the then DOE Secretary, Dr. P P Gupta in 1983, suggesting an academic network for India. The Government of India announced a project in 1986, named Education and Research Network (ERNET), and it was supported by the United Nations Development Program. Teams at five IITs (Bombay, Delhi, Kanpur, Kharagpur and Madras), were contributors to the ERNET, along with teams at the Dept. of Electronics, Govt of India, the Indian Institute of Science, Bangalore, and at NCST. I had the privilege of heading the ERNET team at NCST. Our team set up the first email hub for ERNET and the first International Gateway to the Internet, connecting it initially to Amsterdam and soon after that to the USA. Anil Garg and Shrikumar in my team made very useful contributions to this effort. As the network expanded inside India, Sanjay Pathak, Aika Irani, Bharat Desai and many of their colleagues also joined in managing the expanded networking activities.

Q2: After having worked in non-profit research setup for a long time, you moved on to an industrial setup of HP Labs. How has been your experience there?

Ans. There is greater efficiency in industrial labs. The research is managed in the sense that plans are made and coordinated. Progress is monitored. On the other hand, academic research in which faculty members carry teaching responsibilities and involve students in research for part of the time is also an effective model. The students are good judges of ones work, its significance and promise and of the sincerity of the teacher.

Q3: How would you comment on India’s IT network infrastructure as of date? Have we reached where we should have or much more needs to be done? What should be the strategy for the future?

Ans. Some people say that because of high cell phone penetration in India, 800 million people are ready to use the Internet. That is bunkum. I pay Rs 250/month for a 3G data plan that gives 1 GB/month, but I will be charged 3p per 10 KB if I exceed my quota of 1 GB. That is, if I use one more GB the second GB will cost me Rs 3,000! Why the rate goes up so steeply (from 250 to 3000), I don’t know! I was scared of this for a few years and hence used only a prepaid SIM for data, which stops working when you exceed your allotted quota. It poses other problems – like sudden cut-off if you do not renew at the right time. In case of a service provider I know, you cannot pay for renewal in advance! All this complexity frightens many people away. I know a student whose parents took away his cell phone because an unexpectedly large bill came one month.

Downloading the Wikipedia article on rice (6 MB) costs me Rs 18 because I have a data plan. If student who has no data plan downloads the same article, it costs him Rs 216! We are frightening away data users on the cellular network, killing the goose that could lay the golden egg!

Contrary to what you hear, 80% of the Indian population does not use Internet bandwidth for anything significant. Jokes, cricket scores, rumours, and political jibes over SMS are the main “non-voice services” people get over the cellular network. The language barrier continues to pose a major problem in using information and educational services over the Internet. I have written about this at obvioustruths.blogspot.in/2012/09/the-reality-of-mobile-value-added.html
HEARTIEST CONGRATULATIONS!

To Dr. Srinivasan Ramani for inclusion in Internet Society’s Internet Hall of Fame!

Here is a heartening news that Dr. Srinivasan Ramani, one of the past presidents of CSI and Founder Director of India’s National Center for Software Technology (NCST now C-DAC Mumbai) has been inducted into the Internet Hall of Fame at the Internet Society’s 2014 Induction Ceremony held on 8th April 2014 in Hong Kong. Dr. Ramani is the first Indian to make it to the Internet Hall of Fame and with this he joins an elite rank of notable icons who have been inducted into the Internet Hall of Fame for their significant contributions to the advancement of the global Internet.

The Internet Hall of Fame (http://www.internethalloffame.org) is a recognition program and virtual museum that celebrates the living history of the Internet and the individuals whose extraordinary contributions have made possible the Internet, its worldwide availability and use, and its transformative nature. The Internet Hall of Fame inducted Dr. Ramani for his contributions to the growth, connectivity, and use of the Internet in India. Dr. Ramani has been named a Global Connector, a category which recognizes and celebrates individuals from around the world who have made major contributions to the growth, connectivity, and use of the Internet, either on a global scale or within a specific region or community.

