Contents

Preface

The Caesarea Edmond Benjamin de Rothschild Foundation Institute for Interdisciplinary Applications of Computer Science (C.R.I.) was established at the University of Haifa in 2001 with a generous grant from the Caesarea Edmond Benjamin de Rothschild Foundation. C.R.I. is an advanced research institute, whose raison d'être is to specifically promote research in interdisciplinary applications of computer science. While a number of computer institutes exist in Israel and abroad, few are specifically devoted to interdisciplinary research.

With the support of the Institute, many different disciplines are being advanced through research, education and study programs, and the encouragement of technological greenhouse experiments and startups. The common denominator of all programs inaugurated under the auspices of C.R.I. is that they are inherently interdisciplinary.

Fields of research in which the Institute is active include neural computation, computational linguistics, algorithmic graph theory, artificial intelligence, education, computer science and statistics, combinatorial pattern matching, genome organization, multimedia, virtual reality in rehabilitation, and computer science and law.

From the Director

As founding Director of the *Caesarea Edmond Benjamin de Rothschild Foundation Institute for Interdisciplinary Applications of Computer Science*, I have the pleasure of presenting to you this annual report. The Institute began its academic activities three years ago with the following main goals: to advance interdisciplinary research within the University of Haifa and with external research partners, to provide new initiatives in education through interdepartmental cooperation, and to encourage and support new technology ideas.

Building a new Institute, from the ground up, has been both an opportunity and a challenge. Aided by an exceptional group of computer scientists at the University of Haifa, and a wealth of superb faculty researchers in the humanities, law,

business, mathematical and social sciences, we have made excellent progress in establishing new projects, courses, an international visitors program, and other activities. The interdisciplinary collaboration, colloquia and workshops held and sponsored by the Institute, have had a major impact on a national level in Israel, and have gained recognition internationally.

The scope of topics covered by our activities range from computational aspects of the brain, linguistics, social implications, and fighting terror online, to artificial intelligence, computers and statistics, graphs and pattern matching. What distinguishes the CRI from other centers of excellence is the diversity of its programs and participants, coming from many disciplines, and creating lively research interactions, bringing together many points of view.

I am pleased to acknowledge the leading role of Professor Yehuda Hayuth, President of the University of Haifa, in the realization of his vision to expand and strengthen the University in the direction of interdisciplinary science and technology through the establishment of the Institute. He was assisted by the tremendous efforts of Ms. Yael Metser, Vice-President of the University and Prof. Gad Landau and Dr. Larry Manevitz of the Department of Computer Science. On their behalf and mine, I would like to thank the Caesarea Edmond Benjamin de Rothschild Foundation for having the confidence to support this major project which continues to have substantial positive influence on the future of the University.

As a scientist and an educator, it is exciting for me to be a part of this activity and to see it developing here at the University of Haifa. I encourage all computer scientists and researchers involved in interdisciplinary applications to visit the Institute, participate in its activities, and send us proposals for future cooperation and collaboration.

Martin Charles Golumbic
Director of the Institute
Professor of Computer Science

Members & Staff

The full-time faculty of the Computer Science Department forms the core of the members of the Institute. In addition, long-term visitors and project affiliates are listed.

Faculty

Prof. Martin C. Golumbic, Director, Caesarea Rothschild Institute

Dr. Yossi Ben-Asher

Prof. Dan Gordon, Chair, Department of Computer Science

Dr. Hagit Hel-Or

Dr. Daniel Keren

Prof. Gad M. Landau

Dr. Larry Manevitz, Head of the HIACS Center

Prof. Ilan Newman

Dr. Yuri Rabinovich

Prof. Alek Vainshtein

Dr. Shuly Wintner

Project Affiliates

Dr. Michael Birnhack (Law School)

Dr. Yonathan Cohen (Dept. of Communications)

Dr. Niva Elkin-Koren (Law School)

Prof. Uri Peled (Univ. of Illinois at Chicago, USA)

Prof. Sheizaf Rafaeli (School of Business)

Dr. Rivka Ribak (Dept. of Communications)

Prof. Tamar Weiss (Dept. of Occupational Therapy)

Prof. Michal Yerushalmy (Education School)

Scientific Coordinator

Dr. Irith Ben-Arroyo Hartman

Administrative Coordinator

Ms. Libi Oded

Secretarial & Conference Coordinators

Ms. Orly Ross

Ms. Miriam Daya

System Administrator

Mr. Michael Groisman

Advisory Board

Prof. Alexander Zeev Giora (Dept. of Psychology)

Prof. Dan Gordon (Dept. of Computer Science)

Prof. Gad M. Landau (Dept. of Computer Science)

Dr. Larry Manevitz (Dept. of Computer Science)

Prof. Gadi Moran (Dept. of Mathematics)

Visitors to the Institute

The broad range of expertise covered by the many short and long term visitors to the Institute reflects our dedication to the goal of interdisciplinary interaction.

Giuseppe Attardi, Universita di Pisa, Italy (June 18-19, 2003)

Stefania Bandini, University of Milan, Italy (June 18-19, 2003)

Bruno Bassan, University of Rome, Italy (December 28-31, 2003)

Adi Ben-Israel, Rutgers University, USA (May 25-June 1, 2003)

Jonathan Bernick, Coastal Carolina University, USA (May 15-30, 2002)

Anne Berry, L.I.M.O.S., University of Clermont-Ferrand II, France (January 2003; May 2003)

Moshe Buchinsky, U.C.L.A., USA (December 28-31, 2003)

Chandra Chekuri, Bell Labs, New Jersey, USA (March 3-5, 2002)

Victor Chepoi, University of Marseille, France (March 3-5, 2002)

Maria Chudnovksy, Princeton University, USA (April 28, 2003)

Isaac Cohen, University of Southern California, USA (February 17, 2003)

Ido Dagan, Department of Computer Science, Bar-Ilan University, Israel (2003)

Rina Dechter, University of California at Irvine, USA (May 29-31, 2003)

Mark Jason Dominus, Perl Paraphernalia, USA (May 11-15, 2003)

William Dutton, University of Oxford, UK (August 25-28, 2003)

Fausto Giunchiglia, Universita di Trento, Italy (June 18-19, 2003)

Joseph Glaz, University of Connecticut, USA (December 28-31, 2003)

Calvin C. Gotlieb, University of Toronto, Canada (August 25-28, 2003)

Sudipto Guha, University of Pennsylvania, USA (March 3-5, 2002)

Gregory Zvi Gutin, Royal Holloway College, University of London, England (April 14-28, 2002; September 10-25, 2002)

Alon Halevy, University of Washington, USA (December 28-31, 2003)

Peter Hammer, Rutgers University, USA (May 23-June 2, 2003)

Jaap van den Herik, Universiteit Maastricht, Netherlands (October 15-16, 2002)

Ivo Hofacker Institut fuer Theoretische Chemie, Universitaet Wien, Austria (January 8, 2003)

Abram Kagan, University of Maryland, USA (December 28-31, 2003)

James E. Katz, The State University of New Jersey, USA (August 25-28, 2003)

Jan Kiviet, University of Amsterdam, Netherlands (December 28-31, 2003)

Haim Klebaner, Department of Mathematics and Statistics, University of Melbourne, USA (December 21-26, 2003)

Ditmar Kuhl, University of Hamburg, Germany (June 17-20, 2003)

Haggai Kupermintz, University of Colorado at Boulder, USA (December 23-25, 2002)

Jean Louis Lassez, Coastal Carolina University, USA (October 15-16, 2002)

Rudolph Lerche, University of Freiburg, Germany (December 28-31, 2003)

David Levy, London, England (October 15-16, 2002)

Moshe Lewenstein, Bar Ilan University, Israel (September 2002-September 2003)

Frederic Maffray, CNRS, Laboratoire Leibnitz, France (May 25-30, 2003)

Jiri Matousek, Karl University, Prague (March 3-5, 2002)

Ross McConnell, University of Colorado, USA (June 17-20, 2003)

Tova Milo, Tel-Aviv University and INRIA, France (December 28-31, 2003)

Anthony Ortoney, Northwestern University, USA (October 2002)

Ariel Pashtan, Aware Networks, Inc., USA (November 2003)

Uri N. Peled, University of Illinois at Chicago, USA (July 17-August 16, 2002; May 16-July 17, 2003)

Gerald Penn, University of Toronto, Canada (March 2002)

Paolo Petta, Austrian Research Institute for Artificial Intelligence, Austria (December 18- 21, 2003)

