www.iimclickd.in

Issue No. 1

A Pan IIM Technology Magazine

clickd

Inaugural edition

Swarm Optimization in
Embedded Systems

Cover Story:
A short talk with Dr. Bagchi

Mobile Technologies
of the future

P vs NP and
the Limits to Computing

Challenges in software project management

Google
New offering framework

Meet the Pilgrim who
walked to Copenhagen

Cover design: Ginvanglian

The March of Technology

The Editors

The march goes on. The studying of natural phenomena through inquiry and experiments, their re-application and blending to create new things and ideas, the whole scientific method that started during the Renaissance era has greatly improved the human condition. If we look at history we find that technological progress, invention, creation have been the dominant recipes of successful growing civilizations whether it be ancient Greece, post-AD India, the early Islamic rule, Renaissance Europe or 20th century USA. The heartening thing is, almost all cultures and nations today realize the benefits that technological progress brings, and that has made it a global phenomenon.

We called it a march. But it is also a drumbeat which keeps getting louder. A point comes when the drumbeat cannot be ignored. As we all know, established businesses have a tendency to stick with what works, for their motive is to make money and not take undue risks. New technology, which attempts to change the structure of an industry and to upset the titans, has normally been the preserve of startups and entrants, which the titans tend to either ignore or only grudgingly accept. But that keeps on getting ever difficult. Whole industries which didn't listen to the drumbeat and changed accordingly are getting upended. How many people do we know who buy music on CDs and cassettes nowadays? How many use fixed line phones? Last year the eBook industry registered larger sales than physical books, a trend which won't get reversed. Currently, the upheavals and the casualties are still confined to information processing industries. For its true that products cannot be atomized like information into bits and sent across at zero cost. But those who take comfort in this fact will do well to understand that know-how related to manufacturing products can indeed be passed along, and then it is an open game. If you are still skeptical, consider the growth of firms in high technology industries in Asian countries, who kept working their way up by manufacturing inexpensive products for the West and kept on acquiring technological knowledge to finally emerge as global players.

But all this talk of civilizations and businesses tends to distract us from the larger issue that we fleetingly touched in the beginning, the improvement of our collective condition. Why only technology, you may ask. Aren't there economic and political solutions? Or instead of getting into the abstruse workings of nature, can't we just have social harmony and care for each other? Economics and politics are concerned about allocation of that which already exists, the sharing of a fixed pie. If some get more, some have to do with less. Social harmony is of course desirable, but that alone does not guard us against the scarcities and natural disasters that we face. Caring about each other is one of the noblest human traits, but it also implies that there are problems which lead to the necessity of caring. Why not attack these problems themselves? Technology alone comes across as the win-win solution. It gives us permanent capabilities, improves productivity, helps do more things with less and gives us control over our environment. To get a perspective of what happens to a society which does not invest in technology, consider the Roman Empire. The ancient Romans were practical, assertive, hedonistic people who loved democracy and went about their businesses, earning what they could, spending on pleasures, with little patience for mathematics, science, invention, etc. which the Greeks before them had delighted in. When Rome felt the need for more resources, it would battle and acquire foreign territory. With little change in productivity, finally resources proved inadequate to the needs of the empire, and it went into a gradual decline, never to rise again.

As discussed, these are heady times to be thinking about technology, given the huge activity taking place. So we are really delighted that the IIMs, recognizing the importance of technology to society, have come together for the first PAN-IIM Technology magazine, going by the name ClickD. We asked Subroto Bagchi, co-founder

of Mindtree and a great thought leader, to provide the inaugural cover article for Clickd and set the tone for this whole initiative. Pushpanath Krishnamurthy (affectionately called Push), a great climate change campaigner, and his colleague Viva Kermani provided us some great perspectives on technological issues and other concerns related to climate change.

We had also given a call for articles to students across B-schools, and got a response exceeding even our crazy optimistic expectations. We enjoyed reading the articles for they all talked about different things. Some discussed about future products, some about technology in finance, some about outsourcing, some outlined the strategies that technology companies follow or should follow. Still, after a lot of discussion and debate, we decided to pick 3 articles, and we heartily congratulate the authors. The first analyses Google's entire business strategy and how it has been a phenomenal success, the second talks about some of the mobile technologies that are going to rock the future, and the third is an interesting application of swarm intelligence in embedded systems. Apart from that, we received many contributions from enthusiasts, which spoilt us for choice.

We raise a call for articles for the next issue, and we want our readers to go berserk and send technological perspectives from all fields, whether it be aeronautics, deep ocean photography, microfluidics, genetics, whatever one fancies about. The more niche and unusual, the better. Articles on fundamental research and science-fiction like imagination hold a special place in our hearts and will be especially considered. Enjoy reading and writing about technology.

Editors Click'd

The Editorial Team *(Mail any queries and feedback to editor@iimclickd.com)*

Chief Editor
Kalpesh Muchhal

Editorial Board
Bharadwaj Srivatsan
Varun Sharma

Creative Head
Ginvanglian

Content Review Team
Syed Hussain
Kanwar Rajan Singh
Neelabh Singh
Abakash Saikia

Advisory Board
Avinash Parhi
Alok Kumar Jain

Technical Head
Dinesh Gadge

IN THIS EDITION

A Short Talk with Mr. Bagchi

What do you feel is a technologist's or an innovator's role in society as opposed to say an economist, politician or an artist? What is the importance of innovation?

The term 'technologist' can mean anything. An innovator may or may not be a technologist and most technologists are not innovators. An innovator's role is to question status quo, to not lecture about it like a politician, but be an engaged catalyst; so the innovator not only questions but produces the possibility of a changed, higher state. An economist is usually a sense maker of events past but people like Mohammad Yunus prove that an economist, when involved, can also be an innovator. Innovators and artists have something in common; the urge to create. An artist may not always care about adoption. An innovator does. The importance of innovation is in solving real problems in every walk of life; in everyday life. Without innovation, we would be held hostage to incumbency and eventually, perish.

Prof. Govindarajan in his recent book talks about how companies while touting innovation are actually built for efficiency, rather than to innovate. How big ideas are generated, but rarely implemented. How the organizational structure and performance measures do not incentivize innovation. What are your perspectives on this issue?

Vijay is very right. Organizations do not innovate. People do. Organizations are made up of salaried people. Most of them build an engineering-led approach to life. They seek efficiency and not novelty. They are mostly left-brainers. Innovation comes from amygdalin people, not people who look at life through equations, not people who see the world as cause and effect.

Managers have been mostly enablers in their organizations, when it comes to innovation. Can they and should they take a more active role?

The word 'manager' castrates the power to innovate. The term says it all: "manage"; for heaven's sake, manage and manage some more, and manage more efficiently. The manager is therefore, all Bramha -- sans Vishnu and Siva. The terms 'manage' and in some sense 'management' are mindless and originated in the factory-economy; they fall short of what the world needs today. We need a new set of terminologies to begin with and new mindfulness. Expecting the so-called manager to innovate is like seeking affection from someone who has never experienced affection. That may sound dramatic but if you look under the hood, you would see that the average manager was bred as a left-brain thinker and suddenly we call him and ask him to take an active role; it can't happen like that. You cannot deliver when you are not pregnant, and spasms are necessary but not sufficient conditions to deliver a child.

Considering a broader issue, do you think B-schools in India groom leaders and visionaries or do they just create managers. Do they encourage radical thinking when it comes to solving big problems through technology? Do you think that is too much to ask of a B-school education? Can such skills be taught?

I think B-Schools in India are looking at the universe in a 'present forward' manner, not in

a 'future backward' manner. They are largely focussed on efficiency and not creativity, continuance and not disruption, job seeking and not entrepreneurship. While innovation may even have a genetic factor behind it but building the innovation eco-system is a systemic possibility. At least that part can be explained, taught, understood and the results can be dramatic.

Developing countries like China and India are always keen on technology transfer from the developed ones, which the latter are naturally loath to. What are the challenges to developing the required technologies indigenously?

We must get out of this indigenous versus imported mindset. If you study the nature of innovation, the nuances of societies that breed innovation, you would understand that it is not about policy and control; it is about aspiration, long view of time, celebration of diversity, the right education system and openness as a basic value.

We read that at one point in your life, you were considering becoming a civil servant. Can you try recreating such an alternate life if you had become one? How has the role of a civil servant changed since then?

When I started my work life, becoming a government servant was the thing to do. Almost all my friends in college, and certainly the best amongst them, became government servants. It was an option for me as well, particularly because I come from a government servant's family. But somehow, it did not happen. I did not choose that path. I am happy I did not. I would not trade my past for anything because I have created my own path, I deserved all the ups and downs and ruminating on what else I could be is really a futile exercise. As an individual, I seldom think of the past.

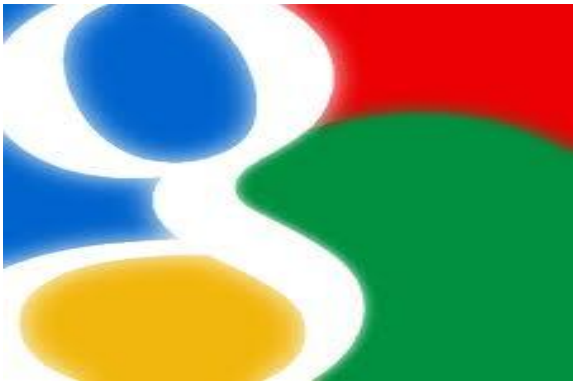
How has the civil service changed? It is barely recognizable from what it was when we were ready for it. Society itself has dramatically changed; so has governance and as a result, the civil service. But I am not a part of it and wouldn't be the right person to make a comment.

