IEEE Information Theory Society Newsletter

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President's Column

Gerhard Kramer

The 2013 Information Theory Workshop was held in Sevilla, Spain, in mid-September. Before the Workshop began, the Board of Governors held their third and final meeting of the year to discuss and vote on a variety of issues concerning our Society. I would like to thank the members of the "core" team for their support during this eventful year: past and future presidents Giuseppe Caire, Muriel Médard, Abbas El Gamal, Michelle Effros, and Alon Orlitsky, treasurer Aylin Yener, secretary Edmund Yeh, conference committee chair Elza Erkip, and editors-in-chief Helmut Bölcskei and Yiannis Kontoyiannis.

The December column gives opportunity to list some of the important changes that the Board deemed useful and necessary for 2014. These changes were thoroughly discussed by an active and supportive Board, and I appreciate their constructive comments, criticisms, and suggestions throughout the year.

1) Our Transactions papers will now receive "moderate/light" editing. This change reduces our IEEE page charges from \$57/page to \$37/page (and reduces our publication costs from \$100/page to \$80/page; we are budgeting 8500 pages for 2014; the Transactions costs will remain a major issue in the near future). What this means, for instance, is that you will no longer have an editor checking your documents closely for grammar and spelling. An important side effect is that the Associate Editor handling your paper may require you to pay for further editing on the order of \$45/page. A future article by the 2014 Editor-in-Chief will give further information.

2) A Thomas M. Cover Dissertation Award was established at the suggestion of Abbas El Gamal and with the help of a committee led by Paul Siegel. The award will be given for the first time next year. Please nominate outstanding dissertations by Jan. 15, 2014. Instructions can be found at www.itsoc.org.

3) The ISIT Student Paper Award was renamed the IEEE Jack Keil Wolf ISIT Student Paper Award. I appreciate Paul Siegel's efforts in managing the change.

4) A Shannon stamp initiative was started at the suggestion of Sergio Verdú, and Michelle Effros kindly agreed to organize a web page with electronic signatures. If you have not done so already, please add your support at http://www.itsoc.org/about/shannons-centenary-us-postal-stamp

5) Two new Annual Schools of Information Theory were founded in Australia and East Asia. A third new School will be held in India together with the established JTG Summer School. A fourth new School is planned for South America. The new Schools will be funded in part by tapping into our reserves for 2014.

6) Five new initiatives were approved: an ISIT video event, a meet-the-Shannon-Awardee lunch event, a WITHITS video initiative, and two online initiatives to enhance and sustain our media content. A sixth initiative on semi-automatic LaTeX-to-XML conversion is being coordinated with IEEE Publishing Operations.

7) A new Membership committee was formed to consolidate the efforts of three committees: the former Membership & Chapters, Student, and Outreach committees. The new Membership committee includes a new School subcommittee to support our

continued on page 3

From the Editor

Tara Javidi

Dear IT Society members,

The last issue of 2013, naturally, contains Gerhard Kramer's last column as the IT society president. Please join me in thanking Gerhard for continuing the tradition of excellence and growth as well as preparing a detailed report on our Society's governance activities. With sadness, we pay tribute to my dear friend, colleague, collaborator, and mentor, Professor Rene Cruz, who passed away in June. This is a loss for us at UCSD as well as for the IT society. I would very much like to thank Bruce Hajek, Rene's PhD advisor and close friend, for preparing the tribute.

On a much happier note, we congratulate David Donoho who was awarded the Shaw Prize in Mathematical Sciences. In addition to our popular and regular contributions by historian Ephremides and puzzle-master Golomb, we have three excellent workshop reports. Babak Hassibi and Raymond Yeung have kindly prepared a report on the First Workshop on Entropy and Information Inequality held in April, Amin Aminzadeh Gohari contributed the report on the First Iran Workshop on Communication and Information Theory held in May, and Emina Soljanin prepared a report on the Dagstuhl Seminar on Coding Theory held in August. These reports all attest to the vibrancy of our society.

As a reminder, 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 jointly at the IT Society website http://www.itsoc.org/, using the quick links "Share News" and "Announce an Event." Articles and columns also can be e-mailed to me at ITsocietynewsletter@ece.ucsd.edu with a subject line that includes the words "IT newsletter." The next few deadlines are:

Issue	Deadline
March 2013	January 10, 2014
June 2013	April 10, 2014
September 2013	July 10, 2014

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 hear your suggestions (especially regarding the new column) and contributions.

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Table of Contents

In Memorium: Rene Cruz

The information theory community lost a dear friend and distinguished contributor last summer with the untimely death, on June 29, of Rene L. Cruz, a professor of electrical and computer engineering at the University of California, San Diego. Cruz was 54.

Rene was born and raised in Urbana where he obtained his bachelor's degree at Illinois. After completing his master's degree at MIT and working as a senior engineer at Stanford Telecommunications, he returned to Illinois for doctoral work with Bruce Hajek. Cruz's 1987 dissertation laid the groundwork for his novel methodology of "network calculus," which enabled engineers to ascertain bounds on delay and buffering requirements in networks. After joining the UCSD faculty in 1987, Cruz refined his dissertation work into a tandem of articles for the *IEEE Transactions on Information Theory* that appeared in 1991 and established the foundation for the new research field of network calculus. Cruz continued to be a leading contributor to the theory of network calculus throughout his career.

In 2004 Cruz cofounded Mushroom Networks, whose products are based on his patented "broadband bonding" technology that enables network appliances to aggregate disparate Internet connections into a single high-speed service. At the time of his death, Cruz was the company's chief science officer.

Cruz's most recent research was in the emerging field of "content-centric networking," an alternative to the current host-centric architecture of the Internet, which aims to reduce congestion and complexity while enhancing speed and security. Specifically, he was investigating algorithms to distribute the message forwarding function among network users so that each received the content relevant to him or her. It's unfortunate he won't be able to develop this work further.

