IEEE Information Theory Society Newsletter

President's Column

Alon Orlitsky

Happy Birthday Claude!

On April 30th, the world celebrated Shannon's centennial. As we anticipated in the last column, Google honored him with an animated homepage doodle, typically viewed over two Billion times daily: http://www.google.com/doodles/claude-shannons-100th-birthday.

Many major media outlets joined, praising Shannon and the advent of information theory. Fortune Magazine called Shannon the "mastermind of the digital age", the New Yorker wrote that his "fingerprints are on every electronic device we own", and Time Magazine called information theory "a truly radical concept that forever altered electronic communication" and "made the Internet possible". The celebration extended globally, with the Telegraph, Die Welt, El Pais, the Hindustan Times, and other publications, all celebrating Shannon's legacy. You can find some links at http://claudeshannon.info/#articles.

While April 30th was an information theoretic eye opener for many, a perplexing obvious question that has baffled many of us for years, persists. Quoting author James Gleick, the New Yorker wrote "Einstein looms large, and rightly so. But we're not living in the relativity age, we're living in the information age". Time Magazine was even more explicit: "given the depth of his influence on our daily lives", "Shannon has gone under-reported on... no full-length biography on him has been written". Inexplicably, though everyone uses and relies on the technologies Shannon enabled, relatively few are aware of his contributions.

As you know, this centennial year the society is on a "crusade" to help diminish this conundrum. Through multiple short-term activities and long-term initiatives we hope to turn Shannon and information theory into if not household-, at least college-names. To begin, we created a new video, a

birthday gift if you will, "The Shannon Centennial: 1100100 years of bits", that has already been viewed over 5,600 times: https://goo.gl/oxHUOk.

A much larger effort of course is the Shannon Documentary, directed by Mark Levinson of Particle-Fever fame. You may recall January's interviews with Shannon's family. In recent additions, Shannon's students and colleagues, including Robert Gallager and Leonard Kleinrock shared insights and anecdotes about him, while industry captains including Google's Eric Schmidt reflected on information theory's lasting impact. Mark is currently preparing for an extensive shoot at Shannon's house. He is especially looking forward to reassembling many of Shannon's toys and recreating the infamous "toy room".

The Shannon Centennials are also going strong. On April 28 and 29, Bell Laboratories, now Nokia's research arm, paid tribute to its prodigal researcher. The "First Shannon Conference on the Future of the Information Age" featured an impressive array of distinguished speakers, the premiere and finale of a unique innovative "Human Digital Orchestra" performance, and an audience of over 300. The occasion also served to dedicate the Shannon amphitheater, unveil the Shannon IEEE Milestone Plaque shown herein, and to inaugurate the Hamming Innovation Hall. Many thanks to Bell Labs President Marcus Weldon for staging an event befitting of Shannon's legacy.

The society-sponsored centennials keep growing with over thirty scheduled worldwide. You can see some at this newsletter and more at http://www.itsoc.org/resources/Shannon-Centenary. The events are easy to organize with materials we have prepared, and we added a final proposal deadline on July 1st. If you are willing to propose an event, please

From the Editor

Michael Langberg

Dear colleagues,

I am very pleased to bring you this summer issue which marks Claude Elwood Shannon's 100th birthday that took place on April 30th.

The festivity is felt throughout our community and beyond its regular boundaries with numerous events including workshops, lecture series, exhibits, and celebrations. Please consider attending one of the many events. A (partial) list of past and future events appears in the newsletter followed by a delightful drawing of Shannon made by Jan Hein van Dierendonck, a science writer & illustrator from Leiden in The Netherlands, in honor of Shannon's 100th birthday.

This issue contains a number of reports alongside our regular columns: A report on the 2016 Australian School of Information Theory by Jamie Evans and Emanuele Viterbo, a report on the DIMCS workshop "Network Coding: the Next 15 Years" by Alex Sprintson, Emina Soljanin, and myself, Tony Ephremides's Historian's column, our ``Students' Corner'' column presenting "The "I" in IT" by Bernhard Geiger, the column ``From the field'' highlighting the IEEE Information Theory Society Seoul Chapter written by the chapter chair Hong-Yeop Song, and the IEEE Information Theory Society Board of Governors meeting minutes from their meeting after Allerton 2015 (Chicago) by Edmund Yeh. Many thanks to all the contributors for their efforts!

This issue also includes Sol Golomb's Puzzle column, which with great sadness is to be his last. Solomon W. Golomb passed away on May 1st. Beyond being a pillar of our society and an amazing scholar, he has shaped the content of our newsletter and has been a long time and consistent contributor enlightening us all, young and old, with his beautiful puzzles. As the Dean of the USC Viterbi School of Engineering Yannis C. Yortsos wrote, "With unparalleled scholarly contributions and distinction to the field of engineering and mathematics, Sol's impact has been extraordinary, transformative and impossible to measure. His academic and scholarly work on the theory of communications built the pillars upon which our modern technological life rests." A full remembrance honoring Sol will appear in the next issue of this newsletter.

With sadness, we conclude this issue with tributes to two prominent members of our community Arthur W. Astrin (1945-2016) who passed away on March 24th, and David MacKay (1967–2016) who passed away on April 14th. Thanks to the IEEE Information Theory Society, Santa Clara Valley (SCV) section; and to Paddy G. Farrell, Brendan J. Frey, Sanjoy

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Shannon Centenary

The Shannon Centenary, 2016, marks the life and influence of Claude Shannon on the hundredth anniversary of his birth on 30 April 1916. Shannon is best known for developing the mathematical foundations of communication (establishing the field of information theory), data compression, digital computers, cryptography, circuit complexity, flow networks, and juggling, as well as laying foundations of artificial intelligence and human–computer interaction.

Past and future events:

1-2 SEPT	**WHEN BOOLE MEETS SHANNON WORKSHOP** University College Cork, Ireland	**5 MAR**	**OPEN DAY** Indian Institute of Science, Bangalore, India
30 OCT	**BOOLE SHANNON LECTURE SERIES / ROBERT GALLAGER** Massachusetts Institute of Technology, USA	**18 MAR**	**BOOLE SHANNON SYMPOSIUM** Massachusetts Institute of Technology, USA
6 NOV	**BOOLE SHANNON LECTURE SERIES / MARC MEZARD** Massachusetts Institute of Technology, USA	**1-30 APR**	**BOOLE / SHANNON EXHIBIT** Massachusetts Institute of Technology, USA
3 DEC	**BOOLE SHANNON LECTURE SERIES / MADHU SUDAN** Massachusetts Institute of Technology, USA	**4 APR**	**SHANNON CENTENNIAL AT THE 2016 EUROPEAN SCHOOL OF INFORMATION THEORY** Gothenburg, Sweden
1-3 JAN	**BOMBAY INFORMATION THEORY SEMINARS (BITS)** IIT Bombay and TIFR Mumbai, India	**11-22 APR**	**SHANNON EXHIBIT** The International Science Festival Gothenburg, Gothenburg, Sweden
26 FEB	**BOOLE SHANNON LECTURE SERIES / ANDREA GOLDSMITH** Massachusetts Institute of Technology, USA	**13 APR**	**BENELUX SHANNON CENTENARY** TU Eindhoven, Netherlands
4-6 MAR	**SHANNON CENTENNIAL EXHIBITION** IIT Guwahati	**15 APR**	**CLAUDE SHANNON CENTENARY 2016 OTTAWA CONFERENCE** Ottawa, Canada

1–30 APR	**CLAUDE SHANNON CENTENARY 2016 HONG KONG** Chinese University of Hong Kong	**3–4 MAY**	**CLAUDE ELWOOD SHANNON 100TH BIRTHDAY CELEBRATION** the Heinz-Nixdorf Museum, Paderborn, Germany
16/23/30 APR	**SHANNON EXHIBITIONS OTTAWA** Ottawa, Canada	**7 MAY**	**UCLA SHANNON CENTENNIAL CELEBRATION** UCLA
23 APR	**FESTISCIENCES AT UNINE** Université de Neuchâtel, Neuchâtel, Switzerland	**19–20 MAY**	**CLAUDE SHANNON 100 CENTENNIAL CELEBRATION** University of Campinas, Brazil
27 APR	**INFORMATION THEORY DAY** University of Balamand, Balamand Al Kurah, Lebanon	**21 MAY**	**A COMPUTER SCIENCE CHALLENGE + EXHIBITS OF CLAUDE SHANNON** City University of Hong Kong
28–29 APR	**FIRST SHANNON CONFERENCE ON THE FUTURE OF THE INFORMATION AGE** Bell Labs, Murray Hill, NJ, USA	**1 JUNE**	**CLAUDE SHANNON EXHIBIT** MIT Museum, USA
30 APR	**CLAUDE SHANNON WEB EXHIBIT** Bell Labs, Murray Hill, NJ, USA	**16 NOV**	**SHANNON SYMPOSIUM** Institute for Advanced Study, Princeton, NJ, USA

Additional past and future events include:

- Shannon Year@UMD, University of Maryland, 2016

- Shannon Centennial at the 2016 European School of Information Theory, Gothenburg, Sweden, 4–8 April 2016.

- Claude Shannon: A Pioneer of the Information Age, Texas A&M University, USA, 9 April 2016.

- 100th Birthday of Claude Shannon Public Lecture, Aristotle University, Thessaloniki, Greece, 11 April 2016.

- Shannon Centennial Celebration, University of Campinas (Unicamp), State of São Paulo, Brazil, 15 April 2016 and 19–20 May 2016.

- Boole Shannon Lecture Series / Irwin Jacobs, Massachusetts Institute of Technology, USA, 27 April 2016.

- Claude Shannon 100th Birthday Celebration, Taiwan) 29 April 2016.

  - National Chiao Tung University, Hsinchu, Taiwan .

  - National Taiwan University, Taipei, Taiwan.

  - National Cheng Kung University, Tainan, Taiwan.

  - National Sun-Yat-Sen University, Kaohsiung, Taiwan.

  - National Dong Hwa University, Hualien, Taiwan .

- Communications and Cryptography: Shannon's Centenary Year Celebration, Shri G. S. Institute of Technology and Science, Indore, India, 30 April 2016.

- IEEE Shannon Centennial Celebration, Catholic Institute of Business and Technology, Accra, Ghana, 30 April 2016.

- Claude Shannon Centenary 2016 Hong Kong, Chinese University of Hong Kong, May-Nov 2016.

- Shannon Centenary in Singapore, National University of Singapore, 5 May 2016.

- Shannon's 100th Birthday, Monash University, Clayton Campus, Australia, 6 May 2016.

- Shannon Centenary Lectures, Modares University, Tehran, Iran, 8 May 2016.

- Centenary of Claude Shannon, Universidad Francisco de Paula Santander, Cucuta, Colombia, 13 May 2016.

- Plenary talk on Claude Shannon by Sergio Verdú and unveiling ceremony of IEEE Milestone, MIT, Cambridge, MA, USA, 17 May 2016.

Some recent media coverage of the Shannon Centenary include:
- J. Horgan, "Claude Shannon: Tinkerer, Prankster, and Father of Information Theory," IEEE Spectrum, 27 April 2016.

- A. Magoun, "Did Claude Shannon Invent a Groundbreaking Personal Computer," The Institute, 1 April 2016.

- G. Pascal Zachary, "Celebrating Claude Shannon," IEEE Spectrum, 23 March 2016.

