Universität Bielefeld
Zentrum für interdisziplinäre Forschung
Center for Interdisciplinary Research
ZiF

in cooperation with

Universität Bielefeld
Fakultät für Mathematik
Department of Mathematics

Symposium in Remembrance of Rudolf Ahlswede

July 25 -26, 2011

Program and Booklet of Abstracts

Symposium in Remembrance of Rudolf Ahlswede

Bielefeld, Germany, July 25 -26, 2011

Program and Booklet of Abstracts

Organizers:

Harout Aydinian, Ingo Althöfer, Ning Cai,
Ferdinando Cicalese, Christian Deppe, Gunter Dueck,
Ulrich Tamm, Andreas Winter

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Monday July 25, 2011	**PROGRAM**
10:15	Warm up: C. Bennett - Quantum information, the ambiguity of the past, and the complexity of the present
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	- Chair C. Deppe -
13:00	M. Egelhaaf - Vice-Rector for Research at Bielefeld University and Member of the ZiF's Board of Directors
13:15	E. Emmrich - Vice-Dean of the Department of Mathematics
13:30	A. Ahlswede and B. Ahlswede-Loghin
14:30	K. Jacobs
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	- Chair U. Tamm -
15:15	Rudolf Ahlswede in the seventies E. van der Meulen: R. Ahlswede 1970-74 J. Daykin: R. Ahlwede's cooperation with David Daykin M. Maljutov: R. Ahlswede and search theory
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20:00	*- Conference Dinner -* During the conference dinner there will be a video presentation of T. Dolgova and V. Lebedev of their last visit of Rudolf Ahlswede in Bielefeld 2010 If you want to contribute something to the Conference Dinner please contact I. Althöfer (ingo.althoefer@uni-jena.de) he coordinates the evening.

During the conference there will be an exhibition related to Rudolf Ahlswede. We want to present there photos and posters related to the research of Rudolf Ahlswede. If you want to contribute something please contact Christian Deppe (cdeppe@math.uni-bielefeld.de).

Tuesday July 26, 2011	
	- Chair V. Blinovsky -
8:00	I. Csiszár - Common randomness in information theory
9:00	P. Narayan - Common randomness and multiterminal secure computation
9:30	A. Winter - Quantum channels and identification theory
10:00	*- Coffee Break -*
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10:30	A. Sarkozy - On the complexity of families of binary sequences and lattices
11:30	A. Orlitsky - String reconstruction from substring compositions
12:00	R. Reischuk - Stochastic search for locally clustered targets
12:30	*- Lunch -*
	- Chair A. Winter -
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15:00	H. Aydinian - AZ-identity for regular posets
15:30	*- Coffee Break -*
	- Chair H. Aydinian -
16:00	N. Cai - Secure network coding
16:30	S. Riis - Information flows and bottle necks in dynamic communication networks
17:00	L. Tolhuizen - A generalisation of the Gilbert-Varshamov bound and its asymptotic evaluation
17:30	*- Coffee Break -*
	- Chair N. Cai -
18:00	L. Székely - Higher order extremal problems
18:30	S. Bezrukov - Local-global principles in discrete extremal problems

RUDOLF AHLSWEDE 1938-2010

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We, his friends and colleagues at the Department of Mathematics at the University of Bielefeld are terribly saddened to share the news that Professor Rudolf Ahlswede passed away in the early hours of Saturday morning 18th December, 2010.

Rudolf Ahlswede had after an excellent education in Mathematics, Physics, and Philosophy almost entirely at the University of Göttingen and a few years as an Assistant in Göttingen and Erlangen received a strong push towards research, when he moved to the US, taught there at the Ohio State University in Columbus and greatly profited from joint work in ***Information Theory*** with the distinguished statistician Jacob Wolfowitz at Cornell and the University of Illinois during the years 1967-1971 (see the obituary [A82]).

