



# CSI Communications

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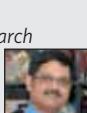
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- an individual.
- 2 are friends.
- 3 is company.
- more than 3 makes a society. The arrangement of these elements makes the letter 'C' connoting 'Computer Society of India'.
- the space inside the letter 'C' connotes an arrow - the feeding-in of information or receiving information from a computer.

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# CSI Communications

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Dear Fellow CSI Members,

Natural Language Processing (NLP) is an emerging area that involves Artificial intelligence, Linguistics, Philosophy, Psychology and Computer Science. NLP comprises of language generation and language recognition. It deals with the techniques related to human-machine interaction. Natural language processing is a difficult task. Research is going at various levels to develop NLP models that can be used in various applications of NLP.

Keeping in mind the importance of Natural Language Processing in today's context, the publication committee of Computer Society of India, selected the theme of CSI Communications (The Knowledge Digest for IT Community) April 2016 issue as "Natural Language Processing".

The first cover story of the issue "WordNet Tool in Natural Language Processing" by H. Mittal and M. S. Devi describes WordNet tool used for natural language processing. In next cover story "Expectation of Native Learners from English to Hindi Machine Translation Engines for Computer Science Domain E-contents", P. K. Goswami has described the need and possible solution of the problems faced by using natural language translation engines. Cover story "Customer Relationship Management Through Natural Language Processing Using Text Analytics" by B. N. Hiremath and M. M. Patil focuses on the customer relationship management through text analytics NLP techniques.

In Research Front category, "Content Delivery Networks: Technology Survey and Research Challenges" by A. Desai, J. K. Parmar and S. Chaudhary describes CDN and its structure, CDN procedures and hierarchical Content Delivery Models along with CDN research. In next article "Multi-Path TCP: Future of Multihoming", A. Jagetiya and C. R. Krishna described Multipath TCP and challenges in its implementation.

Article "Open Source Software Stack for Python Platform: From Academia to Industry" by S. Gowrishankar and Siddaraju provides a gist on the Python.

In Security Corner, "Covert Communication Techniques used by Next Gen High Tech Terrorists", H. Patel, S. Khadsare, M. S. Dahiya and N. R. Mistry describes covert communication used by criminals. Another article in this category "Sustainable Approaches for Time-Critical Surveillance Applications" by R. Shettar, M. Shrivastava and Chaitra R. presents a fast localized search technique of links through graphs and relationships to provide relevant links to a surveillance target during counter-terrorism operations.

This issue also contains Crossword, CSI day celebrations reports, CSI activity reports from divisions, chapters, student branches and Calendar of events.

In the last year our publication team did all efforts for timely publication of CSI communications with quality contents. We also restarted the publication of CSI Student publication CSI Adhyayan, for the student community, who are the future hope and aspiration of the great professional society CSI. We are getting overwhelming response from the student members. My sincere thanks to all



ExecCom members and Publication Committee for their support in completing the task assigned to me.

Next issue of CSI Communications may be published under the guidance of new Publication Committee. I am sure that new publication committee will make more efforts to continue the quality publications for achievement of the scale of excellence. I feel happy to inform that Dr. Vipin Tyagi will continue as the editor of CSI Communications as decided in first ExecCom meeting at Mumbai.

The digital library of the society under the guidance of Dr. Durgesh Mishra shall be available shortly to the members of CSI.

I am thankful to Prof. M. N. Hoda and Dr. Durgesh Mishra for their support.

I extend my gratitude to the entire ExecCom and Publication Committee for their continuous support in bringing all the issues successfully.

On behalf of publication committee, I wish to express my sincere gratitude to all authors and reviewers for their contributions and support to this issue.

Finally, we look forward to receive the feedback, contribution, criticism, suggestions from our esteemed members and readers at [csic@csi-india.org](mailto:csic@csi-india.org).

**Prof. A.K. Nayak**

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## PRESIDENT'S MESSAGE



4 April, 2016

Dear CSI members,

I am delighted to take over as President of Computer Society of India, largest and oldest body of IT professionals in the country. I am thankful to CSI members for providing me the opportunity to serve you as the first person of the society. I welcome new Executive Committee for the year. CSI has a glorious past with eminent academicians and IT professionals leading the society since our formation in 1965. CSI has been part of various different Government agencies to advice on the growth of IT industry and education. The result is for all of us to see, India is emerging as a Software Superpower with exports reaching billions of dollars. We will do our best to get CSI involved in more decision making Government bodies, increase our membership base and organize events on topics of current relevance with substantial participation from industry professionals to make CSI. We plan to work in three dimensions:

- Increasing Quality Events with compendium of the papers presented
- Involve more Industry professionals in the events
- Improve the quality and number of our publications

I firmly believe that if we take adequate steps in these three directions, more and more members from all sections of the IT community will join CSI and CSI will become more vibrant. It will not happen overnight and we need the help and support of all to achieve this. I request Management Committee Members of Chapters to work on involving industry professionals in the events they organize, the Members of ExecCom to keep close touch with the Members and guide and help in organizing quality events, the Members of the executive offices have to work on redressing the grievances of the members.

Our reach among the student community is enviable. We are adding Student Branches and Student Coordinators at both the state and regional levels are working hard to improve our reach in different educational institutes. Unlike other associations, CSI is committed to helping students to become successful IT professionals. For this purpose, CSI Chapters and Student Branches are advised to organize trainings and workshops to help the academic community.

We are in the process of completing the agreements with PMI (Project Management International) and InfoComm for imparting trainings on Project Management and Audio Visual Technology.

To improve the quality of our publications, we are signing an agreement with Springer to publish the proceedings of the CSI Conferences which meets the international standards prescribed by Springer. The terms will be put up in CSIC.



I am happy that CSI Communications and CSI Adhyayan (a publication for the student community) are being published in time, we are in the process of reviving the 'Journal of Computing'. I am sure that our new Publications Committee will focus on doing this.

With the new ExecCom taking over on April 3 in the meeting in Mumbai, we hope to accomplish tasks which have set to achieve, but I can only say that "we have miles to go before we sleep and miles to go before we sleep". I am sure that with the support and guidance of past and present Executive Committee Colleagues, Chapter OBs and Members of CSI, I will be able to work as per your expectations and fulfill CSI mission and objectives.

Suggestions, new ideas are welcome from every CSlian.

With best wishes,

**Dr. Anirban Basu**  
President, CSI



Esteem Members,

Greetings !

CSI has celebrated the Golden Jubilee year after achieving excellent milestones and following family spirit while serving its stakeholders, members and society at large in India and abroad as "**Vasudhaiva Kutumbakam**".

The year 2016-17 is expected to be celebrated with increased activities by expanding the membership base in geometrical progression in order to carry forward and respect the objectives of CSI. Especially, there is an immediate need to reach out to the unrepresented geographical areas and sections of Indian society and make them an integral part of CSI following inclusive development spirit.

The services from the CSI Secretariat and Education Directorate are to be improved qualitatively for serving the members with state-of-the-art professional touch.

Past Glory of CSI with the renewed energies and vision should reach each professional in the country in order to share the experiences and best practices of Computing, IT and allied domains, to enable the Country as a whole to improve the quality of life. Multi-lingual documentation needs to be encouraged.

Excellent communication needs to be established between CSI and its stakeholders including sectors such as Business, Industry, Government, Academia, Research and Consultancy. The above needs deployment of state-of-the-art IT systems at CSI Secretariat, Education Directorate and Chapters across India.

Our CSI values, our CSI ideals, cannot be left within the territory of CSI Chapters and student branches. They must be carried with us every day. Whatever we are, whoever we are with, whether we are involved in Managing Committee / Executive Committee of CSI - we are always representing CSI.

As Vice President of CSI, I would extend my services on fulfilling the above while carrying out my duties as per the CSI Constitution and bye-laws. I believe in working



all together. Inviting each one of you to write to me your expectations via email <[vp@csi-india.org](mailto:vp@csi-india.org)> from CSI and assuring Members of this great professional society to bring CSI to your expectations so that we can make a brand CSI .

With kind regards

S. Mohapatra

**Sanjay Mohapatra**

**Vice President, CSI**



# WordNet Tool in Natural Language Processing

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## Introduction

**W**ordNet<sup>[1]</sup> is a lexical ontology. It is a Natural language Processing tool used in a number of NLP applications. The WordNet Project was initiated in Princeton University by Psychology Department. Originally, it was developed as a network of English language words and treated as a extensive thesaurus. However, it has been now identified as a Ontology and even converted into an OWL Format. It is different from a simple dictionary as it not only groups words and their meanings but also words that are used in similar context. The distance or path length between two words in WordNet indicates the likelihood of using the words together. WordNet is a semantic network of words and there synonyms, antonyms, hyponyms, hypernyms, meronym and many more

relations between words<sup>[2]</sup>.

## Installation of WordNet

WordNet can be downloaded from Princeton website (<https://wordnet.princeton.edu/>). Its version 2.1 is available for windows platform. Linux has version 3.0 as latest version. The download is an executable file, ready to install by just double clicking on it in Windows platform. After installation, the directory structure shown in Fig. 1 is created in C drive program files. The WordNet 2.1 software is backward compatible with Windows XP and runs in x86 mode.

The Bin directory has executables of wordNet and icon files. Doc directory has documentation in html, pdf and postscript formats. Lib directory has compiled code library used in WordNet. Src directory has source code of WordNet. Dict directory is where the

words and relations are stored in files categorised according to noun, verb and senses.

## Applications of WordNet

WordNet is used for a variety of Natural Language Processing Applications. Some of them include:

a) Word Sense Disambiguation: WordNet stores the different forms of a word and all senses. There are Synsets for different context like meaning of words as noun, verb, adjective, etc. Using WordNet the appropriate meaning can be extracted after initially parsing the sentence and recognizing the part-of-speech of the word in consideration<sup>[3]:[4]</sup>

b) Semantic distance between words: Wordnet can be used to find the semantic distance between terms. The WordNet network can be extended and more new terms and domain of words<sup>[5]</sup> can be added. Using WordNet, the

Name	Date modified	Type	Size
adj.exc	4/12/2005 5:06 PM	EXC File	19 KB
adv.exc	2/1/2005 3:10 PM	EXC File	1 KB
cnslist	2/9/2005 1:14 PM	File	876 KB
cnslist.rev	2/9/2005 1:19 PM	REV File	876 KB
data.adj	4/12/2005 2:55 PM	ADJ File	3,164 KB
data.adv	4/12/2005 2:55 PM	ADV File	508 KB
data.noun	4/12/2005 2:55 PM	NOUN File	14,746 KB
data.verb	4/12/2005 2:55 PM	VERB File	2,683 KB
frames.vrb	10/4/2004 3:39 PM	VRB File	2 KB
index.adj	4/12/2005 2:56 PM	ADJ File	831 KB
index.adv	4/12/2005 2:56 PM	ADV File	164 KB
index.noun	4/12/2005 2:56 PM	NOUN File	4,641 KB
index.sense	4/12/2005 2:56 PM	SENSE File	7,137 KB
index.verb	4/12/2005 2:56 PM	VERB File	510 KB
log.grind.2.1	4/12/2005 2:56 PM	1 File	3 KB
noun.exc	4/12/2005 5:01 PM	EXC File	27 KB
sentid.vrb	2/1/2005 3:11 PM	VRB File	72 KB
sents.vrb	10/4/2004 3:39 PM	VRB File	6 KB
verb.exc	4/12/2005 4:58 PM	EXC File	31 KB
verb.Framestext	2/1/2005 3:06 PM	FRAMESTEXT File	2 KB

Fig. 1: Directory structure of WordNet

probability of occurrence of two words together can be identified<sup>[6]</sup>.

c) Machine Translation: WordNet can be used to determine the next word that a writer may type in his writing<sup>[7]</sup>.

d) Search Engine Processing: WordNet can be used for enhancing the working of search engines by fetching synonyms of words in search query and streamlining the search results accordingly<sup>[8]</sup>.

e) Plagiarism Detection: WordNet can be used for establishing semantic distance between texts and can be used to find plagiarism in text<sup>[9]</sup>.

f) Sentiment Analysis: WordNet can be used to classify the documents on basis of sentiment words used by finding relation between common words used in a document of particular sentiment and document under consideration<sup>[10]</sup>.

#### Using WordNet in a Project

After installation of WordNet, integrating it in the projects of NLP requires coding. The code given in Figure-2 is used for accessing WordNet files from Java code<sup>[11]</sup>. The given code can find synonyms of the words.

#### Conclusions

WordNet is used for a number of

applications in natural language processing. WordNet is a lexical database and ontology based on WordNet is being constructed in OWL format. Many NLP applications have been refined with use of WordNet.

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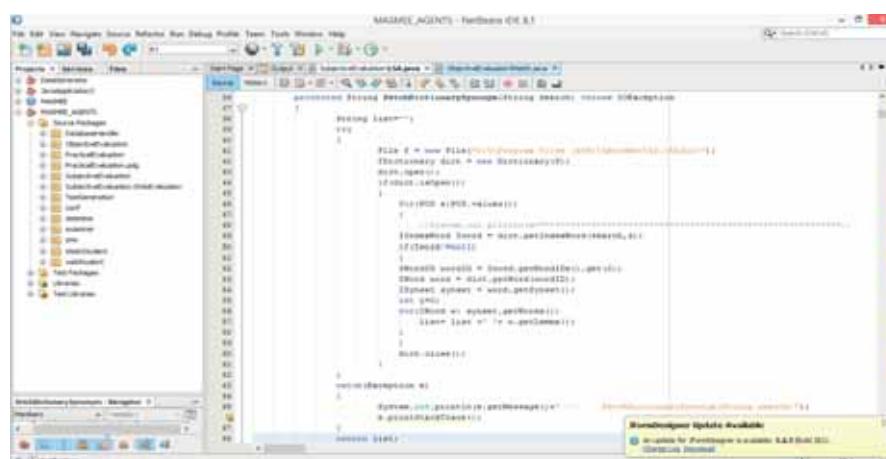


Fig. 2: Code used for accessing WordNet from Java Code using JWNL library

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# Expectation of Native Learners from English to Hindi Machine Translation Engines for Computer Science Domain E-contents

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## Introduction

Machine translation (MT) has a remarkable role in e-learning and the knowledge dissemination from any source language to the native language. There are many online translation engines freely available which can translate from English to Hindi language<sup>[3]</sup>. The computer science related e-contents which are freely available on web in English language may be comfortably translated by freely online available MT engines. The output produced by an existing MT engine is not confidently accepted by the native learners because the target contents are not able to convey the same meaning as the source e-contents. When the e-contents are technical contents specially related to computer science domain then the problem become more critical and the native learner wants dependable MT engines as solution.

## Use of Machine Translation Engines in English to Hindi

It is very convenient to use freely available online MT engines for English to Hindi. The popular engines are Google Translate<sup>[2]</sup>, MS-Bing<sup>[4]</sup> and Anuvadaksha<sup>[1]</sup>, providing support in English to Hindi language pair. Google Translate is working on Statistical Machine Translation (SMT) approach and MS-Bing is based on Rule Based and Statistical MT (RBMT & SMT) with cloud services and Anuvadaksha is based on Example Based and Statistical MT (EBMT & SMT) approach.

## Current Status for English to Hindi Machine Translation Engine

To demonstrate the current status of machine translation engines for domain specific performance, few randomly picked source e-contents from various e-learning websites have been opted. The translation outputs by different MT engines are been

<b>Source E-content</b>	In a similar manner, pushMatrix() puts the current status of the coordinate system at the top of a memory area, and popMatrix() pulls that status back out.
<b>English to Hindi Machine Translation Output through Multiple Engines</b>	
<b>Anuvadaksha Engine</b>	एक समान रीति में, पुशमैट्रिक्स() वर्तमान स्थिति रखता है एक याद कोत्र और पोपमैट्रिक्स शिखर पर प्रणाली संचालन करता है। वह स्थिति वापस बाहर छोचता है।
<b>Google Translate</b>	एक समान तरीके में, pushMatrix () एक स्मृति कोत्र के शीर्ष पर समन्वय प्रणाली की वर्तमान स्थिति डालता है, और popMatrix () वापस बाहर उस स्थिति को छोचता है।
<b>MS_Bing</b>	एक समान तरीके में, एक शेगोरी कोत्र, और स्थिति वापस बाहर popMatrix() छोचतान के शीर्ष पर समन्वय प्रणाली की स्थिती pushMatrix() डालता है।
<b>Multi Engine MT</b>	एक समान तरीके में, पुशमैट्रिक्स() निर्देशक प्रणाली की वर्तमान स्थिति को एक स्मृति कोत्र के शीर्ष पर रखता है, और पोपमैट्रिक्स() उस स्थिति को वापस बाहर छोचता है।

Table 1: Machine Translation of Sample E-content-1

presented in Table-1, 2 & 3. The quality of translation is measured by native learners on the basis of the fluency and adequacy of target translation.

decide confidently about any individual MT engine which may satisfy the translation need and they may rely on any individual MT engine.

<b>Source E-content</b>	This lecture introduces Python tuples, lists, and dictionaries, as well as the concept of mutability and how to avoid problems relating to it.
<b>English to Hindi Machine Translation Output through Multiple Engines</b>	
<b>Anuvadaksha Engine</b>	यह व्याख्यान अजगर टपल , सूचियों और शब्दकोश को प्रयोगित करता है एवं मूलिकिटी की संकलना और कैसे यह संबंधी समस्याओं दूर रहने के लिए।
<b>Google Translate</b>	यह व्याख्यान यह करने के लिए संबंधित समस्याओं से बचने के लिए अजगर tuples, सूची, और शब्दकोशों, साथ ही अस्थिरता और कैसे की अवधारणा का परिचय।
<b>MS_Bing</b>	इस व्याख्यान पायथन विवेचित, सूचियों, और शब्दकोशों, ही mutability से संबंधित और कैसे यह करने के लिए संबंधित समस्याओं से बचने के लिए की अवधारणा परिचय।
<b>Multi Engine MT</b>	यह व्याख्यान पायथन टपल्स, सूचियों, और शब्दकोशों, साथ ही साथ अस्थिरता की अवधारणा और इससे संबंधित समस्याओं से बचने में परिचय करता है।

Table 2: Machine Translation of Sample E-content-2

## Dependability and Reliability of Existing Machine Translation Engines

It has been observed that the translated e-contents by the existing MT engines are not able to produce the good and adequate translation. The native learners are not able to

## MEMTEHiL as one Solution

Due to existing freely available online MT engines are not able to produce the confident output. The proposed solution of Multi-Engine Machine Translation for Engine to Hindi Language (MEMTEHiL) has been inquisitively proposed for the

## ■ COVER STORY ■

<b>Source E-content</b>	VMware product are best for virtualization because VMware provide virtualization for Servers, Applications and Files.
<b>English to Hindi Machine Translation Output through Multiple Engines</b>	
<b>Anuvadaksha Engine</b>	वर्क्सार उपाद विन्युअलाइजेशन के लिए सर्वोत्तम है क्योंकि वर्क्सार सर्वर, अपेंटन पर और प्राइम के लिए विन्युअलाइजेशन देता है।
<b>Google Translate</b>	VMware सर्वर, अनुप्रयोगों और प्राइमों के लिए विन्युअलाइजेशन प्रदान करते हैं क्योंकि VMWARE उपाद विन्युअलाइजेशन के लिए सबसे अच्छा क्योंकि प्रदान VMware virtualization सर्वर, अनुप्रयोगों और प्राइमों के लिए।
<b>MS_Bing</b>	VMware उपाद है विन्युअलाइजेशन के लिए सबसे अच्छा क्योंकि प्रदान VMware virtualization सर्वर, अनुप्रयोगों और प्राइमों के लिए।
<b>Multi Engine MT</b>	वीएम बैचर उपाद विन्युअलाइजेशन के लिए सर्वोत्तम है क्योंकि वीएम बैचर सर्वर, अनुप्रयोगों और प्राइमों के लिए विन्युअलाइजेशन प्रदान करता है।

Table 3: Machine Translation of Sample E-content-3

native learners. The output produced by the MEMTEHiL with respect to each source e-contents are reflected in shaded area as the last item in Table 1, 2 & 3. These are few exemplary cases but it has been proved in detailed study that MEMTEHiL is able to produce confident

output of computer science e-contents from English to Hindi.