Claude Shannon (April 30, 1916–February 24, 2001)

H(F + D) = N(V + D): a tribute to Claude Elwood Shannon (April 30, 1916–February 24, 2001); oil on canvas, 70 $\times$ 50 cm, by Jan Hein van Dierendonck, the Netherlands

April 30th 2016 captured from google.com

4/30/2016   Claude Shannon's 100th birthday

Doodles Archive   About   Doodle 4 Google   Search Doodles   English (United States)

April 30, 2016

Claude Shannon's 100th birthday

Report on 2016 Australian School of Information Theory

The 2nd Australian School of Information Theory was held at Monash University in Melbourne on January 18 and 19, 2016. The School was a great success, attended by over sixty researchers including thirty-six students. Attendees came from sixteen universities and research organisations from around Australia with particularly strong attendance from the University of New South Wales and the Australian National University as well as the local institutions; the University of Melbourne and Monash University. One attendee even made it all the way over the ditch (for those not familiar with the term it means he came from New Zealand).

Attendees at the 2016 Australian School of Information Theory battle the Melbourne heat for the sake of posterity (and so we had a photo for this report)

Participants were treated to four fantastic tutorials over the two days. Andrew Eckford was first out of the blocks with an introduction to molecular communications. He was followed closely by the effervescent Elza Erkip who spoke about source communication over fading channels. She herself showed no signs of fading despite the long flight from New York. Rüdiger Urbanke took the lead on the second morning. Wielding his whiteboard markers with precision he presented on sharp thresholds in coding theory. The School was concluded with a Prezi on scalable learning of graphical models by Monash's own Geoff Webb.

We are sure that all attendees learnt a great deal from the School and were inspired by our guest lecturers. We can't thank them enough for taking the time out of their busy schedules to support the School. Thanks must also go to the organising committee: Shuiyin Liu and Lakshmi Natarajan on local arrangements; Katrina He and Rajitha Senanayake looking after finance and registration; and Bhathiya Pilanawithana sculpting the website.

Finally, the Australian School of Information Theory would not have been possible without the generous support of the Information Theory Society. Their financial injection allowed us to keep the registration costs very low and to provide a number of travel grants to students who otherwise would not have been able to attend.

Jamie Evans and Emanuele Viterbo
(on behalf of the entire organising committee)

DIMACS Workshop on Network Coding: the Next 15 Years

Michael Langberg, Emina Soljanin, Alex Sprintson

DIMACS workshop on "Network Coding: the Next 15 Years" organized by Michael Langberg, Emina Soljanin, and Alex Sprintson took place during December 15–17, 2015. The goal of the workshop was to reflect on the past and stimulate the next 15 years of Network Coding research, discuss the new horizons for Network Coding and related fields, and identify key areas and research problems that may be in the focus of the research community in the short and long terms.

The workshop was very successful, with a prestigious list of speakers and participants including Alexander Barg, UMD; Eimear Byrne, University College Dublin; Viveck Cadambe, Penn State; Chandra Chekuri, UIUC; Hoang Dau, UIUC; Alex Dimakis, UT Austin; Iwan Duursma, UIUC; Michelle Effros, Caltech; Salim El Rouayheb, Illinois Institute of Technology; Christina Fragouli, UCLA; Sid Jaggi, CUHK; Shirin Jallali, Bell Labs; Sudeep Kamath, Princeton; Young-Han Kim, UCSD; Joerg Kliewer, New Jersey Institute of Technology; Oliver Kosut, Arizona State University; Gerhard Kramer, TU Munich; Frank Kschischang, University of Toronto; Mohammad Ali Maddah-Ali, Bell Labs; Muriel Medard, MIT; Prakash Narayana Moorthy, MIT; Bobak Nazer, Boston University; Aditya Ramamoorthy, Iowa State University; Parastoo Sadeghi, Australian National University; and Raymond Yeung, CUHK.

The workshop was jointly sponsored by three DIMACS special foci (Information Sharing and Dynamic Data Analysis, Cybersecurity, and Energy and Algorithms) with additional support from the Institute of Network Coding of The Chinese University of Hong Kong. The fact that network coding relates three different DIMACS special foci reflects its broad potential for improving data transmission and storage by optimizing not only throughput, but also delay, reliability, security, and energy efficiency. The workshop featured presentations on the role of network coding in the broader area of information theory, algorithms for construction of codes with specific properties, and the implications of results in network coding for problems beyond the network coding domain, such as those in network security, theoretical computer science, mathematics, and combinatorial optimization. In addition to the research presentations, the workshop featured a vibrant poster session. The talks were videoed and can be found at http://goo.gl/q168hG.

From the Predisent *continued from page 1*

visit http://inform.epfl.ch/index. php?form=Shannon. Once again, many thanks to the Shannon Centennial committee members Michelle Effros, Lav Varshnay, and Sergio Verdu, and chairs Christina Fragouli and Rudi Urbanke for their extraordinary work in organizing all of this year's Shannon-related events.

It is perhaps an inevitable sign of a mature and large society that within a month from Shannon's birthday celebration we lost two very prominent members of our community.

Sir David Mackay passed away on April 14th after a battle with cancer. He was 48. In a sadly brief, yet extraordinary career, David made profound contributions to information theory, coding, machine learning, energy sustainability, public policy, and human-machine interfaces for the disabled. Many of us vividly remember his inspiring plenary talk at the 2005 Adelaide ISIT, where he demonstrated Dasher, an ingenuous information-theory motivated tool that lets disabled users type using hand gestures, eye movement, and even just their breath. David described some of his work in two influential books, one bridging information theory and machine learning, and the other provid-

ing a quantitative perspective of energy sustainability. For his work David was appointed the Regius Professor at Cambridge University, was selected fellow of the Royal Society, and was knighted earlier this year. A detailed obituary about David appears in this newsletter.

Solomon Golomb, or $(S,G)(olom)(on,b)$ as he would puzzle, and Sol as everyone else called him, passed away on May 1st at the age of 83. He was the ultimate polyglot, being fluent in seven languages, and the quintessential polymath, having made seminal contributions to diverse topics in number theory, recreational mathematics, shift-register sequences, communication, and cryptography. Some of his work greatly impacted the fields he worked on, for example Stephen Wolfram called his maximum-length shift register sequences "probably the single most-used mathematical algorithm idea in history", while some had less likely consequences, for example his polyominos work is said to have influenced the popular video game Tetris.

Sol's achievements were recognized with numerous awards, including the Hamming medal, the national medal of science, induction to the National Academies of both Science and Engineering, and perhaps most significantly to us, the 1985 Shannon Award. We also greatly benefited from his whimsical side and to make education fun. For decades his puzzle column at this very
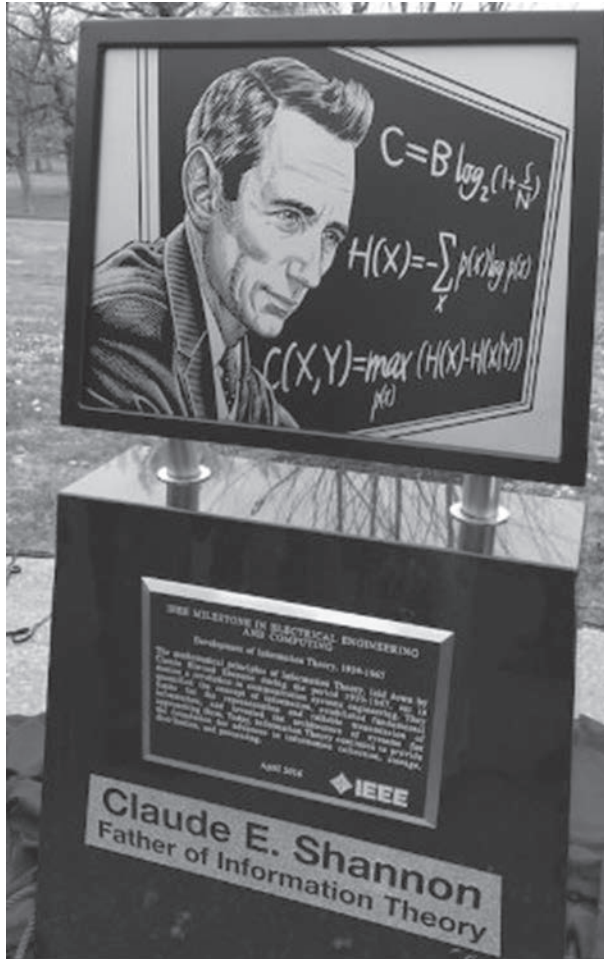
newsletter enlightened and entertained a generation of information theorists. Sol's final puzzle appears in this newsletter. A retrospective of his career and contributions will be published in an upcoming issue.

David and Sol epitomize our society's most valued members. Both were remarkable scientists who in their own very different ways made seminal contributions to the theory of information. Both had significant impact on technology and practice. And both generously contributed their time to social and educational causes they believed in. We will greatly miss them.

Segueing to the future, the society's website http://itsoc.org is our face to the world and interface with each other. It was designed in 2009 featuring state of the art technology such as a Plone content management system, and capabilities far exceeding those offered by other IEEE societies at the time.

But that was an internet lifetime ago. Since then, websites have gotten more vivid, interactive, and mobile, replacing text by texture and clutter by clarity. It is time for our facade to get a facelift too.

Our online committee, headed by Anand Sarwate, has been working with developers at Six Feet Up on a major website revision, aiming to make our portal more engaging and inviting so that curious visitors will linger longer to discover more information, while those looking for specific information can navigate to their destination more intuitively and rapidly.

The new website will also feature additional content, including conference archives, videos of ISIT plenaries, summer-school tutorials, and more. It will facilitate push notifications about important events and deadlines, profile and information uploads, and social-media interaction. There will also be several technical upgrades to increase security, reduce response time, and enable future mobile-site integration.

The new website will be rolled out over the next few months, but if you enjoy seeing sausage being made, you can visit the preliminary construction site http://testing-itsoc.sixfeetup. com and enter using name: access and password: Ahbahn4b Please keep in mind that this is still very much work in progress.

Have a great summer and looking forward to seeing you at an exciting Barcelona ISIT.

The Historian's Column

Anthony Ephremides

We live in the era of "black boxes". What I mean by this is that the concept of "layering" has reached deeply in our lives in ways that may be transformational for our future. It used to be that one could open the hood of a car and, if he/she had some knowledge of how the engine works, it was possible to diagnose a problem, perform some basic tests, and even fix the problem. Now all one sees under the hood is, literally, boxes (perhaps not "black", but still boxes). The only action, not only the owner but also the mechanic can perform is to replace a faulty box. The same is true for almost any piece of machinery and it extends even to more trivial instances, like repairing a pair of shoes or fixing a malfunctioning appliance. Replacement is the trend. We live in the "higher layer" and we have limited interfaces with the "physical layer".

This observation is a parable for a far more serious problem. It appears increasingly prominently in the classroom, both in schools and in universities. Students (and, I dare say, faculty sometimes) slide away from the painful process of reasoning right onto the slippery road of implementing programs and algorithms. It is a universally observed fact that, especially in engineering, the traditional theoretical foundation of our disciplines is being "pushed" down to a lower layer. Recently, a student submitted a solution to an optimization problem I had given. When I asked how he had solved it, he replied that he used an "optimization package" available on the web. The solution method, that is, becomes now a "black box".