The promotion to full professor in Mathematics followed in 1972, but only after Rudolf Ahlswede convinced his faculty by his work in Classical Mathematics. Information Theory was not yet considered to be a part of it.

A problem in p-adic analysis by K. Mahler found its solution in [AB75] and makes now a paragraph in his book [M81].

For a short time concentrating on Pure Mathematics and quitting Information Theory was considered. But then came strong responses to multi-way channels [A71] and it became clear that Information Theory would always remain a favorite subject – it looked more interesting to Rudolf Ahlswede than many areas of Classical Mathematics. An account of this period is given in the books [W78], [CK81], and [CT06].

However, several hard problems in Multi-user Information Theory led Rudolf Ahlswede to ***Combinatorics***, which became the main subject in his second research stage starting in 1977.

Writing joint papers, highly emphasized in the US, helped Rudolf Ahlswede to establish a worldwide network of collaborators.

Finally, an additional fortunate development was an offer from the Universität Bielefeld in 1975, which for many years was the only research university in Germany with low teaching obligations, implying the possibility to teach only every second year.

In a tour de force within half a year Rudolf Ahlswede shaped a main part of the Applied Mathematics Division with Professorships in Combinatorics, Complexity Theory (first position in Computer Science at the university), and Statistical Mechanics.

Among his students in those years were Ingo Althöfer (Habilitationspreis der Westfälisch-Lippischen Universitätsgesellschaft 1992), Ning Cai (IEEE Best Paper Award 2005), Gunter Dueck (IEEE Best Paper Award 1990; Wirtschaftsbuchpreis der Financial Times Deutschland 2006), Ingo Wegener (Konrad-Zuse-Medaille 2006), Andreas Winter (Philip Leverhulme Prize 2008) and Zhen Zhang.

In the second stage 1977-87 the AD-inequality was discovered, made it into many text books like [B86], [A87], [AS92], [E97], and found many generalizations and number theoretical implications [AB08].

We cite from the book [B86] S19 The Four Function Theorem:
"At the first glance the FFT looks too general to be true and, if true, it seems too vague to be of much use. In fact, exactly the opposite is true: the Four Function Theorem (FFT) of Ahlswede and Daykin is a theorem from "the book". It is beautifully simple and goes to the heart of the matter. Having proved it, we can sit back and enjoy its power enabling us to deduce a wealth of interesting results. "
Combinatorics became central in the whole faculty, when the DFG-Sonderforschungsbereich 343 "Diskrete Strukturen in der Mathematik" was established in 1989 and lasted till 2000.
The highlight of that third stage is among solutions of several number theoretical and combinatorial problems of P. Erdős [A01]. The most famous is the solution of the $4m$-Conjecture from 1938 of Erdős/Ko/Rado (see [E97], [CG98]), one of the oldest problems in combinatorial extremal theory and an answer to a question of Erdős (1962) in combinatorial number theory "What is the maximal cardinality of a set of numbers smaller than n with no $k+1$ of its members pairwise relatively prime?".

As a model most innovative seems to be in that stage Creating Order [AYZ90], which together with the Complete Intersection Theorem demonstrates two essential abilities, namely to shape new models relevant in science and/or technology and solving difficult problems in Mathematics.
In 1988 (with Imre Csiszar) and in 1990 (with Gunter Dueck) Rudolf Ahlswede received the Best Paper Award of the IEEE Information Theory Society. He received the Claude Elwood Shannon Award 2006 of the IEEE information Theory Society for outstanding achievements in the area of the information theory (see his Shannon Lecture [A06]).
A certain fertility caused by the tension between these two activities goes like a thread through Rudolf Ahlswede's work, documented in 235 published papers in roughly 4 stages from 1967-2010. The last stage 1997-2010 was outshined by Network Information Flow [ACLY00] (see also [FS07a], [FS07b], [K]) and GTIT-updated [A08], which together with Creating Order [AYZ90] was linked with the goal to go from Search Problems to a Theory of Search.
The seminal paper [ACLY00] founded a new research direction in the year 2000, with many applications especially for the internet. It has been identified by Essential Science Indicators^{SM} as one of the most cited papers in the research area of "NETWORK INFORMATION FLOW". Research into network coding is growing fast, and Microsoft, IBM and other companies have research teams who are researching this new field. The most known application is the Avalanche program of Microsoft.
Rudolf Ahlswede had just started a new research project about quantum repeaters to bring his knowledge about physics and information theory together. Unfortunately he cannot work for the project anymore.
We lost a great scientist and a good friend. He will be missed by his colleagues and friends.