Detailed news of Dr. Ramani’s induction in the Internet Hall of Fame is also available at: http://www.cdac.in/index.aspx?id=pk_pr_prs_r1221

About Dr. Srinivasan Ramani

Dr. Ramani was the President of CSI during the period 1996-98. During 1985-2000 he served as the founding Director of NCST, an autonomous organization under the aegis of the Department of Electronics (now DeitY), Government of India. During his tenure there, Dr. Ramani also served as the Head of the Computer Networks Division, and as Coordinator of the ERNET Team at NCST from 1986 till 2000. As coordinator of the ERNET team at NCST, he led the efforts to set up ERNET’s central mail switch and its international gateway; starting with a link to Amsterdam in 1987, using TCP over X.25. This was the first such international connection from India. A year later his team connected ERNET to the UUNET in Falls Church, Virginia, as well. Partnering institutions of ERNET, in cooperation with Dr. Ramani’s team at NCST, set up domestic TCP/IP links to extend the network nation-wide. Anticipating the potential growth of the domain, Dr. Ramani’s team also taught very early courses at the Post-Graduate level on computer networks technology and contributed significantly to the creation of human resources in this field in India.

Earlier in his career, Dr. Ramani led a team to create communication software for an Indian-made computer in 1976-77, using it in the education field. He played a key role in connecting three cities in 1981 through an experimental satellite-based packet switching network, and co-authored a pioneering paper proposing a Low Altitude Equatorial Satellite for computer messaging in 1982. This proposal led others to build such a satellite and to demonstrate its utility internationally.

For additional information, you may visit:
- http://intermethistory.asia/_Srinivasan_Ramani_s_personal_essay_(Section_7.9),_Book_1

Dr. Ramani’s pioneering paper (written jointly with R Miller) proposing a novel, low altitude satellite for electronic messaging triggered the International Development Research Center (IDRC), Canada, to support development of the concept. Volunteers in Technical Assistance and the Radio Amateur Satellite Corporation — joined forces to test the concept. IDRC funded a demonstration of this experiment in 1985. In 1988, the International Physicians for the Prevention of Nuclear War (IPPNW) and IDRC staff discussed the idea of using a low-cost communications satellite system to address the growing health information gap in developing countries. IPPNW formed SatelLife in 1989 to pursue the concept, and developed the technical aspects over the next few years.

In 1991, IDRC funded the research project HealthNet: Satellite Communications Research for Development. In 1992, the first edition of HealthNet News was transmitted by satellite.

Here are a few relevant Internet references:
- http://web.archive.org/web/20031103103508/http://archive.idrc.ca/nayudamma/health_e.html (on Healthnet that utilised the concept)
Q4: Which IT innovation today in your view has the highest potential for impacting and improving public interests in general and human life in particular?
Ans. I believe that the electromagnetic spectrum goes largely waste in small towns and rural areas as the usage there is small. We need to exploit this unused spectrum in intelligent ways and make Internet access available to every school, every public library and every panchayat office. I believe that access to ac.in and gov.in domains should be free at these places, and on the street just outside these premises! You can expect people to bring a smart phone or a tablet or even a laptop, but give them WiFi free!

We can learn a trick or two from the Nepalese social entrepreneur Dr. Mahabir Pun (Visit http://nepalwireless.net/). IIT Kanpur has also done some interesting work with this technology (visit http://home.iitk.ac.in/~chebrolu/docs/2007-exp-dgp.pdf). Public libraries have lost a lot of their significance today. They can regain their importance by teaching readers how to use the Web to get information.

At another level, I think that there is great promise in what are now called Low Earth Orbit Satellites http://en.wikipedia.org/wiki/Low_Earth_orbit. Inexpensive smart phones should be able to get at least text pages from the Internet by communicating with suitably designed LEOS. This will require significant R & D to realize commercially.