What differences do you find in first generation entrepreneurs nowadays vis-à-vis yourself/your pals when you founded Mindtree?

You make me sound archaic and ancient. Have a heart; MindTree is only 11-years old. We are "now-a-days".

Google – New Offering Framework

By Sajith Shetty



There are about 50 major products which are currently supported by Google. Have you ever wondered about the strategy behind the plethora of products released by Google? How do the products relate to Google's corporate vision and business model? This article proposes a framework which captures Google's product strategy. The framework argues that four underlying themes - *Mass Appeal, Information Channels, Process Information* and *Integration* form the basis for all of Google's products.

Where is the money?

Google is the world's largest ad-driven media company. A vast majority of its revenue (97% in 2009) comes from online advertising (Google Investors, 2010). One of the sub segments under online advertising is *Paid Search*, which is accomplished by Google's two advertising products AdSense and AdWords. The other sub segment is *Online Display Ads*, which consists of graphical ads embedded into web pages (Wikinvest Google, 2010).

Clearly, advertising is Google's core business. . So what is the strategy behind all the free products like Gmail, Gtalk, which Google offers on web? It has to be related to Google's business model i.e. advertising. Using this as the strategic intent, when Google's portfolio of product is studied, four prominent themes appear. These four themes capture the link between advertising (core business) and new product offering (product strategy).

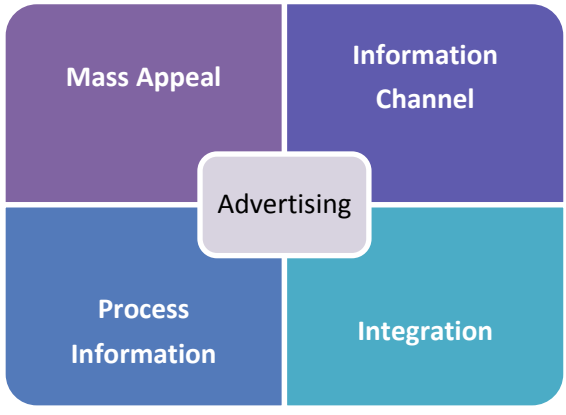


Fig: Google new product offering framework

Mass Appeal

A key strategy for Google is that its products are available and used by as many people as possible. A simple reason is that more the people use Google's product to access information, more the customers can be targeted for advertising by Google. Hence most of Google's products do not target any niche segments. The products are meant to be used by all netizens.

Now in order to diffuse mass products Google observes two simple product aspects. The first is that the product should be simple to use. To quote Albert Einstein - "Make everything as simple as possible, but not simpler." Gmail, GTalk, Google Search are excellent examples of simple to use products. This makes the products usable to even the most naïve users of the internet. The second product aspect is that the product has high relative advantage to boast. This again helps to diffuse the product and to capture market share. For example Gmail, an e-mail service was launched with 2GB free space. This was simply unbelievable at the time, since the existing e-mail providers where either charging money for extra storage or only gave miniscule storage space. Chrome, Google's browser, is another such example.

Information channel

One of Google's business strategies is to cover all possible information channels. Google

would like anyone accessing information to go through at least one of the Google's product. This again ties up to Google's advertising business by increasing the share of target segment. Internet is of course the primary channel for information exchange and Google has captured almost all the possible platforms on it. Gmail covers the mail platform, Gtalk covers the chat platform, Chrome covers the browser segment, and BlogSpot covers the blogging space. Buzz covers twitter kind of platforms, Orkut covers the social networking space, Google News covers new segment, YouTube covers the streaming contents, etc. In conclusion, Google would like to come up with products which try to include an untouched information channel. This is evident from the launch of Android OS to include the mobile channel, and the planned introduction of Google TV to finally get access to one of the most diffused information channels – the TV.

Process information

It is very important that a Google product should be able to process and store user information. One key differentiator in Google's advertising business is the context based advertising. Google uses information collected from users to provide context relevant advertising. For example while reading an email in Gmail if the content of the email has to do with MBA, Gmail will display advertising related to admissions in MBA colleges. To judge the ethical impact of such an act is out of the scope of this article. What this article wants to stress here is that collecting and processing user information is an important competitive advantage for Google. So all Google's products are designed to both access and process information from users.

Integration

The last recurring theme observed is the integration among Google's products. There is a conscious effort to integrate different Google products. For example if you open a word attachment in Gmail, it opens, by default, in Google Docs. Similarly, if you receive a mail in foreign language or if you open a website in Google Chrome which is in a foreign language, Google Translate automatically kicks in and asks whether you would like to translate the mail or the page. Integration accomplishes two things - first it introduces a potential user to a new Google product, second it makes sure that users stay within the Google product portfolio for all their needs. Hence integration across products is another theme in Google's product strategy.

Conclusion

Google's mission is to 'organize the world's information and make it universally accessible and useful' (Google Corporate, 2010). After reading this paper, you can clearly identify how this mission meets Google's core business of advertising. Every time an individual tries to access information, Google wants the individual to use Google's product. This in turn fuels more context based ads. Hence, Google's mission of making information accessible acts as a driver for its growth. Currently Google is one of the main players in the information channel of Internet. It has already made inroads into the mobile channel with Nexus and Android. It has to be seen how Google will fare in the grandest information channel of all, the TV.

Sajith Shetty is a 2nd year PGSEM student at IIM Bangalore. He holds a Bachelor's degree in Computer Science from National Institute of Technology Karnataka, Surathkal. He works with Manhattan Associates as a Senior Analyst and can be reached at sajithshetty@yahoo.com

Mobile Technologies of the Future

By Dhivakar Thiruvalan R

Simple communication devices of yesteryear have rapidly evolved into all-encompassing mobile work stations, highlighting the stunning advances in mobile phone technology. Mobile handset industry is the most dynamic among the tech industries, with a new model or technology being introduced almost every month. Industry pioneers like Apple and Nokia are trying to woo the customers with their cutting edge technology and innovation. When Apple introduced multi-touch features in its iPhone, it took the world by storm and revolutionized mobile phones, especially the smart phones market, and catapulted Apple into the top 5 global manufacturers, starting from nowhere. So what could be the next big thing in mobile phones? Let's look at some of the upcoming technologies that have the potential to revolutionize the way we use mobile phones in the future.

AMOLED

An abbreviation for Active Matrix Organic Light Emitting Diode, this display technology is touted as the next big thing in mobile phones and television. It has several advantages including low cost, ability to be fabricated on multiple surfaces, better viewing angles, increased brightness, faster response times and efficient energy usage. Companies like Samsung, Nokia and Sony have started investing in this technology with Samsung currently holding 98% of the world's AMOLED market. The flexibility of AMOLED has also led to the development of roll-up displays as demonstrated by Sony recently.

NFC (Near Field Communication)

A simple extension of existing RFID technology used in smart cards to mobile phones, this is a short range communication technology that would enable mobile phones to be used as credit cards, smart posters and electronic keys. This aims to introduce the concept of 'mobile wallet' that would boost e-commerce and help integrate various devices into the mobile phone in the future. Research forecasts indicate that one in six mobile users will have a NFC phone by 2014.

4G Network – Successor to 3G and 3.5G networks, 4G promises internet access and a host of other multimedia services at ultra-high speeds. Countries like United States, United Kingdom, South Korea and Canada have already started building infrastructure, aiming to roll out 4G services by the end of 2010 and mobile phone makers like HTC and Apple have started manufacturing 4G enabled phones.

3D display

With the advent of 3D televisions on a mass scale, 3D mobile phones have not lagged behind and industry leader Nokia has already developed a prototype 3D mobile phone, N810. This device doesn't require special viewing glasses and runs on proprietary software. With the increasing development of 3D multimedia content, such devices could gain a huge market share in the future.

Solar powered devices

Increasing awareness about global warming and the need to provide connectivity to rural households without electricity have led companies to develop energy efficient mobile phones. Vodafone recently launched a solar powered mobile phone in India that costs just

Rs. 1500. Other companies like Samsung have followed suit and have introduced similar devices specifically targeting Asian and African markets. This could provide a huge boost to rural connectivity and lead to development of more energy efficient phones in the future.

Eye controlled interface – In an effort to make mobile phones savvier and more sophisticated, Japanese operator NTT DoCoMo has built a prototype device that could be controlled by the movement of our eyes. Simple operations like making/receiving calls, playing and pausing music can be done just by moving our eyes to the right or left. This could very well be the predecessor to increased natural-gesture interfaces and a whole new way to operate/control mobile phones in the future.

Dhivakar Thiruvalan R is a 2nd year PGP student at IIM Ahmedabad. A member of Genesys-the Systems and Technology Club of IIM-A, he holds a Bachelor's degree in Aeronautical Engineering from Madras Institute of Technology (MIT). He worked with Infosys technologies as a software engineer for 3 years and can be reached at 9dhivakart@iimahd.ernet.in

The Coming Age of 3D

By Master Rohit

Remember the days when one used to get red-green glasses when one purchased 3D issues of Diamond Comics. That technology has evolved at 'warp speed' and the future of 3D entertainment has just arrived. Movies, Multiplexes, Console games, TVs, Cameras, Computers, Mobile phones, name anything visual, 3D is just becoming the hygiene factor these days.