References

[A71] R. Ahlswede, Multi-way communication channels, Proceedings of 2nd International Symposium on Inf. Theory, Thakadsor, Armenian SSR, 1971, Akademiai Kiado, Budapest, 23-52, 1973.

[A82] R. Ahlswede, Jacob Wolfowitz (1910-1981), IEEE Trans. Inf. Theory 28, No. 5, 687-690, 1982.

[A01] R. Ahlswede, Advances on extremal problems in Number Theory and Combinatorics, European Congress of Mathematics, Barcelona 2000, Vol. I, 147-175, Carles Casacuberta, Rosa Maria Miró-Roig, Joan Verdera, Sebastiá Xambó-Descamps (Eds.), Progress in Mathematics 201, Birkhäuser, Basel-Boston-Berlin, 2001.

[A06] R. Ahlswede, Towards a General Theory of Information Transfer, Shannon Lecture at ISIT in Seattle 13th July 2006, IEEE Inform. Theory Society Newsletter, Vol. 57, No. 3, 6-28, 2007.

[A08] R. Ahlswede, General Theory of Information Transfer: updated, General Theory of Information Transfer and Combinatorics, Special Issue of Discrete Applied Mathematics, Vol. 156, No. 9, 1348-1388, 2008.

[AB08] R. Ahlswede and V. Blinovsky, Lectures on Advances in Combinatorics, Universitext, Springer, 2008.

[AB75] R. Ahlswede and R. Bojanic, Approximation of continuous functions in p-adic analysis, J. Approximation Theory, Vol. 15, No. 3, 190-205, 1975.

[ACLY00] R. Ahlswede, Ning Cai, S.Y. Robert Li, and Raymond W. Yeung, Network information flow, IEEE Trans. Inf. Theory 46, No. 4, 1204-1216, 2000.

[AYZ90] R. Ahlswede, J.P. Ye and Z. Zhang, Creating order in sequence spaces with simple machines, Information and Computation, Vol. 89, No. 1, 47-94, 1990.

[AZ89] R. Ahlswede and Z. Zhang, Contributions to a theory of ordering for sequence spaces, Problems of Control and Information Theory, Vol. 18, No. 4, 197-221, 1989.

[AS92] N. Alon and J. Spencer, The Probabilistic Method, Wiley-Interscience Series in Discrete Mathematics and Optimization, Wiley & Sons, Inc., New York, 1992.

[A87] I. Anderson, Combinatorics of Finite Sets, Oxford Science Publications, The Clarendon Press, Oxford University Press, New York, 1987.

[B86] B. Bollobás, Combinatorics, Set Systems, Hypergraphs, Families of Vectors and Combinatorial Probability, Cambridge University Press, Cambridge, 1986.

[CG98] F. Chung and R. Graham, Erdős on Graphs: His Legacy of Unsolved Problems, AK Peters, 1998.

[CT06] T. Cover and J. Thomas, Elements of Information Theory, 2nd ed., Wiley, New York, 2006.

[CK81] I. Csiszár and J. Körner, Information Theory. Coding Theorems for Discrete Memoryless Systems, Probability and Mathematical Statistics, Academic Press, New York-London, 1981.

[E97] K. Engel, Sperner Theory, Encyclopedia of Mathematics and its Applications, 65, Cambridge University Press, Cambridge, 1997.

