



**Committee for the Evaluation of Computer Science Study Programs**

**University of Haifa**  
**Computer Science Department**  
Evaluation Report

**November 2014**

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## Chapter 1: Background

The Council for Higher Education (CHE) decided to evaluate study programs in the field of Computer Science during the academic year of 2012-2013.

Following the decision of the CHE, the Minister of Education, who serves ex officio as Chairperson of the CHE, appointed a Committee consisting of:

- Prof. Maurice Herlihy - Computer Science Department, Brown University, USA - Committee Chair
- Prof. Robert L. Constable - Computer Science Department, Cornell University, USA<sup>1</sup>
- Prof. David Dobkin - Department of Computer Science, Princeton University, USA<sup>2</sup>
- Prof. Sarit Kraus - Department of Computer Science, Bar Ilan University, Israel<sup>3</sup>
- Prof. Dmitry Feichtner-Kozlov - Department of Mathematics, Bremen University, Germany
- Prof. Joe Turner, Jr. - (Emeritus) - Department of Computer Science, Clemson University, USA - ABET Representative
- Prof. Moshe Vardi - Department of Computer Science, Rice University, USA

Ms. Maria Levinson-Or served as the Coordinator of the Committee on behalf of the CHE.

Within the framework of its activity, the Committee was requested to:<sup>4</sup>

1. Examine the self-evaluation reports, submitted by the institutions that provide study programs in Computer Science, and to conduct on-site visits at those institutions.

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<sup>1</sup> In accordance with the CHE's policy, Prof. Robert L. Constable did not participate in the evaluation of the Computer Science department at Ben Gurion University to prevent the appearance of a conflict of interests.

<sup>2</sup> Due to scheduling constraints, Prof. David Dobkin did not participate in the site visits to the Jerusalem College of Technology, Hadassah Academic College, Ariel University, the Weizmann Institute of Science, the College of Management Academic Studies, Holon Institute of Technology, the Hebrew University of Jerusalem, and the Technion.

<sup>3</sup> In accordance with the CHE's policy, Prof. Sarit Kraus did not participate in the evaluation of the Computer Science department at Bar Ilan University to prevent the appearance of a conflict of interests.

<sup>4</sup> The Committee's letter of appointment is attached as **Appendix 1**.

2. Submit to the CHE an individual report on each of the evaluated academic units and study programs, including the Committee's findings and recommendations.
3. Submit to the CHE a general report regarding the examined field of study within the Israeli system of higher education including recommendations for standards in the evaluated field of study.

The entire process was conducted in accordance with the CHE's Guidelines for Self-Evaluation of (October 2011).

## **Chapter 2: Committee Procedures**

The Committee held its first meetings on May 21, 2013, during which it discussed fundamental issues concerning higher education in Israel, the quality assessment activity, as well as Computer Science Study programs in Israel.

In May - June 2013, the Committee held its first round of visits of evaluation, and visited the Hadassah Academic College, Jerusalem College of Technology, Ariel University, Tel Aviv University and Bar-Ilan University. In January 2014, the committee held its second round of visits of evaluation, and visited Ben-Gurion of the Negev, the Open University of Israel, the Interdisciplinary Center Herzliya, Tel-Aviv Yaffo Academic College, Netanya Academic College, Weizmann Institute of Science, College of Management Academic Studies, and Holon Institute of Technology. In May 2014, the committee held its third round of visits of evaluation, and visited the Hebrew University of Jerusalem, the University of Haifa, Tel-Hai Academic College, and the Technion. During the visits, the Committee met with various stakeholders at the institutions, including management, faculty, staff, and students.

This report deals with the Computer Science department at the University of Haifa. The Committee's visit to the University of Haifa took place on May 21-22, 2014.

The schedule of the visit is attached as **Appendix 2**.

The Committee thanks the senior management of the University of Haifa and the Computer Science Department for their self-evaluation report and for their hospitality towards the committee during its visit at the institution.

## **Chapter 3: Evaluation of the Computer Science Study Program at The University of Haifa**

*This Report relates to the situation current at the time of the visit to the institution, and does not take account of any subsequent changes. The Report records the conclusions reached by the Evaluation Committee based on the documentation provided by the institution, information gained through interviews, discussion and observation as well as other information available to the Committee.*

### **1. Executive Summary**

Computer science is central to the Israeli economy and even to its security. Among winners of the Turing award (generally considered as the “Nobel Prize” for computer scientists), Israel has more recipients than all but one other country.