Q5: It is often said that information security has been an after-thought in the context of Internet. Tim Berners-Lee, too, who proposed Web on top of Internet which eventually made the Internet popular and caught attention of the commercial world, specifically mentioned copyright enforcement and data security as non-requirements in his original proposal for information management. They say it is the basic nature of TCP/IP protocols on which the Internet is built that has brought in these vulnerabilities as it does not strictly follow the OSI 7 layer model. Could this have been different? Had the seven layer model been followed strictly, would there have been less security vulnerabilities? What would you say regarding this aspect?
Ans. Internet protocols do not rule out data security. You operate your bank account over the Internet. Copyright enforcement is a legal issue; if a country decides that Copyright should be strictly enforced, it is possible to do it over the Internet also. The magic of the Internet is not the Copyrighted matter; it is the free stuff openly accessible. You can access the Encyclopaedia Britannica over the Internet and also the Wikipedia. Which do you access most of the time?

Q6: Now coming to the point of privacy of data and information in the networked world, especially after former NSA contractor who leaked the surveillance practices of his own country USA, what would you say about the righteousness involved in this type of ‘snooping’ activity by the government? Will privacy become a thing of the past soon? What impact would it have on cloud initiatives by organizations?
Ans. So far the snooping seems to have been at the level of tracking who communicated with whom and when? Not “what”, except in special cases. Much of the loss of privacy is because so many of us accept freebee cloud storage, freebee email and put all our photographs on some social networking site. We click “I accept these terms and conditions” even without reading them! I do think that the risk of loss of privacy is a big threat. I do think that the burden of convincing us that the cloud is free from illegal surveillance is to be borne by the cloud service providers.

Q7: What would be your advice to the young entrants in the IT field – both in academics & research as well as in industry in terms of future scope? Will the IT field continue to help generate wealth, provide lucrative careers to young aspirants in years to come or has it already started losing its luster?
Ans. It is not just maintaining someone’s computer or their software or even giving them some programming services that is the core of IT and ITES. It is about new ways of doing things using technology to increase productivity and the quality of life. It is about designing systems to avoid waste, to simplify life and to automate repetitive work. It is about using the Internet to put a whole variety of services on the global market. It is invention and innovation.

IT will morph into new forms but its spirit will remain. IT and ITES services account for 7.5% of India’s GDP now. That is already more than the value of all rice, wheat and jwar grown in the country annually. Within a decade, the IT and ITES sector would be bigger than the whole agricultural sector which is now about 14% of our GDP. However, let us not forget that agriculture gives employment to over 500 million people, while the IT and ITES sector employs only about 2.5 million people!
CSI Reports

From CSI SIGs / Divisions / Regions and Other News »