Rene's pioneering work was recognized by the IEEE INFOCOMM Achievement Award (2009) for contributions to network calculus, the IEEE Communications Society Stephen O. Rice Prize in the Field of Communications Theory (2008), IEEE Fellow (2003), the NSF Presidential Young Investigator Award (1991), and many other honors and awards.

The Rene Cruz Memorial website hosted at UCSD provides more information and a link for donating to pancreatic cancer research in Cruz's memory.

President's Column *continued from page 1*

five international schools (which will hopefully become six in number by 2015).

Apart from the unusual number of initiatives, the Board was involved in various other activities during 2013. For instance, an ad-hoc committee on future directions is being led by Jeff Andrews, and an ad-hoc committee on GOLD (Graduates of the Last Decade) members is considering ways to recognize our early-career members. This is also a good point to mention that we are especially fortunate to have the dedicated support of many senior members whose long careers of extraordinary scholarship and service have shaped our Society and the people in it, and are a continuing inspiration to all our members.

There is much volunteer work that I have not yet had the opportunity to highlight. Perhaps the most important is the work of the Associate Editors, whose quality control is of such great importance to our Society's reputation. Next, the Conference Committee, chaired by Elza Erkip, ensures that ISITs, ITWs, and the technically co-sponsored conferences such as Allerton, ITA, and many others, are planned properly and run well. The Fellows Committee, chaired by Rob Calderbank, ensures IEEE-level recognition of our members. The External Nominations Committee, chaired by Alon Orlitsky, matches our members to IEEE-level and other awards. Our Newsletter Editor, Tara Javidi, has the task of collecting news items, articles, and advertisements in a timely fashion. To all these volunteers, and those I may have overlooked, a heartfelt "thank you" for your (perhaps anonymous) support of our Society and its members.

Looking back, I expect that my experiences during the past year were similar to those of others before me: concern about being able to handle the task ahead, vain hope that there would be no crises, relief after the formal events at ISIT are completed, and some satisfaction as the year draws to a close. I would like to thank you, the Members of the IEEE Information Theory Society, and the Board of Governors for entrusting me with the role of President. The 2014 President is Abbas El Gamal who is simultaneously serving as Chair of the Department of Electrical Engineering at Stanford University. Please help me to support him during what will undoubtedly be a very busy year for him.

I wish you a happy and festive season at the end of 2013, and a successful start to 2014.

The Historian's Column

Anthony Ephremides

In the annals of the evolution of our field there are innumerable interesting bits (no pun intended) and pieces that range from trivia to, perhaps, formative morsels. One such small (and maybe not that small) story came to my attention due to an inquiry by Rami Zamir which led to a full-fledged investigation that engaged the services, and valuable information, from Shu Lin and eventually Toby Berger. They are all named hereby "honorary historians"*. As you know, those who contribute interesting historical facts to this column earn this distinction. The sleuth work goes as follows.

Rami approached me with an unusual inquiry. Did I know anything about a book on n-dimensional geometry that belonged to Claude Shannon and that was discovered eventually at Bell Labs? The reason for the inquiry was that Rami was writing a book about lattice codes in Information Theory and had heard about this anecdote involving this particular book and wanted to include reference to it in his own book. Of course I knew nothing about it. So, after some thinking, I referred Rami to Shu Lin, who was at the University of Hawaii when Dave Slepian had obtained a part-time appointment there. I thought that Dave or Aaron Wyner, the two major Information Theorists at the Labs, would be the most likely persons to know about this book story, but, of course, both of them are long gone. Shu, being Dave's host in a way, might know something about it. Indeed, Shu referred Rami to Toby, a close associate of Aaron, who proceeded to shed full light on the story. Here is what happened. But, before unfolding the sequence of events, it is noteworthy that the University of Hawaii entered the picture. We all await eagerly our next ISIT in Honolulu in June and, a propos that, we should recall that for a time, during the 1970's, the department of Electrical Engineering at the University of Hawaii was a hotbed of activity in our field. Norman Abramson, Wes Peterson, Shu Lin, Dave Slepian, and several other luminaries were on the faculty. And it is fitting to see the group re-emerge with new energy and several young Information Theorists hosting our Symposium.

But, back to our story. Dave Slepian was approaching retirement and, being Aaron's mentor and collaborator, he informed him that he could come to his office and pick any book he wanted for himself. Aaron could not bring himself to walk into Dave's office and start picking books while Dave was still around and active. Until one day a colleague saw Aaron in the corridor and informed him that Dave had announced to everyone that they could come to his office and choose any book they wanted as he decided to give everything away. There was a "run" on the books and Aaron felt that he should finally take up Dave's offer. When he went to Dave's office, only a handful of books remained. One of these was a book by Sommerfeld on n-Dimensional Geometry. Inside the front cover the inscription "C.E. Shannon" was handwritten! This was a copy of the book that belonged to Shannon and that obviously had been passed along to Slepian and, then, to Wyner. It is reasonable to theorize that this book played a role in providing Shannon with the insights that he developed into n-dimensional geometry which led to his famous coding theorems, as n grew to infinity. In other words this was a treasure on which, perhaps, stood the foundations of Information Theory!

Aaron took the book and promulgated the story which, somehow, reached Rami at some point. The book may still be with Wyner's family and it is a valuable piece of memorabilia that traces, not only a sequence of ownership by "knights" of our field, but also the development of Information Theory itself.

And since the University of Hawaii came into the picture, and given my own special ties to Hawaii (my wife was born there), I would like to add some commentary on the University and its role in the field of Information Theory. The natural beauty of the Hawaiian Islands has been of course a major attraction that inspired many top scientists to seek employment there. Norman Abramson was among the first to make UH his home. And we wouldn't have the ALOHA protocol without him. Dave Slepian was offered an appointment that he kept for some years and that would be the envy of many. He could spend a year at UH every other year. Thus, he "commuted" on an annual basis between Bell Labs and Hawaii. Of course the person who almost became synonymous with Information Theory in Hawaii was Shu Lin who spent most of his career there, served as department chair for many years, and was the reason that many of our colleagues spent wonderful sabbaticals and made professional visits to Hawaii. One vignette concerning living and working in Hawaii is inspired by a question that Imre Csiszar once asked Tom Cover when he was visiting Palo Alto. He had asked Tom, "how can you do any work in a beautiful place like this?". And Tom answered, "I HAVE to work if I want to live in a place like this". This applies also to Hawaii, if even more strongly.

