UNDERGRADUATE PROGRAMS IN INFORMATICS: ACM/IEEE RECOMMENDATIONS & NEW ORGANIZATIONAL MODELS FOR TURKEY

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ABSTRACT

Informatics/Computing Curricula is basically considered in five major categories according to ACM/IEEE reports. These are, namely, Computer Engineering (CE), Computer Science (CS), Software Engineering (SE), Information Systems (IS), and Information Technologies (IT). This work discusses and compares the general curriculum guidelines of Undergraduate Programs. Statistical data of Turkish informatics Undergraduate Programs and a comparison with the ACM/IEEE CE guidelines and recommendations for restructuring these programs are given.

Keywords: Informatics/Computing curriculum, ACM/IEEE Computing Curricula, Computing Education.

1. INTRODUCTION

In a joint report by ACM and IEEE published in 2005 [1], "Computing" area was covered in detail and five main disciplines were identified as

- Computer Engineering (CE)
- Computer Science (CS)
- Software Engineering (SE)
- Information Systems (IS)
- Information Technologies (IT)

Although this report reflects mainly the North American focus, the comparative layout helps to clarify the differences. In Turkish, the term "Bilişim (Informatics)" is adopted as an equivalent to "Computing" and hence will be used in the sequel. A study group comprising of the heads of the Computer Engineering Departments of the Turkish Informatics Foundation (TBV) has already produced a similar report to identify the areas and academic computing programs in Turkey [2]. This report concentrates on the Computer Engineering programs and discusses their compliance with the ACM/IEEE recommendations.

In Section 2, a description of each discipline is briefly discussed and differences between areas are put forward. Section 3 summarizes the Informatics programs in Turkey. Section 4 gives some recommendation on restructuring the undergraduate degree programs in Informatics.

2. SUBJECT AREAS

In Figure 1, areas of computing and the hardware-software-business views as seen before and after the year 1990 are shown [1]. Figure shows that software-hardware components of computing are in the interest of CE area. Organizational needs of Informatics appear to be in IS and IT programs. In the sequel each subject is briefly covered. As explained above, the descriptions below reflects the North American focus and considerably different than the views in EU and in particular Turkey.

2.1. Computer Engineering (CE)

This area deals with the design, manufacturing, programming and hardware/software maintenance of computer based equipment. In a CE curriculum, apart from fundamentals of engineering mathematics and electrical and electronic engineering principles, software topics find their place.

