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The 2004 IEEE International Symposium on Information Theory was held at the Chicago Downtown Marriott, USA from June 27 – July 2, 2004. I speak for all of those who attended in saying that this year's ISIT was another great success, thanks to the General Co-Chairs, Daniel J. Costello, Jr. and Bruce Hajek, who put considerable effort and energy into organizing this event. The accompanying picture of Dan, Bruce, and me was taken at the banquet held on July 1, at the Grand Ballroom in the auditorium at the end of Navy Pier. The hosts will give a detailed report of ISIT 2004 in a future issue of the Newsletter.

I would like to mention the delightful Shannon Lecture given by Professor Robert J. McEliece, the recipient of the 2004 Claude E. Shannon Award. As is tradition, the lecture, entitled "Are there Turbo-Codes on Mars?", was the highlight of the Symposium. It consisted of three parts. Part 1 was beautifully constructed to guide us from the elementary levels of information theory to the latest, most advanced coding schemes, using animations that could be easily followed and appreciated by

GOLOMB'S PUZZLE COLUMN™

Countable or Uncountable

A set S is *countably infinite* if its members can be put in 1-to-1 correspondence with the positive integers. If S is an infinite set whose members cannot be put in 1-to-1 correspondence with the positive integers, then S is *uncountably infinite.*

You may use each of the following well-known facts in solving the current set of problems.

a. The set of real numbers on any interval (a, b) of the real line, with $a < b$, is uncountably infinite.

b. The set of all k-tuples of the positive integers is countably infinite.

c. The set of *all* subsets (or, all subsequences) of the positive integers is uncountably infinite.

d. The set of all *finite* subsets of the positive integers is countably infinite.

In each of the following problems, S is a collection of infinite subsets (or, infinite subsequences) A_i of the positive integers. (The subscript "i" does not necessarily come from the set of positive integers. It can just as well come from an uncountably infinite set.) In each problem you are to indicate whether it is possible for S to be uncountably infinite. If so, you are to exhibit a construction for an uncountable set of A_i's meeting the conditions for belonging to S. If S can be (at most) countably infinite, you must prove that S cannot be uncountably infinite.

1. The subsets A_i in S are pairwise disjoint.

2. The intersection of any two distinct subsets A_i and A_j in S is finite.

3. The intersection of any two distinct subsets A_i and A_j in S contains at most m elements, for some positive integer m.

Yaacov Ziv Elected to National Academy of Sciences

On April 20, 2004, Yaacov Ziv was elected as a foreign associate to the U.S. National Academy of Sciences. Such an election is considered one of the highest honors that can be accorded to a scientist or an engineer in recognition of distinguished and continuing research achievements.

Yaacov Ziv is famous for his outstanding contributions to information theory and coding theory, particularly for his work on individual sequences which led to the well-known universal data compression algorithm. Yaacov Ziv has also been a foreign associate of the U.S. National Academy of Engineering since 1988.

The National Academy of Sciences was established in 1863 by a congressional act signed by Abraham Lincoln. The total number of active members in the National Academy is 1,949. Foreign associates have citizenship outside the United States and their total number, from all countries, is 351.

Jack K. Wolf Awarded IEEE Richard W. Hamming Medal

1974 IT Society President Jack K. Wolf, the Stephen O. Rice Professor in the Department of Electrical and Computer Engineering at the University of California, San Diego, has been awarded the IEEE Richard W. Hamming Medal "For fundamental contributions to the theory and practice of information transmission and storage." Jack was the recipient of the 2001]TJT*-0.0

to so many conundrums, and then develop new mathematical concepts and techniques that paved the way for later researchers.

I. A. Ovseevich).

1 ▸

26. “Sequential decoding in a continuous channel,” *Probl. Inf. Trans.*, **3**, No. 4, 1–10 (with K. Sh. Zigangirov and B. S. Tsybakov).

24, No. 3, 253–256 (with L. A. Bassalygo).