The end of the last decade has seen a tremendous growth in 3-dimensional (3D) display technology. 3D content is gaining popularity over normal visuals and this in turn is driving the evolution. Most of the mainstream technology products are now shifting towards it. One of the biggest milestones was the release of the film "Avatar" by James Cameron which grossed over $2.7 Billion in the box office. There was a flurry of 3D movies that released over the past 2 years and the trend is that one out of every five heavy budget movies released is going to be in the 3D format. Hollywood studios increased their production of 3D movies in 2009 by 150%, to a total of 20, and over 50 were planned for release in 2010. The marginal cost of implementing 3D is a lot less than it was for HD, and 3D cinema is creating a 'halo' effect helping drive adoption of 3D related products in general, which is projected to be worth more than $17 Bn by 2014, according to a new report from market research firm Generator Research. All the major hardware players, Samsung, Panasonic, Sony, and LG introduced models which support 3D quite some time back, ranging from 32 inch to a gigantic 152 inch costing around INR 4 Crores. Along with these is the 3D console market for video games which is expected to be around $11.3 Billion at the end of 2010, which includes the Xbox 360, Sony PS3 and Nintendo Wii. Apart from this there is a considerable growth in 3D devices in the digital camera segment, the laptop segment and the latest craze, the tablet PC segment.

However 3D capabilities are not just used for entertainment; they have a lot of industrial uses too. 3D has also been long used by professionals for applications where information can most usefully be analyzed or manipulated in three dimensions. Seeing their work in 3D can be helpful to a car designer experimenting with a new style or a scientist searching for oil and gas in complex layers of seismic data. Semiconductor industry developments will drive 3D Chip technology to new heights. Systems, design, implementation and usage are the other parameters where this is of immense use. The movies and other parts of the entertainment industry can make many applications out of this. Interactive education (e.g. showing things like dissecting frogs without actually killing a frog) is another possibility. Gaming is another. Educational content e.g. the study of the universe, of the human body, of objects and shapes in the mathematical field (e.g. geometry) can all be made more interactive and believable with this technology. Medical surgical procedures, civil structure designs and simulations are all possible. In the field of media, photography-related applications could get a huge fillip. CAD CAM applications will soar to new heights. "In the professional sector, 3D is already a valuable tool for industries such as oil and gas, automotive and medical imaging and we expect that these will continue to grow as the technology becomes more accessible" says Nishant Goyal, Head of Sales, South Asia, and NVIDIA.

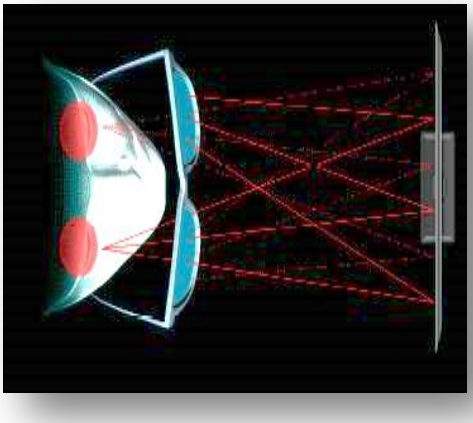
The technology behind 3D

3D imaging uses the fact that humans see things with two eyes that are set slightly apart, to reproduce a sense of depth in addition to horizontal and vertical information. There are primarily three types of technology used behind 3D. The first one is the oldest using polarized glasses. The second one uses active shutter technology which has been pushed by the technology major NVidia for its gaming and PC display systems. The third one has the most potential and will see immense activity in the future, 3D without glasses. The likes of the third has been used by Nintendo 3DS handheld console, the upcoming Apple gadget and even in mobile phones (Spice 3D). With these small gadgets

displaying so much potential for glasses free 3D, televisions won't be far behind. The following diagrams show the 3 systems in depth.

Polarized Glasses

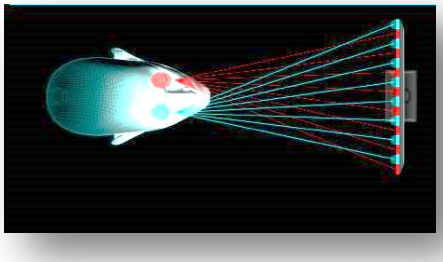
Polarizing filters only allow through light which oscillates in specific ways. On a



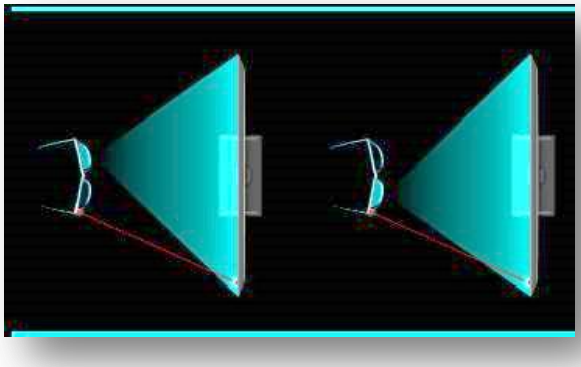
polarizing TV, both perspectives are displayed simultaneously as a series of alternating vertical bands, with each set sitting below same-width bands of one of two differently polarizing filters. The two lenses in the 3D glasses use corresponding filters, so they only let light form one set of bands to pass through. As a result, each perspective can only be seen through its corresponding lens.

Active shutter glasses

This technology works by wirelessly



synchronizing the image on screen with the lenses of a pair of battery-powered glasses. The different perspectives replace one another on the TV every 120th of a second, and LCD blockers in the glasses' lenses flicker on and off alternately at the same rate. Each eye is therefore only able to see one of the perspectives. The flickering is so fast, it's imperceptible – without the glasses on, and



the two perspectives appear overlaid.

Auto-stereoscopic (glasses free)

As with polarizing, both perspectives are displayed on screen in vertical, alternating bands. The lenticular overlay consists of vertical prismatic strips that direct the light from these bands in one of two directions: either towards the right eye, or the left. In addition, a parallax barrier (a layer of material covered in tiny vertical slits) prevents the left eye seeing the right's bands, and vice versa. Nintendo's 3DS and Fujifilm's W3 3D camera use this technology.

Lagging Adoption

Even though the technology exists for display, 3D has failed to start in a major way since no broadcaster gives 3D content. There is still a lot of volatility in the market as to what will be the future standards of 3D content and display technology. One has to deliver 3D content in the form of DVDs, which is an added cost. In addition to this 3D glasses cost extra and one also has to have Blue Ray 3D

players or proper interface with a computer to watch. While this might be enjoyed individually, this becomes the biggest drawback when a group of people are watching content at home. Most of the brands are very eager to introduce their own 3D capable TV sets. High prices and contradictory views from analysts and manufacturers indicate a confused future for 3D technology in India.

The major key challenge for marketers is to get 3D hardware into homes as sales depend on how brands can get people excited about buying new equipment at premium prices. But the current consumer is quite satisfied with the quality shift to HD recently and may not prefer a sudden change again. In the meantime it means that it is a boon for multiplexes which are gaining huge footfalls due to this technology.

NVidia, one of the leading graphic card chipmakers, has also joined the bandwagon to position 3D within the reach of technology enthusiasts and has collaborated with such leading consumer technology brands as Acer, Alienware, Asus, BenQ, Dell, Fuji, HCL, Panasonic, Samsung, Sony and ViewSonic. The opportunity for 3D is immense but the support is lagging.

Promising Future

According to Deloitte analysts, 3D may just be the next trend over the coming years if the pricing is right and content availability picks up. 3D games are popular on LCD TV and this could be an important aspect of entry and growth of newer technologies in 3D TV. However, the pricing will define the success or stagnation of this technology." Last year alone U.S. consumers were expected to purchase a mere one million 3D TV sets. But by 2013, 4.3 million or 25% of all televisions – and nearly 50% of HDTVs – sold in the U.S. should include the new technology. Companies that create and deliver content like Disney, DreamWorks and DirecTV will all take a big share of the revenue pie, but television makers are set to make the most from the new technology. And of that group, Sony could easily come out on top since it's betting so big on 3D as the future. With every sphere of technology going into 3D, there is going to be a convergence of all platforms, from movies and entertainment, gaming, portable devices and communication systems. From Virtual Reality to Augmented reality, all will become a part of our lives and it will be refined continuously. The concept of 4D is already being tested out and a number of other interactive and mind-boggling innovations are brought out every day. The best way is to enjoy the 3D evolution is the way it is.

Rohit is a 2nd year student at IIM Bangalore. He is a tech geek and a marketing freak. He interned with Samsonite in a marketing role. He can be reached at master.rohit@gmail.com

Meet the Pilgrim who walked to Copenhagen

Pushpanath Krishnamurthy, or "Push" as he is better known, is a climate campaigner, who is renowned as the man who walked from Oxford to Copenhagen on foot to highlight the disproportionate effect of climate change on developing countries. He works for Oxfam UK and is currently in Bangalore researching on the impact of business on society.
Viva Kermani is Director (Finance) of Centre for Social Markets (CSM) (www.csmworld.org), a prominent non-profit looking to make markets work for the triple bottom line – people, planet and profit**.** She is currently based in Bangalore**.**
Both kindly agreed to share their perspectives on the issue, which led to this special feature.

Where is the worst impact of climate change being seen?

Push: You have to always measure the worst impact in terms of human impact, and also ecological impact, because of the interdependence in nature. We were just looking at some rankings done in terms of disasters. The most number of disasters happened in America – around 540 in a particular period. The US stands first in terms of number of natural disasters, but the numbers of deaths in the US were quite low, in double digits. If we look at India, it will run in the thousands. So the impact is a consequence of how prepared you are and what kind of strengths do you have to overcome a disaster.