### Conclusion and Future Prospects

Individual online existing MT engines of English to Hindi are not able to satisfy the need of native learners of computer science but the proposed MEMTEHiL will be the

best choice of futuristic native users of MT.

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### CSI Varanasi Chapter Activity Report



A two days National Conference on "Digital India: A Roadmap of Socio-economic Development" was organized by CSI Varanasi chapter at department of Computer Application, Sunbeam College for Women during 20, 21 February 2016. The conference was inaugurated by former National President of CSI Prof. P. Thrimurthy, CSI Publication Committee chairman Prof A. K. Nayak, Founder Chairman of Varanasi Chapter, Dr. Subhash Ch Yadav and Varanasi Chapter Chairman Prof. Sunil Kr Pandey; In the august presence of dignitaries like Mr. Deepak Madhok chairman & Miss Bharati Madhok Director of Sunbeam group of Institution, Prof. Vibha Srivastava, Principal Sunbeam College of Women, Prof Sayta Singh and Prof Bhagwan Singh. Prof. Thrimurthy participated as the chief guest and delivered the key note address. Prof. A.K Nayak participated as the guest of honor and presided the first technical session. Dr. Bhagwan Singh Head Deptt. of Supply Chain Management, Himachal Pradesh Central University & Prof. Sunil Kumar Pandey, Director IT of Institute of Technology and Science of Ghaziabad, UP delivered the invited lectures. All together 20 technical papers were presented and 125 delegates were present.



# Customer Relationship Management Through Natural Language Processing Using Text Analytics

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**Abstract:** This article gives an insight of intersecting two important core concepts, one is customer relationship management, second, Natural language processing. Natural language processing is an area of artificial intelligence which requires the expertise in multi-disciplinary areas, such as statistics, linguistics, expert systems etc. Basically it aims at text analysis by using automation methods. On the other hand, customer relationship management is used to identify categorizing customer feedbacks. This article focusses on the customer relationship management through text analytics NLP techniques.

## Introduction

Natural language processing (NLP) is a competency which needs expertise of statistics, linguistics and software engineering, used by many domains which needs perfection to arrive at a solution using text analytics, where computer interacts text phrases for automation and to structure text to mine and analyze. As the process of understanding language requires spelling, grammar correction, text classification, sentiment analysis, parsing, meaning extraction and machine translation, needs following basic algorithms and models.<sup>[8]</sup>

- n-gram language
- naive Bayes and maxent classifiers
- Hidden Markov
- probabilistic dependency and constituent parsing
- vector-space

N-gram language modelling is building sequence of n-adjacent tokens like bigram, trigram and quadarcs which are distributed on word n-gram and character n-gram. These are useful for exploratory analysis. Google has created a large dataset at its research labs, one such research team built a dataset syntactic-n-grams based on a corpus of 3.5 million English books, it includes over 10 billion distinct items.<sup>[9]</sup> NLP also plays a vital important role in optical character recognition where image representing text is to be determined for the corresponding text.

## Customer Relationship Management

Customer relationship management (CRM) is a business dimension where in all transactions about achieving customer experience of any service

organization revolves around providing customer service, attending requests and getting feedback from them, now a day many organizations built performance indicators around these feedbacks to achieve customer experience to optimize revenues and to scale up organizations performance.

The CRM is an integral part of any organization wherein it is structured to fetch all relevant data pertaining to its customers, the list includes

- Customer profile
- Transactions of all customer activity like email conversation, feedback

Experts estimate that Fortune 500 companies are losing \$12 billion per year in value because they are not exploiting unstructured data such as text  
Joseph Turien Ph.D.<sup>[2]</sup>

- Website visits, clickstream data, prospect capture
- After sales service transaction
- Claim transactions if any



Fig. 1: Data touch points in CRM

As mentioned in Fig. 1, all these basic data units are collected and then the next step is to build solutions and applications to improve various business areas such as:

- Sales
- Loyalty management and analytics
- Marketing solutions
- Campaign management
- BPO processes
- Partner applications (for example: In Travel domain the Airlines business can build its integrated Frequent flyer programs by considering Hotel, Flight, Taxi and shopping transactions with various partners, these can span to Alliance airlines also)
- Content marketing

Currently various CRM engagement centers are available to implement customer support applications like: Salesforce, Oracle, SAP, Pegasystems, Zendesk and Microsoft as per the updates from Gartner IT Research magic quadrant report<sup>[7]</sup>. There are lot of downstream solutions built after building an enterprise integrated CRM systems like business intelligence reporting and to identify customer insights by various analytics solutions (Customer segmentation, Recency, Frequency and Monetization(RFM), Single View of Customer).

The following key points are identified where leads can be achieved:

- Customer retention, anticipate customer behavior and customer satisfaction
- Customer churn analysis
- To understand customer pain

points

- Up sell and cross sell recommendations

When voice data and various other automated recordings can become the datasets to identify patterns to understand what the 'voice of customer' says. Here the problem is challenging to build techniques around reading voice patterns and to build algorithms with a robust grammatical methods and recognition with strings to be constructed with rule based systems in training data sets. In this article the focus is made to identify techniques for text mining out of social media and to arrive at categorizing customer issues on specific key phrase and proposed to take it forward for finding root cause analysis. These processes will not elaborate on analyzing 'customer sentiments' either on brand or on specific services availed by the organization.

The following two such data touch points are discussed:

- Feedback through social media [Web, Tweets, Facebook]- Unstructured and Non-categorized
- Through web, by way of claiming reimbursements from the organization for any claims by loyalty members of the organization - a semi structured and categorized (for example passenger claims for a baggage delay by an Airlines through their web portals). Many organizations have built the ecosystem to handle these customer related transactions by using industry standard database,

CRM and enterprise resource planning (ERP) tools to process loyalty and campaign management processes

It all starts with text and voice data i.e. organizations configure various touch points to fetch data from customers.

### Techniques of Text Mining

As discussed in detail about various data touch points for building CRM integral part, all these data sources originate from a ubiquitous product i.e. Human language as it appears in all customer comments, either voice or text by way of messages (Emails, Feedback comments, Social media and Calls) i.e. Language data. so use of NLP techniques gives the access to arrive at solution, currently in this article one such text analytics solution is depicted to identify customer pain point from Feedback text and Social media text messages. In this case study:

- A CRM feedback category data i.e. compensation transaction for the claim baggage delay, takes a higher pay out for a specific period and for specific Airline, when compared to other category of compensation claim.
- For the same period with the same airline a similar dataset is collected to carry out text analytics basically to understand customer voice from social media channel, as this entire problem revolves around text data with human natural language.

It is estimated that the feedback phrases predominantly written in natural

language are challenging as use of casual language, misspellings, slang and bad grammar. An initial analysis of pain points of their customers can be summarized by doing an analysis of categorized data from the customer feedback system of the organization<sup>[4]</sup>. One of the important fact, that can be identified through this analysis is loss of revenue by way of processing data set which is collected from feedback comments through social media and text mining is done to understand the structure of text.

### Process of Text Mining

A detailed approach to fetch, process and to structure the text in order to make a conclusion about what are the values hidden in the text data about business. The detailed process flowchart is represented in Fig. 2. Fetching data from various social media channels involves authorization and handshake for the specific respective access, the data size, periodicity and the relevance of key phrases to be finalized as part of data fetch. Choosing a period is important because context of the text structure and data analysis changes, as its driven by events for example, During April 2010 the key phrase is 'flight disruption' is the key phrase i.e. predominant for the cause of 'delay' for most of the European Airlines due to Iceland volcanic ash cloud.

After the standard preprocessing steps, there is a need of using trained dataset in word patterns which is required to build lexicon due to following reasons.

- List of synonyms with updated dictionary
- Key phrases based on events in

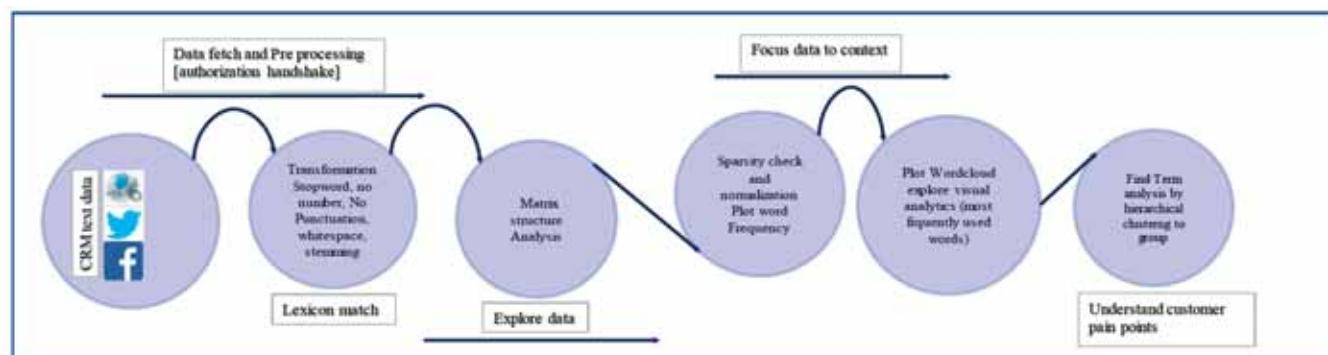


Fig. 2: The Process flowchart to understand text structure

We'll be looking at the entire spectrum, from planning and shopping to traveling and the post-travel experience, to understand how can we enhance each step for the customer. In time, this will help us transform the way customers travel. - South west airlines<sup>[5]</sup>

Interacting with our customers everyday through multiple social channels absolutely drives incremental business to our dealers.  
- David Mingle, executive director of customer experience, General Motors [4]

the selected period to arrive for a specific context for that respective brand

Data exploration involves extracting the core features and bringing it to matrix form to analyze for reduction methods without losing significant relation inherent to the matrix, by way of identifying sparsity matrix, as the data here, points to word, a frequency numbers have to be calculated. A plot of Histogram is a better visualization to analyze and validate.<sup>[1]</sup> A wordcloud visualization is to be generated to know the most frequently used word.

#### Conclusion

It is concluded that text analytics can be a better approach to intersect CRM and NLP. It can be done by structuring key phrase text. To add value to the analysis,

a clustering technique can be proposed to calculate term similarity among group of entities for a meaningful decision. After identifying the key phrase, it shall be mapped to the context of category with customer pain point. The text analytics can also be extended to build a model to determine root cause analysis by the way of hypothesis testing.

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On behalf of CSI Publication Committee

Prof. A.K. Nayak

Chief Editor

# Content Delivery Networks: Technology Survey and Research Challenges

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**Abstract:** Users of smartphones, PCs, and the Internet have already been using Content Delivery Network (CDN) services, and will continue to use CDN services for their entire life. CDN technology is very important due to its increasing usage. This article focuses on the market, services, features, operations, and architecture of CDN technology. The article starts with motivation for CDN and its structure, then discusses CDN procedures and hierarchical Content Delivery Models. Finally, the CDN market and major service providers are introduced, followed by research in CDN and its various topics in development.

## Introduction to CDN

**C**DN is a network constructed from a group of strategically placed and geographically distributed caching servers. CDN is one of the most efficient solutions for content providers in serving a large number of user devices for reduction in content download time and network traffic. In other words, the focus of CDN is for the content providers to make sure that they deliver the content to client when requested for it on smart phone, smart device, or on PC. When a client requests for it, the CDN helps client to receive that information as fast as possible, and also reducing the network traffic load that is going to run over the Internet.

Mobile network performance is highly dependent on the content download of multimedia data and applications. Several mobile network operators have suffered from service outage or performance deterioration due to the significant increase in use of mobile devices. This is due to both, because of the number of mobile devices that are now accessing the Internet through their mobile communication link and through their Wi-Fi link. As these devices are capable of calling, requesting for information and multimedia services anywhere, people are using them all the time, so the amount usage of time has increased. Moreover, the clients are requesting for these new contents from different locations. Due to this, CDN technology is more important than ever. Fig. 1. shows CDN structure.

In order to understand the structure of the CDN, the term content provider must be defined. The content provider contains the content (a movie, social network or cloud). There are two things that can be

observed based upon the color of the lines (Fig. 1). One, the orange line is the content request and delivery route without CDN. Second, the content provider will send information to the user directly, following the orange line. The request will go and come back, and the information will be delivered directly to the user. This does not look that complicated, however, if there is going to be millions of users throughout the world and everybody being in service, one on one directly by the content provider that will put too much load on the content provider. In addition, that is going to fill up the entire Internet and all the other wireless and wired networks by individual request. To overcome this problem, there has to be a more efficient way to deliver these contents. In addition, some of these contents are like movies or big data file. Therefore, using CDN both content

download time and network traffic must be reduced. How it works? The user will ask and try to find some of its contents in local caching servers (Fig. 1. blue-line) and these content servers will connect with the content provider, receive the information in advance, some of the more popular ones, and if a request is made, then it will deliver it to the user. Now, some information needs to be predicted like which information, which type of content will be needed. Further, that has to be moved to the caching server in advance. If, local caching server delivers contents to the user, it will be quick and beneficial, not only to that user, but to every user in that local territory. Therefore, the time of delivery of content to user, and the amount of network traffic in the Internet is reduced, thus CDN is efficient.

The role of caching server is to

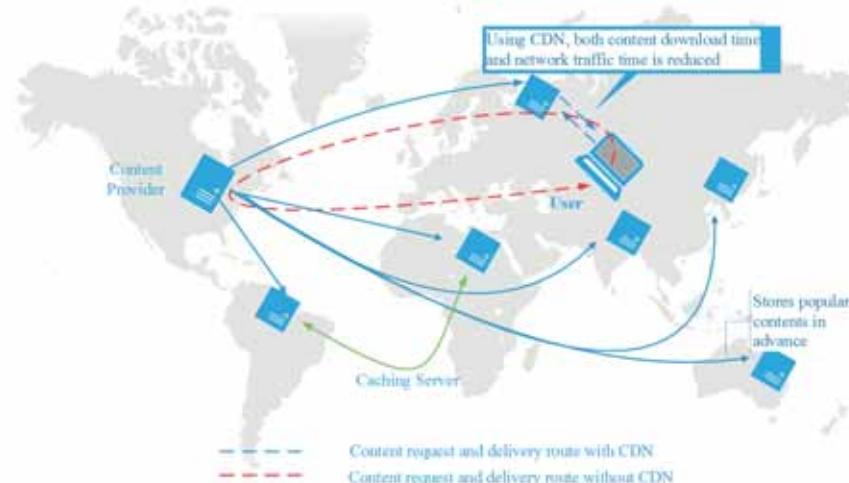


Fig. 1: CDN Structure

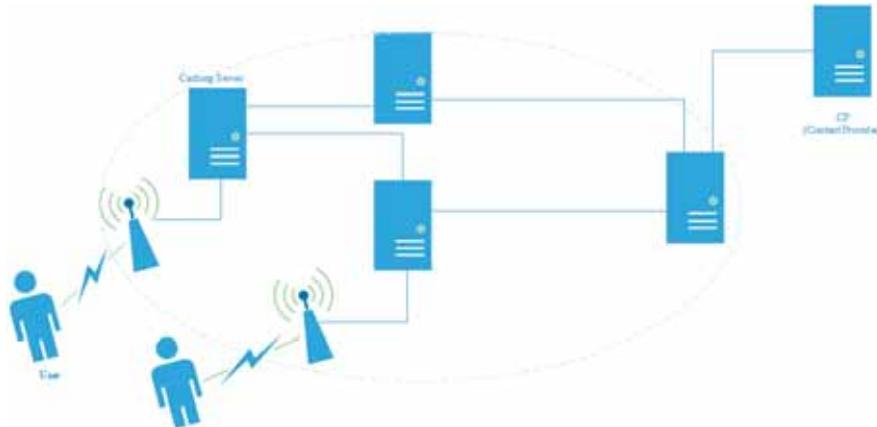


Fig. 2: CDN Structure

store the popular contents in advance. Once again, traffic requests have been increasing at tremendously large rates and fast speeds because of mobile smartphones and smart devices. Mobile communication networks have a stronger need for both reduced traffic load and content delivery time compared to broadband, backbone wired networks. As in these broadband backbone wired networks of the Internet, capacity of links is very abundant and traffic load reduction may not be that much critical issue. Mobile communication networks that serve mobile users, is called a radio access network and in it, delivering the information to all the mobile users, is a big burden. CDN technology is its probable solution. Hence, structure of CDN is needs to be understood in order to customize it as per our requirement. CDN usually consists of a content provider and caching servers. The content provider has all the contents in its original server system, and it will deliver it, based upon requests. Now, the caching servers are distributed throughout the network and it contains selected copies of identical contents that the content provider (CP) stores. The caching servers normally do not have the same capacity of storage of the CP. The CP has a large storage, a large server area that contains all of this memory of all the contents. The caching servers normally have much smaller memory. Therefore, what to put there has to be wisely selected.

When a user requests for content to its nearest caching server, the server can deliver the content if the requested content is in its cache otherwise it redirects other remotely located CP, which can deliver the

required content.

#### CDN Procedures

Fig. 3. , shows, case 1: If the requested content is in local caching server. The sequence of events are depicted in Fig. 3.

In case 2, if the requested content is not in the local server's cache, then content request is redirected to the remotely located content provider.

