FACULTY OF COMPUTER SCIENCE

TECHNION—ISRAEL INSTITUTE OF TECHNOLOGY

GRADUATE STUDIES PROGRAM CATALOG
2017-2018

CONTENTS

1.INTRODUCTION

This booklet aims at guiding the students in the department of computer science for the degrees of M.Sc. and All the rules in this booklet are subject to the regulations of the School of Graduate Studies, as listed in the studies catalog of the Technion. In case of differences between the Hebrew and English versions of this catalog, the Hebrew version shall apply.

The booklet lists the admission requirements and curriculum for M.Sc. and studies, the list of faculty members and their research areas, as well as division into research areas.

The graduate studies catalogue of the department of computer science is also available on the Internet site of the department: **www.cs.technion.ac.il**. The site also includes detailed information (in Hebrew and English) on the department, courses and syllabi, theses submitted in recent years, and other relevant information. It is also advisable to contact the Graduate Studies coordinator in the department:
Limor Gindin, in room 503, tel. 04-8294226, or by email: **limorg@cs.technion.ac.il.**

2. STUDY AND RESEARCH AREAS

The Computer Science Department offers study programs for the degrees of “Master in Science in Computer Science", “Master in Science” and “Doctor of Philosophy”. Excellent students can apply for transfer to the Direct Ph.D. Track during their graduate studies.

The expertise and research areas of the department are:

Theory of Computer Science:
Automata and Formal Languages
Coding
Complexity
Computational Geometry
Cryptology
Distributed Computing
Logic and Semantics
Theory of Algorithms

Systems:
Databases & Data Mining
Distributed & Parallel Systems
Hardware and Computer Architecture
Networks, Communication & Systems
Programming languages
Operating Systems & Virtualization
Software & Hardware verification
Software Engineering
Storage
System Security

Artificial Intelligence:
Learning
Reasoning

Intelligent Systems and Scientific Computation:
Geometric Modeling
Graphics
Image Processing and Computer Vision
Robotics and Complex Systems
Scientific Computation and Numerical Algorithms

Interdisciplinary Research:
Bioinformatics (Computer Science and Biology)
Computational Linguistics and Natural Language Processing
Quantum Information Processing (Computer Science, Electrical Engineering, Physics and Chemistry)
World Wide Web, Electronic Commerce, and Computational Finance

In addition to the theoretic research in these areas, the department has research laboratories in the following areas:

Robotics
Computer Vision
Artificial Intelligence
Geometric Processing
Computer Graphics and Geometric Planning
Computer Communication Networks
Software Systems
Computer Systems
Natural Languages Processing
Cyber and Computer Security
Learning and Reasoning
Data and Knowledge
Information Storage and Memories
Bioinformatics
Quantum Information Processing

3. M.SC. STUDIES

The Department of Computer Science offers a study program for the degree of "Master of Science in Computer Science". The studies are open for graduates of B.Sc. in Computer Science or other fields. The Department also offers a study program for the degree of "Master of Science" for graduates of B.Sc., which is not in computer science (such as Mathematics, Physics, and Electrical Engineering).

3.1 ADMISSION REQUIREMENTS

3.1.1 ADMISSION REQUIREMENTS FOR THE MASTER IN COMPUTER SCIENCE PROGRAM

Students who have graduated with a B.Sc. degree in Computer Science, or in any of the joint tracks of Computer Science and other Departments (e.g., Information Systems Engineering or Computer Engineering) may be admitted. Candidates who received their B.Sc. in another framework will be required to take supplementary courses as detailed below. Professional achievements of candidates

with experience in industry or experience in research, as well as recommendation letters, will be taken into account by the Admissions Committee.

Candidates who wish to improve their academic standing towards admission may do so by taking courses as 'advanced studies'. For this, they have to meet the Vice Dean for Graduate Studies in order to decide what courses they should take, and set minimum acceptance grades for these courses.

The Department prefers internal students who receive a fellowship and who devote all their time to studies, research, and teaching.

A student who completed his B.Sc. in a recognized institute of higher learning in Israel with Computer Science as his major is not required to take supplementary courses.

Students who graduated from a college will be admitted according to the policy of the School of Graduate Studies, as stated from time to time. Furthermore, a graduate of a college may be admitted as a qualifying student, study 20 credits in this status, and must receive an average of at least 88. The subjects of study will be decided upon in coordination with the Vice Dean for Graduate Studies.

3.1.2 Admission Requirements for the Master of Science Program

Students who have graduated with a B.Sc. in scientific or engineering programs may be admitted. The student should secure a faculty member who will serve as an advisor. It is not obligatory to submit a research proposal upon admission. The study program for each student will be determined in coordination with the advisor and the Vice Dean for Graduate Studies, and will be approved by the Admissions Committee.