Through the Climate Hearing process, we bring people in the frontline to start telling us whether the climate is changing and whether it is changing for the good or bad. These hearings reveal many things. Every drought sets back a poor family by 8 to 10 years. Sometimes a flood does that. What I mean by that is that the little you have is finished. For the only asset that many families have is one cow. For them to get a cow as an asset is for us equivalent to buying a house. It takes a long time.

The hearing also showed us that women are the most vulnerable. In Bangladesh, during cyclone Aila, there was this woman shouting at her husband to protect the goat kid. She was worried that the kid will die and the husband may too, but she wanted to protect the kid for it was the only property that she has. This is something to think about. Women, and even urban women, those living at the margins, are the first and the hardest hit.

How can technology help, both from a curative and preventive perspective?

Push: Most countries have what we call disaster preparedness (DP). Disaster happens often, but it becomes a hazard when people, animals and living things die. Western countries have spent a lot of money on DP, especially if you take the example of Netherlands, for their land is submerged otherwise and they have to keep it reclaimed from the sea. For this you need both resources and technology. Both from an immediate view, as in how do you recover from a threat, and how do you mitigate or reduce the impact in the long term.

There are some good examples. Since sea water level is rising and soil is becoming more saline, farmers in Bangladesh are beginning to cultivate in the water itself. Earlier they were using chickens, now they keep ducks. Small meteorological stations help to gather local information so that people can see, for example, that in the last 3 years the wind has changed this and that way. So there are alternate technologies even at the simplest level. There are a lot of opportunities in mitigation too. For e.g. Better seeds is one approach. Technology to harvest the water that is going to waste is another. Renewable energy will play a big part.

Also, technology doesn't happen independently. There are very clear interests that develop around every technology. If you go to Copenhagen or Cancun, one of the largest delegations comes from the oil countries. Whereas a country like Maldives which is going to be submerged has only a few people representing because they don't even have money to come to the event. There are many technologies that we can use, but whose interests it is serving is equally important.

Can technology alone deliver or do we require other approaches too?

Viva: I don't think technology is the only solution. It also has to be behavioral change, and at the personal level. We also require changes in policies. If you start putting a price on some of the 'services' provided by the environment, then a lot will change. Today if somebody wants to build a dam, they will do a typical CBA (cost benefit analysis). They never really take the cost of ecosystem services into account.

A big breakthrough has been the TEEB report. It was done by Pawan Sukhdev who advises the World Bank and he has figured that the only thing people understand is money. So let's monetize, let's find out the value of our forests, of our natural assets. The last one came out in Sep 2010. If you think about it, climate change is the world's biggest market failure, in that while making something, we don't factor in the cost of destroying the environment. Maybe a market mechanism to deal with this can help.

You have visited so many countries. How oriented are their governments towards committing themselves? Have the negotiations, over so many years, reached anywhere?

Push: Whenever we go through a planetary or civilizational crisis, like the one we are going through now, we never respond to it unless it hits us. And much of it is rational. Now the rationality of climate change science took a long time to be established. If you look at the IPCC report, the scientific proof is finally given. But despite the science having been developed, there is a whole group of climate change deniers. In a US congressional hearing a politician said that "*we are dead against this business of stopping reduction in carbon. Why? Because plants have a right to all the carbon dioxide. How can you reduce that, they should get as much as they want.*" These are the kinds of arguments they come up with, even in a formal hearing.

A finance minister will ask that things may happen 40 years from now, and I only have money now, so in anticipation of things going wrong then, how can I invest now? Rational question. Nick Stern, in his book 'Economics of Climate Change' did the costing and he said if you do not spend $1 today [on climate change prevention]; you are going to pay $4 in less than 15 years.

So now the science has been given, the economics has been given, what is not given are the social consequences. Who is paying the price? The poorest people are paying the price. Everybody will pay the price, if not today, then tomorrow. But today the poorest are paying the most for this nightmare that is being created by human activities in selfish interest of particular countries.

We have the science and the economics, but what we need is the political decision to be made.

Viva: I would like to add a couple of points to what Push is saying. The issue that we are asking about is why we are not moving aggressively enough towards a solution, because we all see all these meetings happening between 192 countries year after year, it is covered in the news, and you hear sound bites of ministers saying that we must do this and that.

The problem is that climate change science has become too complex for the politicians to understand and too political for the scientists to understand.

It is political because 192 counties have to agree on a plan. The countries that are impacted the most have not caused the problem. There is not sufficient will in the US to solve somebody else's problem. The US also says that we didn't know for the last 80 years that our activities will cause such a problem. That we had no idea. If we knew, we wouldn't have done this, and you can't punish us for something we didn't know. So the issues are very complicated. And at the same time, a lot of the solutions lie in developing countries as well. Developing countries are not locked in [to a certain model of economy]. Developed ones are, and for them to come out of such a model is impossible. They are very dependent on fossil fuels; they have built their entire economies and countries around that. So they feel the solutions are in developing countries. But the developing countries ask who is going to give them the finance and technology.

Recently there was this controversy over IPCC's report that the science is not correct, that the models are not accounting for everything. What was exactly the problem?

Push: In science, we sometimes think we have found the answer, but over a period of time, that answer is not complete and a new one has to be found. There is always some kind of imperfection involved. I am not defending consciously trying to say a wrong thing. But mistakes are often made in good faith in science.

Viva: The controversy was about an inaccurate prediction about a Himalayan glacier, where they said the glacier is going to disappear by 2030. The climate change deniers picked that up, highlighted it, but they never actually did the right reporting. The media has also been irresponsible, because there is a lot of good work coming out from Potsdam institute, from NASA, but we don't really see that. IPCC has published thousands of reports. There is no question they have done a lot of good work in bringing the issue to the main stage.

Climate science is often described as a wicked science, in that there are no perfect models or solutions. It is a complex interaction between the atmosphere, cryosphere, oceans and the lithosphere. So no one understands it fully. Right now we are only talking about the atmosphere and carbon. We haven't even begun to look at the impact on the oceans. The oceans take much longer to heat up. And

when that happens there is going to be huge devastation. There is something called a lag time in that carbon stays in the atmosphere for a long time. Currently it almost 390 ppm. At the beginning of the industrial revolution it was 285. Using carbon present in long frozen ice cubes, scientists have demonstrated that carbon levels in the atmosphere have never been this high.

Given the political nature that the subject has developed, and hence the stalemates, shouldn't climate change efforts direct all their energy bracing for impact rather than looking for long-term solutions?

Push: Good point. That is why organizations like Oxfam, who are working with the poor people, are shouting about adaptation. Climate change is costing lives and livelihood, and it needs to be said that the impact is particularly poor women, young children and the elderly. These facts have to be said. And that is why we are talking about adaptation quite a lot.

But the other aspect of mitigation is equally important. There are meetings in which people don't agree and it is considered fine because they can agree later. But now time is running out. If temperature rises, the consequences keep getting severe. Each of the disasters we have seen in the last 5 years, we say, God, we never looked at it this way before. Even the scientists at IPCC look at their predictions of 3 years ago and find that they were so conservative. That they underestimated the whole thing. The monster is getting so big, that you cannot help but talk about how you demolish the monster itself. So you can't separate mitigation from adaptation. How far will you adapt, until you are dead? We have to hit at the heart of the issue, which is how do we stop and how do we reduce. And indeed we never had a greater opportunity to do that. We can in fact make a fantastic business case for it.

Viva: People are not even making the connection between climate change and the economy. In Australia, the recent floods happened in the areas with rich natural resources, with coal. They are already seeing that the price of electricity is going to go up. And they have lost 0.5% of their GDP. So if you make that link, then people will act. Or you have to price coal differently. Why is coal so cheap right now? Because it is not fully priced, because they don't include the cost of environmental degradation and the impact on health. Solar and wind are expensive, only because coal is cheap.

Push: While I was walking, I wondered how do we attack the root of this problem. Then I started to think that one of the root problems is cities. Cities occupy 2% of the land mass but they emit 80% of the carbon. So we have to be working in cities. It is also true that in cities most of the wealth is created, by businesses, who contribute almost 40% of the 80% emitted. And so the question arises, is business a force for good towards a sustainable society? And so we have to reconsider the way in which we look at success, because the old way of measuring success is not going to take us anywhere. We are researching into this. Businesses are already doing a range of things, some are innovating, some are presenting themselves as inclusive, etc. We are exploring both commercial and social enterprise, looking at where there is convergence, and where we can remove some blockages. And as much as we look to reduce, we should also check more efficient ways of using energy. Indeed, some people say that if you attend efficiency, you can tackle the problem. And efficiency business is currently one of the largest businesses one can enter into.

In India, how far do you think we are away from making environment a politically decisive issue. So that when we go to vote, we consider whether the party is going to be pro-environment or not.

Push: We have to use different tools. For e.g. getting people on Facebook to put three things they value into a pot called My Earth, or My India, or My Bangalore. And then to make the pot bigger and bigger as people keep putting things in it. A large number of people can be reached quickly using that.

When Gandhi was asked about development similar to the western civilization, he had said that if everyone developed like that, we would need 3 earths. Today they have got actual figures saying that the way we are going, we will need 2 and a half earth. That leads me to think about generational responsibility. When I was walking in Copenhagen, I met a lot of young guys who were criticizing the older generation, saying that they were not doing enough. One of them said that "*the negotiations started in 1992. I am already 18 and you guys have been just sitting and talking. By the time I am 40 you guys will be dead and you will have destroyed the planet by that time. So when are you going to make a decision?*"

It is a great challenge, to make it a burning issue. The only way it is going to happen is through young people.