This phenomenon is at its early stages and I am sure that many people will downplay its significance. I wish they are right. But I am afraid they are not. It is a widespread problem and it seems that, based on discussions with several colleagues, it permeates many disciplines. The ability to think "serially", that is, to understand the notion of axioms and hypotheses and to proceed to reason and reach conclusions based on logical sets of rules seems to be waning. A related observation is that students display a progressively diminishing ability to concentrate and follow a complicated argument or a series of logical inferences. Their attention span has become shorter. Stronger stimuli are required to capture their interest and attention. Exaggerated statements, preposterous claims, absolute aphorisms, and the like will usually do the trick (more now than before).

So, why is that? I believe that it has to do with the way the Information age has assaulted us with huge volumes of data and with devices that use and rely on visual and instantaneous displays. Starting with television and expanding with computer screens and portable devices, we have become literally "flooded" with data (note: not information; we are data-rich but information-poor) that we cannot absorb or process. We have even discovered lately a term for this flood. We call it Big Data. And for adults who grew up in an era of less alarming intensity, where the pace of learning was following a manageable and sustainable pattern, it is possible to make some sense of these developments and maintain a balance. But for the youngsters who, from a very early age, are inundated with the avalanche of visual assaults of all sorts, it seems that it is a natural consequence that their way of thinking will be altered. Clicking buttons seems to be all that is needed to

perform tasks. The layering principle is taking hold. Who cares what lies below? Someone else is responsible.

I have often experimented with deliberately confusing necessary and sufficient conditions to observe whether such confusion is detected. More often than not, and for subtler cases, students fail to make the distinction. This is something that politicians love. They tell you for example that a heinous act was performed by someone who is, say, "Mexican", to conclude that all Mexicans are heinous people. So, the separation of critical thinking from our actions (which is strongly encouraged by the "layering" that we experience) is a problem with serious and, potentially, catastrophic consequences.

A colleague recently observed that perhaps this should not be so alarming. After all, our early predecessors were more muscular and physically fit than we are today. We lost part of their physical prowess because we developed machines and surrogates that perform the onerous tasks for us. We do not have to manually push stones to build pyramids anymore and this is perhaps for the better. Indeed, although one could argue that this may have affected our overall state of health by leading us into a more sedentary way of life. We, of course, take care of that by exercise, medicines, etc. and we have managed to adapt in a way that has benefited us all. There is a difference, however. First of all this evolution took place at a much slower pace than the "information-based" evolution we are experiencing today. And, secondly, the effect of the adaptation we went through was mostly physical and not mental. In fact, the reduced load of muscular labor gave new opportunities to sharpen the mind. Today, the changes we are witnessing seem to, rather, dull the mind.

So, what to do? If we consider the parallel concept of "layering" that we are familiar with from the world of communication networks, we see that layering did facilitate the building of the Internet and the Information Infrastructure all right, but it did create huge operational problems. We finally realized that layering was the "original sin" in the building of networks. And, already by the end of last century, we discovered the concept of "cross-layering". That is, we saw the necessity of bridging the boundaries between the layers. We do not abandon black boxes but we do not simply replace them; we also see what is in these boxes.

People have not lost their intelligence (…yet). Their IQ is probably at comparable levels as in the past. However, their altered thinking process needs to be adjusted. The overwhelming addiction to information- (or, more correctly, data-) devices needs to be moderated. We need to be more choosey. Yes, it is hard to go back to hand-written letters sent by snail-mail to their recipients (although I admit I am truly charmed when this occasionally continues to happen) when we can "fire" email messages instantly (that, often and inadvertently, make fools of ourselves). But do we need to walk the streets looking at a smartphone, or having earphones stuck in our ears, or talking to ourselves like madmen? Mere aesthetic reasons should dictate a modified protocol. But, more

importantly, keeping our sanity, our thought control, and our mental health and agility should be a stronger reason to modify this behavior. Aldous Huxley was among the first to see with his gifted mind the risks of evolving into a terrifying future if we did not stay "alert". His vision, happily, did not come to materialize. But I am concerned that there are signs of that vision re-emerging. Our only defense is to keep crossing the layers. Let us resolve to inspect the contents of the black boxes.

GOLOMB'S PUZZLE COLUMN™

Latin Squares

Solomon W. Golomb

We define a *Latin Square of order* n, L_n, to be an $n \times n$ array of the symbols $\{1, 2, 3, ..., n\}$ such that each row, and each column, of L_n is a permutation of these n symbols. A *transversal* of L_n is a selection of n of the n^2 entries in L_n with one entry in each row, one entry in each column, and consisting of one each of the n symbols. (See Figure 1.)

Two Latin Squares, L_n and L_n', of order n, are called *orthogonal* if the n^2 ordered pairs of corresponding entries from L_n and L_n' are all distinct. (See Figure 2.)

Figure 1. The circled entries form a *transversal* to this Latin Square of order 4.

Figure 2. This Latin Square of order 4 is *orthogonal* to the one in Figure 1, because the 16 ordered pairs: (1,1), (2,2), (3,3), (4,4); (2,3), (1,4), (4,1), (3,2); (3,4), (4,3), (1,2), (2,1); (4,2), (3,1), (2,4), (1,3) are all distinct.

Prove each of the following.

1) A Latin Square, L_n, of order n, has an orthogonal mate, L_n', if and only if one can find n simultaneous, non-overlapping transversals in L_n.

2) The multiplication table of the numbers $\{1, 2, 3, ..., p - 1\}$, modulo p, for prime $p > 2$, is a Latin Square of order $p - 1$, but it cannot have any transversals.

3) If the "multiplication table" (or "Cayley table") of a finite group G, of order n, considered as a Latin Square, has one transversal, then it has n simultaneous, non-overlapping transversals, and hence (by Problem 1 above) an orthogonal mate.

4) There can be no more than $n - 1$ pairwise orthogonal Latin Squares ("Mutually Orthogonal Latin Square", MOLSs) of order n.

5) If a Latin Square of order n has $n - 1$ simultaneous, non-overlapping transversals, then it has n simultaneous, non-overlapping transversals, and hence (by Problem 1 above) an orthogonal mate.

6) It is known that there is no pair of orthogonal Latin Squares of order 6. Accordingly, what is the largest number of simultaneous, non-overlapping transversals that an L_6 can have? Can you find such an example?

With great sadness, this is to be Sol Golomb's last Puzzle column. Solomon W. Golomb passed away on May 1st. Beyond being a pillar of our society and an amazing scholar, he has shaped the content of our newsletter and has been a long time and consistent contributor enlightening us all, young and old, with his beautiful puzzles. As the Dean of the USC Viterbi School of Engineering Yannis C. Yortsos wrote, "With unparalleled scholarly contributions and distinction to the field of engineering and mathematics, Sol's impact has been extraordinary, transformative and impossible to measure. His academic and scholarly work on the theory of communications built the pillars upon which our modern technological life rests." A full remembrance honoring Sol will appear in the next issue of this newsletter.

GOLOMB'S PUZZLE COLUMN™

Simple Counting Problems Solutions

Solomon W. Golomb

1) # (Integers from 1 to 10^6, neither squares nor cubes) = $10^6 - 10^3 - 10^2 - 10 = 998{,}910$.

2) From the set of 10 distinct coins, there are 2^{10} possible subsets (including none or all of these coins). Whichever subset is picked, round it up to ten coins altogether using the identical coins. So there are $2^{10} = 1024$ different-looking assortments.

3) Since $6^z = 2^z \, 3^z$, if 6^z divides $2^{16} \, 3^{24}$, then 2^z divides 2^{16}, with $z \le 16$, and 3^z divides with 3^{24}, with $z \le 24$. So the largest possible z is the smaller of 16 and 24, namely 16.

4) Since $7 \cdot 11 \cdot 13 = 1001$, the number of integers from 1 to 1000 divisible by none of 7 or 11 or 13 is the same as the number of such from 1 to 1001, namely $1001 \cdot \left(1 - \dfrac{1}{7}\right)\left(1 - \dfrac{1}{11}\right)\left(1 - \dfrac{1}{13}\right) = 6 \cdot 10 \cdot 12 = 720$.

5) By a well-known formula, the number of assortments of size k when there are n different kinds of objects (allowing repetition but disregarding order) is $\begin{pmatrix} n+k-1 \\ k \end{pmatrix} = \begin{pmatrix} 3+6-1 \\ 6 \end{pmatrix} = \begin{pmatrix} 8 \\ 6 \end{pmatrix} = \begin{pmatrix} 8 \\ 2 \end{pmatrix} = 28$.

6) From a set of n objects, a first subset having neither all nor none of them can be formed in $2^n - 2$ ways. Then put what's left into the other (non-empty) subset. Since which subset is which does not matter, there are $\dfrac{\left(z^n - 2\right)}{2} = 2^{n-1} - 1$ ways to do this.

From the Editor *continued from page 2*

Mahajan, Robert J. McEliece, Radford M. Neal, Jossy Sayir, Amin Shokrollahi and Christian Steinruecken for preparing the tributes.

Please help to make the newsletter as interesting and informative as possible by sharing with me any ideas, initiatives, or potential newsletter contributions you may have in mind. I am in the process of searching for contributions outside our community, which may introduce our readers to new and exciting problems and, as such, broaden the influence of our society. Any ideas along these lines will also be very welcome.

Announcements, news and events intended for both the printed newsletter and the website, such as award announcements, calls for nominations and upcoming conferences, can be submitted at the IT Society website http://www.itsoc.org. Articles and columns can be e-mailed to me at mikel@buffalo.edu with a subject line that includes the words "IT newsletter."

The next few deadlines are:

July 10, 2016 for the issue of September 2016.

Oct 10, 2016 for the issue of December 2016.

Please submit plain text, LaTeX or Word source files; do not worry about fonts or layout as this will be taken care of by IEEE layout specialists. Electronic photos and graphics should be in high resolution and sent as separate files.

I look forward to hearing your suggestions and contributions.

With best wishes,
Michael Langberg.
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Students' corner: The "I" in IT

Bernhard Geiger

Have you ever asked yourself whether IT is the right field of science for you? I never did, but I guess IT wondered more than once whether I am the right person to work on its problems. Here's my story.

I'm currently a postdoc at the Institute for Communications Engineering, Technical University of Munich, Germany. In this regard, my story has a happy ending, something I wouldn't have dreamed of years ago. When I started my PhD at Graz University of Technology, Austria, I hadn't heard a lecture on IT yet. My supervisor and I nevertheless decided to attempt developing a "theory for deterministic information processing", which is what we called it back then. I knew entropy from communications engineering and thought that I could get all the necessary information from Chapter 2 of the "Elements". I later read Chapter 4 on stochastic processes and even resorted to more detailed results, such as those from Kolmogorov and Pinsker, when I tried taking limits of random variables. Nevertheless, phrases like "a sequence of codes" never appeared in my work. Probably my scientific credibility would be lost if I told you how many of my papers got rejected - so I won't. I will tell you, though, what most reviewers agreed on: That the information-theoretic quantities I introduced to characterize deterministic systems lack an operational characterization. That was a valid criticism, and I learned what an operational characterization is only a few months before I obtained my PhD. Relating to IEEE Spectrum's article on Claude Shannon, I despaired that I had "jumped on the bandwagon without really understanding" (Slepian) and contributed to the "widespread abuse" (Pierce) of IT by other fields.