The University of Haifa Computer Science department has succeeded in attracting substantial research funds, including one highly-competitive European Research Council grant. The department has one of the highest potentials in the University for bringing in research funding, and its success contributes significantly to the university's wealth.

Despite its productivity, the department is greatly under-resourced, has always been, and we see no way that is likely to change. As a result, both the undergraduate and graduate programs do not meet CHE standards<sup>5</sup>. These issues were raised in the previous CHE report, they have not been addressed and there appears to be no plan to address them.

The University has essentially two computer science departments: Computer Science (CS) and Information Systems (IS). Most of the activities in IS would be considered CS in any department in Europe and the US. All of the academic staff in IS would be considered to be computer scientists elsewhere.

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<sup>5</sup> As stated in the CHE standards for studies in Computer Science, attached as Appendix 3.

The committee recommends that the University develop a plan to create a school encompassing the academic staff of the CS and IS departments, possibly including computer scientists currently working in other departments. Such a school would have a structure similar to that of the Hebrew University School of Computer Science and Engineering, where there are no departments, but multiple study programs. The school could be given a name such as “Computer and Information Science”.

This will enable the University of Haifa to distinguish itself among all other universities in Israel, and would provide the university with an opportunity for development from both corporate and philanthropic sources.

## **2. Organizational Structure**

### Observations and findings

The University has essentially two computer science departments: Computer Science (CS) and Information Systems (IS). Most of the activities in IS would be considered CS in any department in Europe and the US. All of the academic staff in IS would be considered to be computer scientists elsewhere. For example, the wish was expressed to hire an HCI person, but there is already one in IS.

Given that the Computer Science department is severely under-staffed it seems that the university's resources are not properly deployed. The lack of faculty in CS is harming both the undergraduate and graduate programs, resulting in their inability to meet CHE standards. That issue was raised in the previous CHE report, but has not been addressed. Considering the restricted resources of the university, it seems that a new structure combining the two existing departments (CS and IS) is a reasonable and a very much needed solution.

Such a structure, that can carry the character of a school, will benefit both departments by facilitating a potential collaboration. In addition it will enlarge

the number of faculty members available to students in CS programs, lowering the student-faculty ratio to meet CHE standards. (Many of the CS graduate students are already advised by IS faculty members.) Moreover, this kind of collaboration may appear as a strategically crucial one, if the University of Haifa is to distinguish its CS program from other programs in Israel and wishes to attract students.

The CS department is located in the Faculty of Social Sciences for historical reasons, which might appear as an anomaly. However, in recent years computer science has developed as an interdisciplinary nature in many respectable universities, collaborating with different social sciences departments. The unique location of the CS department in the University of Haifa might turn into an opportunity for the department to go in such a direction, establishing itself as a unique department in the Israeli landscape and potentially internationally. A collaboration with the IS department is a right step in this direction.

There is no current established alumni relations program, but the university is now trying to establish such a program. We encourage the university and the department to maintain and expand this effort.

We understand the department has no industrial affiliates program. We encourage the department to create such a program, and to go further and set up an industrial advisory board with carefully chosen members. Such a board can advise the department on industry needs and advocate for it. In particular, given its physical location, the department should have stronger ties to IBM Research.

## Recommendations

### **Short term [~ within 1 year]:**

1. The University must develop a strategic plan to create a school encompassing the academic staff of the CS and IS departments, possibly including computer scientists from other departments too. Such a school would have a structure similar to that of the Hebrew University School of Computer Science and Engineering, where there are no departments, but multiple study programs. The school could be given a name such as “Computer and Information Science”.
2. The plan for such a school must address internal governance, development opportunities, and strategic plans for growth.
3. The department must create an industrial affiliate program and set up an industrial advisory board. In particular, the department must establish a stronger relationship with IBM Research.

### **Intermediate term [~ within 2-3 years]:**

Within 3 years, the university must execute the strategic plan for establishing the new school.

### **Medium term [~ within 4 years]:**

Within 4 years, the CHE should appoint a committee to ensure that the department comes into compliance with CHE standards for the graduate and undergraduate programs.