**Content aging procedures.** Content aging is focused on delivering the most popular contents to the user in the most effective way. The important parameters are the location of the caching servers, number of caching servers are there in system, and the memory size of the caching servers. The key point is, certain contents are more popular in a certain area. Also, if there are very few caching servers in that area, then those caching servers need to support a larger

number of local users. The other thing, how much memory does the caching server has? It is very important because the overall memory size cannot be exceeded. Therefore, a mechanism is needed to select what needs to be stored and also delete. Therefore in content aging, there is a delete process, to delete expired contents from the cache server, and then download updated contents from the CP.

What to download needs to be very selectively chosen such that it is most likely to be requested by the users. For this content aging procedure there is one parameter called Update Period, which is the time frame during which each content has an update, it is like the time to live, TTL value. It could be a few seconds for online trading, as trading values changes so fast. However, for the contents of a movie, much longer value may be needed.

#### CDN: Hierarchical Content Delivery

It is not possible for a caching server to save all the contents that the CP has. Retrieving contents from the remote CP can cause long content download time. In addition, if all of these devices are requesting for the content to be sent separately then it is going to generate a large amount of content traffic and all of this is going to make the network Internet much slower. It is important to find a very effective and very efficient way to do this. Hierarchical Content Delivery is used for this purpose.

For the given cache size of each server, it is important to maximize the

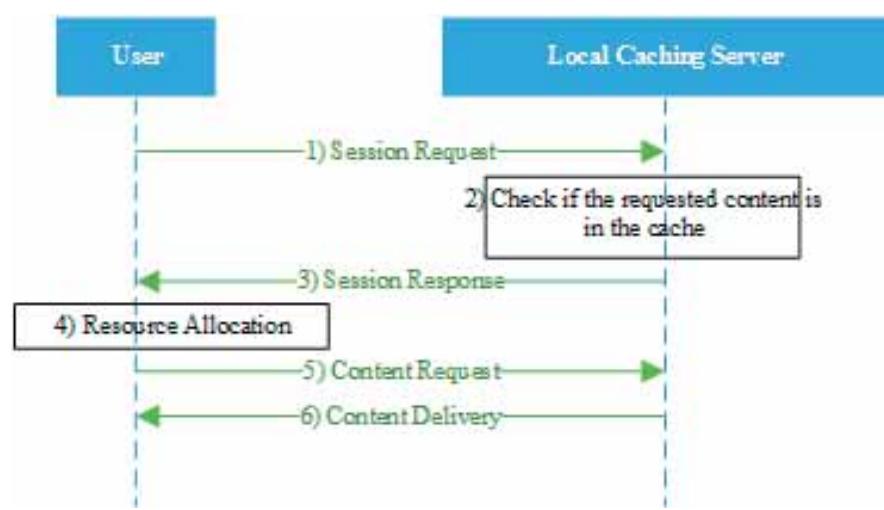
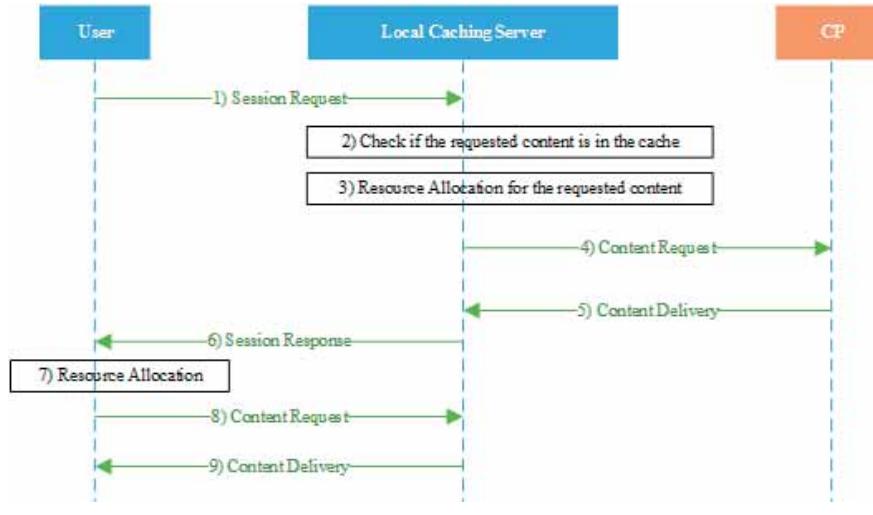


Fig. 3: CDN Procedures (if requested contents is in local caching server)



hit rate of the local caching server such that the requested contents do not have to be retrieved from the CP. This is the objective, so content selection has to be done in a way such that it maximizes the hit rate. Hit rate is the probability rate of the content requested by the user being available in the local caching server. Hit rate must be maximized so that the contents that most likely the user will ask for, is already saved in a local cache server. To accomplish this objective, in the massive Internet, there has to be a very scalable way for implementing this CDN technology and that is where hierarchical cooperative content delivery techniques are used to do this. In order to understand this, there is a couple of components of the CDN that needs to be defined.

First, CD & LCF. These are content distribution and location control functions, they are a set of functions together and it controls the overall content delivery process and has all content IDs that the CDN network would be using. Second, Cluster Control Function (CCF). This controls multiple CDPFs, that is, Content Delivery Processing Functions, and saves content IDs of the cluster. CCF controls Clustering Technology and it also contains multiple CDPFs connected to CCF by a network, along with CD, LCF and CP, which is original content holder. The CDPF is one major function of a cluster and it stores and delivers the content to the user as well as provides information to the user.

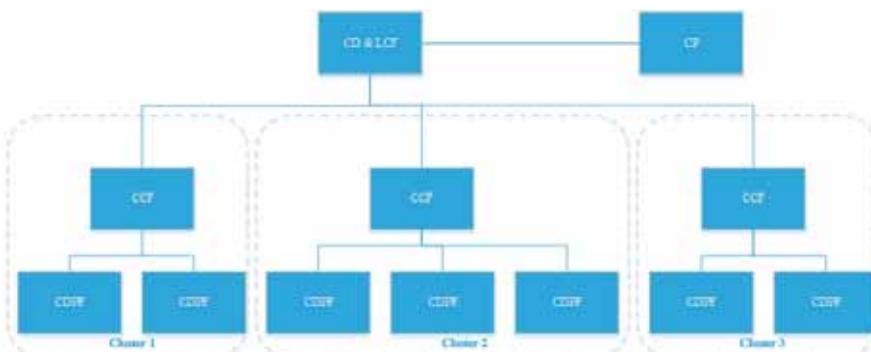
Fig. 5. shows one example network.

Case 1, if the requested content is in

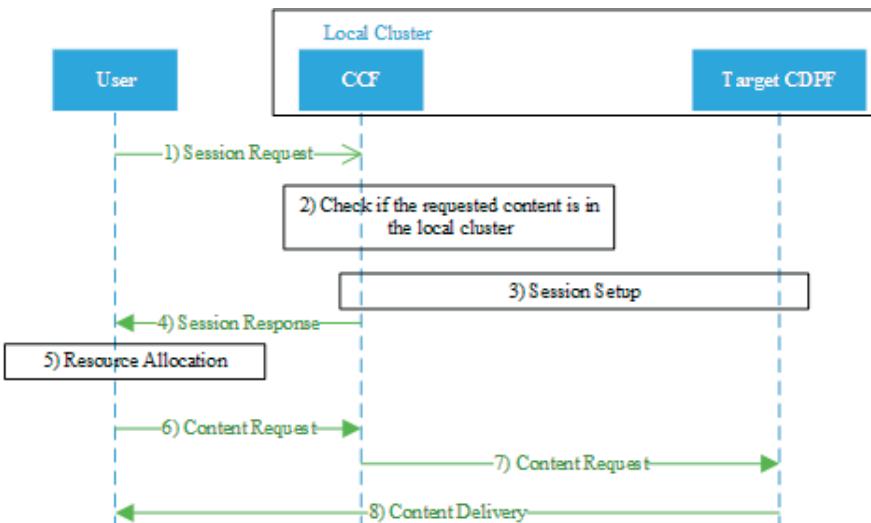
the local cluster. Fig. 6 shows how it may look on a time flow diagram.

Case 2. (Fig. 7.), if the requested content is not in that local cluster but another local cluster, which becomes a target cluster has the content.

The CCF works with the CDPF to check if the content is inside, if not then CCF sends signal to CD and LCF which allocates cluster and responds back to local CCF, so it knows the cluster that contains this content. The local cluster CCF will send a request to the target cluster CCF and a session will be set up between the target cluster CCF and the target cluster CDPF. Then a session response is sent back from the target cluster CCF to the local CCF that is nearby the user, this local CCF will send session response to the



**Fig. 5: Example Hierarchical CDN**



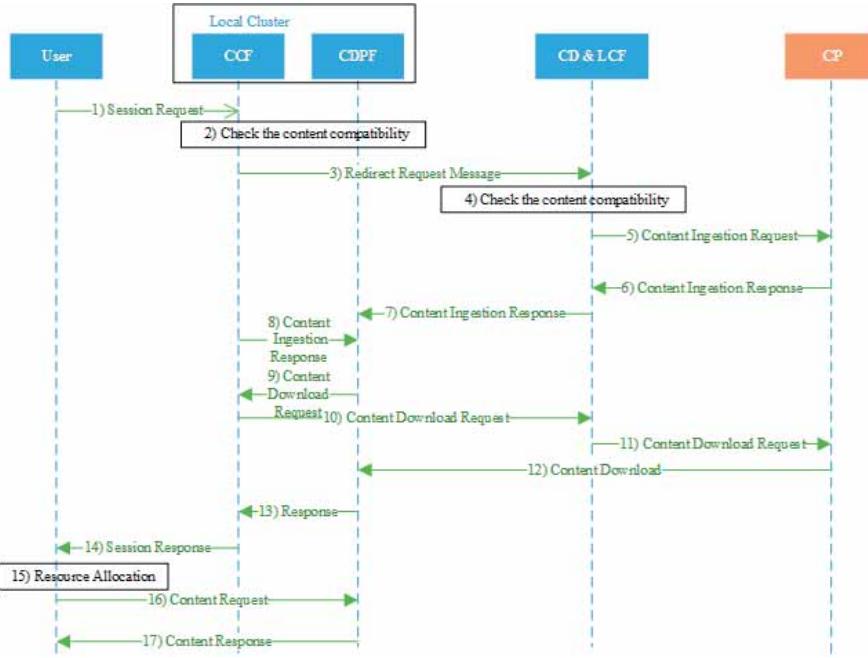


Fig. 7: Requested content is not in that local cluster but another local cluster

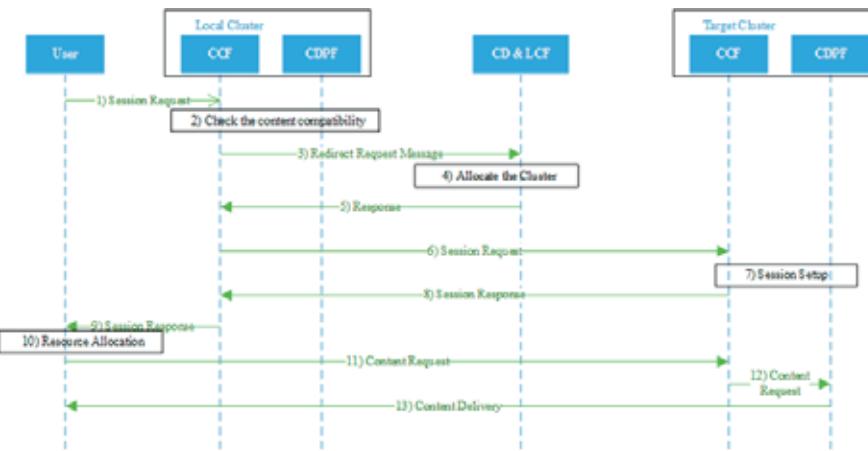


Fig. 8: The requested content is not in the local cluster

user so that user can allocate appropriate memory and send request to target CCF, which will forward to target CDPF, which sends that information to user.

In Case 3, when the requested

content is not in the local cluster. Then, a content request message is sent from the CD and LCF to the CP and the CP delivers the content to the user through the local cluster. The requested content can be

stored in the local cluster for other usage.

#### CDN: Market

There are many ways to evaluate the value of the CDN market. Evaluation is related to diverse range of CDN industry participants. For example, Communications Service Provider (CSP), Industry manufacturers, CDN service providers, Content providers. For communications service providers, the CDN's value includes improving retail service delivery and supporting their efforts to win and retain customers. For industry manufacturers, the market value is related to the demand from telcos, content providers, and other businesses. CDN's estimated market size, in 2014, the CDN market was estimated to be approximately about \$3.71 billion. CDN market components include content delivery technologies, hardware, analytics, monitoring, encoding, transparent caching, digital rights management (DRM), content management system (CMS), online video platform (OVP), and many other. It is estimated that CDN market is expected to grow to about \$12.16 billion by 2019, and this is based on a predicted 26.3% CAGR from 2014 to 2019. Some of the service providers are as follow.

Akamai has about 110,000 servers over the world. Akamai service includes cloud computing, HD video delivery, and others. Amazon Cloudfront delivers static and streaming contents. Amazon Cloudfront works seamlessly with other Amazon Web and Cloud Service solutions, which include S3 and EC2. CDNetworks has Point of Presences (POPs), in six continents, including 20 POPs in China. World's third largest, and Asia's number 1 full-service provider. Level 3 supports a comprehensive encoding suite for video data, and intelligent traffic manager services, which has load balancing features inside. Limelight has 6,000 server at 75 POPs, and more than 30 regional content delivery centers in the United States, Europe, and Asia. ChinaCache is a CDN market leader in China, which has 127 POPs and 11,000 servers in China. CDN services include hotlink protection, custom CNAME for SSL and Purge All. Telcos with a CDN resale agreement are organized in the Table 1. and for CDN provider, such as Akamai, CDNetworks, ChinaCache, EdgeCast, Jet-Stream, Level 3, and Limelight Networks are listed.

#### Conclusion and Research scope

Content type based differentiated support is needed based upon different types of

CDN Provider	Operator (Market Region)
Akamai	Verzon (US), NTT Communications (Japan), du (UAE), Telekom Malaysia (Malaysia)
CDNetworks	Andorra Telecom (Andorra), MegaFon (Russia), Telecom Italia Sparkle (Italy), SingTel (Singapore)
ChinaCache	China Mobile (China), HGC (International)

Table 1. CDN Market

## RESEARCH FRONT



data, different types of multimedia, or for different mobile apps. These type of things can be improved in CDN networking techniques, as well as caching techniques. In addition, content aging control, content selection and deletion and content replication detection is another thing. These types of things can be done in a more dynamic way, especially focusing and supporting mobile communication devices that are supporting, that are making requests and using CDN contents a lot. In addition, dynamic page publishing,

small servers. In this case, server location becomes dynamic and mobile. The next thing is storage memory size. In some cases, the memory size maybe fixed but in some cases how much memory you may be able to use may change based upon what that device is doing and how much other tasks it needs to support while it is saving the information. Content delivery methods are diversified. There is much more to be added to this area, so research is needed. Mobile device characteristics and location need to be considered because these are the devices

into for mobile devices. Mobile wireless networks have additional challenges in supporting CDN services, such as GPS and navigation, mobile TV, intelligent transportation systems (ITS), and location based services. Efficient content providing is required to provide scalable control over wide coverage areas while providing high levels of quality of service with limited resources and these are the topics that need further investigation. In addition, mobile node constraints such as limited storage, processing power, and input capacity due to the portable size of mobile devices needs to be considered. In addition, frequent network disconnection due to mobile users also location oriented service support regarding user mobility needs to be considered. Real time monitoring to obtain the real status of the mobile user also is another topic that is a challenge. Table 2 compares CDN and mobile CDN.

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Table 2. CDN v/s Mobile CDN

digital rights management, live event management are all topics that need further research and development.

On the system side, surrogate server location. This is one thing that needs both enhancement in technology based upon new location based techniques and in some parts of CDN research especially mobile CDN research, they look to the future where mobile devices are participating as

that are making more and more requests of contents and using CDN technology, every day, with increasing rate.

Network latency and delay are two objectives that this article looked at from the beginning. There are also security and information assurance issues. Anomaly detection, user authentication, and content authentication are all needed. CDN research and development also looked

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# Multi-Path TCP: Future of Multihoming

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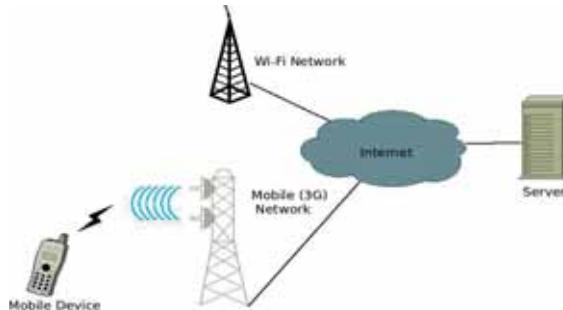
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## Introduction

It is evident that use of Internet is increasing tremendously in all the facet of human lives. And, this has also increased the user's expectation from Internet in terms of Quality of Service (QoS), throughput, reliability etc. In recent years, use of mobile handheld computational devices viz. laptop, smart phone, tablet etc. has enormously increased. And, according to American Internet Analytics Company COMSCORE, uses of mobile devices in Internet access has already overtaken chunky desktop in the year 2014<sup>[1]</sup>. Interestingly, today's mobile devices are equipped with more than one network interface unlike conventional desktops. For example a laptop has interface for Ethernet, Wi-Fi, and 3G/ 4G LTE-A. Therefore, the concept of using multiple interfaces/ internet connections to increase the throughput and QoS is termed as multihoming. And, the mobile devices with several active network interfaces are termed as multihoming devices<sup>[2]</sup>. If one of the interfaces fails due to mobility of the device or due to any other reason, connection will be transferred to another one. Thus, multi-homing increases reliability in case of a network failure and enhances performance. In order to fulfill these requirements, modern Internet mostly uses Transmission Control Protocol (TCP) as the transport layer protocol. It is apparent that TCP is connection oriented protocol that ensures connection management and reliability to application layer processes willing to exchange data over a network. But, popular transport layer protocol TCP is not designed to support Multihoming features.

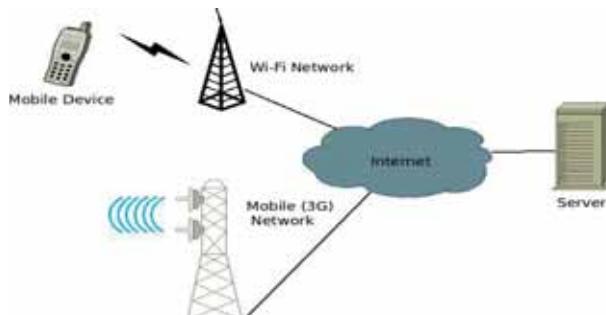
Conventional TCP is single path, i.e. once a path is established, connection end points cannot be changed afterwards. For example, a mobile user as shown in Fig. 1 accessing internet using 3G connection in the absence of Wi-Fi moves into his university campus having Wi-Fi network.