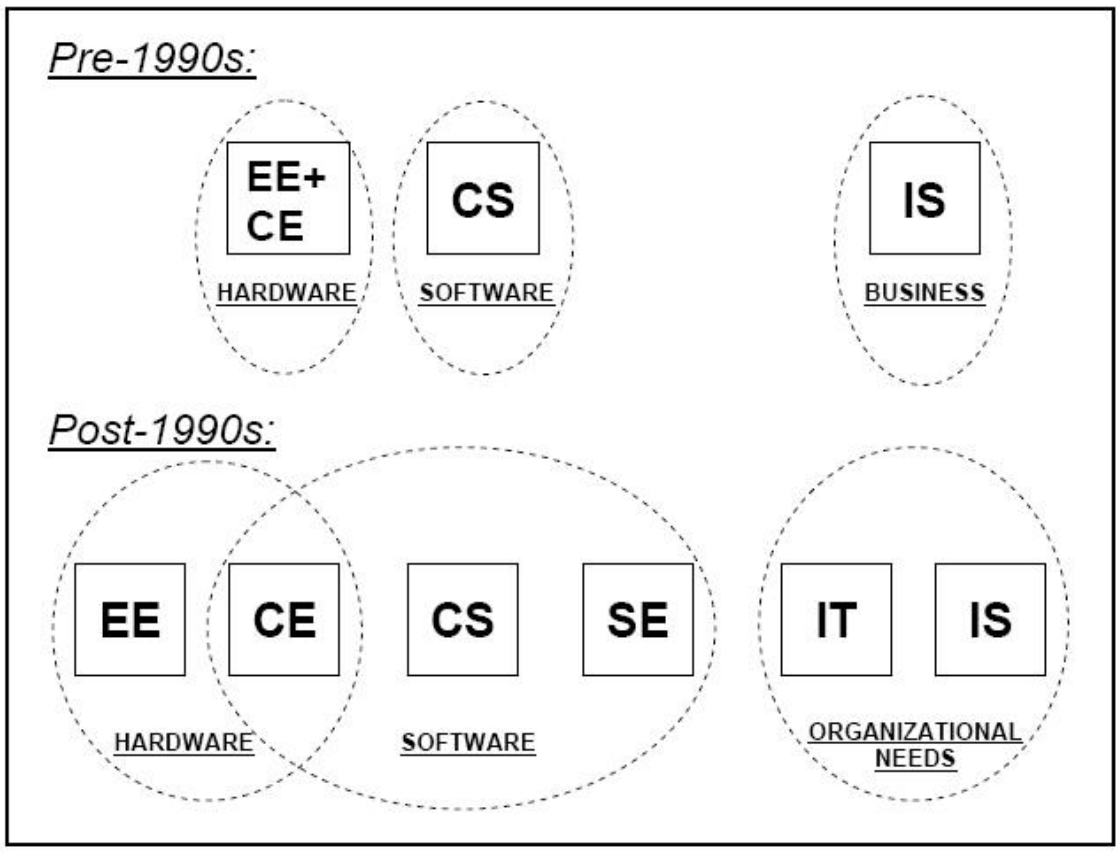

Figure 1. Informatics Subject Areas

In a CE curriculum hardware dominates. Among the popular subjects of CE, one can list, embedded systems, distributed systems, VLSI Design, Digital Signal Processing and Hardware Testing.

2.2. Computer Science (CS)

CS is concerned with a wide range of subjects including algorithm design, software development, and theory of computation, intelligent systems, formal languages and bioinformatics. The CE curriculum incorporates algorithms, network communications, database systems, data mining, pattern recognition and GUI development heavily in its content.

2.3. Software Engineering (SE)

SE deals with the design and development of large scale software. Other important areas of this branch are testing, maintenance, quality, validation and verification of software. SE curriculum is either partially incorporated in CE or CS programs or implemented as a complete degree program via SE departments.

2.4. Information Systems (IS)

IS mainly concerns with the effective use of information technologies within the corporations. Study areas cover basically information and communications. Such degree programs are offered by the Faculties of Economics and Administrative Sciences (FEAS). IS curriculum integrates management and computing subjects in a suitable manner.

2.5. Information Technologies (IT)

There are two different points of view about IT. The first of which considers IT as the whole of Informatics area. Meanwhile, the second considers the IT area as a subject dealing with the technological needs of the corporations. In view of the latter, in an IT curriculum, installation and operation of computer systems, formation of computer networks, network security, web design and multimedia design subjects are incorporated.

2.6. Comparisons

The general characteristics of each subject area given above may present some differences depending on the institution/university. In addition to these short descriptions, a table is prepared and proposed by the joint task force of the ACM/IEEE [2] based on the experiences of the joint task members on a 0-5 scale, 0 representing the minimum and 5 representing the maximum contribution to the curriculum in the respective subject areas. A maximum grade 5 indicates that proposed topic should be placed in the corresponding subject curriculum. This table is of particular use for the curriculum developers.

Table 1. A Comparison of Informatics Subjects on a 0-5 Scale

Topic to be covered	CE		CS		IS		IT		SE	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Programming Fundamentals	4	4	4	5	2	4	2	4	5	5
Integrative Programming	0	2	1	3	2	4	3	5	1	3
Algorithms & Complexity	2	4	4	5	1	2	1	2	3	4
Computer Architecture & Organization	5	5	2	4	1	2	1	2	2	4
Operating Systems Principles & Design	2	4	3	5	1	1	1	2	3	4
Operating Systems Configuration & Use	2	3	2	4	2	3	3	5	2	4
Net Centric Principles & Design	1	3	2	4	1	3	3	4	2	4
Net Centric Use & Configuration	1	2	2	3	2	4	4	5	2	3
Platform Technologies	0	1	0	2	1	3	2	4	0	3
Theory of Programming Languages	1	2	3	5	0	1	0	1	2	4
Human-Computer Interaction	2	5	2	4	2	5	4	5	3	5
Graphics & Visualization	1	3	1	5	1	1	0	1	1	3
Intelligent Systems (AI)	1	3	2	5	1	1	0	0	0	0
Information Management (DB) Theory	1	3	2	5	1	3	1	1	2	5
Information Management (DB) Practice	1	2	1	4	4	5	3	4	1	4
Scientific Computing (Numerical Methods)	0	2	0	5	0	0	0	0	0	0
Legal/ Professional / Ethics / Society	2	5	2	4	2	5	2	4	2	5
Information Systems Development	0	2	0	2	5	5	1	3	2	4
Analysis of Business Requirements	2	5	2	4	2	4	3	5	3	5
Engineering Foundations of SW	1	2	1	2	1	1	0	0	2	5
Engineering Economics for SW	1	3	0	1	1	2	0	1	2	3
Software Modeling & Analysis	1	3	2	3	3	3	1	3	4	5
Software Design	2	4	3	5	1	3	1	2	5	5
Software Verification & Validation	1	3	1	2	1	2	1	2	4	5
Software Evolution (maintenance)	1	3	1	1	1	2	1	2	2	4
Software Process	1	1	1	2	1	2	1	1	2	5
Software Quality	1	2	1	2	1	2	1	2	2	4
Computer Systems Engineering	5	5	1	2	0	0	0	0	2	3
Digital Logic	5	5	2	3	1	1	1	1	0	3