[FS07a] C. Fragouli and E. Soljanin, Network Coding Fundamentals, Foundations and Trends in Networking, Publishers Inc., 2007.

[FS07b] C. Fragouli and E. Soljanin, Network Coding Applications, Foundations and Trends in Networking, Publisher Inc., 2007.

[K] R. Kötter, The Network Coding Home Page, http://www.ifp.illinois.edu/∼koetter/NWC/.

[M81] K. Mahler, P-adic Numbers and their Functions, 2nd ed., Cambridge University Press, 1981.

[W78] J. Wolfowitz, Coding Theorems of Information Theory, 3rd ed., Springer, New York, 1978.

OBITUARY OF THE ZIF

Manuela Lenzen

Just before Christmas last year Professor emeritus Prof. h.c. (RUS) Dr. Rudolf Ahlswede, organizer of the running ZiF Cooperation Group "Search Methodologies" passed away, aged 72. Professor Ahlswede studied Mathematics, Physics and Philosophy, was appointed Full Professor at the Department of Mathematics of Ohio State University, Columbus, 1972 and since 1975 held a chair for Mathematics at Bielefeld University. Professor Ahlswede is well-known for his pioneering work in information theory, theory of complexity and combinatorics. Among his numerous awards are twice the Best Paper Award of the IEEE Information Theory Society and the Claude E. Shannon Award of the IEEE Information Theory Society. Rudolf Ahlswede often joined the ZiF, 1999/2000 as member of the Research Group "Making Choices" and 2002/2003 as organizer of the Research Group "General Theory of Information Transfer and Economics". Still in October 2010 he organized the ZiF workshop "Search Methodologies II". His sudden death deeply saddened the ZiF.

Im Alter von 72 Jahren starb kurz vor Weihnachten letzten Jahres Professor emeritus Prof. h.c. (RUS) Dr. Rudolf Ahlswede, der Initiator der laufenden ZiF-Kooperationsgruppe "Suchmethodologien". Rudolf Ahlswede wurde 1938 geboren und studierte Philosophie, Mathematik und Physik in Freiburg und Göttingen. Nach Assistentenjahren in Göttingen und Erlangen wurde er 1972 zum Full Professor am Department of Mathematics der Ohio State University in Columbus ernannt. Seit 1975 war er Professor für Mathematik an der Universität Bielefeld.

Rudolf Ahlswede hat sich vor allem auf dem Gebiet der Informationstheorie und Komplexitätstheorie, der Kombinatorik, der kombinatorischen Zahlentheorie und der Stochastik weltweit einen Namen gemacht. Viele seiner Forschungsergebnisse gehören heute zu den Grundlagen seines Fachs. Ahlswede machte das Suchen als wissenschaftliches Problem in der Mathematik gesellschaftsfähig und entwickelte mit der Netzwerkcodierung ein neues Verfahren, die Informationsflüsse in Kommunikationsnetzwerken zu organisieren.

Rudolf Ahlswede erhielt für seine Arbeiten zahlreiche Auszeichnungen, darunter gleich zwei Mal den Best Paper Award der IEEE Information Theory Society. 2006 wurde ihm für herausragende Arbeiten auf dem Gebiet der Informationstheorie als erstem deutschen Wissenschaftler der Claude E. Shannon Award der IEEE Information Theory Society verliehen. Auch nach seiner Emeritierung war Rudolf Ahlswede wissenschaftlich auerordentlich aktiv.

Rudolf Ahlswede war dem ZiF seit Langem verbunden: 1999/2000 als Mitglied der Forschungsgruppe Making Choices und 2002/2003 als Leiter der Forschungsgruppe General Theory of Information Transfer and Combinatorics, in deren Rahmen zahlreiche angesehene Publikationen erschienen und die den Grundstein zu vielen interdisziplinären Kooperationen legte. Seine weit gefächerten Interessen führten Ahlswede aber auch zu philosophischen und literaturwissenschaftlichen Vorträgen ins ZiF. Noch Ende Oktober 2010 leitete er im Rahmen seiner zusammen mit Ferdinando Cicalese organisierten Kooperationsgruppe die Tagung Search Methodologies II und zeigte sich sehr erfreut über das breite Echo, das die Veranstaltung erfuhr. Umso mehr hat die Nachricht von seinem plötzlichen Tod das ZiF getroffen.