The program will include:
1. Graduate credits: 18 credits for students who completed a four-year program, 30 credits for graduates of a three-year program.
2. Supplementary study program as necessary.

3.1.3 Admission Requirements for External Students

A student may also be admitted as an external student (that is, without receiving a fellowship). The following three rules apply in this case:

An external student for M.Sc. studies must be present in the Department at least two days a week, for at least one year.

The student has an excellent academic record, with a GPA substantially higher than the admission threshold. Such a student will commit to work outside the department for at most three days a week (with the approval of the employer), and to work as a Teaching Assistant in the Department (regular load) if required to do so.

In case of a student with an exceptional academic record, the committee may consider admission even if the above conditions are not met.

3.2 Curriculum for the M.Sc. Program

During studies, the student should take a number of courses as described above, and perform research (with thesis or minor thesis) under the supervision of a faculty member. Students with a

supplementary program should finish it as well. Course prerequisites are not imposed on graduate students, but students that take a course without its formal prerequisite, must understand that it is their own responsibility to obtain the knowledge necessary for understanding of the course material.

For the supervision of the research, the student should approach a faculty member in his field of interest. In special cases, and in coordination with, and with prior approval of the Graduate Studies Committee, the advisor may be an adjunct teacher or a member of another department in the Technion. External students may neither choose adjuncts nor external faculty as advisors. The research project may be theoretical or involve advanced engineering. In special cases, there is an option of a 'minor thesis', in which case, eight additional credits are required.

3.2.1 Program for Graduates of a Three-Year Program B.Sc.

Students who graduated a three-year program are required to take courses worth 30 credits. For the first 18 credit points, the student must at least six courses courses of the department of computer science from at least four different groups within the 12 groups of the optional courses (which are neither a project course, nor advanced topics, nor a seminar). Subjects listed in the following groups, with similar professions provided by the Department of Electrical Engineering. Listed undergraduate courses may be taken as long as the student does not pass the allowed number of undergraduate credit points. Excellent students can apply for transfer to the Direct Ph.D. Track during their graduate studies.

The group topics are as follows:

1. Complexity of Computations

236307	Expander graphs and their applications	2.0
236308	Algebraic graph theory and combinatorial designs	3.0
236309	Introduction to coding theory	3.0
236313	Complexity theory	3.0
236315	Algebraic methods in computer science	3.0
236359	Algorithms 2	3.0
236374	Probabilistic methods and algorithms	3.0
236377	Distributed Graph Algorithms	2.0
236378	Principles of managing uncertain data	2.0
236508	Cryptography and complexity	2.0
236518	Communication complexity	2.0
236521	Approximation algorithms	2.0
236525	Introduction to network coding, bounds and construction	3.0
236760	Computational learning theory	2.0

2. Theory of Algorithms

236315	Algebraic methods in computer science	3.0
236357	Distributed algorithms A	3.0
236359	Algorithms 2	3.0
236377	Distributed Graph Algorithms	2.0
236521	Approximation algorithms	2.0
236715	Methods in analysis of algorithms	3.0
236719	Computational geometry	3.0
236755	Distributed algorithms B	3.0
236760	Computational learning theory	2.0
236779	Foundations of Algorithms for Massive Datasets	2.0
238739	Discrete algorithmic geometry	2.0

3. Logic and its Applications

236026	Knowledge and games in distributed systems	2.0
236304	Logic for computer science 2	3.0
236342	Introduction to software verification	3.0
236345	Automatic verification of hardware and software systems	3.0
236356	Introduction to database theory	3.0
236368	Formal specification of complex systems	3.0
236378	Principles of managing uncertain data	2.0

4. Cryptology, Coding and Information

236309	Introduction to coding theory	3.0
236350	Computer security	3.0
236500	Cryptanalysis	3.0
236506	Modern cryptology	3.0
236508	Cryptography and complexity	2.0
236520	Coding for storage systems	2.0
236525	Introduction to network coding, bounds and construction	3.0
236990	Introduction to quantum information processing	3.0

5. Development of Software Systems

234319	Programming languages	3.0
236268	Constructive computer architecture	5.5
236321	Software engineering methods	3.0
236332	The internet of things (IoT) – technologies and implementations	2.0
236342	Introduction to software verification	3.0
236347	Program analysis and synthesis	3.0
236363	Database systems	3.0
236368	Formal specification of complex systems	3.0
236369	Managing data on the world-wide web	3.0
236376	Operating systems engineering	4.0
236700	Software design	3.0
236703	Object-oriented programming	3.0
236712	Agile software engineering	2.0
236780	Algorithms for dynamic memory management	2.0