Distributed Systems	3	5	1	3	2	4	1	3	2	4
Security: Issues & Principles	2	3	1	4	2	3	1	3	1	3
Security: Implementation and management	1	2	1	3	1	3	3	5	1	3
System Administration	1	2	1	1	1	3	3	5	1	2
Systems Integration	1	4	1	2	1	4	4	5	1	4
Digital Media Development	0	2	0	1	1	2	3	5	0	1
Technical Support	0	1	0	1	1	3	5	5	0	1

A closer look at the rows with a 0 (min) or 5 (max) grade reveals the fact these extreme indicators are conformable with the description of each subject area as specified above. For example, for the CE subject area, Computer Architecture, Computer Systems Engineering and Digital Logic topics are compulsory. In the subject areas other than CE, maximum grade of 5 is not common. This may be due to the fact that, the topics other than the topics of CE are incorporated into the curriculums with varying degrees of importance. In other words, there is either no clear distinction between those subject areas or voters in the joint task force have different opinions on the subject area coverage.

3. INFORMATICS DEGREE PROGRAMS IN TURKEY

In Table 2 below informatics undergraduate degree programs in Turkey are given. [3]. CE programs constitute the majority of the programs within the Faculties of Engineering. Currently, the student intake into informatics undergraduate programs is about 3951 students in 74 programs including the ones in the Northern Cyprus Turkish Republic. The majority of the university programs is in Computer Engineering (CE). Another well identified area is Software Engineering (SE). Recently, several universities are adopting the title "Information Systems Engineering" to provide man power in the field of networking and security.

Table 2. Informatics Undergraduate Programs in Turkey

Department	Classification	No	Description	2007 intake by general examination
CE	Turkey-Public	26+2	Two departments run 2 programs during the day and 1 program is run in the Cyprus extension campus of METU	2631
	Turkey-Foundation (Private)	22	Programs with full scholarship, half scholarship and tuition fee coverage	
	Turkish Republic of Northern Cyprus	5	Eastern Mediterranean University , Girne American University, Near Eastern University, Lefke University, International Cyprus University	366
CS	Turkey	1	Istanbul Bilgi University	90
	Turkish Republic of Northern Cyprus	1		
ISE[1]	Turkey	1+2	Istanbul Technical University, Doğuş University, and Atılım University	163
	Turkish Republic of Northern Cyprus	1	Eastern Mediterranean University	40
SE	Turkey	4	Izmir Economy University, Atılım University, Bahçeşehir University, Işık University	166
MIS / IT/IS	Turkey	5	Bilkent University (IT and IS), Yeditepe University (IS and IT), Başkent University (Information and Document Management), Kadir Has Univ. (MIS), Okan Univ. (IS and IT)	250

[1] ISE=Information Systems Engineering

	Turkish Republic of Northern Cyprus	4	Eastern Mediterranean University, Girne American Univ., Lefke European Univ., Near Eastern University	245

Since the majority of the programs are CE, it is meaningful to produce a table similar to Table 1 only for CE area. In Table 3 topics are rated between 0-5 based on the CE curricula and the experience of the representatives from different universities involved in the research report [2]. A straightforward comparison between the two tables reveals the fact that there are major discrepancies in the weights assigned. For example, while CE programs in the ACM/IEEE report gives a very little weight to Information Management and Programming Fundamentals, Mathematical Foundations and Algorithms, programs in Turkey, get considerably higher weights. There are several explanations to this discrepancy: (1) Historically, CS programs are founded by non-EE staff (2) It is advantageous to be in an engineering faculty (3) development of hardware area was rather slow in the EE departments (4) majority of the CE graduates find jobs in the software related areas. Nevertheless, a balance of Hard/Soft topics is maintained in almost all degree programs depending on the background of the academic staff and the interests of the local community.