Fabio Pianesi, ITC-IRST, Italy (June 18-19, 2003)

Albert "Skip" Rizzo, University of Southern California, USA (November 12-15, 2002 ; August 19-31, 2003)

Richard Roberts, Educational Testing Service, USA (December 18- 21, 2003)

Dan Roth, University of Illinois, USA (December 28-31, 2003)

Ronit Rubinfeld, Massachusetts Institute of Technology, USA (September 5-14, 2003)

Bert Sakmann, Nobel Prize Laureate, Max Planck Institute, Germany (June 17-20, 2002)

Gert Sabidussi, Université de Montréal, Canada (June 17-20, 2002)

Marie-France Sagot, INRIA, Rhone-Alpes, University of Claude Bernard, France (May 29, 2003)

Jonathan Schaefer, University of Alberta, Canada (October 15-16, 2003)

Steve Skiena, SUNY Stonybrook, USA (September 2001-June 2002)

Vera Sos, Hungarian Academy of Science, Hungary (May 25-June 2, 2003)

Murali K. Srinivsasan, Indian Institute of Technology, India (May 26-June 9, 2003)

Oliviero Stock, ITC-IRST, Trento, Italy (September 1-8, 2002; October, December 2002; April, June, September 2003)

Barbara Strassman, State University of New Jersey, Trenton, USA (December 30, 2002-January 1, 2003)

Robert E. Tarjan, Turing Prize Winner, Princeton University, USA (June 17-20, 2003)

Marilyn Tremaine, New Jersey Institute of Technology, USA (August 25-28, 2003)

Olga Troyanskaya, Princeton University, USA (December 28-31, 2003)

David Trutt, AT&T Laboratories, New Jersey, USA (September 1-7, 2003)

Gyorgy Turan, University of Illinois at Chicago, USA (May 2002 ; May 27-June 1, 2003)

Yehuda Vardi, Rutgers University, USA (December 28-31, 2003)

Moshe Y. Vardi, Rice University, USA (August 11-16, 2002)

Barry Wellman, University of Toronto, Canada (August 25-28, 2003)

Hannes Werthner, ITC-IRST, Universita di Trento, Italy (June 15-17, 2003)

Massimo Zancanaro, ITC-IRST, Italy (June 18-19, 2003)

Assaf Zeevi, Columbia University, USA (May 22, 2003)

Doron Zilberger, The State University of New Jersey, USA (January 8, 2003)

Michael Zuker, Rensselaer Polytechnic Institute, New York, USA (January 8, 2003)

Post Doctoral Fellows

The Institute has already acquired a reputation as a center with a high level of excellence and rich opportunity for conducting state-of-the-art research and collaboration. The CRI post doctoral fellowship program has attracted young Israeli scholars working on different projects in interdisciplinary fields.

Dan Aharoni, Ph.D., Technion: Computer Science Education

Uri Feintuch, Ph.D., Hebrew University: Cognitive Psychology and Virtual Reality for Rehabilitation

Ari Freund, Ph.D., Technion: Approximation Algorithms and Computational Geometry

Meirav Hadad, Ph.D., Bar-Ilan University: Artificial Intelligence and Agent Technology

Aviad Mintz, Ph.D., Bar-Ilan University: Circuit Design Algorithms

Irit Shrieir, Ph.D., University of Haifa: Psychopathology

Michal Stern, Ph.D., Ben Gurion University: Applied Combinatorial Optimization

Malek Yousef, Ph.D., University of Haifa: Intelligent User Interfaces

Promoting Research

Lectures, Seminars, Workshops, and Short Courses

The Institute has organized numerous forums for the presentation and promotion of cutting-edge research. These seminal workshops, seminars, talks and conferences gave participants unique opportunities to engage experts from abroad and close to home through indepth and reciprocal discussions.

January 2-4, 2002: The Seventh International Symposium on Artificial Intelligence and Mathematics (cosponsor, Fort Lauderdale, Florida)

January 31, 2002: Special Colloquium on "Labelling Schemes for Ancestor Queries in Rooted Trees," by Haim Kaplan (Tel-Aviv University)

February 18, 2002: Talk on "Natural Language Processing with the Logic of Typed Feature Structures," by Gerald Penn (University of Toronto)

February 20, 2002: "The Simonino Affair: A Five Hundred Year Blood Libel Against the Jews of Trent" — First in the Distinguished Lecture Series "From History to Multimedia" by Prof. Oliviero Stock (ITC-IRST, Italy) and Dr. Daniel Nissim (Tel Aviv)

March 3-7, 2002: Workshop on "Discrete Metric Spaces and their Algorithmic Applications"

March 19, 2002: Workshop on "Topics in Graph Theory for High School Teachers"

May 9-11, 2002: The First Seminar on "Computers and Thought" (Machshevim uMachshevet), Jerusalem

May 22, 2002: Caesarea Rothschild Institute Computer Science Forum

June 18-20, 2002: Workshop on "Computational Modeling and Neurophysiology: Behavior from Brain - What is Learning in the Neural System?"

June 17-20, 2002: Second Haifa Workshop on Interdisciplinary Applications of Graph Theory, Combinatorics and Algorithms

Second Haifa Workshop on Interdisciplinary Applications of Graph Theory, Combinatorics and Algorithms, June 17-20, 2002

Lecturer:
Eli Shamir – Hebrew University

From left to right:
Yehuda Hayuth – President of University of Haifa
Peter Hammer – Rutgers University, USA
Martin Golumbic – Director of C.R.I.

From left to right:
Lynn Golumbic
Martin Golumbic
Gyorgy Turan – University of Illinois at Chicago, USA
Peter Hammer
Irith Hartman – Scientific Coordinator of C.R.I.

July 10, 2002: Lecture on the "Continual Optimization" by Baruch M. Schieber (IBM York-town)

July 30, 2002: Double Colloquium on "Equisable Graphs and Equisable Chordal Graphs" by Uri N. Peled (University of Illinois at Chicago, USA)

August 11-16, 2002: Summer Course on "An Automata Theoretic Approach to Model Checking" by Moshe Y. Vardi (Rice University, USA)

September 19, 2002: First Annual Doctoral Consortium on Computer-Mediated Communication, the Internet, and Social Aspects Thereof

October 15-16, 2002: Symposium on "Man versus Machine: The Experiment"

November 11-13, 2002: Workshop and Symposium on "Virtual Reality and Rehabilitation: Algorithms, Avatars and Applications"

December 23-25, 2002: Workshop on "Multilevel Analysis in Behavioral, Educational, and Bio-Medical Research"

December 30, 2002 & January 1, 2003: Seminars on "The Write Technologies" and "The Use of Interactive Television" by Barbara Strassman (College of New Jersey, Trenton)

January 8, 2003: Minisymposium: "Computational Advances to RNA World"

January 15, 2003: Lecture on "Minimal Separation and Minimal Triangulation" by Anne Berry (University of Clermont-Ferrand, France)

January 22, 2003: Lecture on "Representing a Concept Lattice by a Graph" by Anne Berry (University of Clermont-Ferrand, France)

Jan. 29, Feb. 5, Feb. 26, & Apr. 2, 2003: Workshop for High School Students: "A Look into the World of Research and Technology"

February 17, 2003: A Lecture on "Visual Sensing of 3D Human Body for Immersive Interactions" by Isaac Cohen (Institute for Robotics and Intelligent Systems Integrated Media System, University of Southern California, USA)

Symposium on "Man versus Machine: The Experiment" October 15-16, 2002

From back to front: **Amir Ban** – Developer of "Deep Junior", **Shay Bushinsky** – Developer of "Deep Junior", **Alan Greenfeld** – Chess Grand Master, **Boris Altman** – Chess Grand Master

Workshop and Symposium on "Virtual Reality and Rehabilitation: Algorithms, Avatars and Applications" November 11-13, 2002

The Vivid System used as a virtual reality tool for rehabilitation

Albert "Skip" Rizzo (University of Southern California, USA) fitting **Martin Golumbic** (Director of C.R.I.) with an HMD (Head-Mounted Display)

April 9-10, 2003: QUBIT 2003 — "An Interdisciplinary Mini-Conference on Quantum Information Processing"

April 28, 2003: Special Colloquium: "A Polynomial Time Recognition Algorithm for Perfect Graphs" by Maria Chudnovsky (Princeton University, USA)

May 11, 2003: YAPC: Israel: 2003 — The First Perl Conference in Israel

May 13-15, 2003: Three one-day Perl courses

May 27-29, 2003: Third Haifa Workshop on "Interdisciplinary Applications of Graph Theory, Combinatorics and Algorithms"

May 29-31, 2003: The Second Seminar on "Computers and Thought" (Machshevim uMachshevet), Jerusalem

June 2, 2003: IBS 2003 — The 6th Israeli Bioinformatics Symposium

June 9, 2003: Open Source and Wireless Workshop

August 19-31, 2003: Summer course: "Human Factors Issues for the Design and Development of Virtual Reality Environments" by Albert "Skip" Rizzo (University of Southern California, USA)

August 25-27, 2003: "Computer Networks and Social Networks": An International Conference

September 7, 2003: A Sampler of AT&T Applied Research in Telecommunications by David Trutt (AT&T Laboratories, New Jersey)

September 24, 2003: "Americans and Internet Privacy" by Joseph Turow (Annenberg School for Communication, University of Pennsylvania, USA) via videoconferencing

December 17, 2003: Israeli Seminar on Computational Linguistics - ISCOL'03

December 18-21, 2003: Rationality and Emotions Workshop

December 28-30, 2003: CS Stat 2003 - Haifa Winter Workshop on Computer Science and Statistics.