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

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<td><strong>DIVISION IV COMMUNICATIONS SIG-WNs, THE INSTITUTION OF ENGINEERS (INDIA) UDAIPUR LOCAL CENTER, SUNRISE GROUP OF INSTITUTIONS, UDAIPUR, RAJASTHAN AND UDAIPUR CHAPTER</strong></td>
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<td>Dr. Rajveer Shekhawat, Dr. Mukesh Sharma, Surendra S. Kachhwaha, Manish Godha, Dr. Dharm Singh, Dr. BR Ranwah, AS Choondawat, Dr. Manuj Joshi, Mr Gaznfer Ali, Himanshu Jain, Dr. Bharat Singh Deora, SK Sharma, Gaurav Mantri, Dr. Harshal Arolkar, Nisarg Pathak and Dr. Nilesh Modi</td>
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<td>4-5 April 2014: National Seminar and Workshop on “Analysis and Simulation for Engineering Applications ASEA-2014”</td>
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<td>Chief Guest Dr. Shekhawat discussed Advancements in Simulations and shared his experiences of Effective Model Analysis before implementation. There were talks by Prof. Kachhwaha on Application of Engineering Equation Solver [EES] for Simulation of Energy Systems and by Dr. Mukesh on Applications of Forensic Science, by Mr. Mantri on Getting started with Software Industry, by Dr. Arolkar &amp; Mr. Pathak on Network Simulations and by Dr. Modi on Cyber Security aspects for Engineering Applications. The recommendations were - 1. Simulations should only be implemented after efficient Model Analysis. 2. Prospective User has to be considered for carrying out simulations. 3. Inhouse experiments on engineering applications need to be sponsored by sponsoring agency. 4. More such activities should be carried out to improve standard of Research and Simulations for Engineering Applications.</td>
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| **DIVISION IV COMMUNICATIONS, SIG-WNS, THE INSTITUTION OF ENGINEERS (INDIA) UDAIPUR LOCAL CENTER, ARAVALI INSTITUTE OF TECHNICAL STUDIES UDAIPUR, RAJASTHAN AND UDAIPUR CHAPTER** |
| BP Sharma, Dr. Durgesh Kumar Mishra, Dr. Meenakshi Tripathi, Dr. Ashok Jain, Dr. Dharm Singh, AS Choondawat, RK Aeron, Hemant Dhabhai and Amit Joshi |
| Two Day Seminar focused on various key areas in Innovations in Engineering & Technology. Prof Aeron expressed that innovation in technological advancements helps the society and no nation can progress without original Idea. Dr Dharm Singh spoke about Role of SIG-WNs in Society. Recommendations in Seminar : 1)Users Prospective has to be taken into consideration before any innovation to be done. 2)Participants/Research Scholars/students must come out with more and more research papers reflecting different areas of Engineering discipline with innovations which is the demand of the day. 3)Researchers must take inspiration from technocrats and initiatives of past, so that they may inculcate in themselves the spirit of becoming innovator. 4)More and more Lucid, attractive, informative & educative presentations should be prepared incorporating latest trends in innovations. |

**NOMINATION COMMITTEE MEMBERS (2014-15)**

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### CSI News

#### From CSI Chapters »

Please check detailed news at:

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<td><strong>AHMEDABAD (REGION III)</strong></td>
<td>4 April 2014: Discover Thinking 2nd National Programming Contest 2014</td>
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<td>Dr. Nilesh Modi, Shekhar Sahasrabudhe, RP Soni, Bipin Mehta, Dr. SM Shah, Dr. Chetan Sindhi and Vallabhbhai M Patel</td>
<td>Chapter along NICSM SB hosted this Final round. At the end of Skype Interview committee scrutinized top 6 contestants, who were finalists from all over India. Online final programming round was carried out by reliscore.com which included real life problem to be solved using C, C++ or Java platform. Mr. Sahasrabudhe elaborated technical information about contest and its functioning. Online evaluation was done by reliscore.com and final result was announced by Dr. Modi. Vishesh Kandhari of Institute of Technology, Nirma University, Ahmedabad, stood First and was declared Winner.</td>
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<td><strong>VADODARA (REGION III)</strong></td>
<td>19 April 2014: Project Competition cum Exhibition</td>
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<td>AM Nayak, Prof. Saurabh A Shah and Prof. Ketan B Rathod</td>
<td>Project Competition cum Exhibition was for final year CSE/CE/IT/MCA students across different colleges in and around Vadodara. The objective was to provide common platform to showcase talent, to bring out innovation in diversified domains and exchange knowledge. Panel of five IT experts was invited having industry/academia experience as Jury Members. Two best projects from different participating institutes were invited for competition. Innovative Projects were presented and jury members gave their comments in order to develop these as products.</td>
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<td><strong>CHENNAI (REGION VII)</strong></td>
<td>29 March 2014: 2nd National Alan Turing Computer Science Quiz 2014 - Finals</td>
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<tr>
<td>HR Mohan, B Sundaram, S Ramasamy and Shekar Sahasrabudhe</td>
<td>Programming Contest was organized with the support of Persistent Systems Ltd, Pune as Event Partner and ReliScore.com as a Skill Assessment Partner. Finals were conducted by chapter along with SB of MGR Education and Research Institute University. Mr. Sahasrabudhe spoke about Computer Scientist Alan Turing before the Quiz. Quiz master conducted quiz in an innovative way. Team of Sivasubramanyam A, Mukesh M from RMK Engineering College, Kavaraipettai won first prize.</td>
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<tr>
<td>Prof. Barry S Cooper, School of Mathematics, University of Leeds, UK</td>
<td>12 April 2014: Special open session on “Saluting the Pioneers”</td>
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<td>Special open session was conducted for Saluting the pioneers like Alan M Turing; widely considered as father of theoretical computer science and artificial intelligence; John von Neumann: pure and applied mathematician, physicist, polymath and key figure in development of game theory and concepts of cellular automata; and Norbert Wiener: American mathematician and philosopher, famous child prodigy, who is considered originator of cybernetics. Prof. Cooper made presentation on &quot;Questions Turing Left Behind&quot;.</td>
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**SPEAKER(S) TOPIC AND GIST**