**Fig. 1: Mobile Device Connected to 3G Network**

Obviously, in this situation, user wants to switch interface to Wi-Fi as it involves less cost and higher throughput. But, the existing internet connection has to be torn down in order to set up a new connection over a new interface.

Because, conventional TCP doesn't permit the simultaneous access of its existing network interfaces viz. 3G and Wi-Fi to achieve higher throughput. This is a serious limitation of TCP in context of today's multiple interface based multihoming devices. Another example is the usability of MPTCP in data centers where many servers are connected to each other via switches. Between servers, there is redundant topology i.e. many paths are there between servers in data centers. The probability that any two servers will choose a same path to transmit data is non-negligible and it may degrade the throughput. Therefore,



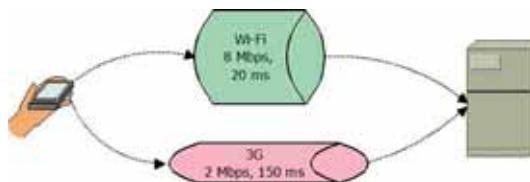
**Fig. 2: Mobile Device Connected to 3G Network moves to Wi-Fi Network**

servers are multihomed to get better redundancy and better throughput<sup>[3]</sup>.

The problems discussed so far may overcome with the introduction of a variant of TCP called Multi-Path TCP abbreviated as MPTCP that allows un-interrupted service to the running applications even if an interface switches and allows the user to access all the available network interfaces in parallel. The good thing about MPTCP is that the applications remain unaware of the changes in the network and user achieves better Quality of Service, throughput, and reliability.

Many solutions have been suggested to implement multihoming feature for past 40 years. Researchers have come up with many solutions on transport and network layer viz. SCTP, Mobile IP, Level 3 Multihoming Shim Protocol for IPv6 (SHIM6), Host Identity Protocol (HIP), and Multi Path TCP (MPTCP) are some of the most novel protocols submitted to IETF in this direction.

Multipath TCP, an extension to TCP, is designed to use these interfaces/resources concurrently so that all the pooled resources will be seen as a single logical resource to the end user. MPTCP aims to make use of available multiple paths in the network to provide better fault tolerance by switching between paths. It increases the network throughput by using multiple paths concurrently. Fig. 3 shows a MPTCP enabled client is using both Wi-Fi and 3G connection simultaneously. The data rate and Round Trip Time (RTT) shown in figure are an approximation to indicate that Wi-Fi connection provides higher data rate with less



**Fig. 3: MPTCP Client Connected to Server through Wi-Fi and 3G Interfaces**

RTT than 3G [4].

In January 2013, the IETF published the multipath specification as an experimental standard in RFC 6824. And a stable release of MultiPath TCP v0.89 in Linux kernel is available at the homepage of IP networking lab<sup>[5]</sup>.

#### MPTCP Goals

MPTCP is a modified version of TCP and it is backward compatible too. It offers reliable, in-order, byte streaming services as TCP. Major goals of MPTCP are hereunder<sup>[4]</sup>.

- **Improve Throughput:** MPTCP must improve the throughput by using multiple concurrent paths. A MPTCP over multiple paths must achieve throughput not worse than a TCP over a single best path.
- **Improve Fault Recovery:** MPTCP must make use of its available multiple paths interchangeably to get recover from faults over a path. Again, in any situation, MPTCP fault recovery mechanism should not be less resilient than a conventional single-path TCP.
- **Application Compatibility:** MPTCP should remain transparent to existing application i.e. application will use the same APIs as with TCP. All it has to do is to upgrade its operating system. End user has no information about MPTCP. Extended APIs could provide additional control to MPTCP enable applications.
- **Network Compatibility:** Traditional

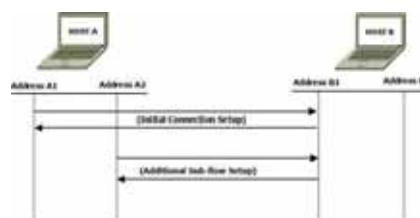
internet architecture says that intermediate devices like switches and router in a connection will work up to layer-3 i.e. only end-to-end systems will make use of transport layer services. But, in some scenarios, firewalls, NAT, proxy, etc. working on the transport layer act as bottleneck. MPTCP design should be resilient to such conditions.

- **Compatibility with other Network Users:** MPTCP flows should co-exist gracefully with single path TCP i.e. it should not behave selfishly with neighboring flows at bottlenecks.

#### MPTCP Concept and Architecture

MPTCP connection begins just as a normal TCP connection between two hosts A and B as shown in Fig. 4, if extra paths are available, then additional sub-flows will be created and combined with the existing connection. Figure indicates two hosts A and B having address A1, A2 and B1 and B2 respectively. Initially, host A initiates a connection from its address A1 to B1 at host B. Later, Host A set-ups a sub-flow from its address A2 to B1 at host B i.e. it joins the ongoing connection with an additional sub-flow. MPTCP identifies the multiple paths by the presence of multiple addresses at hosts. Combinations of these multiple addresses equate to the additional paths. So other possible paths in this diagram can be A1 to B2, A2 to B2.

A path management method in



**Fig. 4: MPTCP Connection Setup Process**

MPTCP is responsible for discovery and set-up of additional sub-flows.

Presently, MPTCP is in infant stage and researchers are still exploring more possibilities before suggesting its wide spread deployment. Some of the key challenges are:

- Availability of multiple data transfer paths leads to the problem of managing separate congestion control schemes for each path with centralized control.
- Scheduling of packets to available network flows with different path characteristics viz. data rate, loss rate, buffer size is another challenge.
- Many times, changing data transmission path causes even higher cost than single path TCP, because, alternate path may be slower than the first one. Therefore, proper path/ interface selection is another major concern. Otherwise, throughput may even go down.

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# Open Source Software Stack for Python Platform: From Academia to Industry

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## Introduction

Python is a free general purpose programming language with a beautiful syntax. It is available across many platforms including Windows, Linux and Mac OS. Due to its' inherently easy-to-learn nature along with Object Oriented features, Python is used to develop and demonstrate applications quickly. Python has the "batteries included" philosophy wherein the standard library comes with a rich set of built-in libraries. It's a known fact that developers spend most of the time reading the code than writing it and Python can speed up Software development. Hosting solution for Python applications is also very cheap. According to IEEE Spectrum ranking, Python stands at fourth position in overall popularity of the languages<sup>[1]</sup>. Python Software Foundation nurtures the growth of Python Programming Language. A versatile language like Python can be used not only to write simple scripts for handling file operations but also to develop massively trafficked websites for corporate enterprise IT organizations. On a personal note, as part of Open Source Software initiative we have introduced Python Programming course for undergraduate program at our institution.

## Thrust Areas of Python

Python is a top marketable professional skill and we have identified the thrust areas where Python plays a very important role. Python is used as a glue to work with other programming languages. Python syntax allows novices to start writing code immediately, at the same time Python can be used to scale for heavy usage in industries. The Zen of Python states that "There should be one and preferably only one obvious way to do it". Even in Enterprise setup Python language is being desired by employers. Even though numerous software are available for each of the thrust areas which we have identified we'll concentrate on the most

popular library that can satisfy most of the requirements.

## Academia

Python is being offered as the introductory programming language in majority of the computer science departments at various American Universities<sup>[2]</sup>. Python is being adapted by Academia for research purpose at an accelerated rate and is competing with MATLAB for the coveted title of most preferred language for research. There are few advantages of Python over MATLAB like MATLAB is not a real programming language as per se but Python is. Python has lots of scientific tools which are almost as good as MATLAB modules. Developers now a days need to work in multiple languages and majority of the languages including Python have their index start from zero while MATLAB index starts from 1 which may lead to more syntactical errors. Also MATLAB uses parenthesis both for indexing and functions, while Python uses square bracket for indexing and parenthesis for functions which brings more clarity in the code. MATLAB is closed and proprietary with a very expensive licensing agreement, while Python is free and open source<sup>[3, 4]</sup>. Raspberry Pi project was started by Raspberry Pi foundation which aims to bring computer knowledge to children, elderly people and the lower strata of the society who are deprived of computer education<sup>[5]</sup>. This foundation brings out Raspberry Pi devices, which are tiny, low cost microcomputers that are powerful enough to do most of the work that can be done using desktop. Python due to its ease of learning is recommended as the preferred programming language for Raspberry Pi.

## Scientific Tools

Scientific tools are essential for simulating and analyzing complex systems. Python ecosystem consists of these core scientific packages namely, SciPy library, NumPy, IPython, Sympy and Matplotlib<sup>[6, 7, 8]</sup>. Most of these tools are available under

BSD license and can be used without any restrictions. Scipy library is mainly used for numerical integration and optimization. Numpy provides N-dimensional array objects which can be used to perform linear algebra, Fourier transform and other mathematical operations. IPython has revolutionized the way programming is done in Python. IPython provides an interactive GUI which is used to write Python programs and embeddable plots to visualize data. IPython can also be invoked from a browser and this mode is called Python notebook which can be saved and exported to several file formats like html. Sympy library is used to generate symbolic mathematics. Matplotlib is the oldest and most popular plotting library available for Python. With these tools we have better chances of solving scientific problems and create working prototypes very quickly than any other competing tools.

## Machine Learning

Machine Learning is an effective and adaptive tool to learn from experience and by dataset. Many machine learning algorithms and techniques have been developed that allow computers to learn. Machine Learning has its origin in Computer Science and Statistics. Scikit-Learn is a well-known Machine Learning tool built on top of other Python scientific tools like NumPy, SciPy and Matplotlib<sup>[9]</sup>. This allows Scikit-Learn to be easily extended to implement new models. Scikit-Learn supports various models for Classification, Regression, Clustering, Model Selection, Dimensionality Reduction and Preprocessing. Some of the advantages of Scikit-Learn are integration of parallelization, consistent API's, good documentation and is available under BSD license as well as commercial license with full support.

## Natural Language Processing

Natural language processing is used to read and understand text. Natural Language Toolkit (NLTK) is the popular library

used for natural language processing in Python<sup>[10]</sup>. NLTK has numerous trained algorithms to understand the text. NLTK has huge corpora of data sets and lexical resources like journals, chat logs, movie reviews and many more. NLTK is available under Apache License V2.0.

#### Data Analysis

This library changed the landscape of Data analysis in Python altogether and is available under BSD license. Pandas is built on top of NumPy and has two important data structures namely Series and DataFrame. Series is a one dimensional array. It can hold any type of data like integers, floats, strings, objects and others. Each of the data stored in series is labeled after the index. DataFrame is a tabular data structure with labeled rows and columns similar to Excel spreadsheet. In real world data is never in order and Pandas can be used to fill in missing data, reshaping of datasets, slicing, indexing, merging, and joining of datasets. Pandas can be used to read CSV files, Microsoft Excel, SQL database and HDF5 format files<sup>[11]</sup>.

#### Statistics

Statsmodels is a Python library used for statistical analysis<sup>[12]</sup>. It supports various models and features like linear aggression models, generalized linear models, discrete choice models and functions for time series analysis. To ensure the accuracy of results Statsmodels is tested thoroughly by comparing it with other statistical packages. Statsmodels can also be used along with Pandas to fit statistical models. This package is available under modified BSD license. Statsmodels is used across various fields like economics, finance and engineering.

#### HTTP Library

The Requests HTTP library is popularly referred to as the library written for Humans. Python has standard HTTP library called urllib2 to carry out most of the HTTP operations. But urllib2 APIs are not easy to use and are verbose. To overcome these problems Requests was created as a standalone library. Common HTTP verbs like POST, GET, PUT and DELETE which correspond to create, read, update and delete operations are fully supported. Also, Requests provides features like thread-safety, support for International Domains, Cookie Persistence and Connection Timeouts. Requests is available under Apache2 license<sup>[13]</sup>.

#### Database Connectors/ORM/NoSQL Connectors

Database connectors are drivers that allows us to query the database from the programming language itself. MySQL and PostgreSQL are the popular open source databases. MySQL-Python-Connector for Python from Oracle<sup>[14]</sup> is the most popular Python connector available for MySQL and Psycopg2 is the Python connector widely used for PostgreSQL<sup>[15]</sup>. The APIs in these connectors are compatible with Python Database API Specification v2.0 (PEP 249).

Object Role Modeling (ORM) is a powerful way of querying the database to achieve persistence so that data can live beyond the application process. There is a mismatch between the object oriented language models and the relational database leading to several problems like granularity, inheritance, identity, associations and navigations. ORM helps in mapping the data from object oriented languages to the relational database and follows the business layer logic. SQLAlchemy is highly recommended ORM toolkit for Python applications to be deployed at enterprise level<sup>[16]</sup>. Python connectors are also available for popular NoSQL databases like MongoDB and Cassandra.

#### Web Frameworks

Django<sup>[17]</sup> and Flask<sup>[18]</sup> are two most popular web frameworks. Both have different purposes. While Django is a full-fledged framework, Flask is a microframework that is used to build small applications with minimal requirements. Django has built-in support for various web related services like caching, internationalization, serialization, ORM support and automatic admin interface, while Flask allows users to configure web services according to their needs by installing external libraries. Both of these frameworks are available under BSD derived licenses.

#### Cloud Computing

OpenStack is entirely written in Python and is used to create scalable private and public cloud. OpenStack Foundation oversees the development of OpenStack software. OpenStack has decent load balancing, is highly reliable, vendor independent and has built-in security. OpenStack uses dashboard as a central unit to manage network resources, processing power and storage in a datacenter<sup>[19]</sup>. Linux distributions like

Fedora and Ubuntu include OpenStack as part of their package. Hosting of Python applications on cloud platform is well supported by various cloud service providers like Google App Engine, AWS, Heroku and Microsoft Azure.

#### Python Distributions

Python Software Foundation releases Python interpreter with standard libraries. But in order to use Python in a scientific or Enterprise environment other packages needs to be installed. Having these packages tested for compatibility with the latest release of Python is cumbersome and time consuming. Anaconda<sup>[20]</sup> and Enthought Canopy Express<sup>[21]</sup> are two popular distributions that come with core Python interpreter and popular scientific tools to help us start working out of the box. Even though both distributions are popular among Python community one notable difference is Anaconda distribution has installer for both Python 2.7 and 3.5 versions while Enthought Canopy has installer for Python 2.7 version only.

#### IDE Available

Integrated Development Environments (IDEs) helps in rapid development of the software and increase in productivity. PyCharm is the most popular IDE for Python programming<sup>[22]</sup>. PyCharm comes in three flavors namely, Professional Edition, Community Edition and Educational Edition. PyCharm has advanced features like auto code completion, code highlighting, refactoring, remote development capabilities and support for various web frameworks. PyCharm is available for various platforms like Windows, Linux and OS X. Microsoft has released an extension for Visual Studio called Python Tools for Visual Studio (PTVS) which transforms Visual Studio IDE into a full-fledged Python IDE<sup>[23]</sup>. Spyder is another IDE that comes as part of Anaconda distribution itself.

#### Community

Community is what really defines the success of Open Source projects. Development of projects is taken forward by adding new features and Community members play important role in testing the software, recommending it to others and in documenting the software<sup>[24]</sup>. Python community members are expected to follow Python Code of Conduct and Python community is generally considered very

helpful. Python community is very active and cordial in accommodating newbies. Python conferences are held regularly across the world where in the core Python developers are invited to share their experience with other developers thus paving way for more Python adaption across the horizon. Python language documentation is renowned for its depth and completeness. Also, various high quality Python text books are made available online for free which helps newbies to learn with minimal investment.

#### Python Stack in Industry

Various companies use Python stack to power up their infrastructure. The popular online photo sharing service Instagram uses Django framework for application development. At Mozilla, which develops the popular Firefox web browser majority of the web development is done using Django framework. PayPal and eBay where transactions worth billions of dollars takes place every year swear by the security features provided by Python libraries. Companies like Pinterest and Twilio have adapted Flask as their web development framework. Requests library is used in major projects of companies like Amazon, Google, Washington Post, Twitter and others. Python Scientific and data analysis tools are being used at LinkedIn, Boeing and NASA. Dropbox has hired Guido van Rossum, Father of Python to add new features to their existing Python stack. Even though this is not a complete list of companies using Python, it surely indicates Industry interest in using Python to solve challenging problems.

#### Conclusion

This article gave an overview of various Python libraries available under different categories. Python due to its flexibility and simplicity reduces the amount of time taken from conceptualization of an idea to building the application and marketing

it resulting in more demand for Python programmers in Enterprise setup. We hope this article motivates younger generation new to programming to consider Python as their first programming language to express their thoughts.

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# Covert Communication Techniques used by Next Gen High Tech Terrorists

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*"While a terrorist has his fingers on the trigger, his children have their fingers on the mouse."*

**Abstract :** Until now people have fought for food, water or territory, but today the definition and motivation of fighting is changed i.e. terrorism. Terrorists often strike soft targets such as innocent citizens and government infrastructure. The aim of terrorists is to turn people against the government. Terrorists are ahead of the Law Enforcement Agencies to adapt to latest changing technology and use it as a medium to spread terror across the globe. In the recent past, terrorists had been physically present to carry out act of terrorism. But with the advent of technology, they have changed their strategies and converted themselves into high tech & sophisticated groups. They have their own cyber cells and command & control centers which are used to monitor and control their activities. The means of communication with their activists have changed from a courier to use of internet, especially the social media. They attract youths to join the terrorist groups and motivate them for terror activities using wrong interpretation about religion. This article throws light on covert communication techniques used by terrorists to communicate using various techniques.

## Prologue

The increased dependency on communication and data networks, storage of information in cyber domain and their vulnerabilities to outside world, lack of mutual consent between countries on effective control of operations in cyber domain has brought a new type of threat. Cyberspace; the fifth space of warfare after land, sea, air, and space is all about the computer networks in the world and everything they connect and control via cable, fiber-optics or wireless. The internet is used for interconnecting people including terrorists who are amongst the first to use the latest technologies even before the government agencies.

The Hyderabad Police arrested three students on 26 Dec. 2015 for allegedly planning to join terrorist group. 'Youtube' was used as a communication medium to seek help. In another case, Delhi Police on 29 Dec. 2015 arrested a former Indian Air Force official from Punjab for allegedly sharing secret documents with other country after he was "honey trapped" by a woman with links to the spy agency. He was allegedly introduced to the spy ring by an unidentified woman whom he had met over a social networking site and shared information through a fake 'Facebook' account.