December 30, 2003: Special Workshop on Bio Informatics

Ongoing Workshops, Seminars and Courses

Computer Science Colloquium

The University of Haifa Computer Science Department hosts weekly lectures under the joint auspices of the C.R.I., presenting contemporary issues in computer science and related fields. Lecturers are invited from academia and industry.

Seminar on "Combinatorial Algorithms and their Applications"

Moshe Lewenstein, a senior lecturer of the Computer Science Department at Bar Ilan University, was a guest of the C.R.I. for the period September 2002- September 2003. During this period at the Institute, Dr. Lewenstein gave a weekly seminar on "Combinatorial Algorithms and their Applications". He also worked with the Institute's MA and PhD students and initiated academic seminars.

The Seminar on the same topic is continuing this academic year (2003-2004).

Dr. Lewenstein will also give an interdisciplinary course on "Advanced Data Structures."

Labs

Neurocomputation Laboratory

Dr. Larry Manevitz

The Neurocomputation Laboratory has been functioning informally over the past three years but is now housed in the Caesarea Rothschild Institute. This will allow the lab to benefit from C.R.I.'s facilities. Neurocomputation is an interdisciplinary field following the paradigm and analysis of computation that occurs in neurons and the brain.

Moreover, the precision gained from modeling techniques has resulted in insights helping to clarify how the human brain works.

Computational Linguistics Laboratory

Dr. Shuly Wintner

The Computational Linguistics Group (CLG) at the Department of Computer Science, University of Haifa, is involved in research and teaching in diverse areas of computational linguistics and natural language processing. Of primary interest are investigations related to Hebrew, as well as to other Semitic languages, notably Arabic.

Current research interests of the CLG include:

- Infrastructure for processing Hebrew
- Computational morphology and syntax of Hebrew
- Computational investigations of Arabic (classical and spoken)
- Finite state technology, with emphasis on Semitic languages
- Unification - based linguistic formalisms
- WordNet for Hebrew

CLG's current members include one staff member, Shuly Wintner, a postdoctoral researcher, Nurit Melnik, and four graduate students: Yael Cohen-Sygal, Ezra Daya, Daniel Feinstein, and Shlomo Yona.
Ongoing and past projects include:

- Collection, organization and annotation of Hebrew corpora
- Unsupervised learning of morphology (with application to learning Hebrew segmentation)

- Supervised learning of Hebrew morphology
- Computational implementation of non-concatenative morphology
- Morphological tagging of the Qur'an
- Computational investigation of Arabic dialects
- Word Net for Hebrew comparison of finite-state toolboxes
- Unification grammars and offline parsability

Laboratory for Innovations in Rehabilitation Technology (LIRT)

***Prof. Tamar Weiss** (Head),*
Dr. Naomi Josman,
Dr. Sara Rosenblum,
***Dr. Uri Feintuch** (post-doctoral fellow),*
***Orit Palmon** (doctoral candidate),*
***Debbie Rand** (doctoral candidate), Department of Occupational Therapy*

The LIRT's objective is to develop and evaluate innovative technologies for rehabilitation assessment and intervention.

Current and Future Research Directions:

- Development and evaluation of new functional virtual environments, to be experienced within 2-D and 3-D platforms
- Identification of characteristics of 2D and 3D platforms in terms of their suitability for different patient populations
- Integration of haptic interfaces into existing virtual reality platforms in order to provide simultaneous multimodal feedback during rehabilitation
- Conceptualization and empirical validation of a model explaining how characteristics of the user, instrument and task interact to create an effective rehabilitation intervention tool
- Development and evaluation of additional sonification routines
- Development and evaluation of synchronous and asynchronous online learning modalities with a focus on virtual simulations

Stringology Laboratory

Prof. Gad Landau

The Stringology Group at the Department of Computer Science, University of Haifa, is involved in researching and teaching of problems related to sequences with applications

in different fields of science like computational biology, image processing and information retrieval. Members of the lab include Prof. Gad M. Landau, Dr. Moshe Lewenstein (guest), Dr. Michal Ziv-Ukelson (researcher), Dr. Dekel Tsur (Post-Doc), and graduate students Ora Arbel, Nadav Efrati, Revital Eres, Carmel Kent, Oren Weimann, Shahar Keret.

Applied Graph Algorithms and Complexity Laboratory

Prof. Martin Golumbic

A growing activity in the Institute is in the area of algorithms and complexity. This group includes Prof. Martin Golumbic, Dr. Irith Hartman, Prof. Ilan Newman, Dr. Uri Rabinovich and Prof. Alek Vainshtein, together with their short and long term visitors, graduate students and postdoctoral fellows. The Laboratory organizes two weekly seminars and working groups with Dr. Moshe Lewenstein (Bar-Ilan University), Dr. Alex Samorodnitsky (Hebrew University) and others.

The lab is responsible for organizing the annual Workshop on Interdisciplinary Applications of Graph Theory, Combinatorics and Algorithms and other special Symposia. It also has an active working group in the area of computational aspects of metric spaces.

Collaboration

Setting up agreements for international cooperation and collaboration between the Institute and prestigious centers from around the world has been an important activity here at C.R.I.

Sister City Cooperation

Following the twinning of Haifa and Fort Lauderdale, the Institute proposed a University of Haifa partnership with Fort Lauderdale and Florida Atlantic University in terms of Prof. Golumbic's organization of the Biennial International Symposium on Artificial Intelligence and Mathematics. It is envisioned that this will serve as a basis for broader cooperation between the two universities.

Cooperation with Italian Trento Center for Scientific and Technological Research (ITC-IRST), Trento, Italy

Scientific cooperation between the Caesarea Rothschild Institute and the Institute for Research in Science and Technology (IRST), Trento, Italy began in June 2001 with an initial collaboration between the two institutions in the fields of information technology and artificial intelligence. IRST has a staff of over 150 people and is one of the leading computer science research institutes in Italy.

On June 19, 2003 a significant extension of the above cooperation was signed. This allows wide research and collaboration, including:

- exchange of scientists
- co-sponsoring of workshops
- cooperation in European Union proposals
- facilitation of scientific relations with other local researchers
- exchange of technical expertise and information

The signing was part of a three-day conference on:
"The Italian - Israeli Forum on CS: Research and

Applications of Artificial Intelligence in Industry" (June 17-18, 2003) and "Research and Applications of Artificial Intelligence" (June 19, 2003).

The collaboration is funded by the Autonomous Province of Trentino and by the University of Haifa. The signing of the agreement was the product of the aspirations of the two Institutes' respective directors — Professor Martin Charles Golumbic, Director of C.R.I. and Professor Oliviero Stock, Director of IRST. The aim is to expand existing contacts and ongoing scientific collaboration.

The Institutes have established a relationship in order to carry out a bilateral cooperation program in the field of artificial intelligence, in particular computational linguistics, algorithms, pattern matching, neural nets, vision, cognitive science and technologies.