1980

71. "Coding for channels with localized errors," in: *Proc. 4th Joint Soviet–Swedish Int. Workshop Inf. Theory*, Gotland, Sweden, pp. 95–99 (with L. A. Bassalygo and S. I. Gelfand).
72. "Delayed epsilon-entropy of a noisy Gaussian message with small reproduction error," *Probl. Inf. Trans.*, **25**, No. 3, 212–218 (with A. K. Gorbunov).

1981

73. "Bounds on the capacity of FCFS multiple-access algorithms," *Probl. Inf. Trans.*, **2** , No. 1, 49–56 (with N. D. Vvedenskaya).
74. "Controllable connector," *Probl. Inf. Trans.*, **2** , No. 2, 170–172 (with L. A. Bassalygo).

1982

75. "Coding for partially localized errors," *IEEE Trans. Inf. Theory*, **3** , No. 3, 880–884 (with L. A. Bassalygo and S. I. Gelfand).
76. "Simple methods for deriving lower bounds in the theory of codes," *Probl. Inf. Trans.*, **2** , No. 4, 277–281 (with L. A. Bassalygo and S. I. Gelfand).
77. "Asymptotic behavior of nonanticipative epsilon-entropy for Gaussian processes," *Probl. Inf. Trans.*, **2** , No. 4, 361–365 (with A. K. Gorbunov).

1983

78. "Bounds for codes with separately localized errors," *Probl. Inf. Trans.*, **2** , No. 1, 11–17 (with L. A. Bassalygo and S. I. Gelfand).
79. "Binary constant-weight codes correcting localized errors," *Probl. Inf. Trans.*, **2** , No. 4, 390–392 (with L. A. Bassalygo).

1984

80. "Asymptotically dense nonbinary codes correcting a constant number of localized errors," *Comptes rendus Acad. Bulg. Sci.*, **4** , No. 1, 35–37 (with R. Ahlswede and L. A. Bassalygo).
81. "Nonbinary codes correcting localized errors," *IEEE Trans. Inf. Theory*, **3** , No. 4, 1413–1416 (with R. Ahlswede and L. A. Bassalygo).

1985

82. "Binary constant-weight codes correcting localized errors and defects," *Probl. Inf. Trans.*, **30**, No. 2, 102–104 (with R. Ahlswede and L. A. Bassalygo).
83. "Asymptotics of the ϵ-entropy of stationary almost Gaussian processes," in: *Proc. IEEE Int. Workshop Inf. Theory*, Moscow, pp. 79–81 (with V. V. Prelov and S. Verd´u).
84. "Information rates in stationary Gaussian channels in weak signal transmission," *Probl. Inf. Trans.*, **30**, No. 4, 291–298 (with V. V. Prelov).

1986

85. "Localized random and arbitrary errors in the light of arbitrarily varying channel theory," *IEEE Trans. Inf. Theory*, **41**, No. 1, 14–25 (with R. Ahlswede and L. A. Bassalygo).
86. "Capacity of the arbitrarily varying channel under list decoding," *Probl. Inf. Trans.*, **31**, No. 2, 99–113 (with V. M. Blinovsky and P. Narayan).
87. "Asymptotically optimal binary codes of polynomial complexity correcting localized errors," *Probl. Inf. Trans.*, *31*, No. 2, 162–168 (with R. Ahlswede and L. A. Bassalygo).
88. "Sensitivity of channel capacity," *IEEE Trans. Inf. Theory*, **41**, No. 6 (with V. V. Prelov and S. Verd´u).
89. "Optimal filtering of a Gaussian signal against a background of almost Gaussian noise," *Probl. Inf. Trans.*, **31**, No. 4, 295–311 (with V. V. Prelov).