6. Communication and Distributed Systems

236026	Knowledge and games in distributed systems	2.0
236334	Introduction to computer networks	3.0
236341	Internet networking	3.0
236350	Computer Security	3.0
236351	Distributed systems	3.0
236357	Distributed algorithms A	3.0
236369	Managing data on the world-wide web	3.0
236370	Parallel and distributed programming	3.0
236377	Distributed Graph Algorithms	2.0
236510	Database management systems implementation	3.0
236755	Distributed algorithms B	3.0

7. Computer Systems

234322	Information storage systems	3.0

236268	Constructive computer architecture	5.5
236278	Computational accelerators and accelerated systems	3.0
236334	Introduction to computer networks	3.0
236347	Program analysis and synthesis	3.0
236350	Computer security	3.0
236363	Database systems	3.0
236369	Managing data on the world-wide web	3.0
236376	Operating systems engineering	4.0
236510	Database management systems implementation	3.0
236780	Algorithms for dynamic memory management	2.0

8. Vision and Robotics

236200	Statistical data processing	4.0
236327	Digital image and signal processing	3.0
236330	Introduction to optimization	3.0
236372	Bayesian networks	3.0
236860	Digital image processing	2.0
236861	Geometric computer vision	3.0
236862	Sparse representations and applications in signal and image processing	2.0
236873	Computer vision	3.0
236875	Visual recognition	3.0
236927	Introduction to robotics	3.0

9. Geometry and Graphics

234325	Computer graphics 1	3.0
236324	Computer graphics 2	3.0
236329	Digital geometry processing	3.0
236373	Image synthesis	3.0
236716	Geometric models in CAD systems	3.0
236719	Computational geometry	3.0
238739	Discrete algorithmic geometry	2.0

10. Learning and artificial Intelligence

236200	Statistical data processing	4.0
236299	Introduction to natural language processing	3.0
236372	Bayesian networks	3.0
236501	Introduction to artificial intelligence	3.0
236756	Introduction to machine learning	3.0
236760	Computational learning theory	2.0
236779	Foundations of Algorithms for Massive Datasets	2.0
236941	Introduction to neural networks	3.0

11. Computational Physics and Scientific Computing

236330	Introduction to optimization	3.0
236336	Numerical solution of partial differential equations	3.0
236339	Acceleration of convergence of iterative procedures	2.0
236790	Multigrid methods	2.0

12. Bioinformatics

236522	Algorithms in computational biology	3.0

236523	Introduction to bioinformatics	2.5

The remaining 18 credits should be of courses that yield expertise in the proposed research topic, according to a program decided jointly with the student's advisor. The student may take up to three seminars and advanced topics courses before the approval of his research program.
The following courses are obligatory. Students who did not study the courses:
234267 Digital computers architecture
236343 Theory of computation
in the framework of their B.Sc. studies are required to study them in the framework of the M.Sc. program (the credits will be counted).

At least six credits should be taken following the approval of the research proposal. Courses will be approved by the advisor or temporary advisor. In special cases, with the recommendation of the advisor and the Vice Dean for Graduate Studies, it is possible to study up to six credits of undergraduate courses. Students whose research is interdisciplinary, may, with special approval of the Vice Dean for Graduate Studies, study up to ten credits of undergraduate courses.

3.2.2 Program for Graduates of a Four-Year B.Sc. Program

The student must complete 18 credits of graduate courses, mostly in Computer Science courses or similar courses in the Department of Electrical Engineering courses. The courses will be chosen jointly with the advisor. The student is required to take at least two courses (six credits) after submitting a research proposal.

The following courses are obligatory. Students who have not studied the courses:
234267 Digital computers architecture
236343 Theory of computation
in the framework of their B.Sc. studies are required to study them in the framework of the M.Sc. program (the credits of the “Digital computers architecture” will NOT be counted within the 12 required credits, i.e., such students will study 21 credits.)

3.2.3 Supplementary Program for Qualifying Students

A student will be credited with graduate credits for a supplementary course at the graduate level (prefix 236), if the student obtained a reasonable grade. A student may be exempted from taking a supplementary course if:

1. The student studied a similar, or a more advanced course, in the same field (possibly in another academic institution).
2. The student received an exemption from the teacher of the course .