Swarm Optimization in Embedded Systems

By Kapil Dhaka

Ever wondered why all the electronic devices ranging from mobile phones, mp3 players, and digital cameras to laptops are getting slimmer and faster day by day. Well, one of the reasons is the improved way of Software/Hardware partitioning of the embedded systems, which form the core of these devices. In Software/Hardware partitioning, each function of an embedded system is implemented using either hardware or software, in order to optimize the system in terms of processing speed and required area. A relatively new algorithm, called "particle swarm optimization" is being used for the partitioning purpose.

Objective

An embedded system is any computer system designed to perform one or a few dedicated functions with real time constraints. These systems consist of one or more processors, which run some software, and another set of hardware blocks implemented using an ASIC. With the development of IC technology, the scale of modern embedded systems has become much larger and the functions more complicated. Nowadays, embedded systems are used in wide range of industrial areas.

This mixture of software and hardware is beneficial since hardware is usually much faster than software and also more power efficient. Software, on the other hand, is cheaper but slow and consumes more power. However, this kind of system design creates some challenges. One of the most critical steps of the design process is partitioning, i.e. deciding which component of a system should be realized in hardware and which ones in software. This problem is referred as the software/hardware partitioning problem in embedded systems.

Our objective in this project is to solve this problem of partitioning using particle swarm optimization technique.

Particle Swarm Optimization

Motivated by the behavioral and sociological characteristics of bees and flies, Eberhartt and Kenedy proposed the PSO algorithm. It has been observed that bees usually identify their food by a collective effort. The dynamics of a bee to move towards the target position (location of food resources) depends on three factors:

I. The current direction of its motion
II. The global best position identified by all its fellow bees until this time (***gbest***)
III. The local best position that the bee has experienced so far (***pbest***)

Let x_i (t) be the current position of the i^{th} bee at time t, v_i (t) be the velocity of the i^{th} bee at time t, p_i^l(t) be the local best position experienced by the i^{th} bee until time t, p_g (t) be the global best position of all the bees at time t, then the dynamics of the i^{th} bee can be described by the following two equations,

$$v_i(t) = w\, v_i(t-1) + \alpha_t^l (p_i^l(t) - x_i(t)) + \alpha_t^g (p_g(t) - x_i(t)) \quad \ldots(1)$$

$$x_i(t) = x_i(t-1) + v_i(t) \quad \ldots(2)$$

Where w, α_t^l and α_t^g denote the inertial velocity, local acceleration coefficient (LAC) and global acceleration coefficient (GAC).

PSO algorithm

Input: Initial position x_i (0) and velocity v_i (0) for each bee i, the fitness function f()

Output: The global best position attained by the bees collectively

Step 1: For each bee i, evaluate f(x_i)

Step 2: Evaluate the bee's next position by executing the basic PSO equations (1) and (2) in order.

Step 3: Repeat steps 1 and 2 until convergence occurs in all x_i.

Software/Hardware partitioning

Problem definition

We have to address the problem of HW/SW partitioning using PSO, with the aim of achieving a near optimal solution efficiency. We have three parameters: cost, execution time and area, based on which we have to optimize.

There are three ways to optimize the partitioning.

i) Minimize the Execution Time, keeping Cost < C_0 and Area < A_0
ii) Minimize the Area, keeping Cost < C_0 and Execution Time < T_0
iii) Minimize the Cost, keeping Execution Time < T_0 and Area < A_0

where C_0, A_0 and T_0 are arbitrary constants.

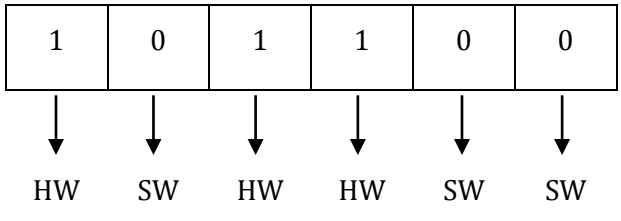
The partitioning formal problem would be expressed as follows:

"Given a set of tasks that together represent a design, the problem is to find a partition of hardware and software implementations, such that by joining them we can construct an equivalent system with minimum cost, while satisfying performance constraints."

Problem Representation

To partition a design, first it must be mappeda> into a task graph. Application can be easily broken down into distinct tasks at a coarse level of granularity and can be specified by a data-dependence based task graph.

Task graph is a directed acyclic graph. It consists of a set of nodes and a set of edges and is represented by G = (V, E). Each node v Є V denotes an operation (task) that has a specific cost, execution time and area for implementation on HW and SW platform. Each edge e Є E denotes data dependencies between nodes. The edges in the data flow graph have communication delays depending on the partition in which the two nodes incident on the edge are present.



Each particle is represented as a string of bits that illustrates a scheme of system partitioning. The length of the particle is equal to the number of tasks. Each bit defines that a task of system must be either implemented in hardware or developed with software. Consider the example particle below where 'zeros' determine software development and 'ones' determine hardware implementation.

Partitioning Methodology

Our overall methodology is illustrated in the diagram below. The evaluation of the fitness function needs various parameters as input. In the beginning, particles and corresponding velocities are randomly generated. In each iteration, fitness of each particle is evaluated and an estimation of cost and time is achieved and p_i^l and p_g are determined. Then position and velocity of each particle is updated using (1) and (2) respectively. This process is continued until the termination condition is met.

Fitness function of the i^{th} particle is defined by

(a) $F_i = \sum C_j$, when time & area constraints are satisfied ...(3)

else F_i = Infinite

(b) $F_i = \sum t_j$, when cost & area constraints are satisfied ...(4)

else F_i = Infinite

Where t_j denotes the execution time on the VLSI platform and C_j denotes cost of implementation.

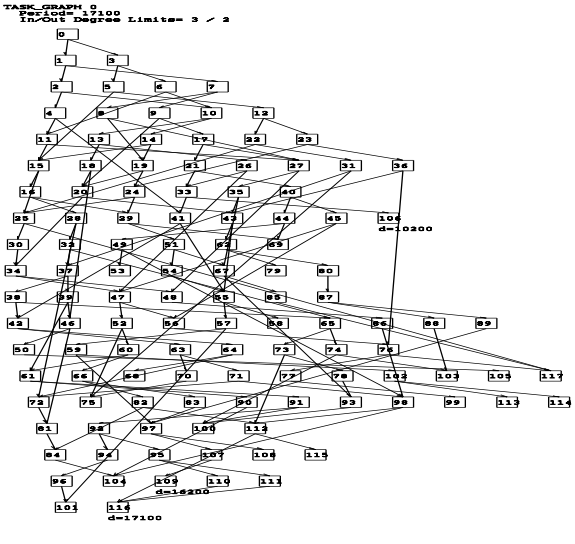


Fig: Optimizing with 118 nodes

Experimental Results

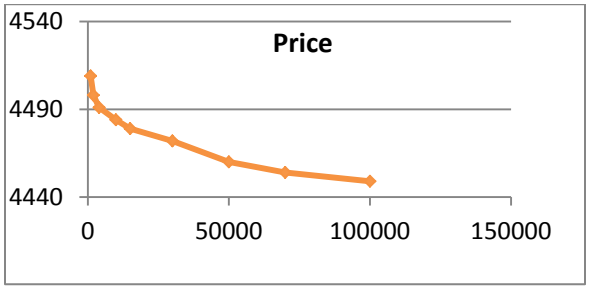


Fig: Price vs Iteration Curve

This graph is obtained when we tried to optimize price keeping area and execution time within a boundary.

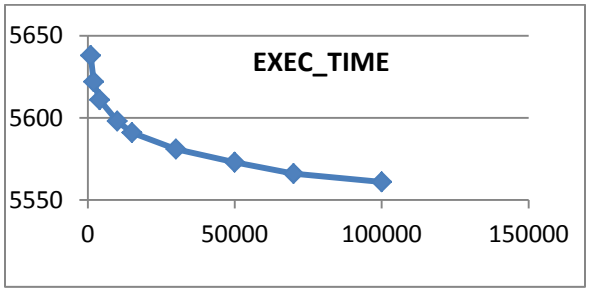


Fig: Execution Time vs Iteration Curve

This graph is obtained when we tried to optimize execution time with constraints on area and cost.

CONCLUSION

Particle swarm Optimization has proved to be an efficient technique for software/ hardware partitioning. As iterations are increased results rapidly move close to the optimization point. Although PSO cannot bring perfectly optimized results, it can bring them close in reasonable run time.

[Note from Editor: The paper submitted is much more comprehensive and elements have been pared down to keep it simple. Do contact the author for more depth and information.]

Kapil Dhaka is a 1st year PGP student at IIM Indore. He holds a Bachelor's degree in Information Technology from Jadavpur University, Kolkata. He can be reached at p10kapild@iimidr.ac.in

Getting the most out of AADHAR

By Maheswar Avadhani

Of late, GOI took up UIDAI (Aadhar project) with an intention to provide a unique identity (biometric based) to all the citizens of India. The total estimated cost of the project is a whopping ₹ 150, 000 crore ($ 33.75 billion) [of course, another estimate puts it at $ 6 billion]. It is glad to note that the project is running as per the schedule and was able to roll out the first set of numbers during Sep 2010. I would like to argue that once "Aadhar" is rolled out completely, GOI will have a cleaner and simpler way to capture the demographic information of most of the citizens of India at each of the encounters (touch points). Hence the question of availability of relevant data is pretty much answered. This opens the doors for data driven governance.