AZ-IDENTITY FOR REGULAR POSETS

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One of elegant results of Ahlswede in combinatorics is the Ahlswede-Zhang identity which has several applications. In particular, it can be regarded as a generalization of the well-known LYM inequality. We show how this result can be extended to the class of regular lattices and present some applications.

QUANTUM INFORMATION, THE AMBIGUITY OF THE PAST, AND THE COMPLEXITY OF THE PRESENT

Charles Bennett

The theory of entanglement provides a coherent view of the physical origin of randomness and the growth and decay of correlations, even in macroscopic systems exhibiting few traditional quantum hallmarks. It helps explain why the future is more uncertain than the past, and how correlations can become macroscopic and classical by being redundantly replicated throughout a system's environment. The most private information, exemplified by a quantum eraser experiment, exists only transiently: after the experiment is over no record remains anywhere in the universe of what "happened".

At the other extreme is information that has been so widely replicated as to be infeasible to conceal and unlikely to be forgotten.

But such conspicuous information is exceptional:

a comparison of entropy flows into and out of the Earth with estimates of the planet's storage capacity leads to the conclusion that most macroscopic classical information—for example the pattern of drops in last week's rainfall—is impermanent, eventually becoming nearly as ambiguous, from a terrestrial perspective, as the transient result of a quantum eraser experiment. Finally we discuss prerequisites for a system to accumulate and maintain in its present state, as our world does, a complex and redundant record of at least some features of its past. Not all dynamics and initial conditions lead to this behavior, and in those that do, the behavior itself tends to be temporary, with the system losing its memory as it relaxes to thermal equilibrium.

LOCAL-GLOBAL PRINCIPLES IN DISCRETE EXTREMAL PROBLEMS

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We consider three types of extremal problems on cartesian products of graphs and posets: edge- and vertex-isoperimetric problems on graphs and shadow-minimization problems on posets. The emphasis is put on existence of nested solutions to these problems. It turns out that under certain conditions, the existence of nested solutions for the second cartesian power of the structures in questions implies one for any cartesian power. First result in this direction was obtained by R. Ahlswede and N. Cai for the edge-isoperimetric problem. We present several further results in this direction and some generalizations for cartesian products of different graphs.

SECURE NETWORK CODING

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In this talk we first present a basic model of secure network coding, wiretap network, and then discuss its relation with 3 well known security systems, Shannon cipher system, secret sharing, the second type of wiretap channel. A few extensions of the model also will be described briefly. Finally we present a simple idea in secure network coding, which plays a key role in many works in the area.

COMMON RANDOMNESS IN INFORMATION THEORY

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Common randomness (CR) is a concept relevant for several fields, for example, CR is a valuable resource for distributed algorithms. Here, this concept will be discussed from the point of view of Information Theory, emphasizing basic contributions of Rudolf Ahlswede. First, information theoretic models of generating CR for two or several parties, and the problem of CR capacity will be addressed, based primarily on joint works of Ahlswede and the author [4], [5]. Then, information theoretic applications of CR will be treated, such as obtaining bona-fide deterministic codes from random codes [1], [5], and the intrinsic relationship to CR capacity of identification capacity introduced by Ahlswede and Dueck [2],[3]. Finally, the perhaps most important application, to information theoretic security, will be briefly discussed where the CR is additionally required to be secret from an adversary, thus representing a secret key. This last part of the talk will be based in part also on joint results of Ahlswede and the author.