## **3. Mission and Goals**

### Observations and findings

The department’s current areas of expertise lie in mainstream computer science. In terms of strategic growth, the committee thinks that there is a unique opportunity to exploit the department’s position in the Faculty of Social Science. Such a direction would distinguish the University of Haifa Computer Science

from other, larger departments in Israel. This would also be consistent with an international trend of considering computer science as a universal enabler of other fields of scholarship, particularly in social science.

#### Recommendation

##### **Short term [~ within 1 year]:**

Computer Science must develop a strategic plan identifying the areas in which it plans to hire.

#### **4. Study Programs**

##### Observations and findings

The department is greatly under-resourced, has always been, and we see no way that is likely to change. As a result, both the undergraduate and graduate programs do not meet CHE standards. As stated in the report, for the undergraduate program, the student-faculty ratio is too high, the percentage of mandatory courses taught by permanent academic staff is too low, and the number of academic staff members is too low for a graduate program. These issues were raised in the previous CHE report, they have not been addressed, and there appears to be no plan by the university to address them.

The committee was concerned about the high attrition rate in the undergraduate program. Given that computer science students are among the best admitted to the university, one would expect the drop-out rate to be lower. There is not enough data to understand the full extent of the problem, and whether there is a need for action. The committee is pleased to note that some corrective actions are planned.

Practice sessions (“tirgulim”) are central to computer science education. Both academic staff and students felt that there were not enough practice sessions and those that exist are not always effective. For example, students are not

exposed to standard software development tools such as Eclipse or GitHub. This detracts from the student's learning experience. One possibility is to employ advanced undergraduates to teach the use of basic technical tools.

The committee was impressed by the undergraduate students, who are enthusiastic and intensely loyal to the department. These students should be invited to work in the department's research programs as a way of establishing a pool of future MSc and PhD students.

Many of the PhD students are supervised by supervisors outside the department, and some appear to have no local supervision.

The committee learned that the Mathematics Department is running a "Math with focus on Computer Science" program. This program was not included in the self-evaluation report and therefore was not reviewed by the committee. Looking at publically available information about this program, however, the committee determined that this program falls short of CHE standards for computer science programs. Furthermore, as far as we can see, some computer science courses in the program are not taught by academic staff members of the Computer Science Department. Given the pressure on university resources, this program seems to be a highly inefficient use of those resources.

The curriculum does not provide students with adequate exposure to the Linux operating system, which today provides infrastructure for many modern computing platforms.

### Recommendations

#### **Short term [~ within 1 year]:**

1. The university and the department must undertake a systematic effort to understand the undergraduate attrition problem, including the number of

students who drop out of computer science across the length of the program, where they go, and their reasons for dropping out of the program.

2. The department must develop a plan to make practice sessions more effective.
3. The department should develop a formal “research track” or “honors track” to attract outstanding undergraduate students to research programs, which will provide a pipeline for students to the graduate programs.
4. The university must ensure the department complies with rules concerning PhD theses advised by people external to the department or the university.
5. The department must incorporate experience with Linux into the study program.

**Medium term [~ within 4 year]:**

The university must eliminate the wasteful duplication in Mathematics and Computer Science programs.

**5. Human Resources / Faculty**

Observations and findings

The committee was impressed by the quality of the academic staff, all the way from senior faculty to new hires. The department brings in substantial research funds, including one highly-competitive European Research Council grant. Among all the departments in the university, this department has one of the highest potentials for bringing in research funding.

When a position becomes open, there is pressure to fill it right away so as not to lose the opportunity, making a long-term strategic hiring plan impossible. If instead, unfilled positions were to persist for several years, the department would be able to hire better people, and have much better control of its strategic growth.

The committee learned that criteria for promotion and tenure were sometimes unclear, particularly the relative importance of journal versus conference publication.

Several courses are taught by instructors who are not full time academic staff members. There appears to be little supervision of the syllabi of such courses. Such supervision is needed to ensure coherence across courses.

### Recommendations

#### **Short term [~ within 1 year]:**

1. The University must commit to keeping positions open until an appropriate hire can be made.
2. The department must make an effort to communicate clearly the expectations for promotion to its academic staff members at all levels.
3. The department must ensure adequate supervision of course syllabi taught by adjuncts.

#### **Intermediate term [~ within 2-3 years]:**

The department must make a systematic and persistent effort to compete for European funding.