### CHENNAI (REGION VII)

Mr. HR Mohan, President CSI and Mr. S Mahalaingam

**17 April 2014: Panel Discussion on “Export of IT and ITES - Opportunities & Challenges”**

Panel discussion was moderated by Mr. Mahalingam. Panelists were Mr. K Purushothaman, Regional Director NASSCOM (on Business Opportunities), Mr. K Senthil Nayagam, Hexaware (on Challenges & Issues), Ms. Mala Venkatram, US Consulate Chennai (on Enabling Opportunities), Mr. K Vaithheeswaram, Advocate & Tax Consultant (on Service Tax Aspects), Mr. S Srikanth, Chartered Accountant (on Income Tax Aspects).

![Participants in the Panel Discussion](image)

### COIMBATORE (REGION VII)

Dr. S Subramanian, Dr. R Nadarajan, Dr. A Selvakumar, Dr. R Rudramoorthy, Sanjay Mohapatra, Ranga Rajagopal, Dr. Sundareshan, Mahalingam, Ms Nithya Priya, Sathish Babu, Murali Meenakshi, Dr. K Girdhar, Dr. Richmond Adiebiaye, Vijay Nair, Pandu Rangan, Iyappan Swaminathan and Dr. N Karthikeyan


Theme was “Next Generation Networks for Cloud and Mobility”. Dr. Rudramoorthy pointed out importance of network communication in future. Mr. Mohapatra talked about COMNET. Mr Mahalingam talked about “Network as a service - An Airport Case study”. Ms. Nithya Priya talked about “Storage area network”. Other sessions were handled by Mr. Sathish Babu and Mr. Murali Meenakshi. Authors of 15 selected papers presented their papers. Total of 33 papers were selected for presentation out of 138. COMNET report was presented by Dr. Karthikeyan. Mr Ranga Rajagopal briefed about COMNET.

![Organising Committee](image)

### From Student Branches »

**REGION-I**

**MAHARAJA SURAJMAL INSTITUTE - NEW DELHI**


**UNIVERSITY OF PETROLEUM & ENERGY STUDIES - DEHRADUN**

16th April 2014 : Annual Magazine Launch & Investiture Ceremony

**REGION-III**

**ACROPOLIS INSTITUTE OF TECHNOLOGY & RESEARCH - INDORE**

05th April 2014 : Expert Lecture on Object Oriented Technology

**JECRC UDML COLLEGE OF ENGINEERING - JAIPUR**

14 & 15 March 2014 : Web Development using Open Source Technologies

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<tr>
<th>ANITS STUDENT BRANCH</th>
<th><strong>SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN - BHIMAVARAM</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>7th to 9th March 2014 : Soft-computing and its Engineering Applications along with LaTeX and Matlab Training</td>
<td>18th – 19th March 2014 : Prof. Thitumoorthy Past President addresses in the National Conference on Advanced Trends and Challenges in Computer Science and Applications</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SANTHIRAM ENGINEERING COLLEGE - NANDYAL</th>
<th><strong>PVP SIDDHARTHA INSTITUTE OF TECHNOLOGY - VIJAYAWADA</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>(REGION-VI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ABHA GAIKWAD PATIL COLLEGE OF ENGINEERING - NAGPUR</strong></td>
</tr>
<tr>
<td>4th Jan 2014 : National Level Workshop on “Advances in Advances in Data Mining”</td>
</tr>
</tbody>
</table>
### (REGION-VII)