1987

90. "Codes detecting localized errors," *Probl. Peredachi Inf.*, vol. 32, no. 2, pp. 36–38 (with L. A. Bassalygo).
91. "Sharp-optimal and adaptive estimation for heteroscedastic nonparametric regression," *Stat. Sinica*, vol. 6, pp. 925–942 (with S.Yu. Efroimovich).
92. "Constant-weight codes detecting localized errors," in *Proc. 5th Int. Workshop on Algebraic and Combinatorial Coding Theory*, Sozopol, Bulgaria, June 1–7, pp. 25–26 (with L. A. Bassalygo).

1988

93. "On error-free filtering of some stationary processes," *Usp. Mat. Nauk*, vol. 52, no. 2, pp. 109–118 [English translation in *Russian Math. Surveys*, vol. 52, no. 2, pp. 349–358] (with V. V. Prelov).
94. "Sensitivity of the ϵ-entropy of stationary continuous-time Gaussian processes," *Probl. Peredachi Inf.*, vol. 33, no. 2, pp. 3–25 (with V. V. Prelov and S. Verdú).
95. "On codes correcting weakly localized errors," *IEEE Trans. Inf. Theory*, vol. 43, no. 1, pp. 363–364 (with L. A. Bassalygo).

1989

96. "Information rates in certain stationary non-Gaussian channels in weak-signal transmission," P*robl. Peredachi Inf.*, vol. 34, no. 1, pp. 3–17 (with V. V. Prelov and E.C. van der Meulen).
97. "Error-free filtering of an entropy-singular signal under independent distortions," *Probl. Peredachi Inf.*, vol. 34, no. 3, pp. 3–6 (with V. V. Prelov).
98. "Upper and lower bounds and asymptotics of the optimal filtering error of a stationary process with a small information rate," *Probl. Peredachi Inf.*, vol. 34, no. 4, pp. 23–38 (with V. V. Prelov).
99. "Information-theoretic methods in filtering problems," in *Trans. 13th Prague Conf. on Information Theory, Statistical Decision Functions, and Random Processes*, Prague, pp. 465–468 (with V. V. Prelov).

1990

100. "Stationary channels with a random parameter which is a completely singular process," *Probl. Peredachi Inf.*, vol. 35, no. 1, pp. 3–12 (with V. V. Prelov and E.C. van der Meulen).
101. "Centered error-correcting codes," Probl. Peredachi Inf., vol. 35, no. 1, pp. 30–37 (with L. A. Bassalygo).
102. "On the Hamming bound for nonbinary localized-error-correcting codes," Probl. Peredachi Inf., vol. 35, no. 2, pp. 29–37 (with R. Ahlswede and L. A. Bassalygo).

2000

103. "Evaluation of the asymptotics of the summarized capacity of an M-frequency T-user noiseless multiple-access channel," *Probl. Peredachi Inf.*, vol. 36, no. 2, pp. 3–9 (with L. A. Bassalygo).
104. "Information rate in memoryless channels for a slowly varying Markov signal," *Probl. Peredachi Inf.*, vol. 36, no. 3, pp. 29–38 (with V. V. Prelov and E.C. van der Meulen).
105. "Entropy of an ellipsoid in a Hamming space," *Probl. Peredachi Inf.*, vol. 36, no. 4, pp. 47–52.
106. "On error-free filtering of singular processes under nonstationary distortions," *Probl. Peredachi Inf.*, vol. 36, no. 4, pp. 89–97 (with V. V. Prelov).

2001

107. "Correction of ordinary and localized errors," *Probl. Peredachi Inf.*, vol. 37, no. 4, pp. 56–59 (with L. A. Bassalygo).
108. "Asymptotic investigation of the information rates in certain stationary channels with and without memory," *Amer. J. Math. Manag. Sci.*, vol. 21, no. 1–2, pp. 29–42 (with V. V. Prelov and E.C. van der Meulen).

2002

109. "Epsilon-entropy of an ellipsoid in a Hamming space," *Probl. Peredachi Inf.*, vol. 38, no. 1, pp. 3–18 (with I. I. Dumer and V. V. Prelov).
110. "An optimization problem related to the computation of the epsilon-entropy of an ellipsoid in a Hamming space," *Probl. Peredachi Inf.*, vol. 38, no. 2, pp. 3–18 (with I. I. Dumer and V. V. Prelov).