## **6. Students**

### Observations and findings

The department is to be commended for the diversity of the student body, both undergraduate and graduate.

The students agreed that the atmosphere is warm and supportive, and the academic staff care for their needs.

Computer Science requires many hours of study, but it appears that there is no space for students to study after hours or on weekends.

The committee found some MSc students had been working for two years with a research advisor without being funded. The committee feels that any student worth supervising should be worth funding. The students were uncertain of the circumstances under which funding is given.

#### Recommendations

##### **Short term [~ within 1 year]:**

1. The department must develop clear rules about the funding of graduate students and communicate these rules to the students.
2. The university must establish a space for students to study after hours.

## **7. Teaching and Learning Outcomes**

#### Observations and findings

Some courses have stated learning outcomes, but the teaching and learning outcomes for the program have not been articulated.

#### Recommendation

##### **Short term [~ within 1 year]:**

The department should set in place a process to define and reflect on the attainment of outcomes in a planned, periodic manner.

## **8. Research**

#### Observations and findings

The University of Haifa Computer Science department's research quality is solid.

## **9. Infrastructure**

### Observations and findings

The department does not have enough office space. As in the natural sciences, computer science graduate students need office space for daily interaction and collaboration with their advisors and with fellow students.

The Caesarea Rothschild Institute (CRI) has been important for the development and visibility of the department, however CRI needs more space to fulfill its mission. There is no sustainability plan for CRI and the funding is likely to go away in a few years.

The department does not have access to the IEEE Computer Science digital library. Such access is necessary for a Computer Science department in a research university.

The department has a Linux server that can be used by undergraduate students, but is not often used.

### Recommendations

#### **Short term [~ within 1 year]:**

1. The University must establish a plan for the long-term sustainability of CRI.
2. The University must offer more space to graduate students.
3. The university must provide access to IEEE Computer Science digital library.  
This can be done either by subscription or pay-per-article arrangements.
4. The department should develop a virtual Linux desktop environment, with a rich supply of software tools, to make the Linux environment more usable to students.

#### **Medium term [~ within 4 years]:**

The University must execute a plan for the long-term sustainability of CRI.

## **10. Self-Evaluation Process**

### Observations and findings

The department made a good effort in their self-evaluation to obtain input from a variety of sources.

## **Chapter 4: Summary of Recommendations and Timetable**

### **Short term [~ within 1 year]:**

1. The University must develop a strategic plan to create a school encompassing the academic staff of the CS and IS departments, possibly including computer scientists from other departments too. Such a school would have a structure similar to that of the Hebrew University School of Computer Science and Engineering, where there are no departments, but multiple study programs. The school could be given a name such as “Computer and Information Science”.
2. The plan for such a school must address internal governance, development opportunities, and strategic plans for growth.
3. The department must create an industrial affiliate program and set up an industrial advisory board. In particular, the department must establish a stronger relationship with IBM Research.
4. Computer Science must develop a strategic plan identifying the areas in which it plans to hire.
5. The university and the department must undertake a systematic effort to understand the undergraduate attrition problem, including the number of students who drop out of computer science across the length of the program, where they go, and their reasons for dropping out of the program.
6. The department must develop a plan to make practice sessions more effective.
7. The department should develop a formal “research track” or “honors track” to attract outstanding undergraduate students to research programs, which will provide a pipeline for students to the graduate programs.
8. The university must ensure the department complies with rules concerning PhD theses advised by people external to the department or the university.
9. The department must incorporate experience with Linux into the study program.
10. The University must commit to keeping positions open until an appropriate hire can be made.

11. The department must make an effort to communicate clearly the expectations for promotion to its academic staff members at all levels.
12. The department must ensure adequate supervision of course syllabi taught by adjuncts.
13. The department must develop clear rules about the funding of graduate students and communicate these rules to the students.
14. The university must establish a space for students to study after hours.
15. The department should set in place a process to define and reflect on the attainment of outcomes in a planned, periodic manner.
16. The University must establish a plan for the long-term sustainability of CRI.
17. The University must offer more space to graduate students.
18. The university must provide access to IEEE Computer Science digital library. This can be done either by subscription or pay-per-article arrangements.
19. The department should develop a virtual Linux desktop environment, with a rich supply of software tools, to make the Linux environment more usable to students.