In May 2015, when two terrorists attempted to kill a whole bunch of people in Garland, Texas, they were stopped by local law enforcement and it was revealed that in the morning one of those terrorists exchanged 109 messages with an overseas terrorist. The government agencies replied, "We have no idea what he said because those messages were encrypted. That's a big problem, and we have to grapple with it." So here encryption played a role in obstruction and helped in secure communication between the terrorists. In Paris Massive attack encrypted communications via TOR and social media were used. For communication purpose they used Telegram like apps, which securely communicate the messages to the other group members involved in that attack.

During Mumbai attacks in November 2008, terrorists used

GPS based maps; Satellite based phones for the communication purpose and live telecasts to monitor the event. The communication medium changed during every stage of the attack. Thus it became very difficult for the Law Enforcement Agencies to hunt them down.

Study has shown that the commonly terrorists communicate through normal network channel using secret encoding techniques, which may not be traced out by Intelligence agencies i.e. Steganography and Hidden watermarking. These techniques with high tech encrypted communication may not be traced out through interception. They have analyzed the various social media platforms and categorized them so that their sympathizers can use these platforms with caution.

## Practical Case Study Scenarios

High tech terrorist groups are using techniques such as steganography and water marking for communicating covertly with each other. Some of the examples are discussed here with actual implementations.

## Add Message to Foreign Language Movie's Sub Titles

Security & intelligence agencies received a report that a suspected person associated with a terrorist group and now probably a sleeper cell was planning a terrorist activity in the coming days. An investigation agency confiscates the digital devices from suspect's house. They recover many files from the suspect's external hard disks. After digital forensic investigation they could not gather any information about the activity planned. They had found some sticky notes with numbers of his home phone and writings such as 00,45,55 scribbled on them which lead the investigation team nowhere. They also found some movies, which were in foreign language, but at the time of forensic investigation they had ignored them. But one of the investigators found one doubtful scene which was the part of that Chinese movie. He played a movie many times with its English subtitles. With available information acquired from investigation the investigator put all things together and trying

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Fig. 1: Still frame from Foreign Movie with Subtitle and Number 004555

to create the intelligence. He analysed all information like movie, numbers and dates, names of folders etc. As a result investigator found below mentioned frame from movie at time 00:45:55.

Investigator found subtitle at 00:45:55 with no voice behind it. Subtitles are normally synchronized with voice and conversations during movies. But this subtitle had no conversation or voice behind it. After getting this evidence they crack down the meaning of message. That message was regarding next Get 2 Gather (G2G) of the sleeper cell group at location mentioned as GPS coordinates to create plan for next target. The GPS coordinate (18.520430, 73.856744) mentioned in sub title of the movie was of German Bakery, Pune, India.

### DTMF & Morse Code for Covert Communication of Code Exchange

A person was recently identified as a suspected terrorist. He was suspected of stealing missile activation codes from the Air force, which were handed to officials for a brief period of time. If suspect misuse the code then Air force may have to face some serious trouble. Thumb drive of Tom was found in formatted state and the same was used to store the activation code. Fortunately, system had made a backup image of the drive. One of the Investigators handled this case, for getting activation code details.

The file name was win7.bak, which was back up of windows FAT file system machine. Investigator created an image file of that backup file for fetching

potential artifacts.

Thus, investigator successfully

fetched the activation code detail from the above-mentioned code.

### Barcodes or QR Codes for GPS Coordinates or Location, Map, Auto Message

Barcode generally have 12- to 20-digit number. It is primarily used for serial numbers, pricing and inventory control of the products worldwide. The most common barcode in North America is the 12-digit Universal Product Code (UPC) code. UPC codes used with groceries and books and could be used to track any merchandise if needed. Marketers track consumer choices by analyzing what they are purchasing. With the advent of free barcode scanners on mobile devices, marketers can also pinpoint what age groups are buying what.

But barcode or Quick response code may also be used for communication

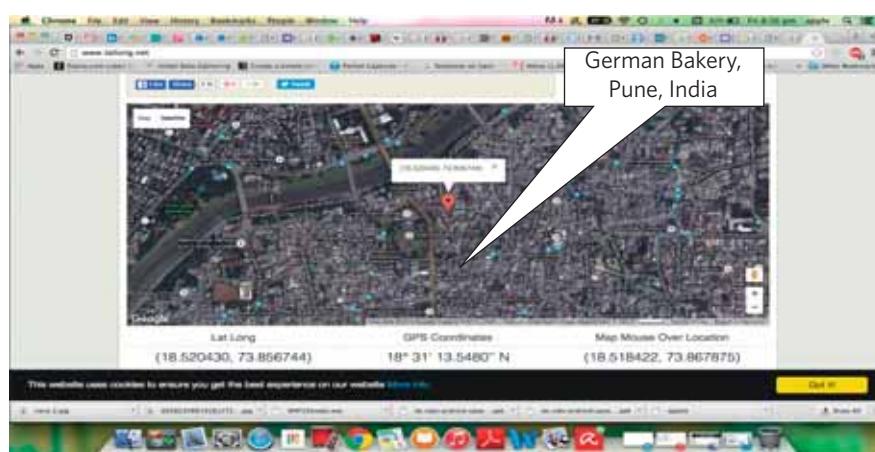


Fig. 2: Location Coordinates 18.520430, 73.856744

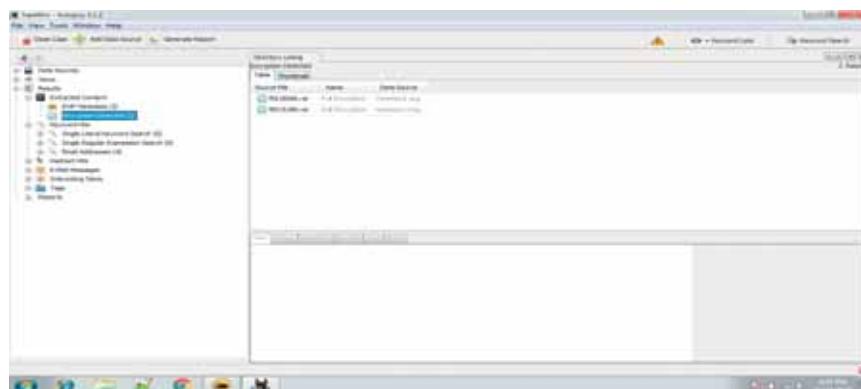


Fig. 3: Found Encrypted Archive File

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Fig. 4: DTMF Code audio file is there In Encrypted Archive File



Fig. 5: DTMF Code is Decoded

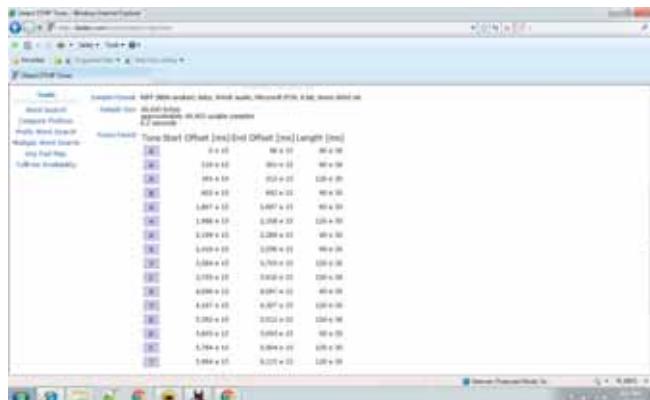


Fig. 6: The Code is Decoded i.e. AA6B A4A8 3C67 DDC7

too. If any terrorist group wants to communicate via covert communication, they can use this technology as a secure message passing system. Figure below shows the meeting will be held at Theatre Royal at 24 February 2016.



Fig. 7: QR Code of meeting place

### Conclusion

Thus, from the above case studies, it can be understood that terrorist can use high-tech medium of covert communication

channels for passing their secret messages to their group members. It is also important that investigator should have out of the box thinking capability to understand the modus operandi and technology. Secret is no more secret when it comes to proper intelligence and applying novel detection strategies to identify the secrecy.

### Suggestions for Readers

This research paper is presenting covert communication used by criminals. Software sometimes fails to detect the covert communication. In such cases investigator has to apply intelligent approach for decrypt communication.

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# Sustainable Approaches for Time-Critical Surveillance Applications

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In a sensitive and important domain like national security and counter-terrorism, relationships like Call Detail Records (CDRs) or financial transfers can provide valuable insights in determination of association of surveillance targets. Determining links in a national security apparatus is time critical. A sustainable approach to link analysis which shuns existing, traditional relational database approaches such as MySQL for a more localized relationship based or graph-based approach using Neo4j is discussed here. The efficacy of which is confirmed by performance statistics which is found to be exponentially faster. Link analysis involves the study of the number and types of connections between nodes of any kind. Link analysis can be used to subsequently apply for models and predict various outliers or objects of interest from a large dataset.

With a low investment required in evasive technologies, it is becoming easier day by day for criminals, nefarious anti-social elements and both state and non-state actors<sup>[1]</sup> to hide their activity from the view of regulating security agencies. These include activities spanning across various domains, such as illegal money transfers or money laundering and redirection and frauds in finance<sup>[6]</sup>, geographical location and cross co-relation with relevant intelligence, surveillance data and linking of activities or targets to each other in social network analysis or intrusion detection in case of cyber-attacks or cyber forensics<sup>[7,8]</sup>. With the aforementioned well-known, publicly available and rather easy to use tactics<sup>[2]</sup>, criminals can hide most traces of their activity. If at all a link is left in plain sight, that link is subjected to intense real-time and forensic scrutiny. Since links are few for any target of surveillance and when a link is indeed found, all possible links are then investigated for possible patterns or events considered to be harmful or potentially harmful, there is a need for analysis of all possible links emanating from a target of surveillance or a person of interest with minimal effort. In the context of intelligence gathering, this actionable intelligence must be treated with top priority until and unless action is taken regarding the input. This presents the unique, vast and insurmountable problem of providing a network link of all possible members of a global network, which is clearly not a computationally sustainable approach. A more sensible and hence, a sustainable approach is to perform a localized search for link analysis, with the query of the link originating from possible multiple sources and presenting the result as an intelligence input. A state of Ubervveillance is proposed<sup>[3,4,5]</sup> to perform interception and tracking given globally unique identifiers<sup>[9]</sup>, but the transition to Ubervveillance and querying huge amounts of data using a purely relational model on globally unique data becomes exponentially intensive.

A fast localized search of links through graphs and relationships instead of traditional relational approaches for

querying to provide relevant links to a surveillance target during counter-terrorism operations through Neo4j has been presented here.

## Relational Model Working and Pitfalls

In a relational data base model, data is organized into table of rows and column. A key unique to each row is present. The placement between a tuple and an attribute in a relation is shown in Fig. 1.

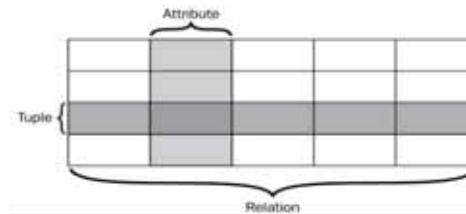


Fig. 1: Representation of tuples, attributes and relation

The relational scheme suffers from inherent problems of scaling where in applications generate huge amount of data on a day to day basis. Additionally, when number of domains in link analysis increase, relational databases start becoming difficult to obtain results out of multiple join operations in a relational database. When multiple tables are queried, the relational database system becomes unresponsive. For a MySQL process allotted 1 GB of memory, a query using multiple join operations may end up in 2 hours, sometimes even more.

Another cause of concern is that in relational databases, a Cartesian product is first created through a join operation, following which any constraints are then applied on this Cartesian product to return the result. If there are multiple join tables with multiple relations spanning each join, the overall query becomes process intensive and as a result, a number of "join bombs" cause the application to crash.

## Graph Databases Working and Functionality

Graph databases store and model data in the form of graphs, unlike relational databases. Each entity or node is related to each other through multiple relationships. Both entities and the relationships which are related can have properties.

The inherent advantage in any graph database compared to a relational database is the power of traversal in a graph. In a relational database, arrival at the result can only be obtained after first performing a Cartesian product of joins and then filtering relevant results based on constraints specified in the query. A graph database performs a traversal, which is the main reason behind its staggering performance. Irrespective of the number of node and relationships in a graph, the traversal will only visit the nodes that are connected to the starting node, which is a basic

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traversal requirement. A simple graph data set containing five types of nodes and 4 types of relationships is as shown in Fig. 2.

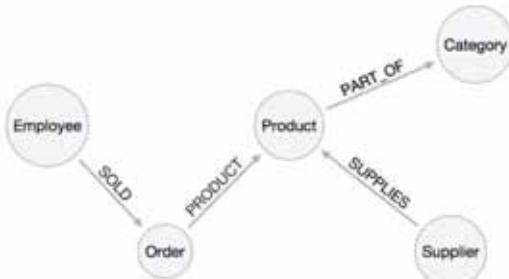


Fig. 2: A simple graph data set

### Neo4j

Neo4j<sup>[10]</sup> is an open source, Java based graph database which implements high performance graph querying through multiple ways. It allows for programming graph-based applications through multiple languages using its Representational State Transfer (REST) API or the built-in Cypher Query Language (CQL), which is similar in syntax, structuring and functions to the popular Structured Query Language (SQL) used extensively in relational databases. More importantly, Neo4j is a fully ACID (Atomic, Consistent, Isolated and Durable) transactional database. The ACID transactional support ensures applications are guaranteed of commits as relational databases offer.

### Experimental Analysis and Results

The experiment has been conducted in Neo4j version 2.1.7 and the results have been compared with respect to execution time of the query against MySQL version 5.5 with datasets having the same properties. To get an estimate of worst-case performance, the database caches were not warmed. The dataset used for the experiment was a randomly created social network with random persons named as friends. The same dataset was used for experimentation using both MySQL and Neo4j. The hardware environment used for experiment involved Windows 8.1 Operating system with 8 GB RAM and an Intel i5 processor. In CQL, the syntax of a node with creation of its relationship is as shown below:

```

CREATE (n: Person {name: 'Rama', id: 1});
CREATE (n)-[:friend]->(b);
  
```

Create tables named "users" and "friends\_user". Table named "users" contains people along with primary key which is represented in the social network. The table named "friends\_user" contains two primary keys per tuple. Each primary key signifies friends which identify a particular person in the "users" table. It depicts that node 'n' is a "friend" of node 'b'. For analysis and testing of the results, a social network is created. For link analysis i.e., to find friend of a friend and so on, depth of the node is considered. The number of distinct friends a node / entity has are returned and the execution times measured. The equivalent SQL query is as mentioned below:

```

SELECT COUNT(DISTINCT fu4.user2) FROM users, friends_
user as fu1,
  
```

```

friends_user as fu2,
friends_user as fu3,
friends_user as fu4
  
```

```

WHERE users.name='person6801' AND
users.id = fu1.user1 AND
fu1.user2 = fu2.user1 AND
fu2.user2 = fu3.user1 AND fu3.user2 = fu4.user1;
  
```

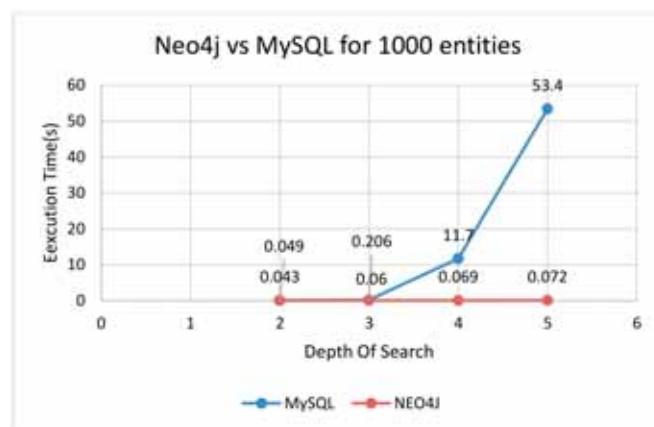
The Neo4j equivalent of the CQL query is simple to understand and could be represented as follows:

```

START target=person (6801)
MATCH      (target)-[:friend]->(a)-[:friend]->(b)-[:friend]-
>(c)-[:friend]->(d)
RETURN COUNT (DISTINCT d);
  
```

The execution time for this query on link analysis for MySQL and Neo4j has been measured and recorded as shown in the Graph 1 and Graph 2.

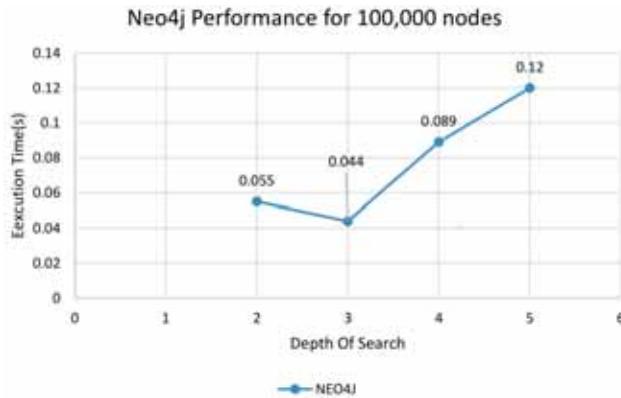
Here, "break" in Graph 1 signifies that either the MySQL terminal crashed or was unable to complete the request in the hour that the script was allowed to run. The exponential difference in execution times for link analysis in Neo4j against MySQL is plotted in Graph 1. It is interesting to note that at depths of 2 and 3, the relational and graph schemes are almost on par. This is because the join tables in the relational scheme are not so complex and can be handled rather easily by MySQL's internal indexing schemes. As soon as the depth of search increases, the Cartesian product overhead comes into play and outweighs the indexing through pure joins.



Graph 1: Execution time of SQL and Neo4j

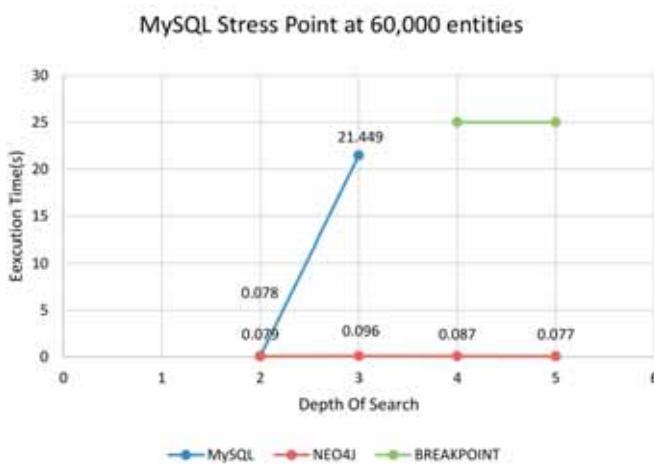
The execution times for Neo4j for a hundred thousand nodes versus the depth of search of friends in the social network graph is shown in Graph 2. Unlike MySQL and its exponential progression, Neo4j allows for multiple depth searches with minimal linear progression in execution time. On the other hand, MySQL starts to break at sixty thousand nodes at a depth search of 4 onwards. The Cartesian product and subsequent dropping of over 95 percent of the Cartesian product rows to satisfy the "WHERE" clause causes an extreme computational overhead.