“The Italian — Israeli Forum on CS: Research and Application of Artificial Intelligence in Industry” June 17-18, 2003

From left to right:
Michael Rodeh – Head of IBM – Science and Technology
Gianni Bonvicini – President of ITC, Trento, Italy
Martin Golumbic – Head of C.R.I.
Yehuda Hayuth – President of University of Haifa
Guliano Terzi – Italy’s Ambassador to Israel
Mauro Leveghi – Minister of Research of Trentino, Italy
Oliviero Stock – IRST-ITC, Trento, Italy

From left to right:
Aaron Ben-Ze’ev – Rector of University of Haifa
Guliano Terzi
Yehuda Hayuth
Gianni Bonvicini

From left to right:
Martin Golumbic
Guliano Terzi
Oliviero Stock

Yael Metser – Vice-President of University of Haifa
Gianni Bonvicini

Promoting Education

Seminar for Caesarea Rothschild Scholars Program

C.R.I. is highly aware of its physical location in the heart of a vibrant university and a flourishing metropolis. Much effort is concentrated on supporting and promoting both the University's and the city's scholars.

Fifteen first- and second-year double major students were named Rothschild Scholars and awarded scholarships at the end of academic year 2001/2002 for pursuing interdisciplinary studies. These computer science students also took courses from one of the following departments: Communication, Education, Philosophy, or Psychology. As part of the qualifications for the scholarship, candidates attended and participated in various seminars, events and projects planned specifically for them. Turnout at the seminars was excellent and the students were enthusiastic and interested in the topics. The meetings were held once a month, coordinated by the C.R.I. staff and Dr. Yonatan Cohen of the University's Communications Department. The first year concluded on September 3, 2002, with a ceremony and a talk titled: "Electronic Nose Research" given by Prof. David Levy (University of Sydney, Australia) via videoconferencing.

During 2002-2003, in the framework of the Rothschild Scholars program organized by C.R.I., the students met on a monthly basis for a series of seminars which brought them together with scholars and practitioners informing them on various topics in the range of interdisciplinary fields. The theme chosen this year was "Technology to the Aid of the Elderly." Specifically, the various lectures focused on a specific technology, Sony's AIBO, which is a toy robot that was initially marketed as a robotic pet for the elderly. The seminar organizers were intrigued by a "Haaretz" article describing the product and its potential benefits as a mechanical pet, and proposed it, among other ideas, as a potentially stimulating theme for this year's lecture series.

Sixteen scholarships were awarded on September 24, 2003. The ceremony included a talk titled: "Americans and Internet Privacy," given by Prof. Joseph Turow (Annenberg School

for Communication, University of Pennsylvania, USA) via videoconferencing.

Seminar Series: Innovations in Information Technology Motivating Research and Development in Education

The seminar series was held in conjunction with the Faculty of Education's Institute for Alternatives in Education, under the leadership of Prof. Michal Yerushalmy. The seminar was aimed at graduate students from the Faculty of Education and Department of Computer Science.

The seminar series provided an opportunity for participants to learn about technological innovations from experts working in the hi-tech industry. The latter described problems and possible solutions, as well as innovations presently being developed. These innovations have applications to the research and development of educational systems.

"Electronic Information and Commerce" Workshop within the framework of the course: "Information Policy in the Area of Law and Technology"

December 11-13, 2002: The workshop was part of a C.R.I.-sponsored course on "Information Policy in the Area of Law and Technology," organized by Dr. Niva Elkin-Koren and Dr. Michael Birnhack, of the University of Haifa's Faculty of Law. This year's seminar was held in Neve Ilan.

The course is designed to fill the gap between the needs of policymakers of all levels for information, data and analyses for the purpose of developing adequate policies and the public's right to take part in the policymaking process. Each year the course focuses on a few controversial and cutting-edge issues. The participating students will conduct a joint study of the focal issue's various technological and legal aspects, leading up to the publication of a position paper. The final paper will be widely distributed among the relevant decision-makers.

The year's workshop focused on "New Copyright Legislation for Israel: Adjusting Copyright Law to the Digital Millennium." The main Israeli copyright legislation dates to the year 1911 [sic], and is the English Copyright Act of that year, which was applied to Palestine in 1924, by the British Mandate. Though it has been updated several times, it

obviously does not address many issues of the digital environment. The Israeli Department of Justice is currently preparing a new copyright bill, and noncommercial, public oriented input is crucial at this point. The workshop aimed to inform and educate a broad assembly of people who will thus be able to contribute to the government's deliberations.

Mini course in Perl

From September 2002 through to July 2003, Mr. Shlomo Yona, a University of Haifa Computer Science graduate student, gave a weekly lecture on Perl topics, from very basic to advanced Perl programming. The course also focused on special applications and research topics, and demonstrated how researchers can use Perl for rapid prototyping and developments. The course was well attended by, among many others, hardware engineers, laboratory engineers, software engineers, Computer Science MA students and faculty members.

Summer Seminar for High School Computer Science Teachers

June 23-24, 2003: The C.R.I. together with "Machshava", the Israeli National Center for Computer Science Teachers, held a summer seminar for selected high school computer science teachers.

The seminar allowed these teachers to interact with computer science researchers, listen to lectures, ask questions and prepare teaching material under the researchers' supervision. This opportunity exposed the teachers to state-of-the-art issues, and introduced them to areas in fields that were new to them. It broadened their view of computer science and deepened their understanding of it. Having completed the workshop, these teachers will bring their newly acquired skills and knowledge into the classroom, thereby enriching their students' education.

Following the seminar, the results of the seminar were further developed under the supervision of "Machshava". They are to be made available on the "Machshava" web site for access by other teachers. In addition, the teachers will also present their theoretical and practical results to their colleagues at

the national teachers' conference (held at the Weizmann Institute on December 21, 2003).

An additional surprising outcome was the establishment of a new 10-unit curriculum on "learning systems" for high school students. Seven participants of the course plan to develop learning materials and start teaching the "learning systems" curriculum next year.

A Look into the World of Research and Technology - High School Students Program

C.R.I. initiated a series of lectures spread over four days during the period of January-April 2003, with the aim of enriching high school students in Computer Science and related topics. The students were from grades 10-12, majoring in computer science, and attending the Leo-Baeck School in Haifa, the Arab Orthodox Municipal High School in Haifa, and Or-Akiva Municipal High School, Or-Akiva. The lecturers were leading researchers from the Computer Science department of the University of Haifa, and from IBM's Haifa Laboratories. The lectures covered a wide spectrum of topics from the world of technology and research such as: computer vision, cryptography, algorithms, complexity, information retrieval and the Internet, and data compression. Participants were also shown a simulation in information theory and scheduling of El Al crews. All lectures were videotaped, thus allowing other interested students and teachers to watch and learn. The students attending the workshops expressed great interest in the different topics and general enthusiasm in participating in the program.

Summer Courses

An Automata Theoretic Approach to Modular Model Checking by ***Prof. Moshe Y. Vardi,*** *Rice University, USA (August 11-16, 2002)*

The automata theoretic approach to design verification uses the theory of automata as a unifying paradigm for design specification, verification, and synthesis. Both designs and specifications are in essence descriptions of computations. The course provided an introduction to the theory of automata on infinite objects and demonstrated its applications to design specification, verification, and synthesis. This theory now underlies tools currently deployed in industry.

Human Factors Issues for the Design and Development of Virtual Reality Environments: by ***Prof. Albert "Skip" Rizzo,*** *University of Southern California, USA (August 19-31, 2003)*

This course was designed to provide a broad overview of the human factors issues relevant to the design, development, implementation, and evaluation of Virtual Reality Environments within the overall context of Integrated Media Systems (IMS) and Information Technology. IMS can be defined simply as advanced computer-based interactive media technologies that integrate combinations of images, video, audio, text, touch stimuli, animation and graphics all in real time for some defined human purpose. Within this context, Virtual Reality (VR) is seen as a form of IMS that allows humans to visualize, manipulate, and interact with computers and extremely complex data. More specifically, VR can be viewed as an advanced form of human-computer interface that allows the user to "interact" with, and become "immersed" within a computer generated simulation or Virtual Environment (VE) in an intuitive and naturalistic fashion. The believability of the virtual experience or sense of "presence" is supported by employing such specialized technology as head mounted displays (HMDs), projection screens, tracking systems, earphones, gesture-sensing gloves, interaction/navigational devices and sometimes haptic feedback devices.

Promoting Technology

The work accomplished at C.R.I. is intended to rise beyond the confines of the Institute. In addition to reaching out to high school students and teachers, the Institute staff is intent on forging ties with industry. The Scientific Advisory Board of the Institute meets regularly to deliberate on the submitted project proposals.