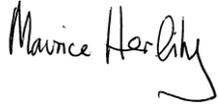
**Intermediate term [~ within 2-3 years]:**

1. Within 3 years, the university must execute the strategic plan for establishing the new school.
2. The department must make a systematic and persistent effort to compete for European funding.

**Medium term [~ within 4 years]:**

1. Within 4 years, the CHE should appoint a committee to ensure that the department comes into compliance with CHE standards for the graduate and undergraduate programs.
2. The university must eliminate the wasteful duplication of Mathematics and Computer Science programs.
3. The University must execute a plan for the long-term sustainability of CRI.

**Signed by:**



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Prof. Maurice Herlihy  
Committee Chair



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Prof. Robert L. Constable



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Prof. David Dobkin



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Prof. Dmitry Feichtner-Kozlov



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Prof. Kraus Sarit



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Prof. Joe Turner, Jr



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Prof. Moshe Vardi

## Appendix 1: Letter of Appointment



הוועדה לתכנון ותקצוב | Planning & Budgeting Committee

12.5.2013  
Jerusalem

Professor Maurice Herlihy  
Computer Science Department  
Brown University  
USA

Dear Professor Herlihy,

The Israeli Council for Higher Education (CHE) strives to ensure the continuing excellence and quality of Israeli higher education through a systematic evaluation process. By engaging upon this mission, the CHE seeks to enhance and ensure the quality of academic studies, provide the public with information regarding the quality of study programs in institutions of higher education throughout Israel, as well as ensure the continued integration of the Israeli system of higher education in the international academic arena.

As part of this most important endeavor we reach out to world-renowned scientists to help us meet the critical challenges confronting Israeli higher education by extending our invitation to participate in an international evaluation committee. This process represents an opportunity to assess the current state of the field and plan for the future. This systematic process of quality assessment also establishes a framework for the interactive consultative process taking place between scientists around the globe regarding common academic dilemmas.

It is with great pleasure that I hereby appoint you to serve as chair of the Council for Higher Education's Committee for the Evaluation of Computer Science. The composition of the Committee will be as follows: Professor Maurice Herlihy, Committee Chair, Professor Moshe Vardi, Professor (Emeritus) Joe Turner Jr., Professor Robert L. Constable, Professor Sarit Kraus, Professor David Dobkin, and Professor Dmitry Feichtner-Kozlov.

Ms. Yael Herzstein will coordinate the Committee's activities.

In your capacity as Chair of the Evaluation Committee, you will be requested to function in accordance with the enclosed appendix.

I deeply appreciate your willingness to join us in this crucial enterprise.

I wish you much success in your role as the Chair of this most important committee.

Sincerely,

  
Dr. Avital Stein  
Director General,  
The Council for Higher Education

*Enclosures:* Appendix to the Appointment Letter of Evaluation Committees

cc: Ms. Michal Neumann, The Quality Assessment Division  
Ms. Yael Herzstein, Committee Coordinator

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**Appendix 2: Site Visit Schedule**