2004

111. "On coverings of ellipsoids in Euclidean spaces," IEEE Trans. Inf. Theory, to appear (with I. I. Dumer and V. V. Prelov).
112. "On the thinnest coverings of spheres and ellipsoids with balls in Hamming and Euclidean spaces," in: *General Theory of Information Transfer and Combinatorics* (with I. I. Dumer and V. V. Prelov).

The following ideas were suggested: (a) mentoring program, (b) Best Student Paper Award (Michelle Effros), and (c) Social event with students and BOG (Andrea Goldsmith).

→ The Board requested that David Neuhoff, along with Michelle Effros and Andrea Goldsmith, follow up on the ideas suggested above.

5. Marc Fossorier presented the Treasurer's report. It was noted that the IEEE is changing policies, resulting in less freedom for individual societies to develop their own finances.

   It was commented that IEEE charges are based on services not on account balance.

   Things are on target for 2003. The Society gets money returned over a two year period for having made its digital library avail-

Here $p_n = n^{th}$ prime number, and $\pi(x)$ = number of primes $\le x$, for positive real x.

1. "Prove that the ratio $\frac{n}{\pi(n)}$, for $n \ge 2$, takes every integer value > 1 at least once."
   Proof. It was given in the Puzzle Column that $\lim_{x\to\infty} \frac{\pi(x)}{x} = 0$ and $\lim_{n\to\infty} p_n = \infty$. Thus the ratio $\frac{\pi(x)}{x}$ ultimately becomes and remains less than any assigned $\epsilon > 0$, as $x \to \infty$. It starts at $\frac{\pi(2)}{2} = \frac{1}{2}$.
   For any $m \ge 2$, there is a *unique largest prime* $p_k = p_{k(m)}$ for which $\pi(p_k) = k \ge \frac{p_k}{m}$. Thus, $m\pi(p_k) = mk \ge p_k$. Either $mk < p_{k+1}$ or $mk \ge p_{k+1}$.
   If $mk < p_{k+1}$, and since $p_k \le mk$, $\pi(p_k) \le \pi(mk) < \pi(p_{k+1})$, from which $\pi(mk) = k$, and $\frac{mk}{\pi(mk)} = m$, so that $n = mk$ is an integer for which $\frac{n}{\pi(n)} = m$.
   If $mk \ge p_{k+1}$, then $\pi(p_{k+1}) = k + 1 > k = \frac{mk}{m} \ge \frac{p_{k+1}}{m}$, which contradicts the choice of p_k as the *largest* prime for which $\pi(p) \ge \frac{p}{m}$. .

2. "Every positive integer belongs to exactly one of the two sequences $\{s_n\} = \{n + \pi(n)\}$ and $\{t_n\} = \{n + p_n - 1\}$."
   Proof. In the land of Primordia, the sequence $\{p_n\}$ is used as a "tax table", in the sense that the sales tax increases by one cent at every term of the sequence $\{p_n\}$ (and at no other values). Thus the sales tax on the price p_k is exactly k. More generally, the sales tax on the price m is $\pi(m)$, the number of terms of $\{p_n\}$ not exceeding m.
   From this point of view, the "total price" (including tax) on an item with a net price of n is $n + \pi(n)$. The sequence $\{n + \pi(n)\}$ thus consists of all numbers which can occur as "total prices". What numbers cannot occur as "total prices"? As the net price increases through one of the terms of $\{p_n\}$, say from $p_n - 1$ to p_n, the total price increases from $(p_n - 1) + (n - 1)$ to $p_n + n$, thus skipping the value $p_n + n - 1$. If m is not of the form p_n, then the total price goes from $(m - 1) + \pi(m - 1)$ to $m + \pi(m)$, increasing by only one cent, because in this case $\pi(m - 1) = \pi(m)$. Thus the integers skipped in the sequence $\{n + \pi(n)\}$ are precisely the terms of the sequence $\{n + p_n - 1\}$.