Sitting in the middle of the vast Pacific Ocean, Hawaii straddles the civilizations of Asia and the West. It is, so to speak, the point where plus infinity and minus infinity meet. It has been the site of numerous conferences in fields related to Information Theory (like the ISITA and the HICSS) but was never, until now, the host venue for the ISIT. Thanks to Anders Høst-Madsen, Galen Sasaki, and many other talented young Information Theorists like Aleksandar Kavčić and Narayana Santhanam, Hawaii is reentering a phase of glory and prominence in the history of our field.

*Toby has earned this title several times before.

David Donoho Receives 2013 Shaw Prize in Mathematical Sciences

The Shaw Prize consists of three annual prizes: Astronomy, Life Science and Medicine, and Mathematical Sciences. This is the tenth year that the Prize has been awarded.

The 2013 Shaw Prize in Mathematical sciences has been awarded to D. Donoho for his profound contributions to modern mathematical statistics and in particular the development of optimal algorithms for statistical estimation in the presence of noise and of efficient techniques for sparse representation and recovery in large data-sets.

Report on the First Workshop on Entropy and Information Inequalities

If information theory is about (Shannon) entropy then "network information theory" is about "joint entropy".

Constraints on joint entropy, mostly in the form of information inequalities have long been a subject of interest in information theory. For a long time, the tools for proving such inequalities had been the non-negativity of mutual information, and inequalities that can be proved as such are collectively called Shannon-type inequalities. The first unconstrained non-Shannon-type inequality discovered in 1998 by Zhang and Yeung reveals the incompleteness of Shannon inequalities.

Since then, determining the set of inequalities that joint entropy satisfies, and thus describing the so-called space of entropic vectors, has emerged as a major challenge in information theory—one with far-reaching implications and applications. For example, it is now recognized that knowledge of the space of entropic vectors reduces the most general network coding problems on acyclic networks (which are all open) to convex optimization. The study of joint entropy has been shown to have surprising connections to some (seemingly) unrelated areas of mathematics and computer science including matroid theory, group theory, combinatorics, determinantal inequalities, and Kolmogorov complexity. The study of joint entropy has also inspired the pursuit of new constraints on the von Neumann entropy in quantum mechanics. The area has proven to be very rich and the problems quite challenging and fundamental.

The First Workshop on Entropy and Information Inequalities was held at The Chinese University of Hong Kong, April 15–17, 2013, with the goal of bringing together researchers who are active, and/or interested, in this field, to survey the progress that has been made, to describe some of the latest results, and to discuss avenues and approaches for future attacks. The workshop included a mix of tutorial presentations, research talks, and ample time for interactive discussion and reflection. Some 30 researchers from across the globe gathered in Hong Kong for the event and contributed to its success.

The workshop was kicked-off with a presentation by Raymond Yeung (The Chinese University of Hong Kong), intriguingly titled "How did we get into this mess?" In his talk, Raymond gave his personal account of the history of the field; how he became interested in information inequalities through his PhD thesis work on multi-terminal source coding problems, through the work of Hu Gudong in 1962 on the relation between set-theoretic and Shannon-information-theoretic identities, and through joint work with Tsutomu Kawabata on information diagrams and I-measures; culminating in the discovery of the first non-Shannon information inequality with Zhen Zhang in 1998. Raymond then proceeded to describe various connections to areas such as finite groups, quasi-uniform arrays, matroids, etc., many of which were further expanded on in the workshop.

Frantisek Matus (Academy of Sciences of the Czech Republic) then gave a tutorial presentation on "Entropy and matroids". Frantisek walked the participants through the various definitions of matroids and poly-matroids, relations to secret sharing, representable matroids, partition-representable matroids, and almost entropic matroids. He mentioned a recent unpublished work claiming that almost entropic matroids have infinitely many forbidden minors. Terrence Chan (University of South Australia) presented the talk "Codes, entropies and groups", where he argued that codes can be viewed as random variables, as a result of which codes must satisfy entropy inequalities and conversely entropy must satisfy constraints established in coding theory (such as Delsarte's linear programming bound). Terence gave several examples and novel implications of this observation and ended his talk with an emphatic "entropy rules"!

Randall Dougherty (IDA Center for Communications Research) gave a presentation titled "Entropy inequalities and linear rank inequalities" describing the latest methods developed and used by him and his colleagues (Chris Freling and Ken Zeger) to generate entropy inequalities and linear rank inequalities (for representable matroids). Randy gave an overview of the collections of such inequalities that are known at this point, and finished with a description of key unresolved questions (such as whether the currently known methods are sufficient to generate all such inequalities). Babak Hassibi (Caltech) gave a talk titled "Gauss, Cayley and projective linear groups", in which he described the relationship

between the space of "discrete-" and "differential-" entropy vectors and how Cayley's hyperdeterminant can be used to describe the space of differential entropy vectors obtained from Gaussian random variables. Babak further described a construction of the smallest Ingleton-inequality-violating group, the projective linear group PGL(2,5), and noted how the group-theoretic connection to entropy can be used to numerically stake out the entropic region and to develop Monte Carlo Markov chain methods for entropy optimization and network coding.

In his talk, "Information geometry, polyhedral computation, and entropic vectors", John Walsh (Drexel University) described the software under development in his group for the purpose of doing efficient computations with the region of entropic vectors, such as methods for computing inner and outer bounds for region of entropic vectors, as well as utilizing them to calculate fundamental rate regions for network coding and distributed storage. John also argued that information geometry can provide a useful tool for understanding the entropic space by describing a simple information geometric interpretation of the Shannon-type inequalities, and certain non-Shannon-type ones. Chandra Nair (The Chinese University of Hong Kong) talked about "Information inequalities in network information theoretic settings" where he described some recently discovered information inequalities motivated by multi terminal information theory settings. One type of these new inequalities holds when under a certain cardinality constraint, whereas the other type, called factorization inequalities, involves functions that are not linear combinations of mutual information terms.