**Wednesday, May 21, 2014**

<b>Time</b>	<b>Subject</b>	<b>Participants</b>
9:00-9:45	Opening session with the heads of the institution and the senior staff member appointed to deal with quality assessment	<b>Prof. David Faraggi</b> , Rector <b>Prof. Perla Werner</b> , Vice Rector <b>Ms. Ruchama Elad-Yarum</b> , Manager, Unit for Academic Quality Evaluation, Office of the Rector <b>Dr. Michal Daloya</b> , Unit for Academic Quality Evaluation, Office of the Rector
9:45-10:30	Meeting with the Dean of the Faculty of Social Sciences	<b>Prof. Gustavo S. Mesch</b> , Dean of the Faculty of Social Sciences
10:30-11:15	Meeting with the Head of the Department of Computer Science	<b>Prof. Shuly Wintner</b> , Head of the Department of Computer Science
11:15-12:15	Meeting with tenured senior academic staff*	<b>Prof. Yosi Ben-Asher</b> <b>Prof. Martin Golumbic</b> (Head of CRI) <b>Prof. Dan Gordon</b> (Head of BSc Committee) <b>Prof. Hagit Hel-Or</b> <b>Prof. Daniel Keren</b> <b>Dr. Rachel Kolodny</b> <b>Prof. Gad M. Landau</b> (Head of Etgar) <b>Prof. Larry Manevitz</b> <b>Prof. Ilan Newman</b> <b>Dr. Margarita Osadchi</b> <b>Dr. Yuri Rabinovich</b> <b>Prof. Ronen Shaltiel</b> (Head of MSc and PhD Committees) <b>Prof. Alek Vainshtein</b> (Head of HIACS)
12:15-13:15	Lunch (in the same room)	
14:00-13:15	Tour of facilities: classrooms, library, labs, offices	<b>Prof. Larry Manevitz</b> , Department library liaison <b>Prof. Shuly Wintner</b> , Head of the Department
14:00-14:30	Meeting with Adjunct academic staff*	<b>Dr. Elad Cohen</b> <b>Mr. Alon Gluska</b> <b>Dr. Oran Sharon</b>
14:30-15:15	Meeting with non-tenured senior academic staff*	<b>Dr. Orr Dunkelman</b> (Head of Computing Committee; Liaison with TAs) <b>Dr. Tamir Hazan</b> <b>Dr. Oren Weimann</b>
15:15-16:00	Meeting with Junior academic staff*	<b>Mr. Ofer Freedman</b> <b>Mr. Matan Livne</b> <b>Mr. Yuri Rapoport</b> <b>Mr. Mahmood Sharif</b> <b>Mr. Majd Srour</b> <b>Mr. Vladislav Tartakovski</b> <b>Ms. Naama Twitto</b> <b>Ms. Evgenia Wasserman Pritsker</b>

**Thursday, May 22, 2014:**

<b>Time</b>	<b>Subject</b>	<b>Participants</b>
9:00-9:45	Meeting with Undergraduate Students**	
9:45-10:30	Meeting with Master Students**	
10:30-11:15	Meeting with PhD Students**	
11:15-12:00	Meeting with Alumni	
12:00-13:00	Lunch and closed-door meeting of the committee (in the same room)	
13:00-13:45	Summation meeting with heads of institution, head of Faculty, Chair of the Department of Computer Science	<b>Prof. David Faraggi</b> , Rector <b>Prof. Perla Werner</b> , Vice Rector <b>Prof. Gustavo S. Mesch</b> , Dean of the Faculty of Social Sciences <b>Prof. Shuly Wintner</b> , Head of the Department of Computer Science <b>Ms. Ruchama Elad-Yarum</b> , Manager, Unit for Academic Quality Evaluation, Office of the Rector <b>Dr. Michal Daloya</b> , Unit for Academic Quality Evaluation, Office of the Rector

\* The heads of the institution and academic unit or their representatives will not attend these meetings.

\*\* The visit will be conducted in English with the exception of students who may speak in Hebrew and anyone else who feels unable to converse in English.

## **Appendix 3: CHE standards for studies in Computer Science**

### **CHE decision of 17.7.08 regarding standards for Computer Science Studies**

#### **Bachelor's Degree Programs**

##### **A. Graduates**

1. In determining these criteria, the committee felt that it would be beneficial to define the "final product", or the ideal graduate of a Computer Science bachelor's degree program:
2. A graduate has an in-depth understanding of Computer Science Theory, Computational Theory, Computational Mathematics, and staunch mathematical knowledge.
3. A graduate has broad knowledge in Computer Science applications (programming languages, software engineering, operations systems and computer design).
4. A graduate is capable of joining development teams in computer-related high-tech industries.
5. A graduate is able to carry out computer-based industrial projects.
6. A graduate is competent in applied analytics, and is capable of developing and integrating effective algorithms in software systems.
7. A graduate has independent study skills and can prepare Computer Science presentations.
8. A graduate is aware of the effects of computerization on individuals, organizations and on society, as well as its ethical, legislative and political ramifications.
9. Excellent graduates are capable of continuing their studies in master's degree programs.
10. To assure that their graduates attain these capabilities, bachelor's degree programs must adhere to the following criteria:

**B. Curricula**

Programs must include required courses as well as an adequate selection of elective courses.