This article assumes that after subsequent deployment of "Aadhar" program, GOI mandates usage of the same extensively, by linking the UID number to bank accounts, to passports, to credit and debit card numbers (so that all cash based as well as non-cash based transactions are tracked), to property registration transactions, to precious metal purchases, to literacy programs, to health care programs, to social welfare schemes, to employee registries, to crime registries, etc. As the identity of an individual would be established with UID number (with no scope for forgery) through a very simple and fool-proof biometric system, a lot of governance applications can be built upon UID.

APPLYING CLUSTERING TECHNIQUES

Clustering is the task of segmenting a heterogeneous population into a number of more homogeneous subgroups or clusters. It can applied in various ways,

For improving voter turnout

Going by the past data, it can be found that the typical turn out in any election varies between 50 to 65%. Such a lower turn out can cause election of a non-suitable (non-desirable) contestant. In order to alleviate such risks, it's important that voting turn out maintained as close to 100% as possible. Below indicated clustering based approach can help in the identification of non-voters so that appropriate measures can be taken to improve the turnout.

GOI can implement the measure of comparing the biometric information of voters with that of all eligible citizens for voting in order to identify the pool of non-voters. Once the characteristics of non-voters are identified, appropriate measures can be identified for improving the voter turnout. Though election is not a frequent phenomenon, it's an important process in our democratic society and any measure that can improve situation shouldn't be undermined.

Below indicated are a few example possible measures for the improvement of voter turnout.

- Simply publish the information in the public domain so that citizens feel responsible and act in a more responsible manner by voting.
- Launch of advertising or sensitizing campaigns targeting those clusters who demonstrate a non-participative and non-responsible behaviour.

For bringing more people under tax net

Today GOI is not able to mop up the tax revenue at full potential due to systemic problems such as fake identities, non-traceable transactions by commercial bodies etc. As the UIDAI provides a unique identity

that can't be faked, GOI has better control over tracking all transactions in cooperation with banks and financial institutions, by deploying necessary controls through possible levers (e.g. mandating mention of UID for all transactions, be it related to currency or be it related to precious metals). Once such levers are tightened, clustering can be used to identify segments of people/bodies that don't pay taxes either fully or partially. Upon identification, GOI can easily bring all such people/bodies under tax net thereby increasing the revenue.

For customized literacy and healthcare programs

In his paper titled "The influence of the demographic characteristics on adult education – A market segmentation approach", Prof. Vishnuprasad Nagadevera (IIM Bangalore) has identified the need to come up with customized literacy improvement programs by taking Dharmapuri as an example scenario. Availability of demographic data upon successful deployment of "Aadhar" provides many more opportunities to GOI in coming up with customized programs that have relatively higher potential for success. It helps GOI in adopting "right approach at right time through right means" rather than the current "one size fits all" kind of an approach.

APPLYING DECISION (CLASSIFICATION) TREES TECHNIQUES

Classification consists of examining the features of a newly presented object and assigning it to one of the predefined set of classes. The classification task is characterized by a well-defined definition of the classes, and a training set consisting of pre-classified examples.

For spotting fraudulent/low performance dealers

As per 2008 data, India has a total of 6,38,596 villages and 2,47,033 Rural Local Bodies (RLBs). GOI runs several social and welfare schemes under 14 categories namely such as 20-Point Programme, Animal Welfare, Backward Classes Schemes, Child Schemes, Disabled Scheme, etc. Deployment of these schemes usually happens through RLBs and dealers (especially in the case of Public Distribution Systems (PDS)).

Once the GOI completely rolls out the "Aadhar" program, and gathers the results of various welfare programs, GOI can subsequently make use of classification techniques to identify fraudulent dealers and weed them out from the system thereby making deployment more effective and less error-prone. The technique can be also used to identify whether a particular dealer is corrupt or not, thereby having a better basis to decide upon whether or not, to award the dealership to that person.

For improving supply chain efficiency and distribution effectiveness of PDS

PDS is one of the largest supply chain networks in the world with 4.99 lakh FPS (Fair Price Shops) and is operated under the joint responsibility of the central and the state government. PDS supply chain consists of several central and state government bodies, private industries, farmers, warehouses and transportation agencies. Though the PDS supply chain provides basic commodities to vast majority of the Indian population, we should accept the fact that the whole chain is mismanaged by corrupt officials. Though enough produce is procured and distributed by PDS, the beneficiaries often face difficulties in getting what they are entitled to. In conjunction with other technologies like RFID (Radio Frequency Identification Technology), GPS (Global Positioning System), data mining can help in weeding out inefficiencies from one of the largest supply chain networks. Please refer to the proposed model in the paper published by Ms. S.Ranjithakumari & Kathiresan.V. Rule-based classification data mining technique can be used to identify suspicious moving behaviour of the objects.

APPLYING NEURAL NETWORKS TECHNIQUES

Neural networks are a class of powerful, general-purpose tools readily applied to prediction, classification and clustering.

For help in budget estimation for inclusive growth

Techniques like neural networks can be applied in conjunction with techniques like classification or clustering in order to arrive at budget estimates at state as well as at the central level. Such bottom-up approach helps in GOI being strategic (goal oriented with specific targets) and accountable rather than the present day "top-down" approach where states have to manage the allocated budget in fulfilling their needs. While the current day approach leaves scope for disparity, a much more refined approach using data mining techniques can help in GOI honouring "inclusive growth" by allocating right amount of resources for right causes.

For predictive models in social welfare programs

Since 1991, India's per capita GDP increased by 50% while malnutrition in India has fallen by only 6% points, despite all the social welfare programs/initiatives taken up by GOI.. While the systemic problems in poor implementation and corruption are to be blamed for such a poor success rate, national level schemes and their planned way of implementation can be relooked for improvement in the wake of data of "Aadhar". A more systematic analysis using predictive models can help in predicting which of the social welfare programs may fail so that necessary course corrective actions can be undertaken.

APPLYING "ASSOCIATIONS" TECHNIQUES

The task of affinity grouping is to determine which things go together.

For improved healthcare through associations

Aadhar program data when integrated with national health registry can help in identifying associated patterns of diseases. For example, there are few geographical regions where the content of Fluorine in water is quite high leading to diseases like Fluorosis. Such type of associations can be easily identified through affinity grouping technique so that necessary actions can be taken by GOI to control such type diseases.

APPLYING DISCRIMINANT ANALYSIS TECHNIQUES

Discriminant analysis is a method used for pattern recognition and machine learning to find a linear combination of features which characterize or separate two or more classes of objects or events.

For countering disproportionate assets

Discriminant analysis technique could be a best fit to identify disproportionate assets. Today due to systemic loop hole of inability to establish a unique identity in an unchallenged manner, a lot of people continue to hold assets that hold no relationship to their incomes. Many also hold assets on "benami" names. By plotting a measure like "Personal Assets Value Vs. Annual Income" (similar to ROI vs. Current ratio), a section of people can be identified who hold assets in a disproportionate manner. Subsequently measures like issuance of show-cause notices and crippling them "by not allowing them to perform any other transactions until either proper justification is provided or until volunteer to forego the disproportionate assets" can be implemented. This approach not only helps in bringing out disproportionate assets out, but also arrests large scale corruption as people will run short of avenues to deploy their unlawful earnings.

For countering unemployment and paving way for inclusive growth

Another problem that can be well tackled through discriminant analysis is unemployment. By plotting a measure like "Population Vs Unemployed people", pockets in India where unemployment is rampant can be identified. Further by encouraging industrialists to establish firms in such regions by offering additional incentives (e.g.

SEZ locations), India can look forward for inclusive growth.

APPLYING FACTOR ANALYSIS TECHNIQUES

Factor analysis is a method used to describe variability among observed variables in terms of a potentially lower number of unobserved variables called factors.

For Crime Reduction

"Aadhar" program paves way for the creation of a national crime registry. Further analysis of people from such a registry may shed light on the observable and unobservable (the ones that can be discovered through data mining) patterns that make these citizens susceptible to crime. Once leading patterns are established, GOI can take suitable measures that can reduce crime rate.

TO SUMMARIZE, AADHAR will enable the GOI to adopt a scientific approach to policy making.

Maheswar Rao Avadhani is a PGSEM student at IIM Bangalore. He can be reached at Maheswar.avadhani08@iimb.ernet.in

Challenges in Software Project Management

By Neelabh Singh

According to a study done by the Standish Group in 2009, 24% of projects failed and 44% were not delivered on time amounting to a staggering 68% of projects either failed or rejected due to bad quality or deadline extensions. In the words of Jim Crear, Standish Group CIO, in Chaos Summary 2009, "*These numbers represent a downtick in the success rates from the previous study, as well as a significant increase in the number of failures.*" These results are in compliance with several other studies done over a period of time in the area of software engineering. This illustrates the need for effective software management to manage the complexities and challenges inherent in large software projects.

Clarity and completeness in requirements

The construction of a building cannot be undertaken without proper floor plan and room layout by an architect. However, there are plenty of software projects on which coding begins before the requirements are clearly specified. Even when we achieve the miraculous task of agreement we hit the next roadblock in terms of customer modifications. The customer keeps on adding changes to the original design unaware of its impact on the budget and the schedule. This problem can be resolved through a strong relationship with the customer and the marketing staff that will enable the team to understand and receive all the requirements in a single batch and make their definition much simpler.