Development of the Geographer Toolbox Educational Website

Dr. Dalit Gasul,
Geography Department

The purpose of the proposed website (see http://geotools.haifa.ac.il) is to establish a store-house of "worktools" that would hold the basic geographical concepts in glossary form, formula pages, a basic bibliography, key words for focused searching on the net, and links to Internet sites on various fields of geography. The site aims to be a Hebrew "gate of geographical knowledge" open to all geographers, including students of all degrees and at all levels, teachers, researchers and amateur geographers.

"QSIA - The Knowledge Repository Project"

Prof. Sheizaf Rafaeli,
Business School & the Center for the Study of the Information Society

The QSIA project is an online web-based academic knowledge resource system. The so-called "discretionary databases" that harness computerized storage and network communication technologies have been in development and experimentation for several decades, especially in engineering and manufacturing environments.

The main problem is to bridge over some of the deficiencies in early attempts to build "discretionary databases". In addition, the existing and underdeveloped tools are not amenable to use in Hebrew, and are not user-friendly. They are unlikely to be used in fields other than highly technical engineering. Also lacking is a focus on the search, retrieval and ranking criteria, and on the human side of such systems.

QSIA is a generic, online web-based academic knowledge resource system. The system offers a unified infrastructure for developing, collecting, managing, and sharing of knowledge items. It fosters collaboration via recommendation, as well as individual learning. The QSIA system was designed to study and enhance communities of

both teachers and students. The QSIA system is a large electronic database with multimedia content that permits geographically or organizationally disparate researchers to work together and use identical remote resources. The system is used, for example, as a knowledge base for exam questions serving students in numerous subjects and different locations around Israel. It is a field-based research tool for the examination of knowledge sharing and recommendation processes among knowledge workers. The tool can be found at http://qsia.haifa.ac.il/qsia/jsp/general/home.jsp

"Bartering Leftovers on the Internet"

Dr. Yosi Ben-Asher,
Department of Computer Science

The project deals with the problem of bartering "leftovers" over the Internet, i.e. goods which do not have any possible "market value." They may, however, have some value to someone else who is willing to exchange them for other goods of similar nature. Typical examples of "leftovers" are: video movies you have watched, tickets you cannot use and cannot return, large stocks in shops which cannot be sold or stored, crops that will become rotten if not sold quickly, old furniture, books you do not need, office space you urgently need to rent out, various factory products with no potential buyers, or vacant hotel rooms.

The main problem in trying to accomplish the exchange is the need to efficiently locate a sequence of exchanges of goods between users over the Internet, such that the number of satisfied users is maximized. For example, a user may have a request such as *I have an old car and a TV set which I would like to exchange for one large table, four chairs and one computer system.*

The aim of the project is to develop theoretical and practical tools related to the bartering "leftovers" problem. More specifically, the project hopes to develop a bartering protocol for exchanging leftovers over the Internet, as well as to implement it as a Peer-to-Peer system in Java, to be posted on the web for public use.

"Support of Innovations in e-Books"

Prof. Michal Yerushalmy,

Faculty of Education

Prof. Michal Yerushalmy has received support in recent years from the Israeli Ministry of Education through MALAM in developing a new electronic environment for student learning through "e-books". Her focus has been mainly on the field of algebra for middle and high school curricula. The current product, completed in July 2002, provides activities in algebra for grades 9 and 10 (see http://www.cet.ac.il/math/function).

"Computational Investigation of Palestinian Arabic Dialects"

Prof. Rafi Talmon,

Department of Arabic Language, and

Dr. Shuly Wintner,

Department of Computer Science

This project builds upon a systematic fieldwork study of the Arabic dialects of the Palestinian area, which are spoken by all the communities located within the northern and central parts of the State of Israel and its close vicinity. It covers a population of over 1.5 million people in some 250 localities. This study also includes the dialects of the 1948 Palestinian refugees, who settled in existing Arab localities included in the project.

Throughout the years of collecting and processing fieldwork material (recorded interviews, detailed linguistic questionnaires), special teams have produced transcripts of large samples of the recordings. This project envisions a systematic publication of the vast amount of collected material, computationally processed, in a suitable format. This would include a corpus of transcribed, translated and annotated texts, a lexicon and a large glossary of the various dialects, a comparative computational study of the dialects and a linguistic atlas. The study of Arabic dialects in general and particularly their distribution has not as yet been integrated in a computational linguistics compendium. The project will represent a pioneering advance in automated analysis of transcribed texts.

"Tele-evaluation of Handwriting Difficulties"

Sara Rosenblum, Prof. (Patrice) Tamar L. Weiss, *Department of Occupational Therapy, and* ***Dr. Dan Chevion,*** *Department of Image and Signal Processing, IBM Haifa Research Labs*

Disturbances in handwriting legibility and speed (known as dysgraphia) are problematic for about 10-30% of elementary school-aged children. Many adults who suffer from neuromuscular pathologies of different types (e.g., Parkinson's disease, multiple sclerosis, Alzheimer's disease) also experience progressive deterioration of the quality of their handwriting. Dysgraphic writing has a variety of academic, emotional and social consequences. The comprehensive and detailed characterization of dysgraphia has diagnostic and treatment value, helping clinicians to differentiate between levels of motor involvement, to evaluate the effectiveness of medication and to achieve better techniques for handwriting remediation.

Many methods have been developed to evaluate handwriting difficulties, most of which are based on subjective analyses of the written product. Relatively little research has been devoted to the development of computerized, quantitative assessment tools that enable examination of the handwriting process of dysgraphic children and adults. Recent developments in data collection technology now permit the examination of a much richer set of handwriting outcome measures than were traditionally available. With the aid of a digitizing tablet and software which was developed by the researchers (POET-Penmanship Objective Evaluation Test), handwriting can be monitored in realtime, and stored in a format amenable to more sophisticated analyses.

The aim of the project is to develop a set of analytic tools for computerized, remote evaluation of handwriting samples from dysgraphic children and adults. The software will be modular such that data collection will take place in various clinical and educational settings throughout Israel and around the world (Hebrew, English, Chinese and Thai handwriting).

These data samples will then be transferred to our laboratory for subsequent analysis and interpretation. Recommendations for handwriting intervention will be returned to clinicians and educators.

"Audio Feedback for Gait Rehabilitation of Post-stroke Hemi-paretic Subjects"

Dr. Ruth Dickstein,
Department of Physical Therapy, Faculty of Social Welfare and Health Sciences

Stroke is the third cause of death and the first cause of disability in adults, with hemi-paresis (paralysis of voluntary muscles on either the left or the right side of the body) affecting about 75% of stroke victims. Impaired walking function is a characteristic disablement of poststroke hemi-paretic patients and a major hindrance to functional independence. Therefore, the improvement of gait function and the regaining of independent walking is a primary goal of physical rehabilitation of these patients. Since recovery of walking occurs mainly during the first six months following a stroke, major efforts to regain functional walking are concentrated during the first weeks after a stroke.

Gait asymmetry is highly resistant to improvement via physical rehabilitation, and while other gait parameters improve over time, the asymmetrical pattern remains largely unchanged. The degree of asymmetry reflects the malfunction of the paretic side, especially of the ability of the paretic lower extremity to accept and bear body weight. In addition, walking itself may further consolidate the asymmetric pattern because it entails practice of excessive reliance on the unaffected leg with relative negligence of the affected extremity.

The project's goal is to use auditory biofeedback for gait rehabilitation of poststroke hemi-paretic patients. The novelty of the suggested approach lies both in the feedback mode (sound), as well as in the gait variables (time of initial contact and vertical ground reaction forces) which patients will also receive through the feedback.

In the first part of the project a new system will be developed by "Alango", an external company. The hardware consist of a pair of insoles equipped with strain sensors. The sensors are connected to an interface device which transfers signals to a Pocket PC. The Pocket PC is connected to headphones to produce the feedback sound. The software executes the main acquisition process, accumulating data, and provides the biofeedback sound to the patient's headphones.

In the second part of the project clinical research will be

carried out at the Flieman Rehabilitation Center in Haifa. The aim of the research is to test the system and to provide a preliminary evaluation of the potential contribution of this system to bilateral feet loading and walking symmetry.

"Decision Making in the Software Life Cycle Using Micro-economic Models"

Prof. Dan Peled,
Department of Economics,
Dr. Eitan Farchi,
IBM- Haifa Research Lab,
Peleg Yiftachel, and Yuval Rapaport-Rom,
Department of Computer Science

Software development follows a methodology called the Software Life Cycle, in which several phases of activity are performed in the production and utilization of software products. These phases include: requirements specification; design; implementation; testing and maintenance. The classical waterfall model for software production is sequential; the completion of each phase leads to the next. Significant waste in software production and usage occurs due to misallocation of resources during the production process, despite the existence of many methodologies for software development with different recommendations for allocating production resources across development phases.