4. RESTRUCTURING

While the CE departments in Turkey design their curricula under the recommendations of ABET, they adjust their subject areas according to the requirements of the informatics sector and the job market. Instead of discussing the reasons for the current status, it would be more meaningful to think about the restructuring of the informatics programs. In the last 5 years, 5 new programs in SE are opened in different universities. Moreover, İzmir Economy University has established a Computer Engineering Faculty comprising of two departments and programs in CE and SE. Since, the highest authority for approving degree programs is the Higher Education Council (YÖK), it is the responsibility of the informatics community to take the initiative for restructuring the informatics programs and make necessary recommendations to YÖK for the new degree programs based on the EU standards, and local parameters.

The authors of this article believe that universities with more than 3 departments in the area of informatics should be structured in the form of a faculty. For example, based on the size of the university, a faculty of informatics can be a house for CS, IS and IT departments. Similarly, CE, SE and Information Systems Engineering Departments can be placed in an engineering faculty or in a faculty of informatics. When a separate faculty is not possible, it may be feasible to place the CE and SE departments in the faculty of engineering and the others in the faculty of arts and sciences. In Turkey, MIS area is not well-defined. Usually, a few numbers of topics are offered by faculty of administrative sciences.

Table 3. CE Subjects in Turkey on a 1-5 Scale

Subject Area	Min (5)	Max (5)
Programming Fundamentals	5	5
Algorithms & Complexity	4	5
Computer Architecture & Organization	4	5
Operating Systems Principles & Design	4	5
Operating Systems Configuration & Use	2	3
Net Centric Principles & Design	3	5
Net Centric Use & Configuration	2	3
Platform Technologies	0	2
Theory of Programming Languages	3	5
Human-Computer Interaction	0	3
Graphics & Visualization	3	5
Intelligent Systems (AI)	3	5
Information Management (DB) Theory	4	5
Information Management (DB) Practice	3	4

Scientific Computing (Numerical Methods)	2	5
Legal/ Professional / Ethics / Society	0	4
Information Systems Development	2	4
Analysis of Business Requirements	1	4
Engineering Foundations of SW	2	4
Engineering Economics for SW	0	1
Software Modeling & Analysis	3	4
Software Design	3	5
Software Verification & Validation	1	3
Software Evolution (maintenance)	1	1
Software Process	3	5
Software Quality	1	2
Computer Systems Engineering	5	5
Digital Logic	5	5
Distributed Systems	3	4
Security: Issues & Principles	2	4
Security: Implementation & management	1	2
System Administration	1	3
Systems Integration	2	3
Digital Media Development	0	1
Technical Support	0	1
Automata Theory & Formal Languages	4	5
Embedded Systems	3	5
Circuits & systems	4	5
Electronics	3	5
Digital Signal Processing	3	5
VLSI Design	0	4
Hardware Testing & Fault Tolerance	0	3
Mathematical Foundations (Discrete Mathematics, Probability and so on)	5	5
Information Systems Organization Management	0	1
Decision Theory	0	3
E-business	0	3
General System Theory	0	1
Risk Management	0	2
Project Management	1	2
Business Requirements Analysis	0	1
Communication	1	4

5. LIST OF ABBREVIATIONS

Abbreviation	Name
TBV	Turkish Informatics Foundation
ACM	American Association for Computing Machinery
IEEE	Institute of Electrical and Electronics Engineers
VLSI	Very Large Scale Integrated Circuits
FEAS	Faculty of Economics & Administrative Sciences

6. CONCLUSIONS

Several suggestions are made for the development of informatics programs in Turkey:

- The reports prepared by ACM/IEEE and the TBV should be carefully evaluated by the Higher education council.
- Job opportunities and the required informatics personnel should be carefully evaluated a degree programs should be modified to meet the global and local demands.

- Variety of informatics programs should be offered according to the recommendations by the Higher Educational Council. For example, CS programs in the Faculty of Science and Arts should be expanded.

7. REFERENCES

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