However, since then I have discovered that this kind of "abuse" is successful in scientific fields outside IT. For example, nonlinear adaptive filters are trained using an error entropy, Rényi and Cauchy-Schwarz divergences are used for learning and classification, and the information-bottleneck method enjoys widespread use in clustering. To the best of my knowledge, only few of these works accompany their objective functions with an operational characterization - mutual information is "just" a nonlinear measure of statistical dependence, and entropy is "just" a statistic that captures more than the error signal's variance. Remarkably, these heuristic methods often show superior performance. Hence, at least *in these other fields*, the works are scientifically justified by *experiment*. (OK, I admit that this is a feeble attempt to justify my work a posteriori. As more self-justification, the Aims & Scope of the IEEE Transactions on Information Theory does state that the journal aims to publish theoretical *and experimental* papers.)

Should I, therefore, try to publish in other fields and transactions? Probably. My supervisor, suggested more than once that I should spread the word, trying to convince scientists in signal processing to use higher-order statistics, i.e., IT quantities. I haven't listened, though, because I feel at home in the IT community, and I would not want to miss meeting my IT friends regularly at our annual events. Even in hindsight, I would rather submit to orthodox pressure and provide operational characterizations rather than to publish in a different community. In the future, I hope that I can do both.

That is my decision. As the IT society, we all must decide: what are our traditions (really) and how strong shall we hold on to them? Especially when dealing with future directions of IT, as mentioned in arXiv:1507.05941, how should we contribute to make our quantities be used in fields such as signal processing, control theory, and machine learning? Or should we not? For example, should we propose clustering algorithms using IT quantities, or should we rather focus on deriving asymptotic limits for the clustering problem? You, as a PhD student, must make your own decision: Are you sufficiently "in IT" so as to be accepted by the community? If your research topic is on the border between IT and another field, in which direction do you want to go?

IEEE Information Theory Society Seoul Chapter

Hong-Yeop Song, Chapter Chair, Yonsei University, Korea,
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April 2016

Founded in 1995 by Jong-Seon No and his close friends in the area of Information Theory, IEEE ITS Seoul Chapter had the very first meeting in May 11, 1996 with six presentations, some from industries and mostly from the local universities. Since the beginning, the chapter has had three seasonal meetings each with about 4~6 technical presentations and 1 special lecture together, usually in February, May, and October. We also have regularly had a 4-day tutorial lecture series in February on error-correcting codes for both graduate freshmen and field engineers in Korea. For the last 20 years, this tutorial has been popular with almost 80~100 registrants (including students) every year that gathered together and studied the very basics of error-correcting codes. Since 2013, we also have held a 4-day Summer Tutorial on information theory. The number of active members (professors from universities and research staffs from local industries) is now about 80.

We had IEEE ISITA in 2006, and also IEEE ISIT in 2009, both in Seoul Korea. It was a great experience that recently we also had the IEEE Information Theory Workshop in Jeju Korea, October 2015 from 11-15. It was my personal pleasure that I (third from the right in the picture) had a chance to co-organize this workshop with G. Caire. The program under the theme of "Big data and Information Theory" was made by three co-chairs: Sae-Young Chung (second from the right in the picture), Rudiger Urbanke and Pramod Viswanath. Lots of local members of the chapter have contributed to the workshop: Kyeongcheol Yang (first from the left in the picture), Jong-Seon No (second from the left in the picture), Kwang Soon Kim, Chan-Byoung Chae, Jungwoo

Lee, Dong-Jun Shin, Sang-Hyo Kim, and JC Park. Young-Han Kim (first from the right in the picture) from UCSD has helped a lot even though he is far away from Korea. The picture shows two plenary speakers in the middle from left to right: Te Sun Han from Waseda University, Japan and Bruce Hajek from UIUC. The workshop was a big success. There were 112 submissions, and 72 presentations were accepted with additional 20 invitations and 4 plenary talks. The total number of registrations was 152 and the organizing committee offered two half-day tours of the Jeju area (UNESCO World National Heritage Sites) for free. All these records, pictures, and plenary presentations can be downloaded from the site: http://www.itw2015.org/

The local members of the chapter are mostly members of the Korean Institute of Information Science and Communications (KICS). We have been working together closely with the Coding and Information Theory Society (CITS) inside KICS since the beginning. CITS started its activity jointly with IEEE ITS Seoul Chapter almost at the same time in 1996, and we both will have our 20th celebration this summer together. The current chair of CITS-KICS, Kwang Soon Kim, will organize 2-day workshop in Jeju Korea,

together with IEEE ITS Seoul Chapter Chair, myself. This workshop will also celebrate the 100th birth year of C.E. Shannon. We will have some plenary talks, invited presentations, and social time for members of both IEEE ITS and KICS together.

IEEE Information Theory Society Board of Governors Meeting Minutes

Hilton Chicago O'Hare, Oct. 3 2015 (9am–2pm) Edmund Yeh

Present: Michelle Effros, Alon Orlitsky, Ruediger Urbanke, Edmund Yeh, Daniela Tuninetti, Anand Sarwate, Elza Erkip, Wei Yu, Abbas El Gamal, Aaron Wagner, Emina Soljanin, Jeff Andrews, Urbashi Mitra, Michael Honig, Michael Langberg, Nick Laneman, Gerhard Kramer (via WebEx), Frank Kschischang (via Skype), Vijay Kumar (via Skype), Osvaldo Simeone (via Skype), Andrew Barron (via Skype), Stephen Hanly (via Skype), Tracey Ho (via Skype)

The meeting was called to order at 9 AM Chicago Time by Information Theory Society (ITSoc) President, Michelle Effros.

1) Voting on the minutes from the June 2015 BoG meeting will be conducted over email.

2) **Motion**: Vote to approve the meeting agenda. Motion was passed.

3) Michelle presented the President's Report. Michelle first gave an update on Society finances. The Society financial outlook is good, with healthy reserves. Michelle reviewed the 50% rule, and discussed a new source of funds from the IEEE-level call for initiatives. It was suggested that the Society should at all times have a prioritized new initiatives list.

Michelle next discussed publications and events. Management of the Transactions is going smoothly, and the Transactions remain very prestigious. Symposia and workshops have been highly successful, involving a wealth of applications of information theory. The Society should foster and preserve the good will of volunteers. The Society should be aware of symposia trends and targets.

We should pursue joint initiatives with other communities. IT schools are continuing with success.

Michelle next reviewed society committees, which have been very active. It was recommended that the Chapters committee continue to monitor the activity level of individual chapters. Activities for the Distinguished Lecture program should be enhanced. Regarding Fellows nominations from the Society, there is concern that the number of nominations has been small. Many society members have been nominated through other societies. Many members are not nominated until quite late in their careers. It is recommended that there be a more organized effort to nominate more members.

Michelle reviewed the hiring of Matt LaFleur as administrative assistant for the Society. The job announcement for this position was posted in late 2014. The position was half-time and therefore somewhat hard to fill. In the end, a full-time position was created with time split between the IT Society and IEEE. In this capacity, Matt LaFleur was hired in mid-2015. Matt has been very active in working with officers to facilitate duties, including scheduling, reminders, and website updates.

Michelle pointed out that one of the main aims for 2015 is to increase the level of outreach activities for the Society. The main initiatives involve building bridges to other technical communities through the Newsletter and conferences, and reaching out to the general public through the Shannon Centennial celebrations and the Shannon documentary.

Michelle expressed thanks to officers and BoG members whose terms end on 12/31/2015: Gerhard Kramer (Senior Past President), Edmund Yeh (Secretary), Elza Erkip (Chair, Conference Committee), BoG members Jeff Andrews, Mike Honig, Vijay Kumar, Emina Soljanin, and Ram Zamir. Michelle also thanked all Society volunteers.

Michelle introduced the new officers for 2016: Abbas El Gamal (Senior Past President), Alon Orlitsky (President), Ruediger Urbanke (First Vice President), and Elza Erkip (Second Vice President). She also introduced new BoG members with terms starting 1/1/2016: Jeff Andrews, Matthieu Bloch, Suhas Diggavi, Pierre Moulin, Krishna Narayanan, and Emina Soljanin.

For 2016, the tentative BoG meeting dates are Sunday, January 31, 2016, San Diego (ITA), Sunday, July 10, 2016, Barcelona (ISIT), and Friday or Saturday after the Allerton Conference.

4) Daniela Tuninetti presented the Treasurer's Report. Daniela reviewed the main components of the Society budget. From 2014 actuals, periodicals make up 60% of the revenue, 59% of expenses; conferences make up 38% of the revenue, 35% of expenses; membership make up 2% of the revenue, 5% of the expenses.

Daniela presented the 2016 budget (as of August 2015), with a project surplus of $35.8k. Daniela then reviewed 2014 actual revenues and expenses. The 2014 actual net was $275k, compared with a budgeted net of $60k. This resulted in part from additional revenue and lower expenses from ISIT 2014. Fifty percent of the 2014 actual net has been donated to the IEEE Foundation "Shannon Centennial" Fund.

Daniela continued to the 2015 budget. The budgeted 2015 year-to-date (YTD) net was $217.1k. The actual 2015 YTD net is $162.0k. If the Society stays on track according to the budget, the end-of-year net is projected to be $70k. Daniela also projected that the worst case end-of-year net is $6.5k.

A discussion followed Daniela's presentation. It was pointed out that with large surpluses and reserves, the Society should find ways to spend beneficially. For instance, conferences with large surpluses could refund some registration fees to students. It was suggested that the financial goal of the Society should be a zero budget surplus.

5) Frank Kschischang presented the Editor-in-Chief (EiC) Report. Frank first thanked outgoing associate editors Yi Ma (Signal Processing), Venkatesh Saligrama (Signal Processing), Devavrat Shah (Communication Networks), Aaron B. Wagner (Shannon Theory) and Kyeongcheol Yang (Sequences) for their service. Frank reviewed the Editorial Board status as of October 2015. The Board currently consists of 41 Associate Editors (AEs).

The number of papers submitted to the Transactions appears to have increased (about 10%) over the past year. The page budget for the Transactions in 2015 was 8500 pages. The actual page count until October was 5764. Frank presented the acceptance and rejection rates in the past 12 months, in overall terms and by editorial area. The fast rejection rate (decision taking fewer than 30 days) is about 15.2%. Excluding decisions made within 30 days, the median time to first decision is 178 days (the overall median is 159 days). The first decision is reached within one year in 88% of cases.

Frank next made a proposal for an online discussion forum for AEs. Frank proposed to use a system called "muut" (see muut.com), which features instant view on updates since last visit, fast search, real-time posts (chat-room style), complete data export, and excellent support for mobile screens. Frank proposes a subscription to the muut MEDIUM plan costing US$48/mo (US$576 annually), which includes a non-profit discount of 50%.

Motion: To approve the expenditure of US$576 for a one-year subscription to the muut MEDIUM plan. Motion was passed.

Frank continued with a proposal for the creation of a Managing Editor position. Frank pointed out that the EiC job is demanding, requiring one to two days per week on average. To alleviate the load, Frank recommends adopting a shift-register model by appointing a Managing Editor (ME) who will transition into Editor-in-Chief after 18 months, upon appointment of next ME. The ME would be responsible for day-to-day paper handling/assignment, dealing with authors and AEs, and interacting with ScholarOne. The EiC would take overall responsibility, be responsible for producing issues, handle appeals, interact with IEEE Production Portal, recruit new AEs (in consultation with ME and EEB), write reports, and make presentations.

A discussion followed. It was agreed that the IT EiC position is very demanding and should be supported with some decentralization. It was suggested that the proposed change is minimal, and could be supplemented by other support, such as area editors. The proposed change would require BoG approval but does not require bylaw changes. Informal support for Frank's plan was noted.