References

[1] Ahlswede, R. Elimination of correlation in random codes for arbitrarily varying channels. Z.Wahrscheinlichkeitsth. verw. Geb. 33 (1979) 159-175.

[2] Ahlswede, R. and Dueck, G. Identification via channels. IEEE Trans. Inf. Th. 35 (1989) 15-29.

[3] Ahlswede, R. and Dueck, G. Identification in the presence of feadback: a discovery of new capacity formulas. IEEE Trans. Inf. Th. 35 (1989) 30-36.

[4] Ahlswede, R. and Csiszr, I. Common randomness in information theory a and cryptography. Part 1, Secret sharing. IEEE Trans. Inf. Th. 39 (1993) 1121-1132.

[5] Ahlswede, R. and Csiszr, I. Common randomness in information theory a and cryptography. Part 2, CR capacity. IEEE Trans. Inf. Th. 44 (1998) 225-240.

THE DEEP IMPACT OF RUDOLF AHLSWEDE ON COMBINATORICS

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We will survey some of the most important works of R.A. in the area of Combinatorics. Let us mention here only the most important results what he jointly achieved with Levon Khachatrian. Erdős, Ko and Rado proved that if $\mathcal{F}$ is a family of k-element subsets of an n-element set, $k \leq \frac{n}{2}$ and the members of $\mathcal{F}$ pairwise have a non-empty intersection then the family cannot be larger than the trivial one: take all k-element subsets containing a fixed element. They also noticed that this trivial construction is not always the best when the condition on the pairwise intersections is that they have to be at least r. The largest family consists of all subsets containing a fixed r-element set only when $n \geq n(k,r)$, otherwise there is a counter-example. Peter Frankl posed a conjecture in the 1970's suggesting a construction for the hopefully best construction for all n, k and r. It was a real breakthrough in this theory when Rudolf Ahlswede and Levon Khachatrian proved the conjecture in 1995.

COMMON RANDOMNESS AND MULTITERMINAL SECURE COMPUTATION

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A set of terminals that observe correlated signals seek to compute a given function of the signals using public communication. It is required that the value of the function be kept secret from an eavesdropper with access to the communication. We show that the function is securely computable if and only if its entropy is less than the "secret key" capacity of an associated secrecy generation model. The proof of sufficiency entails a connection to the common randomness problem of omniscience generation.

STRING RECONSTRUCTION FROM SUBSTRING COMPOSITIONS

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Motivated by mass-spectrometry protein sequencing, we consider the simple problem of reconstructing a string from its substring compositions. Relating the question to the long-standing turnpike problem, polynomial factorization, and cyclotomic polynomials, we cleanly characterize the lengths of reconstructable strings and the structure of non-reconstructable ones. The talk is elementary and self contained and covers work with Jayadev Acharya, Hirakendu Das, Olgica Milenkovic, and Shengjun Pan.

STOCHASTIC SEARCH FOR LOCALLY CLUSTERED TARGETS

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Searching a space with locally clustered targets involves the optimization problem when to leave a current unproductive region and invest effort to go to a hopefully better one? We consider a specific setup of such a search process that models infection screening by T cells in the immune system. Taking an artificial immune system perspective, one could ask whether this model could provide insight for similar problems in computing, for example Las Vegas algorithms with expensive restarts or agent-based intrusion detection systems.

The model is simple, but presents a rich phenomenology. Analytically we derive the optimal behavior of a single searcher, revealing the existence of two characteristic regimes in the search parameter space. Moreover, we determine the impact of perturbations and imprecise knowledge of the search space parameters, as well as the speedup gained by searching in parallel. The results provide interesting new directions for developing tools to tune stochastic search algorithms.