1. Required (core) courses should include:
  - Advanced-level mathematics courses, taught by experienced Ph.D.-level mathematics professors. These should include: Discrete Mathematics, Calculus, Algebra and Introduction to Probability.
  - Courses in Computer Science Theory, including: Automata Theory (or a similar subject), Data Structure, Algorithmic Theory and Computational Theory.
  - At least one seminar and one applications project that includes accepted industry development processes.
  - Applied Computer Science courses in Programming Languages, Software Engineering, Operating Systems, Computer Design and Logical Content.
2. The program should offer as many elective courses as possible in Computer Science and related fields (Economics, Management, Mathematics), as well as Humanities courses, to provide a well-rounded education.
3. The programs should encourage independent study.

**C. Students, Teaching and Learning**

1. Institutions must adhere to the CHE admissions regulation requiring a matriculation certificate.
  2. Students who matriculated in mathematics at a 3-unit level will not be admitted unless they complete (passing a final exam) a preparatory course at the 4 or 5-unit level.
  3. "Conditional" admissions should not comprise more than 10% of all admissions.
  4. Departments will present detailed support programs for weak students admitted on special terms.
  5. Departments will determine rigorous requirements for continuing studies, and coherent diploma eligibility guidelines.
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6. Departments will maintain adequate teaching assistant staff, and present detailed programs for providing students with feedback and appropriate laboratory experience.
7. At least 80% of required courses will be taught by full-time faculty.

#### **D. Faculty**

1. New programs will require at least six senior Ph.D.-level faculty members; three at the program's inception and an additional two to three before the program start its third "cycle" of admissions and as a condition for final/permanent accreditation.
2. Programs will not get final/permanent accreditation if they lack the requisite number of full-time faculty members to teach at least 80% of the required courses.
3. The student-to-faculty ratio will not exceed 50:1 at colleges and 25:1 at research universities.

#### **D. Infrastructure**

The institutions must provide adequate facilities for all programs and faculty research – laboratories, appropriate computers, adequate technical support, up-to-date libraries, fully equipped classrooms, secretarial staff and adequate, fully-equipped faculty office space.

### **Master's Degree Programs**

#### **A. Graduates - General**

1. Demonstrates good Self Study Abilities.
2. Has depth and systematic understanding of knowledge in academic discipline.
3. Has comprehensive theoretical and applied knowledge in a wide range of Computer Science topics.

**B. Graduates – Research-based Master's Degree**

1. Able to undertake independent research and present outcomes in writing.
2. Able to use full range of learning resources relevant to the research topic.
3. Has depth and systematic understanding of knowledge in academic discipline.
4. Excellent graduates should be able to continue their studies toward doctoral degrees.

**C. Non-Research Master's Degrees**

These programs will be offered predominantly at colleges, while universities will offer non-research master's degree programs only to students who can not complete their research projects, or to excellent students whose research results permit continuing directly to doctoral degree programs.

Non-research master's degree programs "produce" graduates with a broad knowledge base and a high level of applications experience, who are increasingly in demand in today's complex computer science market.

The committee found that the grade average in master's degree programs (research and non-research) at all of the universities is exceedingly high. To solve this problem, the committee recommends that at least 50% of required courses in master's degree programs should be advanced graduate-level courses.

The Council for Higher Education approved detailed requirements for accreditation of non-research master's degree programs (the decision taken on July 15, 2003 is attached). All these in addition to the following criteria:

1. Programs should include a major (year-long) applications project.
2. Master's degree students will be required to submit a final paper and/or pass a qualifying exam, to cover all of the Computer Science subjects studied.
3. At least 70% of the required courses in master's degree programs will be advanced graduate-level courses.

**D. Research-based Master's Degree Programs**

The Council for Higher Education approved detailed requirements for accreditation of research-based master's degree programs at non-university institutions of higher education (the decision taken on October 10, 2004 is attached). All these in addition to the following criteria:

1. Research-based master's degree programs at academic institutions will not be approved unless the faculty includes, at colleges - at least ten full-time senior faculty members at Ph.D. level and involved in active research, and at universities, twenty faculty members with these qualifications.
2. Departments will establish academically acceptable approval procedures for research proposals, and follow-up and final approval procedures.
3. Thesis advisors will be Ph.D.-level faculty members at the rank of Lecturer at least.
4. The total number of advisees (master's and doctoral candidates) per faculty member will be limited to 5-7. Exceptional cases must be approved by special committee.
5. At least 70% of the required courses in master's degree programs will be advanced graduate-level courses.