Optimally, software manufacturing resources should be allocated among the different phases of the Software Life Cycle in order to achieve the highest quality product. This requires: (1) an appropriate definition of and a technique for measuring quality; (2) a mechanism for recording the allocation of resources to the various phases in the production process; and (3) an estimate of the mapping from allocated resources to the resulting quality of the software product.

This project suggests a novel approach for experimentally evaluating the resource allocation process in software development and its impact on the resulting quality. The proposed methodology, based on microeconomic theory of the firm and software engineering, designs a model of software production function and estimates it using experimental data. This study will record, in a controlled experimental environment, how software developers combine various software production phases in an attempt to create the most profitable product.

"Quantitative Description of Learning-Induced Modifications in Firing Patterns of Olfactory Cortex Neurons"

Dr. Daniel Keren, *Department of Computer Science and*
Prof. Edi Barkai, *Center for Brain and Behavior, Faculty of Sciences*

Learning related cellular changes can be divided into two general groups: modifications that occur at synapses and modifications in the intrinsic properties of the neurons. While it is commonly agreed that changes in strength of connections between neurons in the relevant networks underlie memory storage, it has been pointed out that modifications in intrinsic neuronal properties may also account for learning related behavioral changes. We propose to study the latter.

The purpose of the proposed research is to characterize and quantify learning-induced modifications in neuronal excitability in pyramidal neurons of the piriform (olfactory) cortex. This multidisciplinary research offers a unique framework in which the mechanisms underlying learning-relevant cellular modifications in the mammalian brain can be identified.

It is our intention to develop a method for identifying the firing characteristics in the frequency domain. We propose to use a combination of ideas from frequency analysis and pattern recognition in order to isolate the most dominant changes in the firing pattern after a process of training. A possible framework is to look at the problem in the context of machine learning: given two populations, A (after training) and B (before training), we seek to differentiate them. This will yield information on what has changed during the training process. However, we want to do more than just construct a black box which can differentiate between A and B; we want to pinpoint what exactly has changed during the training process.

"Boxels, Antichains and Their Application to Virtual Reality"

Prof. Dan Gordon, *Department of Computer Science*

One of the most interesting applications of virtual reality is the ability to take virtual walks in various environments. Urban environments present some of the most challenging scenes for virtual reality because of the need to display, in real time, the "visible" portions of the scene, which contains a huge amount of data. Most of the data in an urban scene is not visible to the observer, so it should be occluded from the displayed image. The topic of occlusion in urban environments is of great interest to computer graphics researchers and practitioners.

The display of a visible scene of a large urban environment in real time is basically one of the most fundamental issues of computer graphics, namely, fast hidden surface removal. On another front, there are some basic results in the study of boxels, a term made up of “box cells” or “box elements”. Boxels are 3-dimensional boxes with sides parallel to the coordinate axes, such that projections of the boxes on the XY plane do not overlap. As such, boxels make up an ideal framework for representing urban scenes.

The aim of the project is to harness the technical properties of the boxels in order to use them for real time display of urban scenes. Furthermore, it is possible to partition the boxels into antichains (of a certain partial order) so that any ray will meet boxels of the antichains only according to the total order. These properties are very promising for rapid front-to-back display of large urban scenes, and also for fast ray-tracing of such scenes. These data structures will be implemented and their usefulness for real-time display tested and evaluated in comparison with other methods.

“Strategies for Searching Graphs”

Prof. Shmuel Gal,
Department of Statistics

Search problems involve detecting an object such as a person, a vehicle, or a bomb hiding somewhere in a graph (on an edge or at a vertex). Most of the earlier work on searching assumes that there exists a probability distribution for the location of the target, which is known to the researcher (i.e. Bayesian approach is used).

The main problem is to find optimal search strategies in graphs. We assume no knowledge about the probability distribution of the target’s location. As in many military situations, the target is an opponent who wishes to evade the searcher as long as possible. The searcher starts moving from a specified point – the origin, and is free to choose any path in the graph subject to a maximal speed constraint. The aim of the searcher is to minimize the (expected) time spent in searching.

The aim of the project is to study the search game in a graph with an arbitrary starting point for the searcher. In particular,

we will find search strategies for non-symmetric stars, and for trees. We will try and characterize the family of graphs for which the optimal search strategy guarantees that the expected search time does not exceed half the minimal length of a path which covers all the edges in the graph. A possible extension is to achieve results for several searchers who search in parallel.

"Using Unspecified Ontologies for E-commerce Applications in P2P Mode"

by ***Dr. Yosi Ben-Asher*** *and* ***Shlomo Berkovsky,*** *Department of Computer Science*

Peer-to-Peer (P2P) systems offer an alternative to the existing client server architectures. In P2P systems every node (peer) acts as both the client and the server and provides part of the system capability. The P2P approach omits many problems of client-server systems, but results in considerably more complex searching and management. P2P technology has been steadily gaining popularity in recent years, for applications that range from the file sharing to the distributed computing. This project will explore the details of implementing systems, based on P2P architecture, dedicated to E-Commerce transactions. The objective will be to develop a notion of "dynamic forms," which are a natural generalization of the fixed forms usually used in the existing E-Commerce systems on the Web. These "dynamic forms" will allow users to enter new fields in any desired order, yet manage to conduct efficient searches, locating only the forms that are relevant to a specific user.

The project will develop and implement a novel concept of semantic routing to efficiently create, search and manage "dynamic forms" in P2P systems. We intend to use a novel technique of Unspecified Ontologies allowing any user to compute a "semantic" routing path to any requested form without knowing its IP address. The implemented system will be tested on a restricted domain and then will be published, and will create a market of general goods, based on the semantic routing. This will elevate E-Commerce applications to the realm of P2P systems, and make E-Commerce activities accessible to a relatively larger community of users.

Publications and Reports

The continual and wide-ranging activities detailed in the preceding pages have resulted in the publication of an extensive list of papers and reports. The following is arranged by subject, with the C.R.I. affiliated authors indicated in bold. The list covers the publications produced during the Institute's first three years of operations.

APPLICATIONS OF ALGORITHMIC GRAPH THEORY AND COMBINATORICS

BOOKS

M. C. Golumbic and A. N. Trenk, "Tolerance Graphs," Cambridge University Press, 2004.

M. C. Golumbic and ***I. B.-A. Hartman,*** eds., "Graph Theory, Combinatorics and Algorithms: Interdisciplinary Applications," Lectures from the Caesarea Rothschild Institute, in preparation.

PAPERS

A. Berry, ***M. C. Golumbic*** and ***M. Lipshteyn,*** Two tricks to triangulate chordal probe graphs, *Proc. 15th ACM-SIAM Symp. on Discrete Algorithms, SODA-2004,* (Jan. 2004).

R. Bhatia, J. Chuzhoy, ***A. Freund,*** and Joseph (Seffi) Naor, Algorithmic Aspects of Bandwidth Trading, *Proc. 30th International Colloquium on Automata, Languages, and Programming (ICALP03), Lecture Notes in Computer Science* 2719, Springer-Verlag, (2003), pp. 751-766.

A. Freund and D. Rawitz, Combinatorial Interpretations of Dual Fitting and Primal Fitting, *Proc. 1st Workshop on Approximation and Online Algorithms (WAOA03), Lecture Notes in Computer Science,* Springer-Verlag, (2003).

M. C. Golumbic, R. E. Jamison and A. N. Trenk, Archimedian $\varnothing$-tolerance graphs, *J. of Graph Theory* 41 (2002), 179-194.

M. C. Golumbic and ***M. Lipshteyn,*** Chordal probe graphs (extended abstract), *Lecture Notes in Computer Science*, Springer-Verlag, (2003), to appear.

M. C. Golumbic and ***M. Lipshteyn,*** On the Hierarchy of Interval, Probe and Tolerance Graphs, *Proc. 32th South-Eastern Conf. on Combinatorics, Graph Theory and Computing, Congressus Numerantium* 153, Utilitas Math., Winnipeg, Canada, 2001, pp. 97-106.

M. C. Golumbic, A. Mintz and Udi Rotics, Factoring and recognition of readonce functions using cographs and normality, *Proc. 38th ACM Design Automation Conference*, (June 2001), pp. 109-104.