Note that in problems 1 and 2, the fact that $\{p_n\}$ is the sequence of the prime numbers (rather than some other subsequence of the positive integers that becomes less dense) plays almost no role.

3. "Given positive integers a and b, there exists a positive integer c such that infinitely many numbers of the form $an + b$ (n a positive integer) have all their prime factors $\le c$."
   Proof. All numbers in the sequence $\{b(a + 1)^k, k = 1, 2, 3, \dots\}$ are distinct and of the form $an + b$. Thus $c = \max(b, a + 1)$ satisfies the condition of the problem.

4. (a) "What is the largest integer N such that, if $1 < k < N$ and k has no prime factor in common with N, then k is prime?"
   Answer. $N = 30$. Since $30 = 2 \times 3 \times 5 = p_1 \times p_2 \times p<3$

Answer. $n = \{5, 17, 41, 77, 100\}$. For "large" n, $\sum_{p \le \pi(n)} p > n$,

and ,

Workshop Report: SPWC 2004

London, England
June 2-4, 2004

The second international workshop on signal processing for wireless communication (SPWC 2004), yet another highly successful event in the series, was organised and chaired by Dr. Mohammad Shikh-Bahaei, and hosted by the Centre for DSP Research at King's College London, and was held in the heart of London between June 2-4, 2004.

During the two-day workshop some of the foremost experts in the fields of wireless communications and signal processing shared their highly respected views with the audience about the latest advances in those fields. Just to name two, the father of space-time coding and the inventor of turbo codes were among the keynote speakers. The workshop also featured two panel sessions that discussed the present techniques and the future trends in signal processing for wireless communications.

Professor Claude Berrou, whose name is associated with invention of turbo codes, presented at the workshop, for the first time, his latest findings on a smart technique to improve turbo codes. Professor Vincent Poor presented a unified approach to power control for multiuser detectors, and Professor Vahid Tarokh spoke on collaborative wireless networks. Professor Sergio Verdu elaborated on his recent work (jointly with Guo and Shamai) on connections between information theory and estimation theory. Professor Bruce Sutter presented his paper about his recent findings on the applications of Hub matrix theory in wireless communication.

Professor Biglieri gave a talk on iterative processing in wireless communications. He provided a tutorial on the fundamentals of iterative processing, and elaborated on iterative interfaces for coded multiple-antenna signaling. One more talk related to coding theory was by Professor Bahram Honary, in which he presented new results on LDPC codes. Professor Hanzo gave an invited talk on adaptive OFDM and MC-CDMA versus space-time coding. Finally, Professor Paulraj presented his comparative results on wireless systems invoking space-time coding and those that feature beamforming.

The workshop also featured poster sessions during which the papers accepted by the workshop were presented by their authors.

Sergio Verdu and Mohammad Shikh-Bahaei at SPWC 2004.

Professors Shikh-Bahaei, Paulraj, Biglieri and Sutter during a panel session at SPWC 2004.

CALL FOR PAPERS

2004 IEEE Information Theory Workshop

Antonio, Texa

October 24-29, 2004

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tion Theory Workshop (ITW 2004) will take place on ... Antonio, Texas, USA. All areas of information theory will ... computer science, and networking. Technical sessions will

merging Applications of Information Theory
nformation Theory and Computer Science
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ireless Systems and Space-Time Signal Processing

- Source and Channel Coding Techniques
- Data Compression
- Graphs, Codes and Iterative Decoding

The 2004 IEEE Inform... October 24-29 in San A... within ... include

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H. El Gamal (Ohio State U.)
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• Source-channel coding
• Iterative (turbo) decoding, Monte Carlo signal processing
• Smart antennas, MIMO systems, and space time coding
• Modeling, est mat

• Cooperative transmission and reception schemes
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• Time, frequency, multi-user
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January 15, 2005 Subr nission deadline Publications
March 15 20 05 Notification of acceptance S. Kishore (Lehigh U.)