6) Gerhard Kramer presented the Nominations and Appointments Committee report. Gerhard first discussed the Board Election for the 2016-2018 term, and congratulated the new and returning board members (see President's Report above). For 2016, the Fellows Committee will be chaired by Helmut Bolcskei, with Emre Telatar, Bert Hochwald, Vijay Kumar, Roy Yates, Emanuele Viterbo and Emina Soljanin as members. The Cover dissertation award committee will be chaired by Andrew Barron with Ruediger Urbanke (ex officio), Ezio Biglieri, Ian Blake, Alex Vardy, Ueli Maurer, and Wei Yu as members.

7) Gerhard Kramer presented the Constitution and Bylaws Committee (CBC) report. The CBC proposes that a new bylaw be added to make the Massey Award sub-committee part of the Awards committee. The proposed text with context is as follows (with new text in italics).

"A subcommittee of the Awards Committee shall be responsible for selecting the recipient of the IEEE Information Theory Society Thomas M. Cover Dissertation Award, according to Article VII, Section 8. *Another subcommittee of the Awards Committee shall be responsible for selecting the recipient of the IEEE Information Theory Society James L. Massey Research and Teaching Award for Young Scholars, according to Article VII, Section 9.*"

A vote to approve the bylaw change will be conducted over email.

8) Elza Erkip presented the Conference Committee Report. Elza first presented the budget for ITW 2017 in Kaohsiung, Taiwan. Two versions of the budget are available with 7.5–10% surplus. There is a 3-day low student registration fee. The workshop has received a $15.5k government grant to cover speaker costs, and a $10k IEEE loan to cover preliminary payment of publication costs and down payment for the venue, banquet, etc. The conference committee recommends BoG approval of the budget and the loan request.

Motion: To approve the ITW 2017 budget and a $10k loan to cover preliminary expenses. Motion was passed.

Elza moved to discuss technical co-sponsorship of ITA 2016. Conference committee recommends BoG pproval.

Motion: To approve technical co-sponsorship for ITA 2016. Motion was passed.

Elza discussed the feedback on semi-plenary sessions at ISIT 2015. According to a post-conference survey, the feedback has been mostly positive: 79% said semi-plenary sessions had improved their conference experience, and 86% would like to see the experiment continue at future ISITs. The survey combined "Yes" and "Somewhat" responses. The conference used a special committee for selecting semi-plenary papers. Elza asked whether ISITs should continue to highlight a subset of papers. Would venue constraints at upcoming ISITs allow for that, and are there other possible formats?

A discussion followed. It was suggested that 86% is a very high percentage, and the Board could encourage this format by making sure future ISITs select venues which allow for semi-plenary sessions. This could be done by the Conference Committee at the time of soliciting conference proposals. In particular, the Committee could check whether ISIT 2017-2019 are capable of handling this format. It was felt that fewer parallel sessions is the key to highlighting papers. Perhaps poster sessions could be used to accommodate more papers. On the other hand, it was felt that poster sessions reduce the importance of certain papers, and some schools cannot reimburse travel for poster presentations.

Elza next reviewed ISIT advanced registration fees, which have been increasing since 2004, adjusting for inflation. Surpluses for ISITs have reached 20%, which is too high. Strategies for lowering the surplus should be considered. For instance, ISIT 2015 reimbursed students for registration fees even after the start of the conference. Perhaps surplus targets for ISITs should be lower. Elza also reviewed

the geographical distribution of IT Society membership in comparison with the distribution of ISITs. The data suggests that both Asia and North America are under-represented by ISITs when considering Society membership.

Elza next discussed the ISIT selection process, which is back on schedule. There have been many recent ISIT proposals, some of which have unfortunately been turned down. Organizers are asking for more feedback. Perhaps this requires more involvement from the BoG in creating a better process. Perhaps a process involving conditional acceptance (subject to an appropriate conference date) could be developed.

Elza moved on to a number of recent workshop proposals which bridge the IT Society with other communities. These include the Nexus of Information and Computation Theories workshop in Spring 2016, co-organized by Bobak Nazer, which connects the IT and computer science communities. Communications, Inference, and Computing in Molecular and Biological Systems is another such workshop taking place in December 2015, co-organized by Ubli Mitra. The workshop connects the IT and biology communities. The Society should develop guidelines for supporting such workshops. Should the support be financial or technical? How much support should be given? Should an educational component be required?

A brief discussion followed. It was suggested that workshop support take the form of initiatives.

Finally, Elza mentioned that starting from December 31, 2015, IEEE will be charging technically cosponsored conferences $1000 per conference and $15 per paper. Thus far, the Society has not received any complaints from conference organizers and there is currently no need to discuss the Society's partly covering this fee.

9) Ubli Mitra presented the plan for a workshop on Communications, Inference, and Computing in Molecular and Biological Systems, to take place December 3-4, 2015 at the University of Southern California. In view of the increased level of interest in the intersection between information theory and biology, the workshop seeks to provide a forum to promote interaction between the two groups. The workshop will feature 12-16 invited talks (11 confirmed) and 30 posters in two poster sessions. Confirmed invited speakers include Behnaam Aazhang, Todd Coleman, Andrea Goldsmith, Olgica Milenkovic, and Mihaela van der Schaar. The targeted participation level is 50-70 participants. Costs are estimated to total $12,535 and revenues to date total $8000. The workshop would like to request support from the IT Society at $2k. This will be followed by a request to the NSF (proposal to CIF) for $2,535.

10) Anand Sarwate presented the Online Committee report. The current committee consists of Anand Sarwate, Matthieu Bloch, Adriaan J. de Lind van Wijngaarden, Stefan Moser, and J. Nicholas Laneman. Committee activities since ISIT 2015 include bringing in Matt LaFleur to assist in website maintenance, consulting with other societies on website design, requesting and obtaining funds from IEEE for major site redesign, surveying ITSOC membership

about site needs/desires, initiating redesign and upgrade process with Six Feet Up, and transferring ISIT Plenary and Shannon Lectures to hosting on Vimeo.

The committee is focusing on improving internal and end-user performance by (1) working with Matt LaFleur to make a master checklist of updates and deadlines to ensure more timely posting and updating of content, (2) overhauling and redesigning the site, (3) soliciting volunteers to assist in curating/organizing/generating content for the site, (4) reaching out to existing initiatives to offer online support.

Anand mentioned that other societies (SPS, Comm, etc.) have external hosting and site design from outside of IEEE, as well as dedicated IEEE staff webmaster who handles light maintenance.

Anand reviewed the results of the ITSoc membership survey. Problems with the site mentioned in the survey response include technical issues (slow page loads, etc), inconsistency and lack of comprehensiveness, failure to encourage exploration, the shortage of content regarding information theory in general. Features desired by respondents include (in order of popularity): more videos, archiving of old conference sites, hosting of existing conference sites, outreach material, and self-organization into interest groups. Desired content include more videos, links to social media, blogs, twitter, etc., talks/slides for general audiences (c.f. TED-talk/Khan Academy), free technical materials or surveys, fora for people to ask questions (technical and general), regular updates and new content, methods to organize a more global audience.

Anand proposed the following work for site upgrade: providing more content; creating mailing lists for each committee; redesigning the main navigation to reduce the number clicks, modernize look and feel, and help promote the Shannon Centenary; upgrading the user management system, sub-site system, and fix load times, database issues.

The Online Committee has requested and received $45k from IEEE to defray costs. It is currently pushing upgrades (back-end) to the front of the schedule. The total expense for the proposed changes will be $47,000 to $78,000 depending on the complexity. The Committee requests authorization to spend an additional $15k (in addition to the $65k from IEEE and current budget) to expedite the proposed site changes.

Anand continued: the site now has a nascent social media presence: ITSOC Twitter account. Twenty-six videos from ISIT are up on our Vimeo page. The site is coordinating with Shannon Centenary initiatives around the web.

Anand continued with Shannon's Channel: a video initiative. Subject to approval, the Online Committee will work with Salim El Rouayheb's "Shannon's Channel" YouTube/videocast talk series. For this, talks are announced ahead on the webpage and are given using the Google+ Hangout platform. Anyone can watch the talks live and ask questions. The talks are recorded and made available on YouTube and can be watched at anytime.

Finally, Anand mentioned that the Committee has started working with Elza Erkip on investigating possibilities for conference app development.

11) Michael Langberg presented the report on the IT Newsletter. The Newsletter is currently published four times a year (March, June, September, December) in hard copy and also on the ITSoc webpage. The number of subscribers is roughly 3300. The editorial board consists of Michael Langberg (Editor since March 2015) and the editorial committee: Frank Kschischang, Giuseppe Caire, Meir Feder, Tracey Ho, Joerg Kliewer, Anand Sarwate, Andy Singer, and Sergio Verdu.

Michael reviewed the timeline for publication of the Newsletter. The current sections include the President's column, Technical contributions, the Historian's Column, the Students' Corner (new), "From the Field", Chapter column, Puzzle Column, Reports, and Calls/Announcements. The Newsletter solicits technical contributions from the community for the community, from "adjacent" communities for the community (introduce our readers to new and exciting problems) and from the community for "adjacent" communities (broaden the influence of our society).

The Newsletter encourages everyone to share any ideas regarding potential contributions, new columns, and any interesting events/topics that need highlighting.

A short discussion followed. It was asked whether the Newsletter should become a more magazine-like publication. It was agreed that this would require a substantially bigger effort. Ubli Mitra agreed to look into such a transition ongoing for the IEEE Antennas and Propagation Society.

12) The Fellows Committee report by Rob Calderbank was presented. The 2015–16 IT Fellows Selection Committee members are Helmut Boelcskei, Andrea Goldsmith, Bert Hochwald, Vijay Kumar, Emre Telatar, Roy Yates. The committee had five strong candidates to evaluate, and provided IEEE with a rank ordering of the candidates before the IEEE deadline. Discussion of candidates was conducted by email. Each candidate was assigned to a committee member who initiated our group discussion by drafting and circulating a succinct description of the candidate's outstanding contributions. Contributions to the email discussion were collected by the Chair, shared with committee members as the discussion proceeded, and they formed the basis for assignment of scores at the end of the process.

The number of nominations is cause for concern. When there are few candidates the expectation is that not all will be elected, so well-qualified candidates start to make the calculation that their chances are better if their nominations were submitted to the Communications and Signal Processing societies. While it is disappointing to have only five candidates, it is a unusual to have five strong candidates. If it is because members of our community delay making nominations until a candidate is well above the bar, then we may want to change our practice.

A discussion followed. It was suggested that the Society provide guidance on the timeline for applying for Fellow. It may be helpful to generate a list of members with associated IEEE grade. More names should be suggested to the Fellows Committee by for instance, former Fellows Committee members.

13) Ruediger Urbanke presented the Membership and Chapter Committee report. The committee is working on an archiving tool for committee tasks which will keep old folders as archive and prepare new folders for successors every year.

The Committee is closely monitoring the activities of chapters around the world. The UK and Ireland as well as the Norway chapters were to be dissolved, but Jossy Sayir and Deniz Gunduz have stepped up to save the UK chapter. The Washington, Kitchener-Waterloo, Philadelphia, South Australia, and Russia chapters are currently on the watch list. New chapters have been started in India (Madras), Italy (Marco Dalai, Ezio Biglieri, Michele Zorzi), and Chicago (Daniela Tuninetti).

For 2014–2015, the Distinguished Lecturer Program hosted Guiseppe Caire (Macedonia), Frans Willems (South Africa), Gerhard Kramer (Spain) and Suhas Diggavi (Canada).