Amos Beimel and Ilan Orlov (both from Ben Gurion University) gave a closely related pair of talks titled "Secret sharing schemes: A survey" and "Secret sharing and non-Shannon information inequalities". The first talk reviewed the problem of secret sharing among a group of n users and stated that the best known secret sharing constructions require a share size that is exponential in the number of users. However, the best known lower bound (developed by Laszlo Csirmaz in 1997, also a participant in the workshop!) is roughly linear in the number of users and there has been little progress in closing this huge gap. The lower bound of Csirmaz is obtained from Shannon inequalities and so the second talk focused on improving this bound using non-Shannon ones. However, the known non-Shannon inequalities fail to improve this lower bound substantially. Mokshay Madiman and Liyao Wang (both from Yale Univesity) gave a pair of talks titled "Upper bounds for entropies of sums, and ramifications" and "Rearrangement and entropy inequalities". In these, the speakers reviewed their recent work on bounding the entropy of the sum and difference of a collection of random variables, and highlighted connections to the entropy power inequality, partition-determined functions and rearrangements. Tarik Kaced (Chinese University of Hong Kong) gave a talk on "Essentially conditional inequalities", linear inequalities for the Shannon entropy that hold for distributions whose entropies meet some linear constraints.

The final talk of the workshop was given by Soren Riis (University of London), titled "Graph guessing games and non-Shannon information inequalities". Soren explained that protocols for a multiple-unicast network can be directly converted into a strategy for a guessing game. The performance of the optimal strategy for a graph is measured by the guessing number, and this number can be bounded from above using information inequalities. Soren described his extensive computer calculations over roughly 12 million graphs with 10 or fewer nodes where he discovered only one graph (up to isomorphism) that has a guessing number which differs from the bound that can be derived from Shannon's information inequalities. Determining the guessing number of this graph is still open.

The workshop ended with a panel discussion moderated by Terence Chan, Randall Dougherty, Babak Hassibi, František Matúš and Raymond Yeung, whimsically titled "How do we get out of this mess?".

The workshop was generously sponsored by the Institute of Network Coding (INC) at The Chinese University of Hong Kong. The general co-chairs were Babak Hassibi and Raymond Yeung. All participants appreciated the tireless efforts of the local organizers Sidharth Jaggi and Alfred Ho. Most importantly, they would like to thank their kind hosts (Raymond, Sid and Alfred) for providing an excellent atmosphere for intellectual exchange and for their impeccable Chinese hospitality.

The complete set of slides and video links for all the talks are available at the workshop website: http://www.inc.cuhk.edu.hk/EII2013/program.html

Looking forward to the Second Workshop on Entropy and Information Inequalities at some future date!

Report on the First Iran Workshop on Communication and Information Theory (IWCIT 2013)

The first annual workshop on Communication and Information Theory (IWCIT) took place at Sharif University of Technology, Tehran, Iran- during May 8–9, 2013. The purpose of the workshop was to bring together top international researchers in communication and information theory and related areas to share and collaborate in various research activities with scholars in a country that, according to UNESCO, is among the most historic and touristic countries of the world. This workshop is planned to be held annually in Iran.

Prof. Kramer, President of IEEE Information Theory Society

The chairs of the workshop were Prof. Mohammad Reza Aref and Prof. Farokh Marvasti; the TPC chair was Prof. Jawad A. Salehi. Prof. Gerhard Kramer, the president of the Information Theory Society, was the keynote speaker for the workshop; also Dr. Tara Javidi, Dr. Mohsen Razavi, Dr. S. Jamaloddin Golestani, and Dr. Farzad Parvaresh gave invited talks. The workshop also included 25 peer-reviewed presentations. The organizers would like to thank all contributors and participants and in particular Professor Kramer for accepting the invitation to come to Iran to give the keynote speech.

The technical program of the workshop began by a welcoming ceremony presented by Prof. Salehi, highlighting the country's advancement in scientific and engineering research, in particular in the field of communication and information theory. Prof. Salehi closed his welcoming ceremony by presenting a brief poem in regards to binary digits, giving a Persian poetic touch to information "bits".

Prof. Salehi, Sharif Univ. of Technology

The technical program continued with an inspiring presentation by the keynote speaker, Prof. Gerhard Kramer, on "Information theory for networks with in-block memory"; he covered block fading, delay and feedback with an emphasis on Guassian channels. Dr. Javidi gave an insightful talk on "Rate-Reliability Tradeoff in Two-Dimensional Visual Search", discussing a fundamental conflict between resolution of the search versus decreasing the probability of error. Dr. Razavi talked on the frontiers of quantum communication networks with "Novel Architectures for Hybrid Quantum-Classical Networks", where he discussed network architectures that benefit from the security offered by quantum systems. Dr. Golestani gave a very thorough overview on scheduling and talked about "Unified Treatment of Network Routing, Flow Control and Scheduling", proposing a new algorithm with a performance far superior to the existing ones. Finally, Dr. Parvaresh gave a very interesting talk on "Computing Half-duplex Relaying Capacity in Networks with Orthogonal Channels", where he talked about a polynomial time algorithm for capacity calculation.

The cultural program of the workshop included visits to museums and historical places in Tehran as well as a tour to the historic city of Isfahan.

The next IWCIT' 2014 will take place again at Sharif University of Technology from May 7 to May 8, 2014; there will be a few invited distinguished guest speakers from across the world including Prof. David Tse and Prof. Gerhard Kramer, the president of IEEE Information Theory Society.