A complete list of the supplementary courses will be compiled for each student at the time of his acceptance, according to the following list:

Mathematics Courses

Number	Name	Credits
114031	Infinitesimal calculus 1M	5.5
114032	Infinitesimal calculus 2M	5.0
104166	Algebra A	5.5
	or	
104134	Modern algebra H	2.5

Computer Science Courses

Number	Name	Credits
234125	Numerical Algorithms	3.0
234141	Combinatorics for CS	3.0
094412	Introduction to probability M	4.0
234122	Introduction to systems programming	3.0
234218	Data structures 1	3.0
234247	Algorithms 1	3.0
234293	Logic and set theory for CS	4.0
234123	Operating systems	4.5
236360*	Theory of compilation	3.0

A student has to pass the supplementary courses with an average of 88, and each course with a minimum grade of 80. Students may register to these courses even if they did not take their prerequisites. The course marked with an "*" is counted as credit points towards the M.Sc. degree. Upon successful completion of the supplementary courses, the vice-dean for graduate studies will approve the students transfer to the regular M.Sc. program (either for graduates of three-year or four-year B.Sc.).

4. PH.D. STUDIES

4.1 ADMISSION REQUIREMENTS

4.1.1 GENERAL

The prime goal of doctoral studies is the development of an independent research capability culminating in original research work. The student will prepare a detailed scientific thesis based on the research he conducted. The research must be innovative, advance the state of knowledge in the student's chosen research field, and be acceptable for publication in respectable scientific journals in the field.

4.1.2 DEFINITION OF TYPES OF STUDENTS

A candidate who fulfills the formal admission requirements for studying towards a Ph.D. degree as set down by the School of Graduate Studies, or has almost completed his Master's degree and is interested in studying for a Ph.D. degree, shall contact (at any time) the committee for graduate studies in order to enroll.

A candidate may be admitted either as a 'qualifying student' or as a 'regular student'. The former status allows the candidate one semester in which he may fulfill the conditions for admission as a regular student, as explained in Clause 31.02 of the School of Graduate Studies Regulations.

A student must be internal for at least one year during his studies.

4.1.3 Request for Admission

A candidate wishing to be admitted to studies will submit at least three letters of recommendation on standard forms provided by the Department. It is recommended that the candidate will have an advisor and a proposed research topic at the time he applies for admission. If the candidate does not have an advisor and a proposed research topic, he should state in which field he intends to conduct his research.

4.1.4 Admissions Committee

If the candidate has no advisor and no research topic, the Graduate Studies Committee will consider the appointment of a special Admissions Committee. The Admissions Committee will consist of three faculty members, at least one of whom will be a member of the Graduate Studies Committee. This committee shall present its recommendation to the Graduate Studies Committee. The Admissions Committee may summon the student for an interview and/or examine his qualifications in any other way it deems fit.

4.1.5 Conditions of Admission

In order to be admitted as a regular student for a Ph.D. degree, the candidate must fulfill the following conditions:

- Comply with all the formal requirements of the School of Graduate Studies.
- Be admitted by the Graduate Studies Committee, and comply with the requirements of that committee.
- Comply with other requirements (e.g., in case of a change in the field of research) that the Graduate. Studies Committee may decide upon, while discussing the student's request.
- Be approved by the Dean of the School of Graduate Studies.

A candidate who does not comply with the first condition may be accepted as a qualifying student for a period of one semester. During this time he must fulfill all the requirements which will allow a change of status to that of a regular student.

4.1.6 Direct Studies

Outstanding students studying for M.Sc. may transfer to the direct study program towards a Ph.D. If the conditions for this transfer are satisfied (according to Clause 24.07 of the School of Graduate Studies Regulations), the student needs to apply, with a recommendation of his advisor and an additional recommendation, to the Graduate Studies Committee.

4.2 RESEARCH

GENERAL

The prime goal of doctoral studies is the development of an independent research capability culminating in original research work. The student will prepare a detailed scientific thesis based on the research he conducted. The research must be innovative, advance the state of knowledge in the student's chosen research field, and be acceptable for publication in respectable scientific journals in the field.

4.2.1 ADVISOR AND RESEARCH TOPIC

The student has to secure an advisor and define a research topic within one semester of his admission. An external student is not allowed to choose an adjunct teacher as an advisor.

4.2.2 CANDIDACY EXAM

Towards the end of the first year, the student has to submit a research plan describing his up-to-date achievements and his plans for the continuation of his research. This plan has to be approved by the advisor and the Graduate Studies Committee, and serves as a basis for the candidacy exam.

4.3 STUDIES

4.3.1 STUDIES CREDITS

As of winter semester 2011, courses requirements for Ph.D. students at the department are:

1. At least 18 credits of graduate courses (or joint courses for undergraduate and graduate studies).
2. Ph.D. Direct Track students will be required to obtain six credits in addition to their M.Sc. Studies sum of credits.

4.3.2 SUPPLEMENTARY COURSES

Candidates for a Ph.D., whose previous degrees are not in Computer Science, will be required to take supplementary courses, selected from the obligatory courses in the three-year program for B.Sc.