<table>
<thead>
<tr>
<th>ADHIYAMAAN COLLEGE OF ENGINEERING - HOSUR</th>
<th>NATIONAL ENGINEERING COLLEGE - KOVILPATTI</th>
</tr>
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<tbody>
<tr>
<td><img src="image1" alt="National Conference" /></td>
<td><img src="image2" alt="National Conference" /></td>
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<table>
<thead>
<tr>
<th>MUTHAYAMMAL ENGINEERING COLLEGE - RASIPURAM</th>
<th>SRI SAI RAM ENGINEERING COLLEGE - CHENNAI</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Muthayammal College" /></td>
<td><img src="image4" alt="Sri Sairam College" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>EINSTEIN COLLEGE OF ENGINEERING - TIRUNELVELI</th>
<th>SASTRA UNIVERSITY - THANJAVUR</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Einstein College" /></td>
<td><img src="image6" alt="Sasstra University" /></td>
</tr>
<tr>
<td>22nd March 2014: National Level Technical Symposium</td>
<td>14th March 2014: Dr. S. Selvakumar, Head of the Department of Computer Science and Engineering, NIT-Trichy inaugurated the new student branch at Sastra University</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>G R GOVINDARAJULU SCHOOL OF APPLIED COMPUTER TECHNOLOGY - COIMBATORE</th>
<th>CHANDRASHEKARA SARASWATHI VISWA MAHAVIDYALAYA UNIVERSITY AT KANCHIPURAM</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7" alt="G R Govindaraju" /></td>
<td><img src="image8" alt="Chandrashekara Saraswathi" /></td>
</tr>
<tr>
<td>CSI Student chapter organized an intercollegiate level programming skill Contest for the student members of CSI Coimbatore chapter on 21st March 2014.</td>
<td>Inauguration of a New Student Branch at Chandrashekara Saraswathi Viswa MahaVidyalaya University at Kanchipuram on 15th April 2014 by CSI President Mr. H.R. Mohan</td>
</tr>
</tbody>
</table>
JEPPIAAR ENGINEERING COLLEGE - CHENNAI

18th 18th March 2014: Project Expo’14 National Level Project Exhibition

KNOWLEDGE INSTITUTE OF TECHNOLOGY (KIOT) - SALEM

Workshop on Big Data Trends and Technologies – 14.03.2014 & 15.03.2014

DR.SIVANTHI ADITANAR COLLEGE OF ENGINEERING - TIRUCHENDUR

28 March 2014: Dr. J.Maheswaran, Principal, Ms.I.Kalaivani AP/CSE, Dr.G.Wiselin Jiji, Prof. &Head/CSE, Mr. B.Suresh, Team-Lead, Adroit Technologies, Prof. M.Kamalraj, Secretary

B.S. ABDUR RAHMAN UNIVERSITY, CHENNAI

14th April,14: Release of 3rd National Conference on Recent Trends In Information Technology Proceedings by Dr. Anirban Basu, Div IV and Mr. H.R. Mohan, President

(ADVERTISING TARIFF)

Rates effective from April, 2014

Computer Society of India

Unit No. 3, 4th Floor, Samruddhi Venture Park, MIDC, Andheri (E), Mumbai-400 093
Tel. 91-22-2926 1700 • Fax: 91-22-2830 2133
Email: hq@csi-india.org

CSI - Communications

COLOUR

Colour Artwork (Soft copy format) or positives are required for colour advertisement