M. C. Golumbic and ***U. N. Peled,*** Block duplicate graphs and a hierarchy of chordal graphs, *Discrete Applied Mathematics* 124 (2002), 67-71.

M. C. Golumbic and A. Siani, Coloring algorithms for tolerance graphs: Reasoning and scheduling with interval constraints, *Lecture Notes in Computer Science* 2385, Springer-Verlag, 2002, pp. 196-207.

G. Gutin, ***A. Vainshtein*** and A. Yeo, Domination Analysis of Combinatorial Optimization Problems, *Discrete Applied Mathematics* 129 (2003) 513-520.

J.-L. Kim, ***U. N. Peled,*** I. Perepelitsa and V. Pless, Explicit construction of families of LDPC codes of girth at least six, *Proc. 40th Allerton Conf. on Communication, Control and Computing,* P. G. Voulgaris and R. Srikant, Eds., Oct. 2-4, 2002, 1024-1031.

E. Korach and ***U. N. Peled,*** Equistable series-parallel graphs, *Discrete Applied Mathematics* 132 (2003) 149-162.

U. N. Peled and U. Rotics, Equistable chordal graphs, *Discrete Applied Mathematics* 132 (2003), 203-210.

SUBMITTED PAPERS and REPORTS

R. Bar-Yehuda, K. Bendel, ***A. Freund,*** and D. Rawitz, The Local Ratio Technique and its Application to Scheduling and Resource Allocation Problems.

A. Berry, ***M. C. Golumbic*** and ***M. Lipshteyn,*** Cycle-bicolorable graphs and triangulating chordal probe graphs.

S. Friedland and ***U. N. Peled,*** Computation of entropy in statistical mechanics and information theory.

S. Friedland and ***U. N. Peled,*** Theory of computation of multi-dimensional entropy with an application to the monomer-dimer problem.

M. C. Golumbic and R. E. Jamison, Rank-tolerance graph classes.

M. C. Golumbic, H. Kaplan and E. Verbin, Cell flipping problems on permutation diagrams.

M. C. Golumbic and ***M. Lipshteyn,*** Chordal probe graphs.

M. C. Golumbic, A. Mintz and U. Rotics, Recognizing and factoring read-once functions and the read number of partial k-trees.

I. B.-A. Hartman, An Extension of the Greene and Greene-Kleitman Theorems to all Digraphs.

J.L. Kim, ***U. N. Peled,*** I. Perepelitsa, V. Pless and S. Friedland, Explicit constructions of families of LDPC codes with no 4-cycles.

U. N. Peled, Neighborhood subtree intersection graphs are strongly chordal: a new proof, (January 2003).

A. Hartman, A. Zlotnick and ***I. B.-A. Hartman,*** "Optimal Test Suite Generation Subject to Time and Cost Constraints" Patent Disclosure number IL8-2002-0034. Published in IBM Technical Disclosure Bulletin.

BIOINFORMATICS AND PATTERN MATCHING

BOOKS

S. Pemmaraju and ***S. Skiena,*** "Computational Discrete Mathematics," Cambridge University Press, New York, 2003.

M. Revilla and ***S. Skiena,*** "Programming Challenges: The Programming Contest Training Manual," Springer-Verlag, New York, 2003.

PAPERS

A. Amir, A. Apostolico, ***G. M. Landau*** and G. Satta, Efficient text fingerprinting via Parikh mapping, *Journal of Discrete Algorithms*, to appear.

A. Amir, A. Butman, M. Crochemore, ***G. M. Landau*** and M. Schaps, Two-dimensional pattern matching with rotations, *Theoretical Computer Science*, to appear.

A. Amir, ***G. M. Landau, M. Lewenstein*** and D. Sokol, Dynamic Text and Static Pattern Matching, *Proc. 8th International Workshop on Algorithms and Data Structures*, (WADS'03), *Lecture Notes in Computer Science* 2748, Springer-Verlag, (2003) 340-364.

A. Amir, ***G. M. Landau*** and D. Sokol, Inplace run-length 2d compressed search. *Theoretical Computer Science*, 290, (2003) 1361-1383.

A. Amir, ***G. M. Landau*** and D. Sokol, Inplace 2D matching in compressed images, *Journal of Algorithms*, 49 (2003) 240-261.

A. Amir, ***G. M. Landau*** and E. Ukkonen, Online time stamped text indexing, *Information Processing Letters* 82 (2002) 253-259.

O. Arbell, G. M. Landau and J.S.B. Mitchell, Edit distance of run-length encoded strings, *Information Processing Letters* 83 (2002) 307-314.

M. Bender, D. Ge, S. He, H. Hu, R. Pinter, ***S. Skiena,*** and F. Swidan, Improved Bounds on Sorting with Length-Weighted Reversals, *15th ACM-SIAM Symp. on Discrete Algorithms (SODA '04)*, January 2004, to appear.

D. Carmel, ***N. Efrati, G. M. Landau,*** Y.S. Maarek and Y. Mass, An Extension of the Vector Space Model for Querying XML Documents via XML Fragments, *Proc. XML and Information Retrieval Workshop*, Tampere, Finland, (August 2002), 14-25.

M. Crochemore, ***G. M. Landau*** and ***M. Ziv-Ukelson,*** A sub-quadratic sequence alignment algorithm for unrestricted scoring matrices, *SIAM J. Computing*, 32 (2003) 1654-1673.

R. Eres, G. M. Landau, and L. Parida, A Combinatorial Approach to Automatic Discovery of Cluster-Patterns, *Proc. Third International Workshop on Algorithms in Bioinformatics, Lecture Notes in Bioinformatics* 2812, Springer-Verlag, (2003) 139-150.

G. M. Landau, B. Schieber and ***M. Ziv-Ukelson,*** Sparse LCS common substring alignment, *Information Processing Letters*, 88 (2003) 259-270.

G. M. Landau and ***M. Ziv-Ukelson,*** On the common substring alignment problem, *Journal of Algorithms* 41, (2001) 338-359.

R. Pinter and ***S. Skiena,*** Sorting with Length-Weighted Reversals, *Proc. 13th International Conference on Genome Informatics (GIW 2002),* Universal Academic Press, 173-182, 2002.

S. Skiena and S. Snir, Restricting SBH Ambiguity via Restriction Enzymes, *Second Workshop on Algorithms in Bioinformatics (WABI 2002),* Rome, Italy, September 17-21, 2002.

O.G. Troyanskaya, ***O. Arbell,*** Y. Koren, ***G. M. Landau*** and A. Bolshoy, Sequence complexity profiles of prokaryotic genomic sequences: a fast algorithm for calculating linguistic complexity, *Bioinformatics* 18 (2002) 679-688.

SUBMITTED PAPERS

R. Eres, G. M. Landau, and L. Parida, Permutation Pattern Discovery in Biosequences.

G. M. Landau, O. Levi, and S. Skiena, Alphabet Permutation for Differentially Encoding Text.

VIRTUAL REALITY FOR REHABILITATION

PAPERS

R. Kizony, N. Katz and ***P. L. (T.) Weiss,*** Adapting an immersive virtual reality system for rehabilitation. Journal of Visualization and Computer Animation 14 (2003), 1-7.

R. Kizony, N. Katz, H. Weingarden and ***P. L. (T.) Weiss,*** Immersion without encumbrance: adapting a virtual reality system for the rehabilitation of individuals with stroke and spinal cord injury. *Proceedings of the 4th International Conference on Disability, Virtual Reality and Associated technologies,* Vezprem, Hungary, September, 2002.

R. Kizony, N. Katz and ***P. L. (T.) Weiss,*** Adapting an immersive virtual reality system for rehabilitation. *Proceedings of the 1st International Workshop on Virtual Reality,* Lausanne, November, 2002.

R. Kizony, L. Raz, N. Katz, H. Weingarden and ***P. L. (T.) Weiss,*** Using a video projected VR system for patients with spinal cord injury. *Proceedings of the 2nd International Workshop on Virtual Reality,* New Jersey, September, 2003.

D. Rand, R. Kizony, ***U. Feintuch,*** N. Katz, N. Josman, A. A. Rizzo and ***P. L. (T.) Weiss,*** Video projection versus HMD VR system for rehabilitation: Within and between comparisons. *Proceedings of the 2nd International Workshop on Virtual Reality,* New Jersey, September, 2003.

S. Rosenblum, S. Parush, L. Epsztein and ***P. L. (T.) Weiss,*** Process versus product evaluation of poor handwriting among children with Developmental Dysgraphia and ADHD. *Proceedings of the 11th conference of the International Graphonomics Society,* Scottsdale, Arizona.