Workshop Report: Dagstuhl Seminar on Coding Theory, August 25–30, Schloss Dagstuhl, Germany

Organizers:

Hans-Andrea Loeliger (ETH Zentrum – Zürich, CH)
Emina Soljanin (Bell Labs – Murray Hill, US)
Judy L. Walker (University of Nebraska – Lincoln, US)

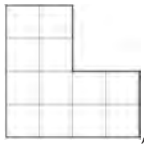
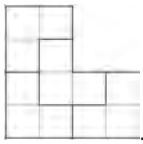
A group of 45 mathematicians and engineers met in the last week of August 2013 at Schloss Dagstuhl, Leibniz Center for Informatics, in Germany to discuss various aspects of coding theory. While coding theory has evolved into an essential ingredient of contemporary information technology, it remains a fascinating area of research where many fundamental ideas of information theory and mathematics meet. Indeed, the diversity and depth of recent ideas as well as new applications of coding theory is truly impressive for, what many would call, a mature field. The presentations at the seminar covered many different areas of coding theory including algebraic coding theory, codes on graphs, polar codes, network codes, as well as codes for cloud and emerging bio applications.

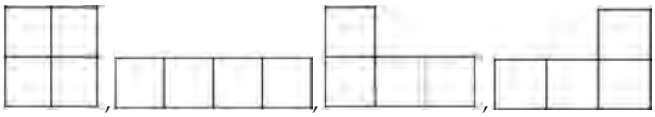
The workshop was a result of nearly two years of consistent effort to make a meaningful and productive gathering of participants from many different backgrounds, who, we believed, could greatly benefit from interacting with each other. Besides the organizers, the group included invited experts and students from diverse fields but related interests. The seminar was held in the usual Dagstuhl style, with a sparse program of formal presentations and much room for informal interaction. Before the workshop, only one of the organizers knew everyone in attendance. However, at the end of the workshop, a number of collaborations had developed that, as one of the participants remarked, could have started only at places like Dagstuhl, DIMACS, and BIRS. For more information, see http://www.dagstuhl.de/de/programm/kalender/semhp/?semnr=13351

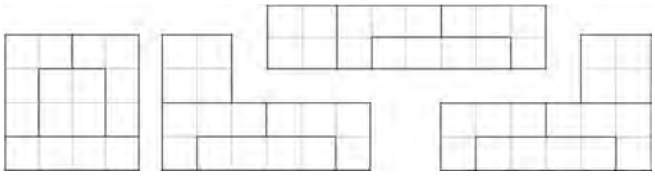
GOLOMB'S PUZZLE COLUMN™

Rep-Tile Sets

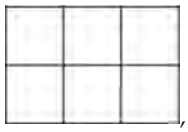
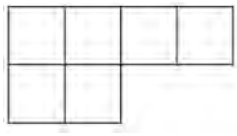
Solomon W. Golomb

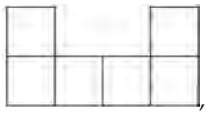
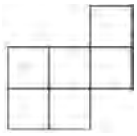
A *rep-tile* is a geometric figure that can be cut into several pieces which are congruent to one another and also similar to the original figure. One example is the figure  , which can be cut into four replicas:  . Equivalently, a rep-tile has the property that several congruent copies of it can be ssembled into an enlarged scaled-up version of it.

A *rep-tile set* is a finite set of figures all of the same area, that can be assembled to form a larger version of each figure in the set, using each member of the set exactly once in each enlarged version of an individual figure. The four tetrominoes  , form a rep-tile set, even if we do not allow the pieces to be turned over (which we usually do allow). Here are the scaled-up figures.



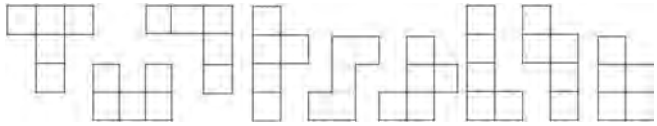
1) It was recently shown (by Lee Sallows) that the four hexominoes

a.  , b.  ,

c.  , d.  form a rep-tile set.

Can you assemble these four shapes to form enlarged versions (doubled in both length and width) of each of these shapes? (Rotations and reflections of the "small" hexominoes are permitted.)

2) The nine pentominoes



form a rep-tile set. Try to form scale models (tripled in both length and width) of each of these nine pentominoes using each small pentomino exactly once in each case.

Pieces may be rotated and reflected (turned over) as you wish. Solutions are not unique.

GOLOMB'S PUZZLE COLUMN™

Combinatorial Counting Solutions

Solomon W. Golomb

1) The coefficient if $wxyz$ when $(w + 2x + 3y + 4z)^4$ is multiplied out is $24 \times 24 = 576$.

2) The number of ways in which a set of 8 distinct elements can be partitioned into 3 non-empty subsets is 966. This is the "Stirling number of the second kind, S_2 (8, 3), where $S_2(n, 3) = \frac{1}{2}(3^{n-1} - 2^n + 1)$. From "first principles", there are five patterns of partitions for this case, each shown with the number of cases it contributes:

   $\{a, b, c, d, e, f\} \cup \{g\} \cup \{h\}, \binom{8}{6} = 28$

   $\{a, b, c, d, e\} \cup \{f, g\} \cup \{h\}, \binom{8}{5}\binom{3}{2} = 168$

   $\{a, b, c, d\} \cup \{e, f, g\} \cup \{h\}, \binom{8}{4}\binom{4}{3} = 280$

   $\{a, b, c, d\} \cup \{e, f\} \cup \{g, h\}, \frac{1}{2}\binom{8}{4}\binom{4}{2} = 210$

   $\{a, b, c,\} \cup \{d, e, f\} \cup \{g, h\}, \frac{1}{2}\binom{8}{3}\binom{5}{3} = 280$

   TOTAL = **966**

3) With $a_0 = 0$, $a_1 = 1$, $a_{n+1} = 2a_n - a_{n-1}$ for $n \geq 1$, it is easily seen, and proved, that $a_n = n$ for all $n \geq 0$. Thus $a_{2013} = 2013$.

4) There are $2^{14} = 16{,}384$ sequences in which all 15 billiard balls can go off the table. The easiest proof is to view the sequence in reverse. The *last* ball off the table will be either "1" or "15", and each *preceeding* ball, in turn, will be from either end of the remaining sequence (a factor of two), except for the *first* ball.