A candidate may be exempted from the above-mentioned courses if:
- The student has already successfully completed equivalent courses.
- The courses were prerequisites for advanced courses that he has already completed.

The Graduate Studies Committee will determine, on a case-by-case basis, the supplementary courses, as well as the number of graduate credits the student has to complete (4–24). These courses will be selected in coordination with the student's advisor.

5. FACULTY RESEARCH INTERESTS

Ailon, Nir
Associate Processor

Machine Learning and Statistics, Combinatorial Optimization and Approximation Algorithms, Algorithmic Dimension Reduction and Applications, Complexity.

Attiya, Hagit
Professor

Distributed computation and theoretical computer science; in particular: fault-tolerance; timing-based and asynchronous algorithms.

Bar-Yehuda, Reuven
Professor

Combinatorial optimization: graph algorithms; scheduling algorithms, computational geometry.

Baram, Yoram
Professor Emeritus

Statistical learning theory, Pattern recognition; Classification; Regression, Neural networks; Associative memory; Non-linear network dynamics; Virtual reality and feedback control aids for movement disorders.

Barequet, Gill
Professor

Discrete and computational geometry; geometric computing; combinatorics; computer-aided geometric design; computer graphics and visualization.

Ben-Chen, Mirela
Associate Professor

Shape analysis and understanding, 3D geometry processing, deformation and animation, fluid simulation on surfaces, vector field analysis and design, numerical algorithms for geometric data, computer graphics.

Ben-Sasson, Eli
Professor

Computational complexity; proof comp-lexity; analysis of sat solvers; sub-linear time algorithms for proof checking and error correcting codes.

Biham, Eli
Professor

Cryptology and cryptanalysis; symmetric cryptography, quantum cryptography and quantum computation.

Bronstein, Alexander
Associate Professor

3D acquisition and processing, deformable shape analysis and modelling, computer vision, machine learning, numerical geometry.

Bruckstein, Alfred M.
Professor

Image and signal processing, image analysis and synthesis; pattern recognition; applied geometry; robotics, especially ant robotics; estimation theory; neural coding.

Bshouty, Nader H.
Professor

Computational learning theory.

Censor-Hillel, Keren
Associate Professor

Distributed Computing, especially Probabilistic Algorithms and Lower Bounds, and Theory of Computing in General.

Cohen, Reuven
Professor

Architectures and protocols for computer networks: the Internet, wireless networks, cellular networks, broadband access networks, sensor networks, routing protocols, multicast, MAC protocols, and Transport protocols.

El-Yaniv, Ran
Associate Professor

Statistical learning theory, data clustering and compression, applications to information retrieval, web mining, human-computer interaction, biological sequence analysis, texture analysis and synthesis, and music analysis and synthesis; online algorithms: design, theoretical analysis and practical experimentation, computational finance: Portfolio selection algorithms.

Elad, Michael
Professor

Signal and image processing, and computer vision; Mathematical methods for image representation; Numerical methods in image processing.

Elber, Gershon
Professor

Computer aided geometric design; computer graphics.

Etzion, Tuvi
Professor

Coding theory; combinatorial algorithms and designs; digital sequences in coding and communication.

Etsion, Yoav
Associate Professor

Computer Architecture, Computer Systems and Parallel Processing, HW/SW Interoperability, Operating Systems, Parallel Programming Models, High-Performance Computing.

Filmus, Yuval
Senior Lecturer

Computational complexity, Proof complexity, Analysis of Boolean Functions, Combinatorics.

Fischer, Eldar
Associate Professor

Efficiency of calculations: especially property testing, statistical deductions, and probabilistically checkable proofs; combinatorics: especially graph theory, regularity theorems in combinatorial structures, and applications to algorithms; logic in computer science: logical characterization of properties for which there exist efficient algorithms or desirable combinatorial aspects.

Francez, Nissim
Professor Emeritus

Primary: formal semantics of natural language; type-logical grammar; computational linguistics; λ-calculus and proof theory. Secondary: semantics of programming languages; program verification; concurrent and distributed programming; logic programming.

Friedman, Roy
Professor

Distributed systems; group communication; wide-area applications; middleware, CORBA and .NET; clustering; distributed multimedia applications; mobile computing.

Geiger, Dan
Professor

Probabilistic networks, Bayesian learning, Computational Genetics.

Gil, Joseph
Associate Professor

Software engineering, in particular: aspects related to the object-oriented paradigm, programming languages and parsing.

Gotsman, Craig (Chaim)
Professor

Computer graphics; animation; rendering; geometric modeling; computational geometry.

Grumberg, Orna
Professor

Computer-aided verification of software and hardware; model checking; formal verification; temporal logics; modularity; abstraction; distributed model checking, sat-based model checking, games, 3-valued logics.