Call for Paper

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CALL FOR PAPERS

2005 IEEE International Symposium on Information Theory

Adelaide Convention Centre, Adelaide, Australia

September 4–9, 2005

isit 05 Adelaide

General Co-Chairs
Alex Grant
Rodney A. Kennedy

The 2005 IEEE International Symposium on Information Theory will be held at the Adelaide Convention Centre in Adelaide, Australia from Sunday, September 4 through Friday September 9, 2005.

Program Committee

Previously unpublished contributions to the following areas will be solicited:

Coded modulation

Information theory and statistics

Quantum information processing
Shannon theory
Signal processing
Source coding

Data compression
Data networks
Detection and estimation

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Marcus Greferath
Piyush Gupta
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Wojciech Szpankowski
Toshiyuki Tanaka
Leandros Tassiulas
Ruediger Urbanke
Henk van Tilborg
Sergio Verdú

Papers will be reviewed on the basis of an extended abstract (not exceeding six pages) of sufficient detail to permit reasonable evaluation. The deadline for submission is **January 30, 2005**, with notification of decisions by May 15, 2005. The deadline will be strictly enforced. In view of the large number of submissions expected, multiple submissions by the same author will receive especially stringent scrutiny. All accepted papers will be allowed twenty minutes for presentation, and one-page abstracts will be printed in the conference proceedings. Authors are strongly encouraged to submit electronic versions of their extended abstracts in the form of Portable Document Format (PDF) files.

Detailed information on paper submission, technical program, accommodation, travel, and excursions will be posted on the Symposium web site

http://www.isit2005.org

Inquiries on general matters related to the Symposium should be directed to

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International Advisory

Conference Calendar

September 15-16, 2004	04 -	Dresden, Germany	http://ofdm.tu-harburg.de Prof. Herman Rohling, TU Hamburg-Harburg, Eissendorfer Str. 40, D-21073 Hamburg, Germany, ofdm@tu-harburg.de	April 30, 2004
September 29-October 1, 2004	42	Monticello, IL	http://www.comm.csl.uiuc.edu/allerton	July 1, 2004
October 6-8, 2004	2004 - (4)	Viareggio, Italy	http://www.exp-math.uni-essen.de/~vinck/aew4/aew4.html	May 1, 2004
October 10-12, 2004	2004 (2004)	Parma, Italy	isita2004@sita.gr.jp http://www.sita.gr.jp/ISITA2004/new.htm	March 26, 2004
October 24-29, 2004	2004 ( )	San Antonio Marriot Riverwalk Hotel San Antonio, Texas, USA	See CFP in this issue. http://ee-wcl.tamu.edu/itw2004 Ms. Sonny Matous Electrical Engineering Department Texas A&M University Room 237 WERC	May 31, 2004
November 29-December 3, 2004	2004	Hyatt Regency Dallas at Reunion Hotel Dallas, Texas, USA	http://www.globecom2004.org	March 1, 2004
April 3-7, 2005	2005	Trento, Italy	http://www.wiopt.org/	Oct. 5, 2004
TBA (before ISIT 2005)	2005 ( )	New Zealand	TBA	TBA
September 4-9, 2005	2005 ( )	Adelaide Convention Center Adelaide, AUSTRALIA	See CFP in this issue. http://www.isit2005.org Dr. Alex Grant Institute for Telecommunications Research University of South Australia SA 5095 Australia Prof. Rodney A. Kennedy Research School of Information Sciences and Engineering Australian National University ACT 0200 Australia rodney.kennedy@anu.edu.au	January 30, 2005
April 3-7, 2006	4	Munich, Germany	http://www-turbo.enst-bretagne,fr/	Oct. 15, 2005
TBA	200 ( )	Seattle, Washington, USA	TBA	TBA