5) Since each player must contribute at least one \$1 chip to the kitty, it is equivalent to start each of the four players with only nine \$1 chips, and reduce the total required for the kitty to \$23, where now each player also has the option of contributing 0. Since at most two players can contribute their entire stack (i.e. $3 \times 9 > 23$), by an inclusion-exclusion argument, the total number of different solutions is $\binom{26}{3} - 4\binom{16}{3} + 6\binom{6}{3} = 480$.

Thomas M. Cover Dissertation Award

The IEEE Information Theory Society Thomas M. Cover Dissertation Award, established in 2013, is awarded annually to the author of an outstanding doctoral dissertation.

The IEEE Information Theory Society Thomas M. Cover Dissertation Award, established in 2013, is awarded annually to the author of an outstanding doctoral dissertation contributing to the mathematical foundations of any of the information sciences within the purview of the Society including, but not limited to, Shannon theory, source and channel coding theory, data compression, learning theory, quantum information theory and computing, complexity theory, and applications of information theory in probability and statistics.

NOMINATION PROCEDURE: Nominations should be submitted electronically to Michelle Effros (effros@caltech.edu) and Edmund Yeh (eyeh@ece.neu.edu) by January 15, 2014. Nominations must be submitted by the dissertation advisor and must include:

1) A copy of the dissertation.

2) Copies of all refereed papers (published or submitted) spawned by the dissertation.

3) A CV of the dissertation author.

4) A statement from the nominator on the qualifications of the dissertation for the award.

A maximum of three letters of support submitted directly to the selection committee.

Call for Nominations

IEEE Information Theory Society 2014 Claude E. Shannon Award

The IEEE Information Theory Society Claude E. Shannon Award is given annually to honor consistent and profound contributions to the field of information theory.

NOMINATION PROCEDURE: Nominations and letters of endorsement must be submitted by March 1, 2014 to the President of the IEEE Information Theory Society, who in 2014 will be Abbas El Gamal <abbas@ee.stanford.edu>. The nomination form is available at http://www.itsoc.org/honors/claude-e.-shannon-award

IEEE Information Theory Society 2014 Aaron D. Wyner Distinguished Service Award

The IT Society Aaron D. Wyner Service Award honors individuals who have shown outstanding leadership in, and provided long standing exceptional service to, the Information Theory community.

NOMINATION PROCEDURE: Nominations and letters of endorsement must be submitted by March 1, 2014 to the President of the IEEE Information Theory Society, who in 2014 will be Abbas El Gamal <abbas@ee.stanford.edu>. The nomination form is available at http://www.itsoc.org/honors/wyner

IEEE Information Theory Society 2014 Paper Award

The Information Theory Society Paper Award is given annually for an outstanding publication in the fields of interest to the Society appearing anywhere during the preceding two calendar years (2012–2013). The purpose of this Award is to recognize exceptional publications in the field and to stimulate interest in and encourage contributions to fields of interest of the Society.

NOMINATION PROCEDURE: Nominations and letters of endorsement must be submitted by March 15, 2014 to the Awards Committee chair, who in 2014 will be Michelle Effros <effros@caltech.edu>. Please include a statement outlining the paper's contributions.

IEEE Joint ComSoc/ITSoc 2014 Paper Award

The Communications Society/Information Theory Society Joint Paper Award recognizes outstanding papers that lie at the intersection of communications and information theory. Any paper appearing in a ComSoc or ITSoc publication during the preceding three calendar years (2011–2013) is eligible for the 2014 award.

NOMINATION PROCEDURE: Nominations and letters of endorsement must be submitted by February 15, 2014 to the Awards Committee chair, who in 2014 will Michelle Effros <effros@caltech.edu>. Please include a statement outlining the paper's contributions.

Thomas M. Cover Dissertation Award

The IEEE Information Theory Society Thomas M. Cover Dissertation Award, established in 2013, is awarded annually to the author of an outstanding doctoral dissertation.

NOMINATION PROCEDURE: Nominations should be submitted electronically to Michelle Effros (effros@caltech.edu) and Edmund Yeh (eyeh@ece.neu.edu) by January 15, 2014. The nomination form is available at http://www.itsoc.org/news-events/recent-news/call-for-nominations-thomas-m.-cover-dissertation-award

IEEE Fellow Program

Do you have a colleague who is a senior member of IEEE and is deserving of election to IEEE Fellow status? If so, please submit a nomination on his or her behalf to the IEEE Fellows Committee. The deadline for nominations is March 1. IEEE Fellow status is granted to a person with an extraordinary record of accomplishments. The honor is conferred by the IEEE Board of Directors, and the total number of Fellow recommendations in any one year is limited to 0.1% of the IEEE voting membership. For further details on the nomination process please consult: http://www.ieee.org/web/membership/fellows/index.html

IEEE Awards

The IEEE Awards program pays tribute to technical professionals whose exceptional achievements and outstanding contributions have made a lasting impact on technology, society and the engineering profession. For information on the Awards program, and for nomination procedures, please refer to http://www.ieee.org/portal/pages/about/awards/index.html

ITW2014

IEEE Information Theory Workshop

Hobart, Tasmania, Australia | 2–5 November

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University of Tasmania

Gottfried Lechner
University of South Australia

Publicity

Brian M. Kurkoski
Japan Advanced Institute of Science and Technology (JAIST)

The 2014 IEEE Information Theory Workshop will take place 2-5 November in Hobart, Tasmania at the Hobart Function And Conference Centre. The Australian island of Tasmania varies geographically from old-growth forests and grasslands to mountains and volcanic lakes, supporting unparalleled biodiversity, with many flora and fauna species unique to the island. Tasmania's rugged wilderness offers ample opportunities for hiking, bushwalking, kayaking, swimming and scuba. Hobart is Australia's second-oldest city, where historic buildings and districts stretch along the Derwent River. A burgeoning art and restaurant scene are complemented by fresh local seafood and established wineries.