Heymann, Michael
Professor Emeritus

Specification and Control of Discrete-Event and Hybrid Systems; Systems and Control Theory; Robotics; Optimization Theory.

Ishai, Yuval
Professor

Cryptography, Complexity theory.

Itai, Alon
Professor Emeritus

Deterministic and Randomized Data Structures and Algorithms, Algorithms for secondary storage, Corpora Based Natural Language Processing, Computational Learning Theory, Distributed Computing.

Itzhaky, Shachar
Senior Lecturer

Software synthesis; High-level and automated programming; Functional programming languages; Formal proof assistants.

Kaminski, Michael
Professor

Non-monotonic logic; complexity of algebraic computations; finite automata theory; temporal logic.

Kantorowitz, Eliezer
Associate Professor (Ret.)

Software engineering; user interfaces; component oriented programming; internet programming; components with semantic interfaces; statistical estimation of the number of software faults

Katz, Shmuel
Professor Emeritus

Program verification; formal specification methods; aspect-oriented software development; distributed systems; programming methodology; temporal logic; partial orders; programming languages; software engineering.

Kimelfeld Benny
Associate Professor

Database systems and theory, information extraction, information retrieval, data mining, probabilistic and inconsistent databases.

Kimmel, Ron
Professor

Image processing, computer vision, medical image analysis, computer graphics, differential geometry, scientific computing, machine learning.

Kohavi, Zvi
Professor Emeritus

Failure-Tolerant design, testing and fault diagnosis of digital systems; Switching and finite-automata theory; Reliability.

Kushilevitz, Eyal
Professor

Cryptography; Machine learning; computational complexity and commu-nication complexity; randomized distributed protocols.

Lempel, Abraham
Professor Emeritus

Application of discrete mathematics to problems in computer science and information theory; Imaging and compression technology.

Lindenbaum, Michael
Professor

Image processing and computer vision, especially the statistical analysis of visual tasks.

Litman, Ami
Associate Professor (Ret.)

Interconnection networks; parallel computation on fixed connection networks; systolic systems; layout of networks; digital systems, VLSI.

Makowsky, Johann
Professor Emeritus

Logic and complexity; complexity over the reals; algebraic combinatorics.

Markovitch, Shaul
Professor

Artificial Intelligence; Machine Learning; Multi-agent systems; Game playing; Opponent modeling; Search; Speedup Learning.

Mendelson, Avi
Professor

Computer Architecture - heterogeneous systems, system-on-a-chip, power management, fault-tolerance, GPGPU; Operating Systems - for system-on-chip and hetero-geneous systems; Real-Time systems - WCET for single processor and multi-processors, operating system, mix-criticality power management for RT systems.

Mor, Tal
Associate Professor

Theoretical quantum information processing (computing, cryptography, information, communication); implementation (hardware) of quantum information processing; modern cryptology.

Moran, Shlomo
Professor Emeritus

Algorithmic aspects of bioinformatics (with emphasis on phylogenetics); combinatorics and graph theory.

Naor, Seffi (Joseph)
Professor

Theory of algorithms and applications; Randomness and computation; approximation and on-line algorithms; combinatorial optimization; randomized algorithms; communication networks;

parallel computation.

Ornan, Uzzi
Visiting Professor

Natural language processing, machine translation, information retrieval, processing of Hebrew in all levels (phonology, morphology, syntax, semantics), speech recognition.

Paz, Azaria
Professor Emeritus

Theory of automata, deterministic and probabilistic; Theory of algorithms and integer algorithms; Theory of Bayes networks and Theory of Graphoids

Petrank, Erez
Professor

Concurrent Algorithms: theory and practice; Memory Management (in particular for modern arallel architectures); Operating Systems, Programming Languages.

Pinter, Ron
Professor

Bioinformatics; high performance computing; programming languages; compiler technology; automated design of integrated circuits; information organization and retrieval; data integration.

Raz, Danny
Professor

Theory and applications of management related problems in IP networks; active networks, network location problems, theory of network management, QoS routing, wireless networks, and other optimization problems.

Rivlin, Ehud
Professor

Robot vision; robot navigation; motion planing; visual servoing; active vision; object recognition; artificial intelligence; image understanding, image processing; image databases.

Roth, Ronny
Professor

Error-correcting codes; coding for magnetic and optical recording; application of coding theory to complexity; information theory; digital communication.

Schwartz, Roy
Senior Lecturer

Design and analysis of algorithms, combinatorial optimization, approximation algorithms, the geometry of metric spaces and its applications, submodular optimization, and randomized algorithms.