P. L. (T.) Weiss, Y. Naveh and N. Katz, Design and testing of a virtual environment to train CVA patients with unilateral spatial neglect to cross a street safely. Occupational Therapy International 10 (2003), 39-55.

P. L. (T.) Weiss, P. Bialik and R. Kizony, Virtual reality provides leisure time opportunities for young adults with physical and intellectual disabilities. *CyberPsychology & Behavior 6* (2003), 335-342.

SUBMITTED REPORTS

U. Feintuch, D. Rand, R. Kizony and ***P. L. (T.) Weiss,*** Development of a "low end" multimodal feedback program for motor, cognitive and sensory rehabilitation, *Cyber- Therapy 2004,* San Diego, January 2004.

D. Rand, R. Kizony, ***U. Feintuch,*** N. Katz, N. Josman and ***P. L. (T.) Weiss,*** Effect of performance demands and constraints within virtual environments, *CyberTherapy2004,* San Diego, January 2004.

P. L. (T.) Weiss, P. Bialik and R. Kizony, Virtual reality provides leisure time opportunities for young adults with physical and intellectual disabilities, *CyberTherapy2003,* San Diego, January 2003.

COMMUNICATIONS AND SOCIAL SCIENCE

PAPERS

G. Mesch and Y. Levanon, Community Networking and Locally-Based Social Ties in Two Suburban Localities, *City and Community* (December 2003).

R. Ribak and J. Turow, Internet power and social context: A globalization approach to web privacy concerns. *Journal of Broadcasting and Electronic Media* 47 (3) (2003), 328-349.

J. Turow and ***R. Ribak,*** Toward a world-systems perspective on cross national web research. In R. Mansell, R. Samarajiva, and A. Mahan (Eds.), *Networking Knowledge for Information Societies: Institutions & Intervention,* Delft: University of Delft Press, (2002), pp. 328-333.

SUBMITTED REPORTS

G. Mesch and I. Talmud, Making Friends Online: Personal Needs and Social Compensation.

R. Ribak and J. Turow, Internet power and social context: A world system approach to web privacy concerns. Presented at the Annual Conference of the Association for Education in Journalism and Mass Communication, (Miami, 2003).

R. Ribak, Parents' concerns over web privacy: A cross-cultural comparison. Presented at the annual conference of the International Communication Association, (San Diego, 2003).

R. Ribak, The construction of dependence in adolescents' discourse about technology. Presented at the annual conference of the Association of Internet Researchers, (Toronto, 2003).

I. Talmud and G. Mesch, Virtual Social Capital and Network Density among Adolescents in Israel.

J. Turow and ***R. Ribak,*** Using cross-cultural intergenerational data to study concerns over web privacy. Presented at Digital dynamics: Control, participation and exclusion (sponsored by ICA, IAMCR, Loughborough, UK, 2003).

COMPUTATIONAL LINGUISTICS

PAPERS

J. Dror, D. Shaharabani, R. Talmon and ***S. Wintner,*** Morphological Analysis of the Qur'an, *Literary and Linguistic Computing* 19(2).

Y. Cohen-Sygal, D. Gerdemann and ***S. Wintner,*** Computational Implementation of Non-Concatenative Morphology. In *Proceedings of the Workshop on Finite-State Methods in Natural Language Processing*, an EACL'03 Workshop, Budapest, Hungary, April 2003.

R. Talmon and ***S. Wintner,*** Computational processing of spoken North Israeli Arabic. In *Proc. ARABIC Language Processing: Status and Prospects*, ACL/EACL 2001 Workshop, Toulouse, France, July 2001.

R. Talmon and ***S. Wintner,*** Morphological Tagging of the Qur'an. In Proceedings of the Workshop on Finite-State Methods in Natural Language Processing, an EACL'03 Workshop, Budapest, Hungary, April 2003.

COMPUTING, TECHNOLOGY AND THE LAW

PAPERS and REPORTS

M. D. Birnhack and N. Elkin-Koren, eds. "Fighting Terror Online: The legal Ramifications of September 11," [English and Hebrew], 2002.

M. D. Birnhack and N. Elkin-Koren, eds. "New Copyright Legislation for Israel," [English and Hebrew], (2003).

M. D. Birnhack and N. Elkin-Koren, The Invisible Handshake: The Reemergence of the State in the Digital Environment, Virginia Journal of Law & Technology (2003) [English]

ARTIFICIAL INTELLIGENCE AND NEUROCOMPUTATION

PAPERS

L. Manevitz and S. Marom, Modeling the Process of Rate Selection in Neuronal Activity, J. Theoretical Biology 216, 317-343.

L. Manevitz and ***M. Yousef,*** One Class SVM for Document Classification, J. Machine Learning Research 2, 139-154.

L. Manevitz and ***M. Yousef,*** A Web Navigation System Based on a Neural Network User-Model Trained with Only Positive Web Documents, Web Intelligence and Agent Systems.

SUBMITTED PAPERS and REPORTS

M. Hadad, S. Kraus and ***I. B.-A. Hartman,*** Cooperative planning with time constraints.

M. Hadad and S. Kraus, Planning under Temporal Constraints by Collaborative Agents.

M. Kashkoosh, ***L. Manevitz*** and D. Navon, Role of Outcome Conflict in Dual Task Interference Using Neural Networks.

L. Manevitz, D. Givoli and A. Bitar, Finite Element Mesh Adaptation for Time-Dependent Partial Differential Equations via Time Series Prediction Using Neural Networks.

L. Manevitz and ***M. Yousef,*** Document Classification via Neural Networks Trained Exclusively with Positive Examples.

FOUNDATIONS AND THEORY OF COMPUTING

PAPERS

H. Buhrman, L. Fortnow, ***I. Newman,*** H. Rohrig, Quantum property testing, Proc. 14th Annual ACM-SIAM Symposium on Discrete Algorithms 2003, (SODA03) and EQIS‘01: Erato Quantum Information Science, September 6-8, 2001, Tokyo Japan.

C. Chekuri, A. Gupta, ***I. Newman, Y. Rabinovich*** and A. Sinclair, Embedding k-Outerplanar Graphs, *Proc. 14th Annual ACM-SIAM Symposium on Discrete Algorithms* 2003, (SODA03).

A. Czumaj, F. Ergun, L. Fortnow, A. Magen, ***I. Newman,*** R. Rubinfeld and C.Sohler, Sublinear-Time Euclidean Minimum Spanning Tree, *Proc. 14th Annual ACM-SIAM Symposium on Discrete Algorithms* 2003, (SODA03).

E. Fischer and ***I. Newman,*** Functions that have read-twice, constant width, branching programs are not necessarily testable, First in *Proc. COMPLEXITY 2002 pp. 73-79. J. Random Structures & Algorithms,* (to appear).

APPLIED NUMERICAL COMPUTATION

PAPERS

L. Manevitz and D. Givoli, Towards automating the finite element method: a test-bed for soft computing, *J. Appl. Soft Computing* 3, 37-59.

PATENT

L. Manevitz and D. Givoli, “Apparatus and Method for Efficient Adaptation of Finite Element Meshes for Numerical Solutions of Partial Differential Equations”, U.S. Patent Pending, September 2003.

INFORMATION SYSTEMS AND INTERNET SERVICES

PAPERS

S. Rafaeli and Y. Dan-Gur, 'Advising Groups' in Recommender Systems, *Proc. of the Sixth Pacific Asia Conference on Information Systems*, Tokyo, Japan, Sept. 6 (PACIS-2002).

S. Rafaeli, M. Barak, Y. Dan-Gur and E. Toch, Knowledge Sharing and Online Assessment, *E-Society Proceedings of the 2003 IADIS conference,* IADIS e-Society 2003, pp. 257-266.

S. Rafaeli, M. Barak, Y. Dan-Gur and E. Toch, QSIA - A Web-based environment for learning, assessing and knowledge sharing in communities, Computers and Education (in press).

SUBMITTED PAPERS

M. Barak and ***S. Rafaeli,*** Online Question-Posing and Peer-Assessment as Means for Web-based Knowledge Sharing in Learning.

Y. Ben-Asher and A. Tamam, Bartering Left-overs Over the Internet.

S. Rafaeli, Y. Dan-Gur and M. Barak, Finding friends among recommenders: Social and "Black-Box" recommender systems.

S. Rafaeli and M. Barak, Knowledge Sharing in Science Contexts.

Graphic Design: Publications Department, University of Haifa