## SECURITY CORNER



**Graph 2: Linear progression of Neo4j execution time for a 100,000 nodes**

The break points for MySQL for sixty thousand nodes occur at depths of four and five and are depicted in green in Graph 3.



**Graph 3: Breaking in MySQL (60,000 entities)**

### Conclusion

In a time critical area of link analysis such as fraud detection, national security, cyber-attacks, forensics and counter-terrorism, timely results can be ensured by using a graph for storage of

data for querying as purely relational data stores are ineffective and may also be prone to crashing because of their internal mechanisms of handling joins. A graph based database like Neo4j provides better performance in terms of link retrieval by orders of magnitude when scaled compared to existing systems like MySQL, thus proving to be the perfect fit for counter-terrorism link analysis across various domains such as telephony, geo-location and financial transactions.

Further, integration of such domains across a network of known criminals for complete analysis through graph databases could be performed. It must also be noted that performance can be improved further if the caches were warmed multiple times for ensuring fast querying.

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### About the Authors



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## BRAIN TEASER

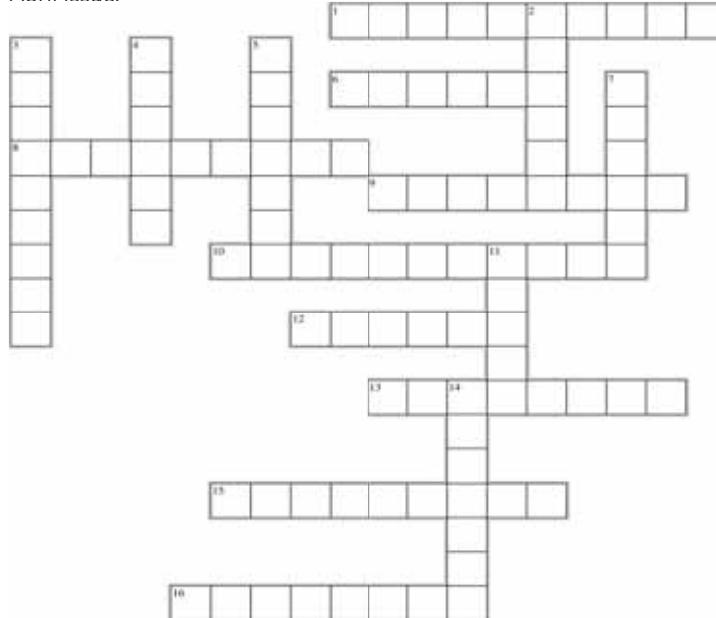


Dr. Durgesh Kumar Mishra, Chairman, CSI Division IV Communications, Professor (CSE) and Director Microsoft Innovation Center, Sri Aurobindo Institute of Technology, Indore

## Crossword »

### Test your knowledge on Natural Language Processing

Solution to the crossword with name of first all correct solution provider(s) will appear in the next issue. Send your answer to CSI Communications at email address [csic@csi-india.org](mailto:csic@csi-india.org) and cc to [drdurgeshmishra@gmail.com](mailto:drdurgeshmishra@gmail.com) with subject: Crossword Solution - CSIC April Issue.



### Upload Image at Captionbot.ai to Know its Description



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The website Captionbot.ai from Microsoft asks to upload photo and it will describe the contents of image with some accuracy. The site uses computer vision and natural language processing to describe the contents of the image. It gives important pathway for big data analytics.

Rashid Sheikh

Associate Professor, Sri Aurobindo Institute of Technology Indore

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

### Congratulations!

All nearby Correct answers to March 2016 month's crossword received from the following readers:

**Smita Saxena**, Assistant Professor, S P Pune University, Pune  
**Bira Sudhakar**, Asst.General Manager, Visakhapatnam Steel Plant, Visakhapatnam

**Ravi Sundaram**, Consultant, TCS Chennai, India

**Dr. Sandhya Arora**, Assistant Professor, Cummins College of Engineering for Women, Pune

**Rakesh Dand**, Scientist DRDO, Bangalore, India

**Archana G Pai**, Assistant Professor, MCA, Veermata Jijabai Technological Institute, Matunga, Mumbai

## CLUES

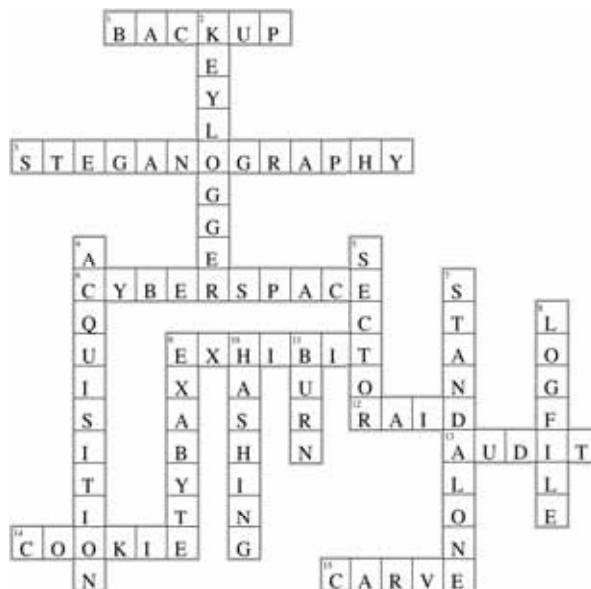
### ACROSS

- A rewriting rule in grammar
- Component that recovers the sentence structure
- When something convey multiple meanings
- Providing a rough translation
- A language neutral text representation
- Component that labels words
- Reducing a word to its root word
- An extended sequence of sentences
- An inventory of objects or processes in a domain

### DOWN

- Collection of text
- The study of linguistic meaning
- Scientist who led foundation for Computer Science Theory
- A dictionary
- A prioritized list of parser tasks still to be executed
- A sequence of n tokens
- The degree of randomness or disorder in a system

### Solution to March 2016 Crossword



# CSI Regional and State Student Conventions

## CSI Regional State Student Convention - Region VI



The Regional Student Convention for Region-VI was held at MET's Institute of Engineering, Nashik. Dr. V. P. Wani Principal MET's BKC IOE, Dr. M. U. Kharat, HOD Computer Engineering, Dr. Anirban Basu, Vice President, CSI, Mr. Sanjay Mohapatra, Hon. Secretary, CSI, Mr. R. K. Vyas, Hon. Treasurer, CSI, Dr. Shirish Sane, RVP, Region VI, CSI, and Mr. Sandip Karkhanis Hon. Secretary, CSI Nashik Chapter attended the Inaugural Function. Dr. M. U. Kharat welcomed and

introduced the dignitaries. He gave an introduction about CSI Convention and the activities held under CSI. Dr. V. P. Wani motivated the students with his speech. He spoke about experience, job opportunities and employability skills. Dr. Shirish Sane spoke about CSI in length. Dr. Anirban Basu spoke about how to conduct activities in International standards and how to improve quality of Events. Apart from technical activity platform was given to the students to visualize Digital India through the poster competition. There was overwhelming response from the participants, visitors for all events and activities. A total of 1500 students participated.

## CSI Delhi State Student Convention

CSI Regional Students' Convention was held at Bharati Vidyapeeth's College of Engineering, New Delhi on 3rd & 4th February 2016 to bring together budding engineers, developers, and practitioners of Delhi-NCR and its surrounding states. The Theme for the Convention was "**SKILL INDIA - CAMPUS CONNECT**". The ceremony was presided over by Principal Prof. Dharmender Saini. The dignitaries who graced the occasion included Mr. Arvind Dixit, Delivery Director, Oracle University, Mr. Shiv Kumar, RVP, Region I, CSI; Mr. Himanshu Bindal, Co-Founder, One Internet and Mr. Nishant Jain, Co-Founder Startup Masterz. The ceremony commenced with the lighting of the lamp of knowledge followed by felicitation of the guests by the Principal. Thereafter, the Guests of Honour inspired the students and the august gathering with their priceless words of wisdom and stressed upon the need to develop skills from the grassroot level, in order to make India more competent and self-reliant.



## CSI Gujarat State Student Convention



The CSI State Level Student Convention for Gujarat state with theme of "Digital India" was organized by School of Computer Studies, Ahmedabad University and AESICS-CSI Student Branch, Ahmedabad on 4th & 5th March 2016. The event was chaired by Prof. Bipin Mehta, President, CSI & Director, School of Computer Studies, Ahmedabad University. Event conveners were Dr. Aditya Patel, Dr. Sandeep Vasant & Dr. Kuntal Patel, Assistant Professors, School of Computer Studies, Ahmedabad University. The student convention received excellent response and participation from all leading Institutes/Colleges and Universities of Gujarat.

More than 500 student participants were participated. This convention and its various events ignited young students to brainstorm and come out with new digital innovations for "Digital India, Make in India and Startup India".

## CSI Karnataka State Student Convention



CSI State Student Convention for Karnataka was held at Global Academy of Technology, Bangalore on 26th & 27th Feb 2016. The aim of this convention was to bring out the best out of the students in co-curricular and extracurricular technical capabilities. It also helped them to get a break from their routine class room atmosphere and yet utilize the time to enrich themselves technically and test their team spirit and leadership qualities. Convention started with inauguration ceremony with bird's eye view of workshop by the Chief Coordinator of the workshop, Dr. B. R. Vijayakumar, Prof. and head, Dept. of CSE and presidential address by Dr. Rana Prathap Reddy, Principal, GAT, Bengaluru. Mr. Srinivasa Rao Kottamasu spoke about the industry expectations from aspirants and the key for their success in their career. Sri Ventakappa stressed on the

students active participation in such events enhances their confidence to face the world.

## CSI Andhra Pradesh State Student Convention

CSI State Student Convention for Andhra Pradesh was held at NBKR Institute of Science and Technology, Vidyanager on 14th and 15th March 2016. The event was inaugurated by Sri Raju L Kanchibhotla, Regional Vice President, Region V CSI, Dr. Vijayakumar Reddy, Director, Dr. Maruthuperumal, HOD CSE and SBC-CSI, Prof. M Nataraja Suresh and Mr Murali, Manager, RamInfo, Hyderabad. The Guests addressed the gathering from various colleges. So Many Students from different engineering colleges in AP have registered for the different events such as Paper Presentation, Poster Presentation, Project Expo, Technical Quiz, Mobile App Contest, Web page Design Contest, Brain Drain, and Exciting Spot Events. The two day event went on with overwhelming response from the participants. Winners and Runners on each event were recognized by giving electronic gadgets and books as prizes. On the inauguration event Convention Proceedings as well as Volume I of CSI SB Newsletter of NBKRIST was released.



## CSI Maharashtra State Student Convention



CSI State Student Convention for Maharashtra was held at Padmashree Dr. D. Y. Patil Institute of Master of Computer Applications, Pune on 12th February 2016. The convention offered excellent opportunities to the students to improve their technical proficiency and provided platform for extensive interactions with peers and pioneers in the domain. The event commenced with an inaugural ceremony. Mr. Siddhesh Bhobe, Mr. Anand Tamboli, and Col. S. K. Joshi, (Retd.), were present for inaugural ceremony. The welcome address was given by Prof. Rajesh Math, Director, DYPIMCA. Dr. Kavita Suryawanshi, Convener, This Convention gave a gist of the theme of the convention. 213 students from overall state attended the convention.

## CSI Tamil Nadu State Student Convention



CSI State Student Convention for Tamil Nadu was held at A V C College of Engineering, Mannampandal on 26th & 27th February 2016. Mrs. K. Krishnakumari, SBC welcomed the gathering. In the inaugural function Prof. Anand, HoD/CSE presented the overview of CSI Convention. Dr. Sundar Raj, Principal proposed the inaugural address. Dr. Govinda, Regional Vice-president, CSI, India presented the chief guest address. Mr. Karthikeyan, Secretary presided the inaugural function and motivated the participants. Mr. Suresh Thanga Krishnan, Regional Student Co-ordinator, CSI as a Special Invitee. Ms. Shanmathi, Student President of CSI Student Branch from Final CSE proposed the vote of thanks. A total of 170 students participated.

## CSI Kerala State Student Convention

The Kerala State Student Convention was held on 19th February 2016 at Sree Buddha College of Engineering, Pattoor, Alappuzha. The convention was inaugurated by Shri Santhosh Kurup, CEO, ICT Academy of Kerala. Around 106 students from various colleges including CSI student members participated. The inauguration was presided over by Shri Sivadasan, Treasurer, Sree Buddha Educational Society in the august presence of Dr. Suresh Babu, Principal, SBCE, Dr. K. Govinda, RVP, CSI-Region 7 and Prof. Suresh Thangakrishnan, Tamil Nadu State Student Coordinator. Prof. Anil, HOD-CSE and Kerala State Student Coordinator welcomed the gathering. Chief Guest Shri Santhosh Kurup delivered a inspiring and thought provoking session on the theme of the convention, "Emerging Technology Trends for Sustainable Development". Dr. Suresh Babu, Principal, SBCE also stressed the importance of having new innovations in this area. Shri Sivadasan, in his presidential address touched upon the technological innovations made by the Indians from ancient times and observed that the pace of technological development in India has now slowed down. Dr. Govinda felicitated the gathering by his address. Ms. Lakshmi, SBC of Sree Buddha College of Engineering proposed the Vote of Thanks.



## Opening of CSI Student Branch at S.M.I.T., Bhuj



Sanskars Institute of Management and Information Technology, Bhuj has inaugurated its CSI - Student branch on 12- 13 February, 2016. As a part of this celebration two seminars were organized on "Digital Marketing" and "Recent Trends in Computer Science". More than 140 students from various colleges of Kachchh region have attended seminars. Speakers of this event were, Dr. Sandeep Vasant, Ahmedabad University and Hon. Secretary, CSI Ahmedabad Chapter who is also a Distinguished Speaker

CSI-Region III, Mr. Shyam Chavda, Team leader at Krishna Softech, Mr. Jayesh Khandor, CEO, "The Brand Saloon", Mr. Jignesh Gohel, founder and CEO, OLBUZ. The whole event was executed under the able guidance of Mr. Chintan Morabia, Director, Sanskar Institute of Management & Information Technology. The seminar was coordinated by Mr. Archit Vohra (I/C Principal) and Mr. Dhiraj Solanki.

## ■ FROM CHAPTERS AND DIVISIONS ■



### Bangalore Chapter



CSI Bangalore chapter and InfoComm Bangalore International Organized a Seminar on "ICT Solutions for Digital & Smart Karnataka on March 18 (Friday), 2016. The Seminar was supported by the Smart Cities India Foundation. The half Day Seminar was inaugurated by Padma Bhushan Prof. V. Rajaraman, CSI Fellow and Life Time Achievement Awardee of Computer Society of India who shared his views on "The Role of Big Data Analytics in Smart Systems." Dr. A. Ravindra, past Chief Secretary of the Government of Karnataka and Chairman of the Smart Cities Foundation, spoke on "The Needs and Challenges of Smart Cities in India. "The digital transformation happening in India is one of the most exciting applications of audiovisual and information and communication technology (AV and ICT) in the world", said Mr. David Labuskes, Executive Director and CEO, InfoComm International, the trade association representing the commercial audiovisual industry worldwide.

Dr. Anirban Basu, Vice President and President-Elect of CSI, said that there are many opportunities for organisations like CSI and InfoComm to work toward a common objective of furthering ICT benefits for society at large. "CSI is very keen to associate with innovative and future technology providers who can bring positive change to the Indian education and IT environment," he said.

An interactive panel discussion was organized on Opportunities for ICT development in Karnataka featuring participation of Mr. David Labuskes, Executive Director & CEO, InfoComm International, Mr. G. Prabhu, Commissioner, Belagavi City Corp., Mr. V. Krishnamurthy, Assoc. Director, NIELIT , Mr. B. Ananda Rao, Charter President, Federation of IT Dealers' Associations - Karnataka (FITDAK), Dr. Ravi Gupta, CEO, Elets Technomedia and Editor-in-Chief, e-gov, Mr. Arun Acharya, Digital Service Line Head - Europe, Capgemini India.

About 120 engineers attended the half day Seminar and found it informative.



The presentation covered subjects covering Information Security solutions that provide protection against current and evolving cyber threats. It also outlined the product portfolio which includes eScan and MailScan that encompass Anti-Virus, Anti-Spyware, Content Security, Anti-Spam and Network Intrusion Prevention solutions. The program was conducted by Shri S. Kar, Hon. Secretary, CSI Bhilai chapter. The program was attended by more than 100 delegates.

### Bhopal Chapter



CSI Bhopal Chapter organised a one day Expert Talk on "Android Application Development" on 18/03/2016 with Department of CSE, IT and MCA of Oriental Institute of Science & Technology, Bhopal. Mr. Vijendra Singh Bhaduria, (Corporate Trainer) conducted the workshop and it was attended by more than 250 students. He designed some live android apps to give practical exposure to students. Prof. Sandeep Monga welcomed the speaker before start of the session. Mr. Rajesh K. Shukla, Secretary, CSI Bhopal chapter appreciated the Department of CSE, IT and MCA of Oriental Institute of Science and Technology, Bhopal for providing the opportunity to conduct this event.

### Bhilai Chapter

CSI Bhilai Chapter organized a seminar on 'e-Security' on 05.03.2016 to commemorate the golden jubilee of Computer Society of India. The event was organized in association with Institution of Engineers (India)- Bhilai Local centre at Engineers Bhawan. Shri R Sreenivasan, GM(C&IT)- Bhilai Steel Plant and Chairman CSI-Bhilai was the chief guest on this occasion.

M/S Microworld gave a presentation on the theme 'e-Security'.

### Mathura Chapter

CSI Mathura Chapter conducted a Two day National Workshop on 4-5 March 2016 on "Soft Computing and its Engineering Applications using MATLAB" (SCEAM 2016) at the Dept. of CEA and Mathematics, GLA University, Mathura.

The inaugural function was started by Mr. M.P. Singh, Agra university. Prof. A. S. Jalal delivered the keynote address. Chief Guest Prof. D.S. Chauhan, Vice Chancellor GLA University presided over the function. In his presidential address, he

## ■ FROM CHAPTERS AND DIVISIONS ■



highlighted the importance of Artificial Intelligence and pattern recognition in today world. Prof. A.S. Jalal, Head of the Department, CEA welcomed the distinguished Guests.. Vote of thanks was given by Convener of workshop Prof. Dilip Kumar Sharma.

Prof. Anirudh Pradhan, Dean R & D, GLA University was Chief Guest for valedictory ceremony. Prof. Dilip Kumar Sharma and Dr. Pooja Pathak GLA University were the Conveners of this National Workshop.