Schuster, Assaf
Professor

Parallel and distributed computing; peer-to-pear computing large scale data mining; scalable model checking; high-performance computer architecture; shared memory consistency models; java memory model; fault tolerance; distribute shared memory; non-stop systems.

Shachnai, Hadas
Professor

Design and analysis of algorithms for combinatorial optimization problems, in particular, algorithms for packing, scheduling and resource allocation problems arising in Information and Communication services; parameterized algorithms and their usage in approximation; randomized algorithms; parallel computation.

Shlomi, Tomer
Associate Processor

Bioinformatics/Systems-Biology; biological-network analysis: constraint-based modeling of metabolic networks; protein-interaction network analysis.

Shmueli, Oded
Professor

Database systems: theoretical aspects of query processing in relational databases, xml databases and logic based databases (datalog); system issues: physical storage, concurrency control, recovery, replication and distribution; querying the WWW; electronic commerce; automated negotiation.

Sidi, Avram
Professor Emeritus

Theory and application of scalar and vector extrapolation methods; numerical integration; numerical linear algebra; numerical solution of integral equations; padé and other related rational approximations.

Tsafrir, Dan
Associate Processor

Operating systems, parallel systems, security, performance evaluation.

Ungarish, Marius
Professor

Simulations of rotating fluids (incompressible, compressible, two-phase, liquid metals); two-

phase flows; gravity currents; computational fluid dynamics, implementation of parallel computers, numerical methods.

Yaakobi, Eitan
Assistant Professor

Information and coding theory with applications to non-volatile memories, associative memories, data storage and retrieval, and voting theory.

Yahav, Eran
Associate Professor

Program analysis, abstract interpretation, program verification, program synthesis, concurrent and distributed systems, programming languages, and software engineering.

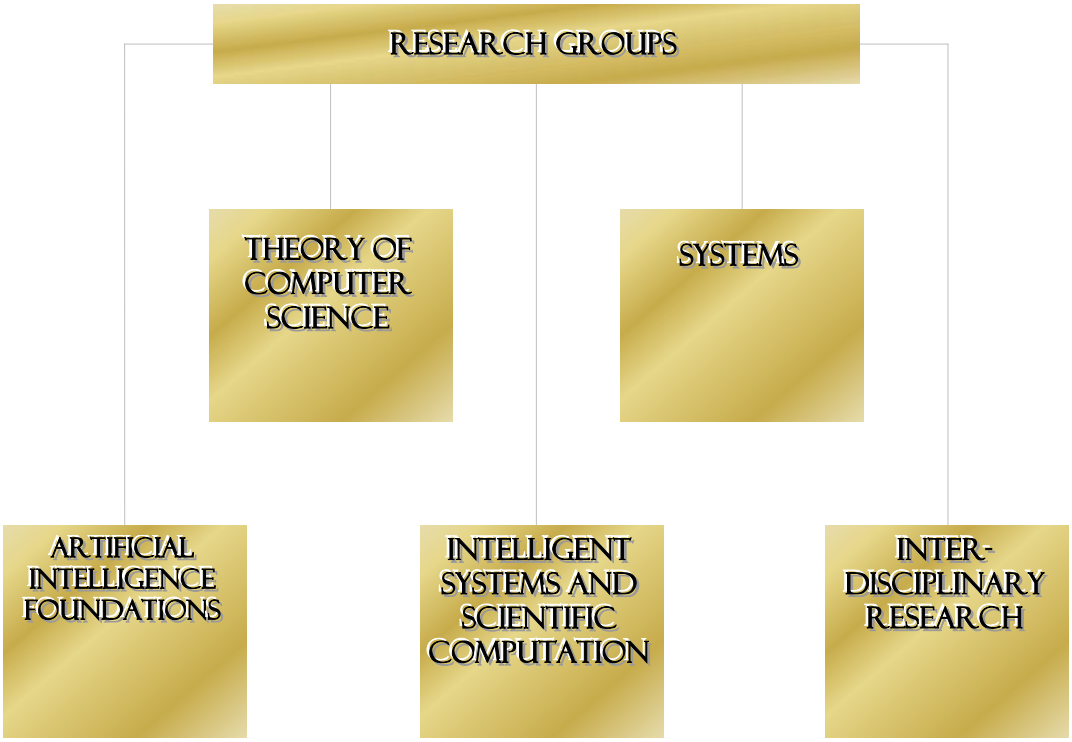
Yavneh, Irad
Professor

Multigrid computational methods; scientific computing; computational physics; geophysical fluid dynamics; image processing and analysis; numerical analysis.

Zaks, Shmuel
Professor

Theory of distributed computing; atm and optical networks; combinatorial and graph algorithms; combinatorics and graph theory; discrete mathematics.