14) Osvaldo Simeone presented the Students Subcommittee report. The subcommittee is currently cochaired by Osvaldo and Deniz Gunduz. Student/postdoc Volunteers for the subcommittee are Jonathan Scarlett (EPFL) and Bernhard Geiger (TUM).

At ITA 2015, the subcommittee co-organized a panel discussion on "101 reasons to study IT" with the Outreach subcommittee. The panelists were Ubli Mitra, Andrea Montanari and Emina Soljanin. The event had very high attendance. At ISIT 2015, the subcommittee organized lunch with Shannon awardee Rob Calderbank. The interview from the event will be available online soon. Expenses for the ITA 2015 and ISIT 2015 events total $3,500. Other initiatives include the introduction of a new "Student Column" in the IT Newsletter (in collaboration with M. Langberg).

For 2016, the subcommittee will select a faculty co-chair to replace Deniz Gunduz, extend membership to students/postdocs with the aim of enhancing diversity and establishing a presence in Asia and Latin America, continue with the ITA panel and ISIT Meet the Shannon Awardee events. The budget for 2016 is set at $5k.

15) Alon Orlitsky presented the Schools report on behalf of Aylin Yener. For 2015, all schools have concluded. The European school took place in April (reported presented in Hong Kong). The North American school took place in August. The East Asia school, India school, South Africa school, and Australia took place in June 2015, July 2015, August 2015, and November 2014, respectively. No report has been received for these schools yet.

For 2016, The European school (Chalmers, Sweden) was approved at ITA 2015. The North American school (Duke,

NC) was approved at ISIT 2015. The Australian school (Monash) was also approved at ISIT 2015. The preparations for these schools are all on track. The proposal for the India school has been received and is being reviewed by the School Subcommittee (current members: Michael Gastpar, Stark Draper, Young-Han Kim, Alex Dimakis, Gerhard Kramer, Ruediger Urbanke and Aylin Yener).

16) Aaron Wagner presented the Outreach Subcommittee report. The Subcommittee members are Joerg Kliewer, Aaron Wagner, Bobak Nazer, Tara Javidi, and Michele Wigger.

At ISIT 2015, the Subcommittee organized the panel discussion "The 99 Biggest Career Mistakes and How to Avoid Them" with panelists Elza Erkip, Alex Dimakis, Ruediger Urbanke and Madhu Sudan. Tara Javidi moderated. The event had an estimated 120 attendees. The event video will be posted to itsoc.org.

Aaron discussed the Mentoring Program, which currently has 34 pairings. Some reported problems include (1) few new applications, (2) only a few pairings really stick, and (3) a small pool of mentors. Aaron pointed out that mentees arguably need a mentoring network more than a single mentor. Perhaps we should help mentees identify their network instead of "assigning" mentors. For junior faculty, some key questions for identifying a mentoring network are (1) who could read your CAREER proposal? (2) who could you consult about work/life balance? (3) who could nominate you for IEEE Senior Member/Fellow? (4) who could you consult about tenure issues?

One idea is to have an ISIT event centered around mentoring. This could involve "speed mentoring," a mixer with prompted discussion, having senior ITSoc members available to discuss work/life, tenure, publication troubles, etc.

17) Anand Sarwate presented the WITHITS committee report on behalf of Negar Kiyavash. At ITA 2015, WITHITS held a luncheon, which served as an informal setting for networking. The main aim was to recruit more members, especially from the student, and postdoctoral body. Discussions items included (1) for students and postdocs, positioning IT graduates successfully for getting academic positions and giving good job talks; (2) for junior faculty: how to choose and successfully advise students, how to get research grants.

At ISIT 2015, WITHITS held an event which included two networking and mentoring oriented games. Natasha Devroye and Lalitha Sankar ran the meeting. The event had about 30 participants. The aim of the event was to encourage a sense of community by finding what the participants had in common with each other.

18) Ruediger Urbanke gave an update on the activities of the Shannon Centennial Planning Committee. The committee consists of Christina Fragouli, Michlle Effros, Ruediger Urbanke, and Lav Varshney. The committee's mission is to plan and coordinate events for Shannons Centenary, and to make the general public aware of Shannons contributions.

Ruediger introduced a crowd-sourced logo for the Shannon Centennial celebrations. The committee has contacted various schools concerning the Centennial celebrations. A Wikipedia entry has been created for the Shannon Centenary, and the ITSoc website is featuring the event. Emre Telatar and Greg Wornell are working to list Shannon's contributions as an IEEE Milestone. A number of volunteers are designing posters featuring different aspects of Shannon's contributions. Joerg Kliewer, Aaron Wagner, and Anand Sarwate are interacting with Reddit, and Eren Sasoglu and Ardan Arac are interacting with Google to feature the Shannon Centenary. Ninoslav Marina is working to place Shannon's image on a stamp in Macedonia.

Further ideas for the Shannon Centenary include the production of a five-minute video, contacting local science and technology museums (e.g. Math Museum in New York, Computer Museum in Palo Alto), and contacting radio and local press regarding the celebrations.

19) Michelle Effros presented a progress report on the Shannon documentary. The film maker Mark Levinson (Particle Fever) is writing the treatment, which is scheduled for completion next week. The proposed budget is currently $600k. Funds raised or pledged to date total more than $415k. The target distribution channels for the documentary include public broadcasters, direct distribution, film festivals, and educational distributors. Early conversations regarding these are underway. Michelle welcomes help or involvement in this project. Michelle Michelle noted that the IT Society will own the film and can decide its contents, while IEEE will need to give approval for its release.

The meeting was adjourned at 1:45 PM.

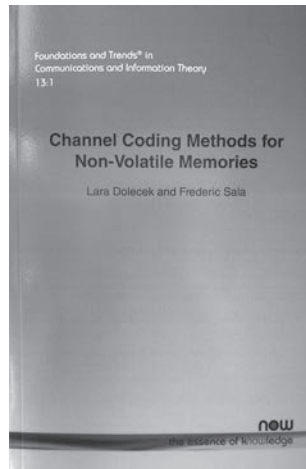# Channel Coding Methods for Non-Volatile Memories

Lara Dolecek, University of California, Los Angeles

I am happy to share that the monograph "Channel Coding Methods for Non-Volatile Memories" has been published in Foundations and Trends in Communications and Information Theory (Editor in Chief : Sergio Verdu).

http://www.nowpublishers.com/article/Details/CIT-084

Abstract

Non-volatile memories (NVMs) have emerged as the primary replacement of hard-disk drives for a variety of storage applications, including personal electronics, mobile computing, intelligent vehicles, enterprise storage, data warehousing, and data-intensive computing systems. Channel coding schemes are a necessary tool for ensuring target reliability and performance of NVMs. However, due to operational asymmetries in NVMs, conventional coding approaches—commonly based on designing for the Hamming metric—no longer apply. Given the immediate need for practical solutions and the shortfalls of existing methods, the fast-growing discipline of coding for NVMs has resulted in several key innovations that not only answer the needs of modern storage systems but also directly contribute to the analytical toolbox of coding theory at large. This monograph discusses recent advances in coding for NVMs, covering topics such as error correction coding based on novel algebraic and graph-based methods, rank modulation, rewriting codes, and constrained coding. Our goal for this work is multifold: to illuminate the advantages—as well as challenges—associated with modern NVMs, to present a succinct overview of several exciting recent developments in coding for memories, and, by presenting numerous potential research directions, to inspire other researchers to contribute to this timely and thriving discipline.

In Memoriam: Arthur W. Astrin, (Artur Ichnowski), 1945–2016

IEEE Information Theory Society, Santa Clara Valley (SCV) section (communicated by Tom Gardner)

Long time Chapter Chair

Artur Ichnowski, known professionally as Arthur W. Astrin, passed away March 24, 2016, in Palo Alto, CA, at the age of 70 after a gallant 13 year long struggle with metastatic melanoma. He was born in Krakow, in Russian- occupied Poland, on December 6, 1945. His father Wladyslaw Wilhelm was the Polish Forestry Minister and his mother Maria Kupferblum, a concert pianist, was a radio music archivist and a pioneer in music therapy. Both were Holocaust survivors.

At an early age Art developed his lifelong interest in science and, more specifically, radios. Before he was 9, he had constructed his own telegraph. He built his own radio and as a teenager secretly listened to rock music over Voice of America and Radio Free Europe with his friends. During the Cuban Missile crisis they hovered over Art's radio to learn the true status of negotiations between Kennedy and Khrushchev. His high school army unit was mobilized and waiting on the tarmac for a Russian transport plane when the crisis ended. This was too close a call for his mother's peace of mind. She applied for a US student visa for him. It was none too soon, because when the government subsequently banned the music of Elvis, Brenda Lee, and Ricky Nelson, Art was arrested as he and his friends marched down the main street of Warsaw in protest. He was released on condition he leave Poland in 24 hours.

Art arrived in the US on January 2, 1964. He lived with family friends in Los Angeles, took ESL classes at night (though he says he really learned English by watching cartoons), and enrolled at Cal State University, Northridge, where he studied math and physics. He received a Master Degree in Mathematics from UC San Diego, and, in 1984, a PhD in Communication Engineering from UCLA.

Art's first engineering job was at Northridge Engineering/Unicomp. There he developed a Fast Fourier Transform algorithm in hardware for radar applications. He loved to describe his 1970 encounter with the legendary US Navy Rear Admiral Grace Hopper whom he met when he was sent to an aircraft carrier to repair the FFT. In 1977 Art moved to Palo Alto where he continued a long career in tech. He held technical and management positions and developed computer and communication systems for Memorex, ROLM, Siemens, and Apple. At Apple, he was recruited to convert the Apple product line to wireless. He was instrumental in birthing the Wi-Fi industry. He has seven patents.

Throughout his career, Art was active in IEEE. He was Chair of the IEEE Information Theory Group in Santa Clara, a Senior Member of IEEE, a recipient of the IEEE Third Millennium Medal, and in 2011 he was honored with the IEEE Hans Karlsson Award for the leadership and diplomatic skills he applied in developing network standards. He was a member of the Bluetooth SIG and a member of the IEEE 802.11/15 standards committee since 1997. Beginning 2005 he lead the stanardization in Body Area Network (BAN) and at the time of his death he was chair of the BAN Task Group 6 of IEEE 802.15 (see BAN Standardization and future applications). Art also taught communication and computer engineering at San Jose State University and UC Berkeley. He never forgot a face or a name—even if he met someone only once.

One of Art's passions in life was skiing. He and his wife, Jeanne, met on the slopes and were married in July, 1968. He loved sailing and was intrepid when sailing his "little" 25 foot McGregor in the Bay and when hauling his "big" 25 foot McGregor up to the Sierras to sail at Huntington Lake. He was an Eagle Scout in Poland and remained active in the Boy Scouts in the US. He did 50 mile hikes in the Grand Canyon (rim to rim to rim) and in the Sierras. He loved swimming and continued doing laps even when metastasis left him partially paralyzed. He joked at the time that he was only able to swim circles. His wacky sense of humor made an impression on everyone he met.

He is survived by his wife Jeanne, his daughter Amy, son Jeff, daughter-in-law Chrissy Kistler, 3 grandsons: Alexander, Roy and Carl; his sister Elizabeth and her husband Elliot Landaw and nephews Maximilian and Julian and numerous cousins around the world. Contributions may be made in his honor to the Computer History Museum, 1401 N Shoreline Blvd, Mountain View, CA 94043. A private memorial has been held for his family and close friends.