Controlling Feature Creep

Microsoft's Windows Vista was planned to be a minor release between Windows XP and the then codenamed Windows "Blackcomb"(Windows 7), but it transformed into a major release which took 5 years of development and was cumbersome to use due to the continuous addition of unnecessary new features. Over imaginative designers or the requests made by customers well after the requirement gathering stage can lead to a bloated software project. This phenomenon is called "*feature creep*." Extra features go beyond the basic function and can result in over-complication rather than simple design. Feature creep results in software products that are slower and harder to use and often go over budget and over schedule. It can even kill products and projects as was observed in the case of Apple's Copland operating system.

Creating and maintaining an Effective Team

According to Rainwater in "*Herding Cats: A primer for programmers who lead programmers*" the task of creating and maintaining an efficient team of software developers is similar in difficulty to herding cats. The Project Manager must be deliberate and sometimes heroic to achieve coherence in the team so that there will be effective performance management. Individualistic by nature, programmers should be managed carefully to enable them to use their creativity and ingenuity on one hand and herding them to move in the same direction as others.

The need for a limited team with conceptual clarity can be best expressed by this quotation from Brook's book on '*The Mythical Man-Month*': "*Software products are both complex and fiercely competitive in schedule. Any product that is sufficiently big or urgent requires the effort of many minds and must be conceptually coherent to the single mind of the user and at the same time designed by many minds*". The importance of social interaction among team members is also stressed upon by software development gurus like McConnell and Grady Booch.

I would like to conclude this article emphasizing the importance of project management in the software industry by this quote from Tony Collins -"*Computers rely for their functioning on reason but projects defy logic because of human caprice".*

Neelabh is part of the Editorial team

The Definitive Guide to Web Browsers

By Varun Sharma

Among those reading this article, all of those who have done your MBA or who have been in the tech industry long enough will know the oft talked story of how Microsoft killed Netscape Navigator by 2002. It's a wonderful real life story – one that defines the power that Microsoft had (some would say still has) in the tech industry, the politics of which even Kautilya would be proud of and a story that would define the debate on software copyrights, software monopoly and competition over the years. Those years are long gone now and Microsoft has had its share of litigation from the US government and the European Union. At the center of this story lies a strange entity called the ***Web Browser*** – something mysterious to all those who don't understand the technology and something of a miracle to all those who know its history.

Wikipedia defines a web browser as "**A software application for retrieving, presenting, and traversing information resources on the World Wide Web**". Seems like a simple enough definition. In layman's terms one would say the browser is a window to the Internet – that behemoth of a creature which purportedly has all the information (ranging from the useful to the useless, from the benign to the dangerous) in the world. To access the Internet one has to have a web browser - it's as simple as that. The last decade has seen Microsoft lose its monopoly over the browser business. Today there are 6 primary players in the web browser business – Microsoft, Mozilla Foundation, Apple Inc., Opera Software, Google and Nokia. Except for Nokia all the others are major players in the desktop web browser business and in this article I will be primarily exploring this business.

The first big name in the browser business was the Netscape Navigator. After its demise in 2002, Mozilla Foundation rose from Netscape's ashes. Mozilla Firefox, in the beta testing phase for its 4.0 release today, is one of the most popular browsers in existence – it is loved by developers and has the best extension support among all the existing browsers. Firefox came

into existence when the open source movement was gaining momentum and both have gained from each other's existence. I believe Firefox is the best example out there for an open source movement out there, after Linux. It is one of the best executed open projects and has been responsible for popularizing many features that we expect of a web browser – tabbed browsing, search box and extensibility to name a few. One could almost say that it was single-handedly responsible for forcing Microsoft to come up with newer and safer versions of Internet Explorer. Mozilla Foundation describes itself as "***a non-profit organization dedicated to preserving choice and promoting innovation on the Internet***". Mozilla Corporation a for-profit subsidiary of Mozilla Foundation drives the development of Firefox and Thunderbird (an open source email client). Its sole revenues have been from the fees that Google pays to place Google search as the default option in its search box. A strong ecology consisting of Mozilla employees, hundreds of volunteer developers (who double as first line of testers) and a long beta release cycle has been associated with the Firefox development cycle. With the sole aim of the corporation to provide a better web browser, the company has its heart in the right place. However the place of an open source company in the high revenue earning tech environment of today is yet to be cemented so we have to wait and see how the company moves forward.

Microsoft's Internet Explorer 6 is what most of us would have associated with Internet browsing while growing up. The browser came with tons of ads, tons of

toolbars and tons of security holes. And Microsoft took its time before it came up with the next version of Internet Explorer in late 2006. As late as July 2009 IE 6 was in the top 3 browsers that people used. Microsoft's primary strategy in the software categories that it participates in is to be the one with the largest market share. Over the years it has adopted various strategies to ensure this – like copying the most popular Mac OS features, developing an office suite and allowing early adopters like students and universities to use them for free or at minimal cost, developing a developer environment closely modeled upon the office suite and so on. Internet Explorer was one of the ways through which Microsoft tried to lure users into using its operating system, Windows. By making it a default "feature" and offering it for free in its operating system Microsoft ensured that users didn't need to look beyond Microsoft for solutions. The monopoly over operating system that Microsoft has enjoyed over the years ensured that Internet Explorer was the most used browser in the world. And today Internet Explorer in its various versions is still the most used browser in the world (above 41% according to w3counter). Microsoft is currently in the beta stage for Internet Explorer 9. Despite its interesting features I doubt if hardcore Firefox and Chrome fans are ever going to be enticed by this product – one can only wait and see.

Google was a late entrant to the browser business. As expected of Google, it did something interesting before the release of its browser and published a a very nice story talking about the structure of a browser in layman terms in the form of a comic. Google Chrome was released in September 2008 and was immediately downloaded by many and tried. The user experience on Chrome was completely different compared to that on other browsers; it was blazingly fast and consequently many people started enjoying it. After multiple releases Chrome today is the 3rd most popular web browser in the world. It is interesting to think why Google, a search company, wanted to develop a browser. Google's revenue model is ad based. Thus the more of a web page the user is able to see, the better for Google. Look at Chrome; it is the web browser which takes the least screen real estate to display the URL, menu options and the tabs – thus ensuring maximum visibility of the web page and all the ads along with it. Google has also promoted the Chrome browser, through billboards and video advertisements, as a precursor to its Chrome OS where the whole netbook will only have the Chrome browser as its primary interface and all the user data will be stored in the cloud. Once again we can clearly see how this strategy ties in closely with its fundamental revenue generation model. Google has released most of Chrome's code under open source and I guess it is a smart move. As long as the Chrome browser is adapted quickly and people like the website real estate that is offered by the browser – Google's work is done.

Opera Software's fundamental business is the browser business. It has a large installed base in the mobile business and its primary revenue model is like that of Firefox. Opera has been the pioneer of many of the browser features that people accept as taken – like tabbed browsing. Today Opera has one of the best browsers in business, feature wise, but its adaptation has been low. Chrome and Firefox's popularity has meant that Opera has had to suffer in its adoption rates.

Safari is the primary browser for all the OS platforms coming out of Apple – primarily Mac OS and iOS. In the mobile arena Safari is deemed by many reviewers as the

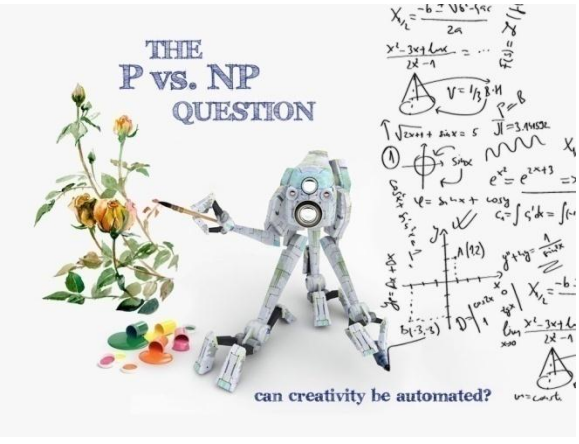
best in business. Apple has tried to push the sale of Safari on Windows platform, sometimes even going as far as silently installing it along with iTunes or QuickTime update, but its adoption in the platform has been low.

As we can see, each of the top players has completely different reasons for being in the browser business, i.e. the reason for them competing is completely different. Like in any competing economy, in this ensuing battle, the consumer has benefitted the most. The rate at which the consumer has been inundated with new features and new tweaks is staggering. The consumer now has a choice to run any browser and each one offers some unique features that others don't – it can be said that the consumer is spoiled for choice now. Another interesting thing to note in this whole browser war is that many a times the competitors have been collaborators too. Safari and Chrome run on the Web Kit JavaScript engine which was created by Apple and further enhanced by Google. Firefox also uses the Web Kit's assembler to create its JavaScript engine. All the 5 companies have come together many times to determine the way forward with HTML5 and other web standards. The recent decision by Apple to not allow Flash on its handheld device and by Google to stop supporting H.264 in Chrome - comes at a time when video related standards are being hotly debated. Thus we can see that the whole browser environment is still in the developing stage without a clear idea of whose strategy is the correct one. It will take time before we will see a sure shot winner or some sort of balance being achieved in this area. But as users it will be a very interesting journey as we discover newer ways to explore the web, and observe the various strategies that are adopted by different players, and see and decide who emerges as the winner.