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<tr>
<th>Item</th>
<th>Rate</th>
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<tr>
<td>Back Cover</td>
<td>₹ 50,000/-</td>
</tr>
<tr>
<td>Inside Covers</td>
<td>₹ 40,000/-</td>
</tr>
<tr>
<td>Full Page</td>
<td>₹ 35,000/-</td>
</tr>
<tr>
<td>Double Spread</td>
<td>₹ 65,000/-</td>
</tr>
<tr>
<td>Centre Spread (Additional 10% for bleed advertisement)</td>
<td>₹ 70,000/-</td>
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MECHANICAL DATA

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<td>28.6 cms x 22.1 cms</td>
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<tr>
<td>Full Page</td>
<td>24.5 cms x 18.5 cms</td>
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<tr>
<td>Double Spread with Bleed</td>
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<tr>
<td>Double Spread</td>
<td>24.5 cms x 40 cms</td>
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</tbody>
</table>

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Tel. 91-22-2926 1700 • Fax: 91-22-2830 2133 Email: hq@csi-india.org
**CSI Calendar 2014**

**May 2014 events**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Details &amp; Organizers</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| 8-9 May 2014  | **ICASG 2014: International Conference on Architecture Software systems and Green computing 2014**  
At Chennai. Organised by Dept. of CSE & IT, Aarupadai Veedu Inst. of Technology in association with CSI Chennai & IEEE CS Madras  
http://www.avit.ac.in/icasg2014.php                                                                                                                                  | Mr. M Ramasubramaniam  
icasg2014@gmail.com                                                                                                                                                    |
| 17 May 2014   | **WTISD 2014: Broadband for Sustainable Development**  
At Udaipur. Organised by SIG-WNs- CSI and IEI ULC                                                                                                                      | Dr. Dharman Singh  
singhdharm@hotmail.com                                                                                                                                                |
| 31 May-7 Jun 2014 | **ICSE 2014: 36th International Conference on Software Engineering**  
At Hyderabad. Organised by CSI SIGSE  
http://2014.icse-conferences.org/                                                                                                                                     | Sharon Neetal  
sharon@kvwconferences.com                                                                                                                                                |

**June 2014 events**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Details &amp; Organizers</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| 2 – 4 Jun 2014 | **IFIP Networking 2014 Conference**  
At Trondheim, Norway  
http://networking2014.item.ntnu.no/                                                                                                                                                   | Prof. S V Raghavan  
svraghavan@nic.in                                                                                                                                                    |

**July 2014 events**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Details &amp; Organizers</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| 4-5 Jul 2014  | **ICIS-14: International Conference on Information Science**  
http://www.icisccec.in/                                                                                                                                             | Ms. Sony P  
jcisccec@gmail.com                                                                                                                                                    |

**August 2014 events**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Details &amp; Organizers</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| 8 – 9 Aug 2014 | **ICICSE: II International Conference on Innovations in Computer Science and Engineering**  
At Hyderabad. Organized by Guru Nanak Institutions, Ibrahimpatnam, Hyderabad in association with CSI Div IV                                                                                     | Dr. H S Saini  
hssaini@gmail.com  
Dr. D D Sarma  
ddddsarma@gmail.com                                                                                                                                                |
| 20 Aug 2014   | **Workshop on “Ethernet LAN Construction using Crossover and Patch Cable”**  
At Hyderabad. Organized by CSI SB and Dept. of IT, Nalla Malla Reddy Engineering College, Hyderabad                                                                                                     | Mr. K C Arun  
hodt@nmrec.edu.in                                                                                                                                                    |
www.icpsd.gibsbd.org                                                                                                                                                  | Dr. Anirban Basu  
abasu@pqrsoftware.com                                                                                                                                                |