Call for Papers

ITW2014 is a forum for technical exchange among scientists and engineers working on the fundamentals of information theory. The agenda is broad and will cover the diverse topics that information theory presently impacts. There will be both invited and contributed sessions. Papers for the contributed sessions are solicited in, but not limited to, the following areas:

- Source coding
- Distributed source and channel coding
- Joint source and channel coding
- Coding for wireless systems
- Coding for sensor and ad-hoc networks
- Coding and biology
- MIMO and space-time coding
- Graph-based codes and iterative decoding
- Cooperation in wireless systems
- Sequences and coding
- Secure communication and cryptography
- Compressed sensing
- Coding applications: optical communications, smart grid, underwater, etc.
- Information theoretic security

Paper Submission

Interested authors are invited to submit previously unpublished contributions. Papers for the contributed sessions, not exceeding five pages, should be submitted according to the directions which will appear on the conference website:

itw2014.jaist.ac.jp

The ITW proceedings will be published by the IEEE and will be available on IEEE *Xplore*.

Schedule

Paper submission deadline: 4 May 2014
Acceptance notification: 27 July 2014
Final paper submission: 1 September 2014

Plenary Speakers

Presentations by plenary speakers are planned.

ISITA2014 will be held nearby in Melbourne, Australia on 26-29 October 2014

images: ccdoh1, Jyot Boparai

Symposium Committee

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ISITA2014 — the **International Symposium on Information Theory and Its Applications** — will be held in **Melbourne, Australia** from **26 to 29 October 2014**. This biennial event, first held in 1990, is a leading conference in the information theory community. ISITA2014 features world-class speakers, plenary talks and technical sessions on a diverse range of topics within the field of information theory.

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

Paper Submission

Authors should submit papers according to the guidelines on the conference web site:

www.isita2014.org

This link points to the permanent site http://www.isita.ieice.org/2014/. Submissions will be selected on the basis of a full paper, reviewed by subject-matter experts. Accepted papers will appear in the symposium proceedings. To be published in the symposium proceedings and IEEE *Xplore*, an author of an accepted paper must register at a non-student rate and present the paper. IEEE does not guarantee inclusion in IEEE *Xplore*.

Schedule

Paper submission deadline	**6 April 2014**
Acceptance notification	**22 June 2014**
Final paper submission	**20 July 2014**

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

The IEEE Information Theory Workshop (ITW2014) will be held from 2 to 5 November 2014 in nearby Hobart, Tasmania, Australia.

Sponsor
Research Society of Information Theory and Its Applications, IEICE

Technical Co-Sponsor
IEEE Information Theory Society

image by R. Michalski

PRINCETON

Call for Papers CISS 2014

48th Annual Conference on Information Sciences and Systems

March 19, 20, & 21, 2014

Princeton University - Department of Electrical Engineering

and Technical Co-sponsorship with

IEEE Information Theory Society

Authors are invited to submit previously unpublished papers describing theoretical advances, applications, and ideas in the fields of: information theory, coding theory, communication, networking, signal processing, image processing, systems and control, learning and statistical inference.

Papers, requiring 20 minutes for presentation, will be reproduced in full (up to six pages) in the conference proceedings.

Electronic submissions of up to 6 pages (in Adobe PDF format) & 3-4 keywords must be submitted by **January 3, 2014**. Submissions should be of sufficient detail and length to permit careful reviewing. Authors will be notified of acceptance no later than **January 31, 2014**. Final manuscripts of accepted papers are to be submitted in PDF format no later than **February 23, 2014**. These are firm deadlines that will permit the distribution of the Proceedings at the Conference. IEEE reserves the right to exclude a paper from distribution after the conference (e.g., removal from IEEE Xplore) if the paper is not presented at the conference.

For more information visit us at: http://ee-ciss.princeton.edu/

CONFERENCE COORDINATOR	PROGRAM DIRECTORS	IMPORTANT DATES
Lisa Lewis Dept. of Electrical Engineering Princeton University Princeton, NJ 08544 Phone: (609) 258-6227 Email: CISS@princeton.edu	**Prof. Sanjeev Kulkarni** **Prof. Emmanuel Abbe** Dept. of Electrical Engineering Princeton University Princeton, NJ 08544	**Submission deadline:** **January 3, 2014** **Notification of acceptance:** **January 31, 2014** **Final manuscript due:** **February 23, 2014**

8th International Symposium on Turbo Codes & Iterative Information Processing

Bremen, Germany, Aug. 18-22, 2014

Honorary General Chair:
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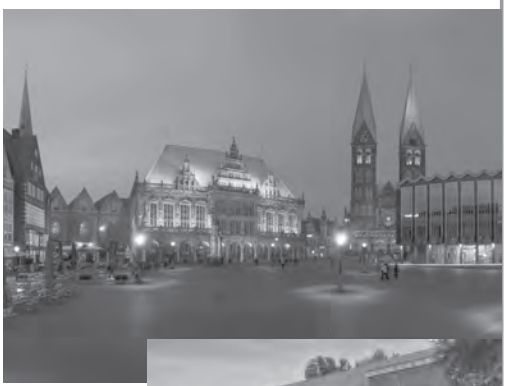

JACOBS UNIVERSITY

CALL FOR PAPERS

The 8th International Symposium on Turbo Codes & Iterative Information Processing will be held from Monday August 18 to Friday August 22 in Bremen, Germany. The symposium will be an opportunity to acquire a broad overview of the current status of advanced research in iterative information processing and its application to information theory and digital communications. All original contributions will be considered, in both theoretical and applied fields. The non-exhaustive list below provides possible topics for paper submissions:

- Error correcting coding
- Turbo and LDPC codes
- Bit-interleaved coded modulation
- Interleaving and labeling
- Graph codes for compression
- Joint source-channel coding
- Coding for storage
- Coding for secrecy
- Detection; iterative detection
- Multi-user and MIMO applications
- Turbo equalization
- Synchronization
- Cooperative Communications
- Iterative processing over networks
- Applications to wireless and optical
- Bounds, performance, and convergence
- Iterative algorithms
- Bayesian inference and factor graphs
- Analog decoders
- Chip applications
- Applications in bio-informatics
- Applications in neurosciences
- Data fusion

This symposium will have a session dedicated to information- and coding-theoretic investigations of genome structures, its evolution, and related topics.

