COMPUTERS AND SOCIETY: A PROPOSED COURSE FOR COMPUTER SCIENTISTS

by

E. Horowitz, H. L. Morgan, and A. C. Shaw

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Department of Computer Science
Cornell University
Ithaca, New York 14850
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ABSTRACT:

The purpose of this paper is to describe a course concerned with both the effects of computers on society and the responsibilities of computer scientists to society. The impact of computers is divided into five components: political, economic, cultural, social, and moral; the main part of the paper defines each component and presents examples of the relevant issues. In the remaining portions, we discuss the possible formats for such a course, give a topic by topic outline, and list a selected set of references. It is hoped that the proposal will make it easier to initiate courses on this subject.

KEYWORDS: Computers and society, social implications, course proposal.

CR CATEGORIES: 1.0, 1.52, 2.1.
Introduction

Today, we are witnessing some of the disastrous effects of technology upon man and his environment. Many people have concluded that research without concern for its influences on all aspects of society can become a destructive rather than a constructive mechanism. Technological and scientific discoveries such as the automobile, nuclear power and pesticides all are examples of developments which have had both positive and negative effects in their application. Our fragmented institutions of higher learning tend to perpetuate a lack of societal concern since the study of science and the study of society are kept in separate classrooms. However, some universities have recognized this dichotomy and are presently offering or planning to offer courses on the interaction between society, and science and technology. A course on the impact of computers is clearly appropriate in these programs.* While there are many publications describing the virtues and vices of computers, there has not yet been published an outline for such a course.

The purpose of this paper is to present a practical organization to make it easier to initiate courses of this type. The course to be described here is intended primarily for undergraduate and graduate computer science majors and assumes a background equivalent to a year's introductory sequence in hardware and programming systems. The main objectives are to educate computer scientists on the present and future impact of computer technology, to investigate

*By computers we mean the entire spectrum of programmers, software and hardware associated with a computer system.
some of the difficult moral questions concerning the responsibilities of scientists, and to gain a more humanistic perspective on the use and misuse of computers.

In the main part of the paper, the course content is briefly described with the aim of delineating the scope of each topic and presenting some illustrative examples. Possible formats are then discussed in the following section. Finally, the appendix contains a detailed outline of the proposed course and a selected bibliography.

The Course

The topics covered and order of presentation during the course are roughly as follows. The first few lectures and discussions are devoted to a brief review of the present state of the art of computer hardware and software, short and long range predictions on technological advances [3], and to summarizing the international and national economics and applications of computers [11]. Some areas of technology which might be discussed today are: 1) the development of telecommunications; 2) the manufacture of cheap, large storage; 3) the growth of computer utilities; and 4) the proliferation of inexpensive, mini-computers.

The remainder of the course can be organized in several different ways: by specific applications e.g. the national data bank, by technology e.g. telecommunications or by societal components. In order to emphasize the impact on society over technological questions we have chosen the latter organization using the headings: political, economic, cultural, social, and moral implications. These categories are certainly over-
lapping but define different perspectives on society. In general, the order is such that the study proceeds from the "harder" to the "softer" components. We leave the moral and ethical implications to the end since these permeate the other four and represent a unifying theme for the course.

Political

The political area of impact includes both government use of and government regulation of computers. Increasingly, governments are using computers to compile, organize and analyze the data of their citizens. These data banks provide benefits of economy and efficiency in governmental operation, although serious questions arise over their use. What sort of information can the government legally require of its citizens and how should government be constrained from using this data are two such examples.

Governments at all levels are incorporating automated data files within their operations. Law enforcement agencies now have data banks on everything from criminals to traffic control. Legislative bodies are using computers to maintain up-to-date information on bills that are introduced into their houses. The judiciary is beginning to use computers to speed up the processing of court cases. Though all of these uses provide benefits, there are certain threats which are implicit in applying the new technology. A tendency towards centralization can well lead one branch of government to expand its role, thus taking away the perogatives of another branch. Governments concerned only with efficiency may impinge on the personal freedom of its citizens.
Laws have already been passed in several countries to regulate private data banks and there is interest in explicitly defining and guaranteeing the right to privacy for individuals. It is to be expected that over the next few years there will be more legislation and more adjudication regarding computers and their uses. It should certainly be the concern of computer scientists to be familiar with and to help create these laws.

One can also consider the concomitant effect of the private use of computers on government. Computer analyzed voter profiling for example has become a standard technique among politicians. Even further one can explore the implications of real-time referenda as a viable technique to strengthen the democratic system or as a tool for demagoguery.

Economic

The economic and financial structure of society is changing at both an organizational and an individual level as a result of the computer. It would be difficult, if not impossible, for modern industrialized economies to function without the aid of computers. In the course, one can examine several key areas in which computers interact with economic systems.

First, there has been a massive change in the flexibility with which individuals and corporations can obtain and manage money. The international credit systems, such as Mastercharge and Bankamericard which permit an individual to obtain credit throughout the world almost instantly, would not be possible without computers. Yet, will the cashless society merely simplify our financial dealings? Other possible effects would
be to fuel inflation and to aggravate the impact of recession.

Second, the ability of computers to aid in automating processes which had been performed by humans is causing a change from a labor intensive economy to a computer and machine intensive economy. Whereas the industrial revolution permitted men to rid themselves of some manual labor, the computer revolution permits men to be relieved of many decision processes. Which decisions do we want to delegate and which are too critical to be left to machines?