**December 2014 events**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Details &amp; Organizers</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| 19-21 Dec 2014 | **EAIT-2014: Fourth International Conference on Emerging Applications of Information Technology**  
At Kolkata. Organized by CSI Kolkata at Indian Statistical Institute, Kolkata  
https://sites.google.com/site/csieait/  
For paper submission visit  
https://cmt.research.microsoft.com/EAIT2014                                                                                                                      | Prof. Aditya Bagchi  
drdebashishjana@gmail.com  
Prof. Pinakapani Pal  
prof.r.tgoswami@gmail.com                                                                                                                                                |
CSI 2014
49th Annual Convention
Organised by
Computer Society of India, Hyderabad Chapter
In association with
JNTU-Hyderabad & DRDO
Theme: Emerging ICT for Bridging Future
Dates: 12-14, December 2014
Venue: JNTUH, Kukatpally, Hyderabad

Call for Papers & Participation

Introduction: CSI-2014, the 49th Annual Convention of Computer Society of India (CSI) is being organized as a part of CSI@50, the Golden Jubilee celebrations of CSI by CSI Hyderabad Chapter, in association with Jawaharlal Nehru Technological University, Hyderabad to bring together researchers, engineers, developers, and practitioners from academia and industry working in interdisciplinary areas of information system engineering and computing, innovative IT professionals from government establishments to small, medium & big enterprises, from non-government organizations to multi-national companies to share the experience, exchange ideas and update their knowledge on the latest developments in emerging areas. Following the big successes of previous conventions, CSI, Hyderabad Chapter is set to conduct this Annual Convention during the Golden Jubilee period at Hyderabad. CSI-2014 will serve as a forum for discussions on the state-of-the-art research, development and implementations of ICT applications for bridging future.

The progress and growth of any country depends on how to make the lives of its people comfortable and to steer them for a better lifestyle and better living conditions. ICT had become an integral part of governance and the small footprint of the country with great population density makes the implementation of ICT at every walk of life a necessity. ICT is the means to bridge the future of the country with the legacy of the past. CSI in its journey of 50 years witnessed all the changes in the growth of the country, and decided to select Emerging ICT for Bridging Future to consolidate the ideas of all partners involved to achieve the goal.

Invitation: We invite authors to submit papers reflecting original research work and practical experiences in the areas of interest to the convention. Invitation is extended to CEOs/CIOs, IT professionals, IT users, academicians, researchers, students, and all the members of the CSI to attend as delegates in this convention. Software firms, industries and business houses are invited to participate in the convention and present and exhibit their products and services. CSI-2014 invites papers of original research and pertaining to 'Emerging ICT for Bridging Future' on the following topics (but not limited to): ICT in Agriculture, Education, Governance, Rural Development, Industry, SME Management, Healthcare, Hospitality, Logistics, Security Challenges, Broadband and Wireless Technologies to cover the entire nation, and any other area which is relevant.

We also invite proposals for workshops, pre-conference tutorials and doctoral consortium.

Publication: Prospective authors are invited to submit paper(s) not exceeding 8 pages written in A4 size, and as per the AISC, Springer format on any one of the tracks listed above. The proceedings will be published by AISC series of Springer.

Important Dates:

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submission of Full Manuscript</td>
<td>15 - July - 2014</td>
</tr>
<tr>
<td>Notification of Acceptance</td>
<td>15 - Aug - 2014</td>
</tr>
<tr>
<td>Camera ready copy</td>
<td>31 - Aug - 2014</td>
</tr>
<tr>
<td>Submission of Tutorial/Workshop Proposals</td>
<td>30 - July - 2014</td>
</tr>
<tr>
<td>Registration Starts</td>
<td>31 - Aug - 2014</td>
</tr>
</tbody>
</table>

Address for Communication
CSI-Hyderabad Chapter, #302, ArchanaArcade,10-3-190, Opp to Railway Reservation Complex, Secunderabad-500025, INDIA
Email: csi2014@csihyderabad.org

Paper Submission for CSI - 2014
https://www.easychair.org/conferences/?conf=csi2014
For more details please visit
http://www.csihyderabad.org/csi-2014

Sri. J. A. Chowdary
Organizing Committee Chair
Dr. A. Govardhan, JNTU, Hyderabad
Programme Committee Chair
Sri. Gautam Mahapatra, RCI, DRDO
Finance Committee Chair