Prof. Jerry Spoke on one of the most problematic elements of cyber security which is quickly and constantly evolving nature of security risks. Participants from various industries and colleges of Mysuru city attended the program. Mr. Rampur Srinath, CSI-Mysuru Chapter Chairman, Mr. Venkatesh & Mr. M. S. Veerendra Kumar of CSI-Mysuru chapter and Dr. G. Raghavendra Rao, CS Division Chairman NIE, Dr. K. Raghuveer, Head, Information Science Engineering, NIE, Dr. H. D. Phaneendra, TEQIP Nodal Officer, NIE & M. J. Yogesh, Coordinator, NIE and Dr. R. Srinivasan, Professor, Emeritus, MSRIT, Bangalore were present at the event.

### Mysuru Chapter



CSI, Mysuru Chapter celebrated the CSI Foundation Day on 6th March in a very innovative manner. As part of this event CSI-Mysuru Chapter organized a program to create awareness on computers and on a fly Quiz program. Members of CSI Mysuru Chapter along with student members visited different parts of Mysuru city and interacted with people and informed them about CSI. Questions regarding Computers were asked to people of various age groups which consisted of high school children, medical students, retired people, house wives and engineering students. For a correct answer prizes and goodies were given. CSI Mysuru Chapter members present were Rampur Srinath - Chairman, Anita Venkatesh- Vice Chairman, Aruna Devi- Secretary, Dr. A.M. Sudhakara- Past Chairman, Venkatesh C J & Yogesh - MC members. The whole event was hosted by 92.7(big) FM RJ Mr. Avinash. The Event was supported by 92.7 (big) FM and VSG Software Solutions, Mysuru.

CSI Mysuru Chapter and Computer Science Division of The National Institute of Engineering, Mysuru jointly organized a Technical Talk on "Aspects and Importance of Cyber Security" on February 28th 2016. Prof. Jerry Miller, Research coordinator, Discovery Lab and Associate Director for Renewable Energy & International Security Research, School of Computing and Information Science, Florida International University, Miami, USA delivered the talk.

### Rourkela Chapter



CSI, Rourkela chapter organized a Technical talk on "Wireless Communication 1G-5G: Demystified" at Computer & IT Dept conference hall on 16th Dec. 2015 by Prof. Sarat Kumar Patra of NIT Rourkela.

Members of CSI Rourkela Chapter from OCL Rajgangpur, NIT Rourkela and RSP have attended the talk. Mr. Swaroop Panigrahi, Chairman CSI Rourkela welcomed the gathering and Mr. Sanjay Gautam gave vote of thanks. Mr. Biswajit Mandal coordinated the event.

In a function organized by Computer Society of India (CSI), Rourkela Chapter, at Rourkela Club on 30th January 2016, winners of the School CSI-Quiz-2015 and CSI-Elocution-2015 Competitions held earlier were awarded.

Mr. Subhendra Das, ED (Projects), RSP was the Chief Guest of the programme, while Mr. H.B. Panigrahi, DGM Incharge (C&IT), RSP was the Guest of Honour. Principals, Teachers, winning students, their parents and a large number of CSI members were present on the occasion. The competitions were held at St Paul's School, Rourkela on 29th November 2015. Awards and certificates were presented to 37 students from different schools by the Chief Guest. The CSI rolling trophy-2015 was won by St. Paul's School, Hamirpur, Rourkela for winning maximum number of awards.



Mr. H.B. Panigrahi presented the CSI Chapter Patron Award and Significant Contribution Award given by National body of CSI to Mr. N.S. Kumar and Mr. Indramani Samal respectively.

At the outset, Mr. Swaroop Panigrahi, Chairman of the Chapter welcomed the gathering. Mr. Vijay Prakash Arya and Mr. Govind Kumar briefed about the CSI Quiz-2015 and Elocution-2015. Mr. Sanjay Kumar Gautam, Secretary of the Chapter proposed a formal vote of thanks.



A Technical talk on "Stem Cell Therapy: A Computational Perspective" was organised at C & IT Departmental conference hall on 29th February. The programme was organised by Computer Society of India, Rourkela Chapter which has been playing a key role in spreading computer awareness amongst the people in and around Rourkela for the last 3 decades.

Prof. Mukesh K. Gupta, Department of Biotechnology and Medical Engineering of NIT Rourkela delivered the talk. Speaking on the Stem Cell Therapy, the emerging promising treatment strategy for end-stage diseases. He also discussed the future prospects of stem cell therapy from a computational perspective.

Members of CSI Rourkela Chapter from OCL Raigarh, NIT Rourkela and RSP attended the talk. Mr. Swaroop Panigrahi, Chairman CSI Rourkela welcomed the gathering and Mr. Sanjay Gautam, General Secretary proposed a vote of thanks. Mr. Biswajit Mandal coordinated the event.

## Vellore Chapter

CSI Vellore Chapter organized a panel discussion on "Digital India" on 07-03-2016 as a part of CSI foundation day. The moderator for this panel discussion is RVP VII, all the members are actively participated in the panel discussion and discussed about Digital India, Clean India, Startup India, Standup India, Make in India, reform to transform and different schemes of our Hon. Prime Minister designed for the development of India.



CSI Vellore Chapter organized a guest lecturer on "Recent Trends in Computer Science" on 18-02-2016 at VIT University. Dr. Anirban Basu, Vice-President Elect cum President, CSI covered Introduction computing, different paradigm shift in computing and explained in detail about IOT, Big Data, around 45 students attended the guest lecture, the Vice President met the OB's of Vellore chapter and motivated them to increase the membership base and event is organized by Prof. G. Jagadeesh and Prof. K. Govinda.



## Visakhapatnam Chapter



**A**t a grand function held at ZP High School, Thotada, Munagapaka Mandal Vizag District, AP, Sri D.N. Rao, Director (Operations), Visakhapatnam Steel Plant & Vice Chairman, CSI-Visakhapatnam Chapter inaugurated "Smart Computer Lab" on 15-Mar-2016, which was provided by CSI-Visakhapatnam Chapter to impart IT knowledge to the young students of the school. CSI - Visakhapatnam chapter has taken up this event by adopting a remote Government school for promoting IT among the student community. Thotada ZP High School stands first rank in the Munagapaka Mandal and has a strength of 500 students. Last year One Girls High school was adopted to provide the smart lab benefiting around 850 Girl Students.

The program started by garlanding the Mahatma Gandhi statue, Vivekananda statue, Saraswathi statue etc. Later the "Smart lab for better tomorrow was inaugurated by Chief Guest Sri D.N. Rao, Director (Operations), Visakhapatnam Steel Plant.

## ■ FROM CHAPTERS AND DIVISIONS ■

The Facilities provided in the lab was explained by Sri Y. Satya Narayana. Sri D.N. Rao expressed confidence that the students would make best use of the excellent facilities provided by CSI chapter for their better future. Sri D.N. Rao assured further assistance on behalf of CSI to provide the maintenance of the systems and Internet service by one more year. As part of this, CSI-Visakhapatnam Chapter has provided IT infrastructure like Personal Computers, Printer, Scanner, Projector etc. along with internet for the benefit of the students who so far did not have such facility.

Speaking on the occasion, the villagers thanked Sri DN Rao and CSI-Visakhapatnam Chapter for giving the best IT facilities to the school located in a remote village. They felicitated Sri DN Rao on behalf of the villagers to express their sincere thanks and affection. Guest of Honor Sri KVSS Rajeswara Rao have appealed to the students the make best use of the facilities provided.

Earlier Sri Y. Madhusudana Rao, Secretary, CSI Visakhapatnam Chapter welcomed the gathering. Secretary CSI Visakhapatnam Chapter explained to the students about Computer Society of India and its various activities in the society and also highlighted the focus on the Student fraternity. Sri Y. Satyanarayana, Treasurer, CSI- Visakhapatnam Chapter proposed the vote of thanks. Concluding the function, Students of the school performed various cultural programs. Munagapaka ZPTC, MPP, MPTC, Sarpanch, Dy. DEO, Head Master of the school, hundreds of villagers, students have participated in the program and appreciated the efforts put by COMPUTER SOCIETY OF INDIA Visakhapatnam Chapter. Local Press and media publicized the event in a big way.



CSI, Visakhapatnam Chapter conducted "CSI-WIZKID QUIZ" Competition on 28th Jan., 2016 at Uku Club, Ukkunagaram, Visakhapatnam to bring IT awareness among the school children of class VIII to X. Invitation was given to all the Schools in and around Visakhapatnam. Online registration was provided to enroll the students in the Quiz with no entry fees. Around 180 teams (Each team has 3 students) from 42 schools have participated in the Quiz. Total gathering was about 600 including faculty. Sri Sabyasachi pani, DGM (TPP), Visakhapatnam Steel plant was the Quiz master.

Vice Chairman, CSI, Visakhapatnam Chapter, Sri D.N. RAO, Director (Operations), RINL has inaugurated the program by lighting up the lamp. The Quiz was conducted in three phases. The first phase is preliminary one and it's like a written test.

Top 12 teams were selected for next phase i.e. Semi finals. Two semi finals were conducted with six teams each. Three teams from each semi final were selected for final phase of the Quiz. In the finals, six teams were participated and three prizes viz. Winners, 1st Runner Up, 2nd Runner up were announced by the Quiz Master.

Chapter Chairman & Vice Principal AUCE, Prof. P.S. Avadhani distributed cash awards and prizes to all the winning teams. Cash award worth 30000 was distributed to winners. Winners are Rohit Mishra, Vipul Shukla, Dena Tatha Malik all X class of Navy Children School. 1st runner up Ankit Biswas, Pratik Utham, Anshuman Panda all 9th class of DPS, Ukkunagaram. 2nd runner up B. Sai Rohit Reddy, U. Amogh, K. Arun Teja all X class of Sri Prakash Vidya Nikethan. Participation certificates were also issued to all the participant students in the Quiz.

Secretary, CSI, Visakhapatnam Chapter, Sri Y. Madhusudana Rao, AGM (IT), Vizag Steel, has taken the program to greater heights. Program Convener Dr. B.G. Reddy, DGM (IT) with coordinators Sri S. Gopal, AGM (IT), and Sri B. V. Vijaya Kumar, AGM (ERP) organized the event in a big way.

Continuing the last year WIZKID QUIZ in Visakhapatnam, the chapter conducted the Quiz with no registration fee as it is a non-profit professional body. Parents and school principals appreciated the organizers for conducting a grand quiz program with huge participation of students. Sri P. S. Avadhani, Chairman, CSI, Visakhapatnam Chapter & Vice principal AU, Engineering college , Sri KVSS Rajeswara Rao, GM(IT) have graced the occasion.

Treasurer, Sri Y. Satyanarayana , AGM (MM), proposed the vote of thanks.

Chapter Chairman & Vice Principal AUCE, Prof P. S. Avadhani distributed cash awards and prizes to all the winning teams. Vice Chairman, CSI, Visakhapatnam Chapter, Sri D. N. Rao, Director (Operations), RINL has inaugurated the program by lighting up the lamp.



CSI, Visakhapatnam chapter has celebrated 51st foundation celebrations of CSI by conducting different techno and social activities in Visakhapatnam. It has taken CSI's name into public and industry to the great extent.

IT Department, Visakhapatnam Steel Plant and Computer Society of India Visakhapatnam Chapter collectively organized a technical talk on 'MOBILE HACKING & COUNTER MEASURES'



on Saturday at ED(W) Main conference hall. Sri R. Nagarajan, Executive Director (Services)-RINL, Chief Guest of the function inaugurated the technical talk. Speaking on the occasion Sri Nagarajan highlighted the need for taking sufficient precautions while using the smart mobiles. He lauded the efforts of Computer society of India Visakhapatnam Chapter in association with IT Department for conducting a very useful technical talk in this direction. He appreciated CSI Visakhapatnam Chapter for its initiative for promoting IT in various walks of the life, especially in the remote areas.

Delivering the technical talk the main speaker Sri K. Anand, Certified EC-Council Instructor, PMP, ITIL (ITIL, formerly known as the Information Technology Infrastructure Library, is a set of practices for IT Service Management (ITSM) that focuses on aligning IT services with the needs of business.)

During an enthusiastic interactive session, Sri Anand clarified an array of queries raised by VSP Officials. Sri KVSS Rajeswara Rao, GM (IT & ERP), presented a memento to Sri Anand. In his welcome address Sri Y. Madhusudana Rao, AGM (IT), Vizag Steel & Secretary, CSI, Visakhapatnam Chapter highlighted various measures being taken up by CSI Visakhapatnam Chapter in promoting IT. Sri Suman Das, Head of Department (Information Technology), Several Senior officials of VSP have graced the occasion.

CSI-TECH WHIZ QUIZ 2016 competition was held at Dr.YVS Murthy auditorium, AU Engg. College of Andhra University on Sunday as part of the 51st formation day celebrations of Computer society of India. Around 300 students from 18 colleges have participated in the Quiz. Secretary, CSI, Visakhapatnam Chapter, Sri Y. Madhusudana Rao, AGM (IT), Vizag Steel welcomed the gathering. Chapter Chairman & Vice Principal AUCE, Prof P. S. Avadhani has inaugurated the program by lighting up the lamp. The Quiz was conducted in three phases. The first phase is preliminary one and it's like a written test. Top 12 teams were selected for next phase i.e. Semifinals. Two semifinals were conducted with six teams each. Three teams from each semifinal were selected for final phase of the Quiz. In the finals, six teams were participated and three prizes viz. Winners, 1st Runner Up, 2nd Runner up were announced by the Quiz Master Sri J. Rahul, AGM (HRD), Visakhapatnam Steel Plant.

First Winning team Sri Ankur Bhattacharya, Gunisetti Ayyappa Chaitanya and Romit Dhara from GITAM University received cash award of Rs.15000/- 1st Runner ups Sri K. S. Asish Kumar, Sri C. Amareswara Prasad and Ms. K. P. S. Sahitya from Andhra University college of engineering received cash

award of Rs.9,000/- and 2nd Runner-up team Sri P. Sai Pavan, Sri K. Sai Kishore and Sri G. Raghuram from AU College of Engineering received Rs.6000/- besides individual trophies and Certificates. All the three winning colleges also received the Trophies. Participation certificates were also issued to all the students in the Quiz.

Secretary, CSI, Visakhapatnam Chapter, Sri Y. Madhusudana Rao, AGM (IT), Vizag Steel and Prof. Lalitha Bhaskari-AUCE(Autonomous) have coordinated the programme. Executive members of CSI-Visakhapatnam Chapter, hundreds of engineering students, staff of AU College of Engineering have actively participated in the programme.

## Div IV (Communications)



C SI Div IV organized a two days National seminar on "Assemblage of Digital Era 2016" at The Bhopal School of Social Sciences on 18th & 19th March, 2016. The Seminar was inaugurated by Dr. C. S. Rathore, IIFM, Bhopal. The Seminar was attended by 100 delegates from in and around the near vicinity. Papers were presented by the academicians, research scholars. Eminent Speakers were invited to deliver the keynote and invited talks.. Dr. Vipin Tyagi, Vice President - Region 3 - CSI, Jaypee University of Engineering & Technology, Guna, delivered the key note address and Highlighted topics like Digital Era, Digitalization, Big Data, Li-Fi, Comparison between Li-Fi & Wi-Fi, Search Engine Optimization.

Other speakers were Dr. Anurag Seetha, HOD, Computer Applications, MCRPV, Bhopal, Ms. Sini Joseph, NRI Eng. College, Bhopal, Dr. R.S. Thakur, MANIT & Chairman, CSI Bhopal, Prof. M.A.Rizvi, Dr. Nishchol Mishra, UIT RGPV, Bhopal, Ms. Monika Sahu, Govt. Polytechnic College, Dindori, Mr. Hemraj Chouhan, Chief Manager Red Hat, Dr. Prashant Singh, Project Manager, ISC, Bhopal, Mr. Nischal Saxena, Testing Manager, ISC, Bhopal, Dr. N. C. Ojha, Regional College, NCERT, Bhopal. Dr. M. A. Rizvi, Dr. Vipin Tyagi were the chair of the various sessions. Dr. John P. J., Principal BSSS and the Vice Principal BSSS, congratulated the whole organizing team including the convener of the seminar Ms. Archana Naik, HOD Computer application, Organizing Secretary Ms. Jincy Renji Thomas and Joint Secretary Mr. Zeeshan Siddiqui.

■ CSI DAY CELEBRATIONS @ STUDENT BRANCHES ■ ■



REGION - I		REGION - III	
DRONACHARYA GROUP OF INSTITUTIONS, GREATER NOIDA		VIKRANT GROUP OF INSTITUTIONS, GWALIOR	
5-3-2016 - Technical events on Programming Competition, Technical Lecture & Practical Interactive Session		5-3-2016 - Prof. Madhuraj Singh is giving presentation on ANDROID technology	
REGION - III		REGION - V	
G H PATEL COLLEGE OF ENGINEERING & TECHNOLOGY, VALLABH VIDYANAGAR		THE LNM INSTITUTE OF INFORMATION TECHNOLOGY, JAIPUR	
6-3-2016 - Two expert lectures on Artificial Intelligence & Student Startups		12 & 13-3-2016 two-day Python Workshop	
REGION - V		REGION - V	
SRINIVAS INSTITUTE OF TECHNOLOGY, MANGALORE		G PULLA REDDY ENGINEERING COLLEGE (AUTONOMOUS), KURNOOL	
5-3-2016 - one day Hands-on workshop on the topic LaTeX Document Creator		9-3-2016 - event on Poster Presentation	
REGION-V		REGION-V	
BRINDAVAN INSTITUTE OF TECHNOLOGY AND SCIENCE, KURNOOL		JYOTHY INSTITUTE OF TECHNOLOGY, BANGALORE	
7-3-2016 - Teams at the quiz competition		5-3-2016 - Technical Quiz contest	

## ■ CSI DAY CELEBRATIONS @ STUDENT BRANCHES ■

REGION-V	
SIR M VISVESVARAYA INSTITUTE OF TECHNOLOGY, BANGALORE	K V G COLLEGE OF ENGINEERING, SULLIA
	
11-3-2016 - Prof. Dilip K Sen, Prof. Kini, Prof. Patnaik, Prof. Vijaykarthick during CSI Day Celebrations	12-3-2016 - Technical talk on BLUMIX- Next Generation Cloud Application Development Platform
REGION-VI	
VIDYA VARDHAKA COLLEGE OF ENGINEERING, MYSURU	SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR
	
5-3-2016 - workshop on PYTHON applications	12-3-2016 - Faculties and CSI Student Branch Team celebrated CSI foundation day Programme
REGION-VI	
KIT'S COLLEGE OF ENGINEERING, KOLHAPUR	GANADIPATHY TULSI'S JAIN ENGINEERING COLLEGE, VELLORE
	
7-3-2016 - one day workshop on Internet of Things (IoT)	11-3-2016 - Mr. H R Mohan, Immediate Past President during CSI Day Celebrations
REGION-VII	
VELAMMAL ENGINEERING COLLEGE, CHENNAI	KNOWLEDGE INSTITUTE OF TECHNOLOGY, SALEM
	
4-3-2016 - Dr. Rajalakshmi, Professor, Dean-IT & SBC, Shri Bhaskaran, Chairman, CSI Chennai Chapter, Dr. Duraiapandian, Principal	5-3-2016 - Dr. Kumar, HOD-CSE Inaugurated CSI DAY Celebrations

## ■ CSI DAY CELEBRATIONS @ STUDENT BRANCHES ■

REGION - VII	
S A ENGINEERING COLLEGE, CHENNAI	VEL TECH HIGH TECH DR. RANGARAJAN DR. SAKUNTHALA ENGINEERING COLLEGE, CHENNAI
	
7-3-2016 - Participants in the Technical Events (Paper Presentation, Web Design, Code Debugging)	7-3-2016 - Mr. Siddharth and his team receiving First prize from the Principal in Technical Quiz Competition

## CSI Golden Jubilee National Student Convention



CSI Golden Jubilee National Student Convention was organized at GLA University, Mathura organized on March 12 -13, 2016, in association with Computer Society of India, Mathura Chapter, Region-1 & Division-1 in which more than twenty institutions from Agra, Mathura, Aligarh, NCR Region other states such as Rajasthan participated.