INFORMATION FLOWS AND BOTTLE NECKS IN DYNAMIC COMMUNICATION NETWORKS

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Traditionally, communication networks are modeled and analyzed in terms of information flows in graphs. In the talk we introduce a novel symbolic approach to communication networks, where the topology of the underlying network is contained in a set of formal terms from logic. The main result is a general principle for many-to-many cast communications in dynamic multi-user networks. It is shown that if each demand can be satisfied locally, then they can all be achieved globally, which happens when the respective min-cuts satisfy the demands. The talk is aimed at an general mathematical audience.

ON THE COMPLEXITY OF FAMILIES OF BINARY SEQUENCES AND LATTICES

Andras Sarkozy

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Pseudorandom binary sequences play a crucial role in many applications, in particular, in cryptography. In the applications these sequences are taken from large families of sequences generated by a pseudorandom bit generator. In the practice it is not enough to know that the individual sequences possess strong pseudorandom properties; it is also necessary that their family should possess a ”rich”, ”complex” structure. Thus Ahlswede, Khachatrian, Mauduit and Sarkozy introduced and studied the notion of family complexity for families of binary sequences. Since that their definitions and results have been extended in various directions; in the talk a survey of the related papers will be given.

HIGHER ORDER EXTREMAL PROBLEMS

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Professor Ahlswede's seminal work in extremal combinatorics include - the Ahlswede-Daykin inequality, a common generalization of several correlation inequalities - the Ahlswede-Zhang identity that turned the familiar LYM inequality into an unexpected identity - the complete solution (in collaboration with L. Khachatrian) for the maximum number of t-intersecting k-element sets—a problem from the 1930's - breakthrough results, where he and L. Khachatrian used the shifting technique to resolve old Erdos problems in number theory, like what is the number of positive integers up to n such that no k of them are pairwise relatively prime. This talk will focus on some lesser known though important work. In several papers, in part part with Ning Cai, in part with Zhen Zhang, Ahlswede initiated the study of higher order extremal problems and solved a good number of problems of this kind. Ordinary extremal set problems ask "how many subsets can we have in an underlying set with certain conditions on intersection and/or inclusion" or under other set theoretic conditions. Higher order extremal problems ask "how many families of subsets can we have" under certain conditions. We will review progress in this area, among others, results on intersecting chains, intersecting partitions, intersecting permutations.

A GENERALISATION OF THE GILBERT-VARSHAMOV BOUND AND ITS ASYMPTOTIC EVALUATION

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The Gilbert-Varshamov (GV) lower bound on the maximum size of a q-ary code of length n with minimum Hamming distance at least d can be obtained by applying Turáns lower bound on the size of a clique to the graph with vertex set $\{0, 1, ..., q1\}^n$ in which two vertices are joined if and only if their Hamming distance is at least d. We generalize this lower bound by applying Turáns bound to the graph with vertex set C^n, where C is a a given q-ary code of length m and two vertices are joined if and only if their Hamming distance at least d. We asymptotically evaluate the resulting bound for $n \to \infty$ and $d \sim \delta mn$ for fixed $\delta > 0$, and derive conditions on the distance distribution of C that are necessary and sufficient for the asymptotic generalized bound to beat the asymptotic GV bound. By rewriting these conditions and invoking the Delsarte inequalities, we conclude that no improvement on the asymptotic Gilbert-Varshamov bound is obtained.

QUANTUM CHANNELS AND IDENTIFICATION THEORY

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When Ahlswede and Dueck originated identification theory, it was immediately clear that the theory and methodology can be adapted to various channel models. So, it was natural that from ca. 1998 in Bielefeld quantum channels were considered. Important discoveries made in the early years were the ID capacity of so-called cq-channels (equal to the classical communication capacity) and of the ideal channel (twice the classical capacity!). However, one can also define a natural identification task for quantum information, giving rise to the concept of quantum-ID coding. Together with Patrick Hayden the present speaker recently made considerable progress on this problem, proving coding theorems and converses for quantum-ID capacities and a single-letter formula for what we call the ”amortized” quantum-ID capacity. Unexpectedly, the latter turns out to be equal to the entanglement-assisted classical capacity of the channel.

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