In Memoriam: David MacKay (1967–2016)

Paddy G. Farrell, Brendan J. Frey, Sanjoy Mahajan, Robert J. McEliece, Radford M. Neal, Jossy Sayir, Amin Shokrollahi and Christian Steinruecken

The information theory society mourns the tragic loss of David MacKay, who passed away on 14 April 2016 following a nine-month battle with cancer. David is survived by his wife Ramesh and children Torrin and Eriska.

Although the eight of us involved in writing this obituary interacted closely with David as his co-author, PhD student, friend or collaborator, it is hard for any person to write a comprehensive obituary for David. He is credited within the information-theory community for rediscovering and further developing Gallager's low-density parity-check (LDPC) codes starting in 1995 and for his unique and original textbook *Information Theory, Inference and Learning Algorithms* [1]. Meanwhile, many in other communities

would be surprised to learn that he contributed in our field at all, such is his fame and diversity of contributions in Bayesian inference, in neural networks, in human-machine interfaces, in biological sequence analysis, and in sustainable energy.

David John Cameron MacKay was born on 22 April 1967. His father, Donald MacCrimmon MacKay, was a physicist with strong interests in information theory and the brain. His elder brother Robert MacKay is a celebrated mathematician at the University of Warwick and a Fellow of the Royal Society. David attended Trinity College to read natural sciences at the University of Cambridge, where he learned Bayesian inference from Steve Gull and from John Skilling during summer internships.

Bob + David 7/14/94
Steele Fell

David then turned his attention to neural networks, pursuing a PhD at the California Institute of Technology (Caltech) under John Hopfield. At Caltech, he attended Bob McEliece's information-theory courses. Bob remained a major influence in David's information theory research, and they interacted frequently over the years. Paddy Farrell recalls:

> Bob McEliece and I used to hike regularly in the Lake District, and sometimes David would join us. In a way Bob was the USA academic with whom David worked most. As Bob used to say to me, "I think David has decided that I am bright enough to be a worthy co-researcher!". David was of course a very bright guy, and Bob was very pleased to have made the grade!

David also began interacting with Radford Neal, and frequently visited Radford and others in Geoffrey Hinton's group in Toronto.

After his PhD, David returned to Cambridge first as a research fellow at Darwin College, and was then appointed a Lecturer in the physics department, promoted to Reader in 1999 and to Professor in 2003. He was a Fellow of Darwin College and an Honorary Fellow of Trinity College. He was elected a Fellow of the Royal Society in 2009. He was appointed Chief Scientific Advisor for the UK's Department of Energy and Climate Change in 2009. He retained that civil-service role until 2014, when he returned to the University of Cambridge in a new role as the university's first Regius Professor of Engineering. He was knighted on 1 January 2016. He gave lectures at the University of Cambridge until early March 2016 and couldn't repress a chuckle when some students started addressing him as "Sir David."

David's major contributions to information theory began with a paper [2] on cryptanalysis and error-correcting codes, based on probabilistic inference using free-energy minimisation. Discussion of this with Radford Neal led to David and Radford working on an old idea of Radford's (developed as "MN codes"). In the end, both these ideas were useful mainly as a path to David re-inventing the Low Density Parity Check codes and associated probabilistic decoding method of Bob Gallager [3], which could now be recognised as an instance of "belief propagation"

as studied in the literature on artificial intelligence [4]. David and Radford also made an important innovation in designing codes with an irregular parity check matrix, and recognising that this produces very impressive performance [5], though the full benefit of irregular parity check matrices was only recognised with further work by David and others (eg, [6], [7]). This work also led to a recognition that other algorithms, old and new, can also be seen as doing "loopy" belief propagation [8]. David had further contributions in our field, notably on codes for insertions, deletions and subsitutions [9] and on quantum codes [10].

David attended the IEEE Information Theory Symposium (ISIT) in Adelaide in 2005 where he demonstrated his keyboard-free text input software Dasher in an inspiring plenary lecture. Initially born from an attempt to illustrate arithmetic coding using statistical language models, Dasher is like a video game where the user navigates through zooming letters to type words and phrases. It can be used for efficient text entry using a joystick or an eye movement detector. As a result, it has transformed the lives of many people with impaired mobility. A new version 5.0 of Dasher is currently being developed by Ada Majorek at Google[1].

David stood out for his playful approach to research and teaching. David's research breakthroughs were often scribbled in red, green, blue and black using his favourite cheap plastic four-colour ballpoint pens, sometimes on the back of unfolded used cereal boxes. His book [1] is a rarity among engineering textbooks in that it mixes humour, entertainment, and sharp mathematics so naturally that one wonders why more textbooks aren't written in this style. Where other books present elaborate and imposing mathematical edifices with austerity and purpose, David seemed to pluck truths from nature with effortless simplicity and with mathematical rigour sufficient for all but perhaps a few. David particularly appreciated Bob McEliece's back-cover recommendation that everyone "would want *two* copies of this astonishing book, one for the office and one for fireside at home."

David's students remember him as an inspiring and original teacher. He thought that students too often learned material by rote. Consequently, he invested great effort in planning his lectures so that every student, from the bright lass in front to the silent chap at the back, reflected on the material and understood it. To that end, his lectures were punctuated with peer-instruction pauses [11] during which he gave the class a conceptual question and had them vote on their preferred answer. To encourage students to think the question through and to bring out misconceptions, he then said, "Talk to your neighbour and try to convince him or her of your answer." For those few minutes, David wandered the lecture room listening to snippets of the arguments. Then the whole class discussed the merits, or otherwise, of the possible answers. This participation through voting and class-wide brainstorming featured in every lecture, and David would pursue and think through even the most unlikely idea thrown back to him by the students.

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[1]https://github.com/ipomoena/dasher/releases

David was unusual for modern day scientists in that he never shied away from public engagement and social responsibility. He was involved in the campaign to free Sally Clark and created and maintained their website[2]. The following paragraph from Jossy Sayir's lecture notes, proofread and approved by David only three months ago, describes these events:

> "Sudden infant death syndrome" (SIDS) is the sudden and unexplained death of an infant. In the UK, SIDS occurs in roughly 4 out of 10,000 live births. Sir Roy Meadow, a reputed paediatrician, repeatedly argued as an expert witness in trials against parents who had lost several infants to SIDS, with what became known as "Meadow's law" *one death is a tragedy, two is suspicious and three is murder*, quoting odds of 1:73,000,000 against two SIDS in the same family in white affulent non-smoking families. Meadow's calculation of this figure from statistics he had available was erroneous and overly simplistic. The Royal Statistical Society took position against Meadow during a historic appeal, with some statisticians calculating adjusted probabilities showing there was no basis for the guilty verdict. The case led to several guilty verdicts being overturned on appeal after parents had spent years in jail falsely convicted of murdering their children on the basis of Meadow's expert opinions. Meadow appeared in front of the General Medical Council accused of serious professional misconduct.[3]

David's gifts as a teacher, writer, and thinker and his commitment to social responsibility came together in his celebrated work on sustainable energy. Its beginning happened during his teaching at the African Institute for Mathematical Sciences in Cape Town where he got into a heated discussion with another visiting professor about energy-conservation measures. David studied the subject in more detail, seeing it with his fresh eyes, and started writing what became *Sustainable Energy – Without the Hot Air* [12]. This book was hailed by reviewers as diverse as the *Economist* and the former executive director of Friends of the Earth. Available for free download, it sold 40,000 copies within its first two years and had over 400,000 downloads. It is playfully written and reflects a deep understanding of the physics of sustainable energy and of how to write about and teach it. One consequence of the book and of its reception was David's appointment as Chief Scientific Advisor for the UK's Department of Energy and Climate Change, where he contributed to shaping government energy policy in, as David would have liked to say, a "pro-arithmetic" direction.

A symposium to celebrate David's work[4] was held in March 2016 at the University of Cambridge, attracting speakers and listeners from around the world and from the diverse fields that David

engaged in. The "surprise talk" closing the symposium was by David himself, who, in a final display of playfulness, gave a mathematical talk about his children's toy wooden blocks and toy trains. In the first half, he reflected on counting the packings that can be achieved with toy wooden blocks. In the second half, he investigated the conditions that a circuit must fulfil so that trains can visit every segment in either direction without leaving the track. It is a small consolation for David's admirers in our field that he chose a topic with an information theoretic flavour for his final talk.
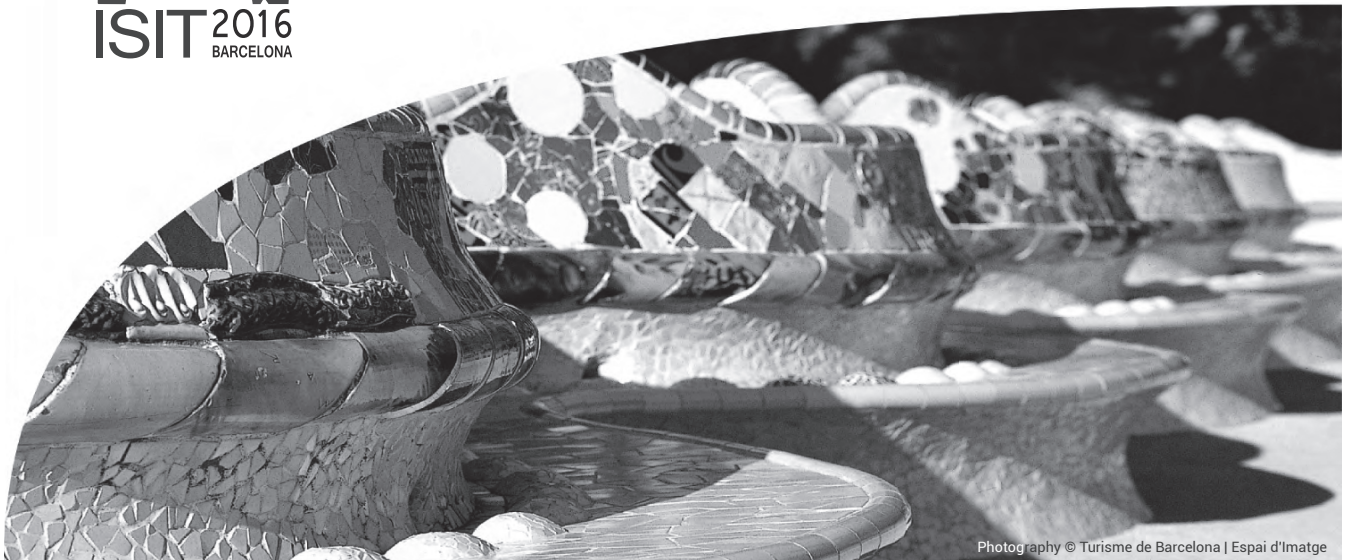
David was a bright light in our community and in the world, and we will miss him greatly.