Varun is part of the Editorial team

P vs NP and the Limits to Computing

By Kalpesh Muchhal



Computers often seem all-powerful. Give them a problem, an algorithm, and they will perform millions of calculations per second to quickly spit out an answer. Want to solve a thousand simultaneous equations? That's child play. Want to sort a million numbers? Can be done without breaking a sweat. So to the uninitiated, it may appear as a shock that there are thousands of problems, from all areas of life, which though a computer could solve given enough time, that enough would exceed the age of the universe.

First we need to get into a bit of theory. To keep matters simple, I skip concepts like Turing machines, determinism and non-determinism, sequential calculations, etc. which readers should explore for themselves. Problems whose solutions can be computed in polynomial time belong to a set called class P. What is the input variable of this polynomial function? Some quantifiable aspect of the input which keeps growing as the input keeps growing. For e.g. The number of digits in a number, or the size of a set. And although we say time, the polynomial actually gives the number of steps required to solve the concerned problem. Since we are not directly interested in the number of steps, but in how long will it take to solve a problem, we assume that every step will take a certain amount of time to be executed. Hence we get the concept of polynomial time. So for example, the quicksort algorithm in the worst case scenario takes n^2 steps to sort n numbers. Linear programming is also in P. To take a more complicated example, it was shown by 3 IIT Kanpur mathematicians in 2003 that verifying a number to be prime is in P. This was one of the most celebrated results in the last decade.

Now the polynomial under consideration can have a very large degree like 100 or 1000. If now a large n is given to such a polynomial, computers will still not be able to solve it in reasonable time, but we leave this technicality aside. Our main concern is those problems for which the solution time required grows more than "polynomistically" with size of input n.

Problems whose answers can be verified in polynomial time but for whom no algorithm is known that can compute solutions in polynomial time belong to class NP. We do not have to consider the concept of infinite. As mentioned at the beginning, the steps required are still finite, but unreasonably large. Take the famous travelling salesman problem which involves finding the shortest route to cover n cities exactly once. As n increases, the time required to solve the problem increases exponentially. Computers have been able to solve TSP instances with around 34000 cities. You will say that is more than enough, but TSP is just a fancy way of stating a more general problem: How do you optimally traverse n nodes? And now n can run into millions.

The famous P=NP problem

Note that not knowing polynomial time solutions to NP problems doesn't necessarily mean that there doesn't exist such solutions. This has been an area of much debate and research and is known as the P=NP problem: To prove conclusively for or against that class P is fundamentally the same as class NP. And all it requires to prove P=NP is to find a polynomial time algorithm to any one of the NP-complete problems, which are the hardest ones in class NP. Why is that? Because one can reduce any NP problem to any NP-complete problem in polynomial time. And

similarly one NP-complete problem can be converted to another easily. There are about 3000 known NP-complete problems. But not even one of them yields. Talk about unity. Maybe thinking of them as different problems is the real issue. They are just innumerable ghosts of the same one monster.

Meanwhile there is a $1 million prize waiting for anyone who can give a conclusive proof. Many powerful proof techniques have been tried such as relativizing and algebrizing proofs, and all we learned was that at least they won't be able to provide the required proof. Recently Vinay Deolalikar, a principal scientist in HP Labs, made the most serious attempt at a proof, using ideas from a huge number of mathematical fields, and also physics. Such multi-disciplinary effort is rare, and it also means that few can understand your work correctly. Still, he has to correct or elaborate some of the approaches he has used in the proof.

Does NP-complete means that a solution can never be found in practice?

No. There are many heuristics available which can solve an NP-complete problem for many values of input size n. But these heuristics are applicable only for special sets of values, not all n. Hence, till a general algorithm is found, there will exist at least one value of n, for which the concerned NP-complete problem cannot be solved in reasonable time. From a practical point, this makes life both easy and hard. For many n, NP-complete problems are no longer that unscalable thing that theory may seem to project. But if a heuristic is found for a certain n, then the problem formulator can immediately start using a new n for which no heuristic exists. Thus, without a general algorithm, the solver is doomed to a never ending cat and mouse game.

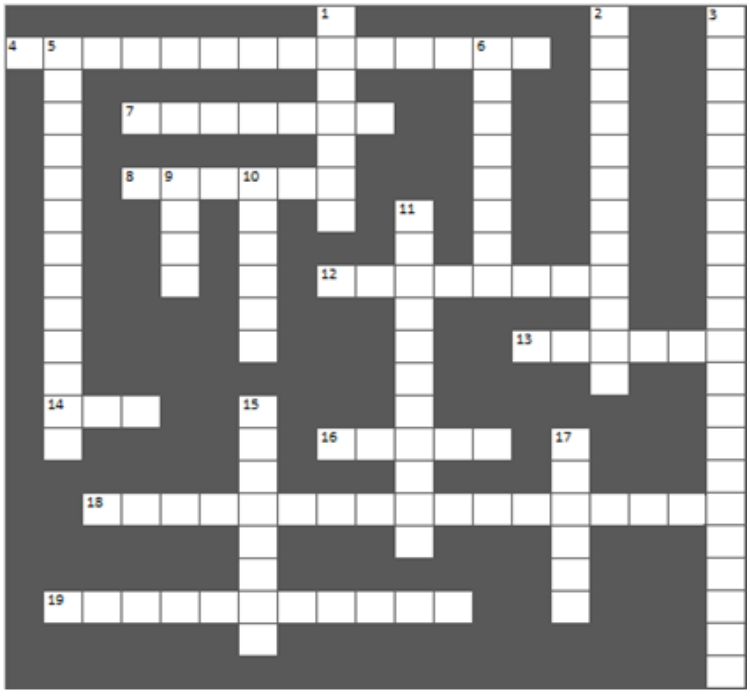
What will P=NP imply?

Many fields specifically rely on problems which are extremely difficult to crack but easy to verify. Now strictly speaking, it is not known whether the factorization problem is in class NP, but let us still take it as an example. The RSA algorithm in cryptography uses the product of 2 very large prime numbers as the public key, which is used to encrypt messages to be sent over a communication channel. The message can be easily decrypted if the 2 prime numbers are known, but factorizing the public key to obtain them is extremely difficult. This inherent difficulty or "one-way"ness of modern cryptographic methods allows secure communication to take place. The entire system of online transactions, as it exists in the current form will collapse if P is actually equal to NP and cracking algorithms are discovered. But don't lose hope. There are problems even harder than NP-complete, for e.g. playing a game of chess, based on which we can keep encrypting messages. This raises an interesting possibility in a world of P=NP. Only chess masters and other types of brainiacs will have the luxury of ordering things online. Everyone else will have to rush to the physical store.

On the other hand, there are many positives to P=NP. Some of the most important problems will become feasible to solve, thus greatly accelerating progress. The biggest contribution is likely to be mathematics itself. No matter how difficult a proof to a conjecture, if the proof is of finite length, then P=NP implies that it can be found using a computer.

But don't hold your breath. While skepticism and neutrality is fine, it is likely that P is not equal to NP, and that some problems will always remain hard. Deolalikar's proof concludes with P not equal to NP. Some NP-complete problems have been known since centuries, but no polynomial solution has ever been found. Some mathematicians like Scott Aaronson tend to view it positively. After all, if everything could be computed, what would be the use of creativity and serendipity? True breakthroughs are always going to be a little accidental, and will tend to require extraordinary genius.

Kalpesh is part of the Editorial team



Across

4	X is a person. If X had his way, avian flu outbreak would have crippled the Internet.	*(5,8)*
7	Wars in the virtual world admittedly brought down nuclear power plants.	*(7)*
8	Firefox, but without the Firefox logo!!	*(6)*
12	A competitor to USB, this standard could never garner the market share it had hoped for.	*(8)*
13	What's common between an American comedy film and a technique for anonymous communication over the Internet?	*(5)*
14	X defied the 'power of 2' rule in the war of cores. Identify X.	*(3)*
16	Feeling hungry!! Complete the series: *Cupcake, Donut, Éclair, _____, Gingerbread, Honeycomb.*	*(5)*
18	This is a sequel to a game released in 1996. Development started in 1997 and gamers will be lucky if they get to see it this year. What are we talking about?	*(4,5,7)*
19	I am in jail. Please take care of my file system. Who am I?	*(4,6)*

Down

1	This US satellite TV company caught the hacking community unprepared before a super bowl event.	*(7)*
2	Jimmy Wales is furious with those who parody his pet creation.	*(12)*
3	Virtual equivalent of Great Wall of China. What is the official name?	*(6,6,7)*
5	Thanks to X, I like ';qjkxb'. Identify X.	*(6,6)*
6	Budding entrepreneurs may learn a thing or two from this person on how to make a million dollars from a single page website. Identify the person.	*(4,3)*
9	CPU is so traditional. I like my algorithms faster on a Quadro using X.	*(4)*
10	This virtual office assistant invited a lot of flak and so, was put to rest.	*(6)*
11	In his own words, he is an 'Internet expert'. Ironically, his experience also makes him reluctant to allow internet access to his compatriots. Which country are we talking about	*(5,5)*
15	X is the second word in the name. X is a homophone for 'heard'. While running, it declares the 'death of a server' euphemistically. What are we talking about?	*(3,4)*
17	This has got to be an easy one. Our own 'Spidi's' backend.	*(6)*

Comment/Feedback mail to: editor@iimclickd.in
http://iimclickd.in
ALL RIGHTS RESERVED
A Pan IIM Initiative