The symposium will include regular papers for oral and poster sessions as well as invited papers. Accepted and presented papers/posters will appear in the symposium proceedings as well as IEEEXplore (upon final decision by IEEE).

Submissions
Authors are invited to submit a full manuscript (not exceeding 5 pages) before March 26, 2014 via the symposium website detailed below..

Submission of papers deadline: **March 25, 2014**
Notification of acceptance: **May 16, 2014**
Final papers and early-bird registration deadline: **June 11, 2014**

For further information regarding paper submission, registration, accommodation, and travel, please consult the symposium website at:

http://www.jacobs-university.de/turbo-symposium-2014

For symposium-related questions, please use

turbo@jacobs-university.de

Call for Papers

2014 Iran Workshop on Communication and Information Theory

May 7th and 8th, 2014, Sharif University of Technology, Tehran, Iran

The **second Iran Workshop on Communication and Information Theory (IWCIT)** will take place at Sharif University of Technology, Tehran, Iran on **Wednesday May 7th and Thursday May 8th, 2014.** IWCIT intends to bring together researchers in communication and information theory for exchanging their research results and latest developments. Prospective authors are invited to submit high-quality, original, and unpublished contributions to IWCIT 2014. All submitted papers will be subject to peer review. This workshop is included in the IEEE Conference Publications Program (CPP). The scope of the workshop includes the following topics:

Shannon Theory
- Complexity theory
- Information theoretic security
- Multi-terminal information theory
- Quantum information theory

Communication Theory
- Cognitive radio systems
- Cooperative communications
- Network resource sharing and scheduling
- Molecular and Nano communications
- Optical and Quantum communication theory

Coding Theory
- Compressed sensing
- Data compression
- Network coding

Applications of Information Theory
- Information theoretic learning
- Information theory and data mining
- Information theory and signal processing
- Information theory and statistics
- Information theory in biology
- Information theory in networks
- Information theory in practice

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Sharif University of Technology

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Sharif University of Technology
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Shahed University

Important Dates:

- Paper Submission:
  January 11th, 2014
- Notification of Acceptance:
  March 15th, 2014
- Camera Ready Submission:
  April 15th, 2014

Contact Us

E-mail:
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iwcit@sharif.ir

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Secretariat of IWCIT 2014
Room 503
Dept. of Electrical Engineering
Sharif University of Technology
Tehran, Iran

Tel: +98 21 66165910

www.iwcit.org

NASIT'14

June 18 - 21. 2014
Toronto, Canada

In its seventh year, this event, to be hosted at the Fields Institute at the University of Toronto, is designed to provide graduate students with opportunities to:

- Learn from distinguished researchers in the field who will present long-format tutorials;
- Participate in a stimulating and inviting forum of scientists;
- Present work for feedback and potential collaboration;
- Deepen connections with the community

Program Overview:

- Lectures by invited speakers
- Student presentations/posters
- Special social events/activities

Organizing committee:

- Stark Draper - Chair (University of Toronto)
- Warren Gross (McGill University)
- Ashish Khisti (University of Toronto)
- Patrick Mitran (University of Waterloo)
- Serdar Yüksel (Queen's University)

Advisors:

- Frank Kschischang (University of Toronto)
- Gerhard Kramer (Technical University of Munich)
- Aylin Yener (Pennsylvania State University)

For further details and applications (due spring 2014 - date TBA):
http://www.fields.utoronto.ca/programs/scientific/13-14/infotheory/

2014 North American School of Information Theory

Conference Calendar

DATE	CONFERENCE	LOCATION	WEB PAGE	DUE DATE
December 9–13, 2013	**2013 IEEE Global Communications Conference (GLOBECOM 2013)**	Atlanta, GA, USA	http://www.ieee-globecom.org/	Passed
December 16–17, 2013	**6th International Workshop on Multiple Access Communications (MACOM 2013)**	Vilnius, Lithuania	http://www.macom.ws/	September 5, 2013
February 3–7, 2014	**17th Conference on Quantum Information Processing (QIP 2014)**	Barcelona, Spain	http://benasque.org/2014QIP/	Passed
February 09–14, 2014	**2014 Information Theory and Applications Workshop (ITA 2014)**	San Diego, CA, USA	http://ita.ucsd.edu/workshop.php	By invitation
March 19–21, 2014	**48th Annual Conference on Information Sciences and Systems (CISS 2014)**	Princeton, NJ, USA	http://ee-ciss.princeton.edu/	January 3, 2014
April 27–May 2, 2014	**33rd IEEE International Conference on Computer Communications (INFOCOM 2014)**	Toronto, Canada	http://www.ieee-infocom.org/	Passed
May 7–8, 2014	**2014 Iran Workshop on Communication and Information Theory (IWCIT)**	Tehran, Iran	http://iwcit.org/	January 11, 2014
May 12–16, 2014	**WiOpt 2014**	Hammamet, Tunisia	http://www.wi-opt.org/	December 16, 2013
May 18–21, 2014	**2014 79th Vehicular Technology Conference (VTC2014-Spring)**	Seoul, Korea	http://www.ieeevtc.org/vtc2013spring/	September 16, 2013
June 10–14, 2014	**IEEE International Conference on Communications (ICC 2014)**	Sydney, Australia	http://www.ieee-icc.org/	September 15, 2013
June 29–July 4, 2014	**2014 IEEE International Symposium on Information Theory (ISIT 2014)**	Honolulu, Hawaii, USA	http://www.isit2014.org/	January 19, 2014
October 26–29, 2014	**2014 International Symposium on Information Theory and its Applications (ISITA 2014)**	Melbourne, Australia	http://www.isita.ieice.org/2014/	April 6, 2014

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