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[2]https://github.com/ipomoena/dasher/releases [2]http://www.sallyclark.org.uk/
[3]More details about this case http://en.wikipedia.org/wiki/Roy_Meadow
[4]http://divf.eng.cam.ac.uk/djcms2016/

2016 IEEE International Symposium on Information Theory
Barcelona, Spain | July 10-15, 2016

ISIT 2016 BARCELONA

Photography © Turisme de Barcelona | Espai d'Imatge

Call for papers

The 2016 IEEE International Symposium on Information Theory will take place in Barcelona, Spain, from July 10 to 15, 2016. A lively city, known for its style, architecture, culture, gastronomy and nightlife, Barcelona is one of the top tourist destinations in Europe. Interested authors are encouraged to submit previously unpublished contributions from a broad range of topics related to information theory, including but not limited to the following areas:

Topics

Big Data Analytics	Detection and Estimation	Physical Layer Security
Coding for Communication and Storage	Emerging Applications of IT	Quantum Information and Coding Theory
Coding Theory	Information Theory and Statistics	Sequences
Communication Theory	Information Theory in Biology	Shannon Theory
Complexity and Computation Theory	Network Coding and Applications	Signal Processing
Compressed Sensing and Sparsity	Network Information Theory	Source Coding and Data Compression
Cryptography and Security	Pattern Recognition and Learning	Wireless Communication and Networks

Researchers working in emerging fields of information theory or on novel applications of information theory are especially encouraged to submit original findings.

The submitted work and the published version are limited to 5 pages in the standard IEEE conference format. Submitted papers should be of sufficient detail to allow for review by experts in the field. Authors should refrain from submitting multiple papers on the same topic.

Information about when and where papers can be submitted will be posted on the conference web page. The paper submission deadline is January 24, 2016, at 11:59 PM, Eastern Time (New York, USA). Acceptance notifications will be sent out by April 3, 2016.

We look forward to your participation in ISIT in the centennial year of Claude Shannon's birth.

General Co-Chairs	**TPC Co-Chairs**	**Finance**
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http://www.isit2016.org/

Joint Telematics Group (JTG)
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**The 8th Summer School on
Signal Processing, Communications, and Networks
Indian Institute of Science, Bangalore
June 27 - July 1, 2016**

Speakers

B. V. Rao

Adjunct Professor

Chennai Mathematical Institute

Topic: Concentration Inequalities

Upamanyu Madhow

Professor

University of California, Santa Barbara

Topic: Millimeter-wave systems: Theory, systems, and algorithms

Erdal Arikan

Professor

Bilkent University, Ankara

Topic: Polar coding

Dates and Venue

June 27–July 01, 2016

Golden Jubilee Hall, Department of Electrical Communication Engineering

For more information

http://www.ece.iisc.ernet.in/~jtg/2016/

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iTw 2016 CAMBRidGE

Information Theory Workshop
Call for Papers

11 - 14 September 2016

The 2016 IEEE Information Theory Workshop will take place
from the 11th to the 14th September 2016 at Robinson College, Cambridge, United Kingdom.

*Founded in 1209, the University of Cambridge is a collegiate university consisting of 31 constituent colleges.
ITW 2016 will take place at Robinson College, the youngest of the Cambridge colleges founded in 1979, offering modern dedicated conference facilities in a cosy residential setup and easy access to the sights and attractions in central Cambridge that lie within a 10 minutes walk of the college.*

Plenary Speakers
Yonina Eldar, *Technion—Israel Institute of Technology*
Andrew Blake, *Microsoft Research Cambridge*
Thomas Strohmer, *University of California, Davis*

Call for Papers
The 2016 IEEE Information Theory Workshop welcomes original technical contributions in all areas of information theory. The agenda includes both invited and contributed sessions, with a particular emphasis on the interface between:
- Information Theory, Statistics and Machine Learning
- Information Theory and Compressed Sensing
- Information Theory and Radar

Paper Submission
Authors are invited to submit previously unpublished papers, not exceeding five pages, according to the directions that will appear on the conference website: ***http://sigproc.eng.cam.ac.uk/ITW2016***
The ITW proceedings will be published by the IEEE and will be available on IEEE Xplore.

Schedule
Paper Submission Deadline: 13th March 2016
Acceptance Notification: 12th June 2016
Final Paper Submission: 31st July 2016

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The **Fifty-Fourth Annual Allerton Conference on Communication, Control, and Computing** will kick off with Opening Tutorials being held on Tuesday, September 27, 2016 at the Coordinated Science Laboratory. The conference sessions will start on Wednesday, September 28, 2016 through Friday, September 30, 2016, at the Allerton Park and Retreat Center. The Allerton House is located twenty-six miles southwest of the Urbana-Champaign campus of the University of Illinois in a wooded area on the Sangamon River. It is part of the fifteen-hundred acre Robert Allerton Park, a complex of natural and man-made beauty designated as a National natural landmark. Allerton Park has twenty miles of well-maintained trails and a living gallery of formal gardens, studded with sculptures collected from around the world.

Papers presenting original research are solicited in the broad areas of control, communication and computing, including but not limited to biological information systems; coding techniques and applications; coding theory; data storage; information theory; multiuser detection and estimation; network information theory; sensor networks in communications; wireless communication systems; intrusion/anomaly detection and diagnosis; network coding; network games and algorithms; performance analysis; pricing and congestion control; reliability, security and trust; decentralized control systems; robust and nonlinear control; adaptive control and automation; robotics; distributed and large-scale systems; complex networked systems; optimization; dynamic games; machine learning and learning theory; signal models and representations; signal acquisition, coding, and retrieval; detection and estimation; learning and inference; statistical signal processing; sensor networks; and data analytics.

Final versions of papers to be presented at the conference are required to be submitted electronically by October 2, 2016 in order to appear in the Conference Proceedings and IEEE Xplore.

PLENARY LECTURE: Professor **Naomi Leonard** from the Mechanical and Aerospace Engineering, Princeton University, will deliver this year's plenary lecture. It is scheduled for Friday, September 30, 2016 at the Allerton Park and Retreat Center.

OPENING TUTORIAL LECTURES: Professor **Panagiotis Tsiotras**, Georgia Institute of Technology, and Professor **Emmanuel Abbe**, Princeton University, will both present tutorial lectures on Tuesday, September 27, 2016 at the Coordinated Science Laboratory, University of Illinois at Urbana-Champaign.

INFORMATION FOR AUTHORS: Regular papers suitable for presentation in twenty minutes are solicited. Regular papers will be published in full (subject to a maximum length of eight 8.5" x 11" pages, in two column format) in the Conference Proceedings. Only papers that are actually presented at the conference and uploaded as final manuscripts can be included in the proceedings, which will be available after the conference on IEEE Xplore.

For reviewing purposes of papers, a title and a five to ten page extended abstract, including references and sufficient detail to permit careful reviewing, are required.

Manuscripts can be submitted during **June 15-July 8, 2016** with the submission deadline of July 8th being firm. Please follow the instructions at the Conference website: http://www.csl.illinois.edu/allerton/.

Authors will be notified of acceptance via e-mail by August 8, 2016, at which time they will also be sent detailed instructions for the preparation of their papers for the Proceedings.

Conference Co-Chairs: Minh Do and Naira Hovakimyan
Email: allerton-conf@illinois.edu   URL: www.csl.illinois.edu/allerton/

COORDINATED SCIENCE LABORATORY AND THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
University of Illinois at Urbana-Champaign

ISITA2016
Monterey, California
October 30 – November 2

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ISITA2016
October 30–November 2, 2016
Monterey, California, USA

The **International Symposium on Information Theory and Its Applications (ISITA)** is a leading conference on information theory. Since its inception in 1990, ISITA has been an exciting forum for interdisciplinary interaction, gathering leading researchers to discuss topics of common interest in the field of information theory. In 2016, the biennial ISITA will be held October 30–November 2 at the Hyatt Regency Monterey Hotel in Monterey, California, USA.

Call for Papers

Interested authors are invited to submit papers describing novel and previously unpublished results on topics in information theory and its applications, including, but not limited to:

• Error Control Coding	• Coding Theory and Practice
• Coded Modulation	• Data Compression and Source Coding
• Communication Systems	• Data Storage
• Detection and Estimation	• Mobile Communications
• Signal Processing	• Pattern Recognition and Learning
• Rate-Distortion Theory	• Multi-Terminal Information Theory
• Stochastic Processes	• Cryptography and Data Security
• Network Coding	• Applications of Information Theory
• Shannon Theory	• Quantum Information Theory

Paper Submission

Authors should submit papers according to the guidelines which will later appear on the conference website:

http://www.isita2016.org/

This link points to the permanent site http://www.isita.ieice.org/2016/. Accepted papers will appear in the symposium proceedings. To be published in IEEE *Xplore*, an author of an accepted paper must register and present the paper. IEEE does not guarantee inclusion in IEEE *Xplore*.

Schedule

Paper submission deadline	April 7, 2016
Acceptance notification	June 30, 2016

Further information on the technical program, plenary talks, social events and registration will be posted on the symposium web site as it becomes available.

The Asilomar Conference on Signals, Systems, and Computers will be held from November 6 to 9, 2016 in nearby Pacific Grove, California.

Financial Support
The Telecommunications
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2016 Workshop on Network Coding and Applications

Washington, DC, USA,   December 4, 2016

CALL FOR PAPERS

The 2016 Workshop on Network Coding and Applications (NetCod 2016) will be held in Washington, DC in conjunction with Globecom 2016. We invite original, previously unpublished papers in the broad area of network coding. Topics of interests include (but are not limited to) the following:

- Information theory and fundamental limits of network coding
- Network code constructions and algorithms
- Architectural design and optimization aspects of network coding
- Cross layer paradigms in network coding
- Robustness, energy, feedback, or delay aspects of network coding
- Security and codes for network error correction
- Index coding

- Coded caching
- Codes for streaming
- Codes with locality
- Physical layer network coding
- Codes for distributed storage
- Network coding for wireless communication
- Applications of network coding
- Implementation and deployment
- Aspects of network coding
- Network coding for computing and compression

Submission deadline:
July 1, 2016

Acceptance notification:
September 1, 2016

Camera-ready deadline:
October 1, 2016

Submission link http://edas.info/N22557

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www.netcod16.org

Conference Calendar

DATE	CONFERENCE	LOCATION	WEB PAGE	DUE DATE
June 21–23, 2016	**9th North American School of Information Theory**	Duke University, Durham, NC	https://www.soihub.org/events/summer-school-2016.php	Passed
July 3–6, 2016	**The 17th IEEE International Workshop on Signal Processing Advances in Wireless Communications.**	Edinburgh, UK	http://www.spawc2016.org.uk	Passed
July 10–15, 2016	**2016 IEEE International Symposium on Information Theory.**	Barcelona, Spain	http://www.isit2016.org	Passed
September 11–14, 2016	**2016 IEEE Information Theory Workshop.**	Cambridge, United Kingdom.	http://sigproc.eng.cam.ac.uk/ITW2016	Passed
September 27–30, 2016.	**54rd Annual Allerton Conference on Communication, Control, and Computing.**	Allerton Retreat Center, Monticello, Illinois, USA.	http://allerton.csl.illinois.edu	
July 8, 2016 October 9–11, 2016	**57th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2015).**	New Brunswick, New Jersey, USA.	http://www.wisdom.weizmann.ac.il/~dinuri/focs16/CFP.html	Passed
Oct. 30–Nov. 2, 2016	**The International Symposium on Information Theory and Its Applications (ISITA).**	Monterey, California	http://www.isita2016.org/	Passed
December 4, 2016	**2016 Workshop on Network Coding**	Washington DC, USA	http://www.networkcoding.org/	July 1, 2016
December 4–8, 2016	**IEEE GLOBECOM.**	Washington DC, USA	http://globecom2016.ieee-globecom.org/	Passed
December 7–9, 2016	**IEEE Global Conference on Signal and Information Processing (GlobalSIP).**	Washington DC, USA	http://www.ieeeglobalsip.org/	Passed

Major COMSOC conferences: http://www.comsoc.org/confs/index.html