Convention was inaugurated by Vice Chancellor Prof. Durg Singh Chauhan, Pro-Vice Chancellor Prof. A.M. Agarwal, Director Prof. Anoop Kumar Gupta, Head of the Department CEA Prof. Anand Singh

Jalal, Chairman of CSI Mathura Chapter & Convener of Convention Prof. Dilip Kumar Sharma and Chief guest Prof. M.N.Hoda, Director of Bhartiya Vidyapeeth Institute of Computer Applications and Management, New Delhi lightened the lamp before the idol of Goddess Saraswati and source of inspiration to many Shree Ganeshlal Agarwal. After that Vice Chancellor, GLA University Prof. Durg Singh Chauhan talked about IT industry in a way that today IT industry with the IT enthusiasts share their knowledge and exchange ideas in the direction of the growth of this emerging sector and hence CSI playing a key role in fulfilling the social responsibilities by guiding and helping student in the field of computer education for research and development.

Chief guest Prof. M.N. Hoda addressed the members and participants and emphasized the need to learn from failures instead of getting distraught. Pro-Vice Chancellor and Convention Chairperson Prof. A.M. Agarwal motivated the students to show participation in such activities and wished them for the bright future. Head of Department CEA & Organizing Chairperson Prof. Anand Singh Jalal introduced the theme of the event to all the participants and also underscored the vision that CSI holds and its mission. Also GLA Alumni Kumar Dharmendra B.Tech CSE 2013 batch who was the Guest of honor for the event was awarded for his excellent performance as he got 21st Rank in UPPCS Exam. Vote of thanks was given by Chairman CSI Mathura Chapter, Convener & Program Committee Chairperson of convention organized, Prof. Dilip Kumar Sharma. Prof. Sharma also gave the seminar on the convention theme Digital India. He shared the information about the prevailing digital age and ways to communicate across the globe by incorporating technologies and coordination of the next generation altogether by generating innovative ideas. Also ways to connect people on the strength of human values not identities

In this Computer Society of India 50<sup>th</sup> National Student Convention twenty events including Expert talk on Digital India, Seminar on Digital India, Technical Paper Presentation, Robowar, Technical Quiz, Bug it out, Project Expo, Website Designing, Cook the Query, CPU Assembling, Multimedia Quiz, PCM interrogation, Chess (Brain Game), Clix, Treasure Hunt, GLA's Got Talent, LAN Gaming, Dancing, Singing, Music were organized and over 1000 participants showed active participation. The event was successfully winded up by giving away trophies and certificates to winners and participants and to student and faculty coordinators for their crucial role played in organizing the convention.



Presence of Deepak Mangal, Saurabh Singhal, Deepali Singh, Rakesh Kumar Galav, Nitin Tyagi, Neeraj Varshney, Ashish Sharma, Narendra Mohan Sharma, Manoj Kumar, Praveen Mittal, Saurabh Anand, Nikhil Govil, Rahul Pradhan, Kailash Kumar and students including Keshav Goyal, Manuj Mittal, Nishant Kumar, Tejaswi Sharma, Kapil Agarwal etc. was also marked.

## ■ FROM STUDENT BRANCHES ■



REGION - I		REGION - III	
AMITY UNIVERSITY, NOIDA		THE LNM INSTITUTE OF INFORMATION TECHNOLOGY, JAIPUR	
4-2-2016 - Mr. Vineet Choudhary addressing the students during the expert talk on IoT, RFIDs and Sensor Devices		15-2-2016 - during the event on Winter Internship Project	
REGION - III		ACROPOLIS INSTITUTE OF TECHNOLOGY & RESEARCH, INDORE	
ACROPOLIS INSTITUTE OF TECHNOLOGY & RESEARCH, INDORE		ACROPOLIS INSTITUTE OF TECHNOLOGY & RESEARCH, INDORE	
24-2-2016 - during Collage & Poster making competition		25-2-2016 - during Coding Competition	
REGION-III		JAYPEE UNIVERSITY OF ENGINEERING & TECHNOLOGY, GUNA	
JAYPEE UNIVERSITY OF ENGINEERING & TECHNOLOGY, GUNA		JAYPEE UNIVERSITY OF ENGINEERING & TECHNOLOGY, GUNA	
7 & 8-3-2016 - during two days workshop on Cyber Security		15 & 16-3-2016 - two days workshop on A Byte of Data Structures	
REGION-V		ANURAG GROUP OF INSTITUTIONS, HYDERABAD	
BRINDAVAN INSTITUTE OF TECHNOLOGY AND SCIENCE, KURNool		ANURAG GROUP OF INSTITUTIONS, HYDERABAD	
13-2-2016 - during one day workshop on Internet of Things		26 & 27-2-2016 - during the State Level event on INFOQUEST 2016	

## ■ FROM STUDENT BRANCHES ■

### REGION-V

MLR INSTITUTE OF TECHNOLOGY, HYDERABAD



3-1-2016 - Mr. Ram Shankar delivering an Expert talk on Tips on middle tier development in enterprise apps

MLR INSTITUTE OF TECHNOLOGY, HYDERABAD



17 & 18-2-2016 - during two days workshop on Internet of things

### REGION-V

STANLEY COLLEGE OF ENGINEERING & TECHNOLOGY FOR WOMEN, HYDERABAD



11-3-2016 - during the event on 1st Success Meet

G PULLAIAH COLLEGE OF ENGINEERING & TECHNOLOGY, KURNOOL



5-3-2016 - Chief Guest Mr. Pattabhiramaiah lighting lamp during 7th National Level Technical Symposium

### REGION-V

GIT, GITAM UNIVERSITY, VISAKHAPATNAM



12-3-2016 - during State level Technical Symposium on PRAUDYOGIKI 2k16

### REGION-VI

K V G COLLEGE OF ENGINEERING, SULLIA



19 & 20-3-2016 - during Android App Development Workshop

### REGION-VI

K K WAGH INSTITUTE OF ENGINEERING EDUCATION & RESEARCH, NASHIK



11-3-2016 - Ms. Deepti Kulkarni welcomed by Prof. Sane, Regional Vice President, Region-VI, CSI & Vice Principal during expert talk on The Agile Way

K K WAGH INSTITUTE OF ENGINEERING EDUCATION & RESEARCH, NASHIK



17 & 18-3-2016 - Mr. Suchit Tiwari, Prof. Kolapkar, Prof. Shahane, Prof. Sane, Prof. Nandurkar, Prof Kamlapur, Prof Banait & Mr. Rohit Patil during inauguration of National Level Technical Symposium Equinox16

## REGION-VI

PROF RAM MEGHE INSTITUTE OF TECHNOLOGY & RESEARCH, AMRAVATI



29 to 31-1-2016 - during three days workshop on Android Application Development

KAVIKULGURU INSTITUTE OF TECHNOLOGY & SCIENCE (KITS), NAGPUR



9-3-2016 - Students during the event on DataQuest

## REGION-VI

SHARAD INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING, YADRAV (ICHALKARANJI)



2 & 3-3-2016 - during two days FDP on FOSS

SHARAD INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING, YADRAV (ICHALKARANJI)



4 & 5-3-2016 - during two days workshop on FOSS

## REGION-VI

UNIVERSAL COLLEGE OF ENGINEERING, VASAI



21-3-2016 - Prof. Vishakha Shelke delivering lecture during Latex Workshop

MARATHWADA MITRA MANDAL'S COLLEGE OF ENGINEERING, PUNE



3-3-2016 - Keynote Speech by Mr. Anand Paropkari, Vice chairman, CSI Pune Chapter during hands-on session on Agile Methodologies

## REGION-VII

JCT COLLEGE OF ENGINEERING AND TECHNOLOGY, COIMBATORE



14-3-2016 - during CSI Student Branch Inauguration

KSR INSTITUTE FOR ENGINEERING AND TECHNOLOGY, TIRUCHENGODE



25-2-2016- during One-day Workshop on Game Programming and Development

## ■ FROM STUDENT BRANCHES ■

### REGION-VII

SATHYABAMA UNIVERSITY, CHENNAI



4 & 5-3-2016 - during Two Days Training Programme on PhP

SATHYABAMA UNIVERSITY, CHENNAI



26-2-2016 - during Student Branch Inauguration

### REGION-VII

ER. PERUMAL MANIMEKALAI COLLEGE OF ENGINEERING, HOSUR



23-2-2016 - Dr. Chitra, Principal during the Inaugural address of one day event on Sagnanana - CSI Online Quiz Competition-16

ER. PERUMAL MANIMEKALAI COLLEGE OF ENGINEERING, HOSUR



15-3-2016 - Dr. Venkatesan handling the Workshop on R-programming and RapidMiner

### REGION-VII

SASTRA UNIVERSITY, KUMBAKONAM



26-2-2016 - Mr. Hariprakash addressing during the Guest Lecture on A Deep dive into Flash Memory Technology

RAJALAKSHMI ENGINEERING COLLEGE, CHENNAI



20-2-2016 - during one day workshop on Software Requirements Engineering – Industry Practices

### REGION-VII

S A ENGINEERING COLLEGE, CHENNAI



12-2-2016 - Mr. Sridhar, Dr. Nagarajan, Mr. Parthasarathy & Mr. Srinivasan Mohandass during National level Symposium

S A ENGINEERING COLLEGE, CHENNAI



21& 22-3-2016 - Dr. Umarani Srikanth, Ms. Ponnalar & Prof. Geetha during two days Workshop on Mobile Application Development

### REGION-VII

PRIYADARSHINI ENGINEERING COLLEGE, VANIYAMBADI



9-3-2016 – during Guest Lecture on Things you should know about Network Security & Privacy

PRIYADARSHINI ENGINEERING COLLEGE, VANIYAMBADI



10-03-2016 – during one day Workshop on Internet of Things

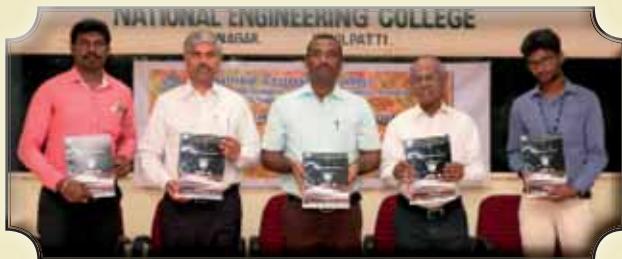
### REGION-VII

RAJALAKSHMI ENGINEERING COLLEGE, CHENNAI



13-2-2016 – Mr. Ramesh delivered a Lecture on Agile Methodology

NATIONAL ENGINEERING COLLEGE, KOVILPATTI



25 & 26-2-2016 – Mr. Jerart Julius, Dr. Shanmugavel, Dr. Chockalingam & Mr. Sangalipandi during two days National Level Technical Symposium

### REGION-VII

VIT STUDENT BRANCH, VELLORE



24-2-2016 – during one day workshop on App development and Project Management Tool

VIT STUDENT BRANCH, VELLORE



9 & 11-3-2016 – during two days workshop on Android app development

### REGION-VII

EINSTEIN COLLEGE OF ENGINEERING, TIRUNELVELI



18-3-2016 – Dr. Sundaram motivating the students on Analytical skill developments and effective handling of campus drives

SYED AMMAL ENGINEERING COLLEGE, RAMANATHAPURAM



5-3-2016 – during TECHCON'16 - a Student Level Technical Convention

## ■ FROM STUDENT BRANCHES ■

### REGION-VII

VALLIAMMAI ENGINEERING COLLEGE, KATTANKULATHUR



2-3-2016 - during one day Guest lecture on Wireless Sensor Networks

ADHIYAMAAN COLLEGE OF ENGINEERING, HOSUR



24-2-2016 - Prof. Sakthivel, explains the PHP Scripting language during one day National Level Workshop on PHP Scripting Language

### REGION-VII

K L N COLLEGE OF INFORMATION TECHNOLOGY, POTTAPALAYAM



26 & 27-2-2016 - during two Days Workshop on Android Development

GANADIPATHY TULSI'S JAIN ENGINEERING COLLEGE, VELLORE



28-1-2016 - during Computer Awareness program for panchayat union middle school students

### REGION-VII

KARUNYA UNIVERSITY, COIMBATORE



16-3-2016 - Mr. Vishnu Potty awarding the Prize to the winners along with Dr. Kumutha Raimond & Mrs. Ramalakshmi during the event on Invenio'16

J P COLLEGE OF ENGINEERING, TENKASI



23 & 24-2-2016 - during Two Days Workshop on Android Programming

### ExecCom Meeting - April 2016





# CSI Executive Committee

## 2016-2017/2018



### EXECUTIVE COMMITTEE



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## CSI CALENDAR 2016



**Sanjay Mohapatra**, Vice President, CSI & Chairman, Conf. Committee, Email: [vp@csi-india.org](mailto:vp@csi-india.org)

Date	Event Details & Contact Information
23 April 2016	<b>International Conference on "Advances in Information Technology and Computer Science and Engineering"</b> at Uttarakhand University, Dehradun <b>Contact :</b> Mr. Sumit Chaudhary, Mob: 09917155889, <a href="mailto:iimtsumit@gmail.com">iimtsumit@gmail.com</a>
10-11 May 2016	<b>National Conference on Recent Trends in Computer and Communication Technology (RTCCT 2016)</b> at Sarvajanik College of Engineering and Technology, Surat, Gujarat. <a href="http://www rtcct2016 scet ac in">www rtcct2016 scet ac in</a> <b>Contact :</b> <a href="mailto:info rtcct16@scet ac in">info rtcct16@scet ac in</a> , Phone: 0261-2240145-158
28-30 May 2016	<b>International Conference on Computational Intelligence and Informatics (ICCI-2016)</b> by Dept. of CSE, JNTUH College of Engineering, Hyderabad <a href="http://www icci net">www icci net</a> <b>Contact :</b> 7680995513, <a href="mailto:convener icci2016@jntuh ac in">convener icci2016@jntuh ac in</a>
30 May -1 June 2016	<b>National Workshop On Applicable Mathematics to Engineering and Science (NWAMES)</b> at Jayee University of Engineering and Technology, Guna <a href="http://www juet ac in">www juet ac in</a> <b>Contact :</b> Dr. H.K.Mishra, <a href="mailto:hkmnnit@gmail com">hkmnnit@gmail com</a> , 9407570623, Dr. Anuj Kumar, <a href="mailto:anujkumar jiet@gmail com">anujkumar jiet@gmail com</a>
29-30 July 2016	<b>International Conference on Advances in Computing and Data Sciences (ICACDS-2016)</b> . Organized by Krishna Engineering College (KEC), Ghaziabad. <a href="http://icacds2016 krishnacollege ac in">http://icacds2016 krishnacollege ac in</a> <b>Contact :</b> Dr. Mayank Singh, <a href="mailto:icacds2016@krishnacollege ac in">icacds2016@krishnacollege ac in</a> . Mob: 09540201130
18-19 August 2016	<b>International Conference on "Internet of Things"</b> , Venue : APS College of Engineering, Bangalore <b>Contact :</b> <a href="mailto:hodcse apsce@gmail com">hodcse apsce@gmail com</a>
16-17 Sept. 2016	<b>2016 International Conference on Frontiers of Intelligent Computing: Theory and applications (FICTA)</b> , KIIT University, Bhubaneswar. <a href="http://www ficta in">www ficta in</a> <b>Contact :</b> <a href="mailto:fictaconf@gmail com">fictaconf@gmail com</a>
8-10 Dec. 2016	<b>CSI-2016 Computer Society of India's 51st Annual Convention on Digital Connectivity - Social Impact</b> Organized by CSI - Coimbatore Chapter <b>Contact :</b> Mr. Ranga Rajagopal, Convener, 9442631004 <a href="mailto:office@csi-cbe org">office@csi-cbe org</a>
	<b>CeBIT INDIA 2016 - Global Event for Digital Business in association with CSI</b> Venue: BIEC, Bengaluru <a href="http://www cebit india com">www cebit india com</a> <b>Contact :</b> Mohammed Farooq, <a href="mailto:farooq@hmf india com">farooq@hmf india com</a> , +91 9004691833

### Kind Attention: Prospective Contributors of CSI Communications

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

- May 2016 - Smart Cities

Articles may be submitted in the categories such as: **Cover Story, Research Front, Technical Trends and Article**. Please send your contributions **before 20th April 2016** for May issue. The articles may be long (2500-3000 words maximum) or short (1000-1500 words) and authored in as original text. **Plagiarism is strictly prohibited.**

Please note that CSI Communications is a magazine for members at large and **not a research journal** for publishing full-fledged research papers. Therefore, we expect articles written at the level of general audience of varied member categories. Equations and mathematical expressions within articles are not recommended and, if absolutely necessary, should be minimum. Include a brief biography of four to six lines, **indicating CSI Membership no.**, for each author with high resolution author photograph.

Please send your article in MS-Word and/or PDF format to **Dr. Vipin Tyagi**, Guest Editor, via email id [dr.vipin.tyagi@gmail.com](mailto:dr.vipin.tyagi@gmail.com) with a copy to [csic@csi-india.org](mailto:csic@csi-india.org).

(Issued on the behalf of Editorial Board CSI Communications)

Prof. A. K. Nayak

Chief Editor

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## **51st Annual Convention of Computer Society of India**

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