6. RESEARCH GROUPS STRUCTURE



THEORY OF COMPUTER SCIENCE

Automata and Formal Languages:
N. Francez
O. Grumberg
M. Kaminski
B. Kimelfeld
A. Paz

Coding:
E. Ben-Sasson
E. Yaakobi
T. Etzion
A. Lempel
R. Roth

Complexity:
R. Bar-Yehuda
E. Ben-Sasson
N. Bshouty
Y. Filmus
E. Fischer
Y. Ishai
M. Kaminski
E. Kushilevitz
J. Makowsky
J. Naor
R. Rothblum

Computationl Geometry:
R. Bar-Yehuda
G. Barequet

Cryptology:
E. Ben-Sasson
E. Biham
Y. Ishai
E. Kushilevitz
E. Petrank
R.Rothblum,

Theory of Algorithms:
N. Ailon
R. Bar-Yehuda
G. Barequet
E. Ben-Sasson
K. Censor-Hillel
E. Fischer
A. Itai
S. Moran
J. Naor
A. Paz
E. Petrank
H. Shachnai
R. Schwartz
I. Talgam-Cohen
S. Zaks

Distributed Computing:
H. Attiya
K. Censor-Hillel
R. Friedman
E. Petrank
A. Schuster
S. Zaks

Logic and Semantics:
N. Francez
O. Grumberg
M. Kaminski
S. Katz
B. Kimelfeld
J. Makowsky
E. Yahav
Y. Vizel

Database Theory:
B. Kimelfeld,
O. Shmueli

SYSTEMS

Databases and Data Mining:
J. Gil
B. Kimelfeld
A. Schuster
O. Shmueli

Distributed & Parallel Systems:
H. Attiya
Y. Etsion
R. Friedman
E. Petrank
A. Schuster
D. Tsafrir
E. Yahav

Hardware & Computer Architecture:
Y. Etsion
Z. Kohavi
A. Litman
A. Mendelson
T. Mor
Y.Vizel

Networks, Communication & Systems:
R. Cohen
A. Litman
D. Raz
R. Roth
S. Zaks

Operating Systems & Virtualization
Y. Etsion
A. Mendelson
A. Schuster
D. Tsafrir

Programming Languages:
J. Gil
S. Itzhaky
E. Petrank
D. Tasfrir
E. Yahav

Software & Hardware Verification:
O. Grumberg
M. Heymann
S. Katz
Y.Vizel
E. Yahav

Software Engineering:
J. Gil
R. Friedman
S. Itzhaky
E. Kantorowitz
S. Katz
R. Pinter
Y.Vizel
E. Yahav

Storage:
Y. Kanza
E. Petrank
A. Schuster
D. Tsafrir
E. Yaakobi
E. Yahav

System Security:
E. Biham
D. Tsafrir
E. Yahav

ARTIFICIAL INTELLIGENCE FOUNDATIONS

Machine Learning:
Y. Baram
A. Bronstein
N. Bshouty
A. Itai
R. El- Yaniv
M. Elad
D. Geiger
R. Kimmel
S. Markovitch
U. Ornan
K. Radinsky

Neural Networks & Deep Learning:
R. El- Yaniv
M. Elad
Y. Baram
A. Bronstein
A. Mendelson
R. Kimmel

Logical and Probabilistic Reasoning:
D. Geiger
M. Kaminski
A. Paz

INTELLIGENT SYSTEMS AND SCIENTIFIC COMPUTATION

Geometric Modeling:
A. Bronstein
A. Bruckstein
G. Barequet
M. Ben-Chen
G. Elber

Graphics:
A. Bronstein
M. Ben-Chen
G. Elber
C. Gotsman
R. Kimmel

Image Processing & Computer Vision:
A. Bronstein
A. Bruckstein
M. Elad
R. Kimmel
M. Lindenbaum
E. Rivlin
I. Yavneh

Robotics & Complex Systems:
A. Bruckstein
M. Heymann
E. Rivlin

Scientific Computation & Numerical Algorithms:
A. Bronstein
M. Elad
R. Kimmel
A. Sidi
M. Ungarish
I. Yavneh

Biological Computation:
Y. Baram

INTERDISCIPLINARY RESEARCH

Bioinformatics:
D. Geiger
S. Moran
R. Pinter
T. Shlomi
Z. Yakhini

Computational Linguistics & Natural Languages Processing:
N. Francez
A. Itai
B. Kimelfeld
U. Ornan

Quantum Information Processing:
Y. Baram
E. Biham
T. Mor

WWW, Game Theory, Electronic Commerce, Crypto Currency, Computational Finance
E. Ben-Sasson
R. El-Yaniv
S. Markovitch
J. Naor
K. Radinsky
O. Shmueli
I. Talgam-Cohen