Third, corporate structures are changing as a result of the availability of large-scale information systems with telecommunications capability. The international decentralized, conglomerate corporation is now a reality because management can have up-to-date accounting and other information with which to make decisions, while leaving control of production, etc. to the individual divisions. If left unchecked, these corporations may produce harmful multinational economic effects.

Cultural

The computer is having a substantial impact both on our culture and on the institutions that embody it. In education investigations are underway to create programs that will allow truly individualized instruction. How can these systems be prevented from leading instead to increased mechanization and standardization of the educational process. Libraries are beginning to offer the benefits of computerized catalogues and indexes; and research is being done to create fully automated information retrieval systems. In the universities, social scientists and humanists as well as physical scientists are
Computerized art, films, music, and literature raise the question of whether to utilize the computer in the creative arts or to leave these enjoyable pursuits to man.

Popular culture has come to reflect the tension that exists between the view that the machine is a beneficent giver of progress and the view that it is a threat. The full spectrum of attitudes is revealed in the characterization of the computer in science fiction, popular films, television and cartoons. The public image is a mixture of fact and fiction; computers who make out payroll checks merge with the "great brains" and robots of fantasy. The computer scientist should be aware of these misconceptions and the ways in which they may be corrected. For above all, the computer in the popular mind has become the symbol of the ever-increasing world of mechanization that is impinging on human life.

Social

Social aspects consist of the study of how individuals and groups might interact in a society that is potentially dominated by computers, and the examination of the new social groups and new activities created in response to the threats and promises of machines. This area clearly covers many of the topics already mentioned in the other areas; for example, many of the cultural aspects could equally well be described as social instead. The content of this part of the course will be restricted to several specific topics not treated elsewhere.

Of obvious importance is the widely predicted, and perhaps already realized, appearance of a technocratic elite with powers beyond the control of the traditional legal and political system. The behavior and significance to society of a computer
elite can be studied by looking at those corporations and government agencies where one presently exists and by examining other current and past elite groups in areas such as banking, the military, science, and other professions.

A second topic of significance arises from the sociology and psychology of man-machine interaction. If much of a human's activities is spent in written, graphical, and verbal dialogue with machines as opposed to other humans, man's view of himself, others, and his institutions will probably change profoundly. This question can be investigated by examining the personality and group characteristics of programmers, by case studies of children receiving computer-aided instruction or even of psychiatric therapy through computer interaction.

A third area is the projected increase in leisure time for a large segment of the population caused not only by computers but by the use of machines of all types to replace physical and mental labor. What should the man of the future do in his leisure time? Will he turn to computerized games or will he return to activities of the pre-industrial society.

Moral

This final part of the course examines the moral responsibilities of both individual computer scientists and professional computer societies. The many issues raised in the course will be brought together to indicate the complexity of making a decision that is both technically and morally wise. What should a computer specialist do when asked to work on applications or research which might be used for causes he considers morally repugnant? Should the profession have
technical information, regardless of the reason?

The code of ethics published by the ACM provides an appropriate discussion topic for the individuals responsibilities. The adequacy of this code can be investigated by comparing it with those for other professions and by testing it with various real and imaginary scenarios. A good and controversial example of such a scenario appears in the feasibility arguments for the U.S. anti-ballistic missile system proposals of 1969.

The role of the professional society can be studied in a similar manner. Is the computer profession different in character from other professions such as engineering, medicine and law? Other significant questions can be raised. Should computer programmers be licensed? Should the societies take public positions on political and social issues; if so, what sort of mechanisms should they set up to aid these advisory processes?

Course Format

The nature of instruction in the social implications of computing is different from that found in most technical courses. One must impart not only understanding and knowledge, but also the motivation and encouragement necessary to ensure that the student will consider these implications in his future work.

We propose a course whose format includes both lectures and discussion sections. Lectures are used to motivate the students and to provide though provoking material of both a technical and non-technical nature for the discussion sessions.
cover as broad a range of topics as outlined here. For example, a lawyer might lecture on privacy rights of individuals, and the laws of patent, copyright, and trade secrets; an educator could describe the impact of computers on curriculum and the instructional process.

In a course such as this, students should be challenged to read, think, and explore sensitive issues. There are several ways in which their explorations may be channeled.

1. Surveys in which the students go out into the world to gather data. Examples might include a study of security at several local databanks, a look at community attitudes towards computers, or a survey of the frequency with which errors occur in a particular system (say department store billing).

2. Papers for which the student is required to do some research, e.g. a study of local laws affecting privacy, of computers in science fiction, of computerized education.

3. Projects in which the students propose solutions to problems—e.g., a proposal for safeguards on the campus computer system to protect student records.

4. Formal debates or panel discussions on controversial issues such as: National Data Bank, can computers think, should there be government standards for computing.

Some of these additional assignments could be presented to the discussion sessions or perhaps in lectures. The insights which can be gained from real world studies may well
For effective discussions the class should be divided into small groups. One must take care to ensure that they are moderated and do not degenerate into "rap sessions", which, while entertaining, may not provide the proper forum to raise all of the issues. From our limited experience it seems useful to have more than one professor at each discussion. This lets the students know that there are often different opinions on the subject of computers and society, and encourages them to voice their own opinions.

The availability of competent instructional personnel is always a problem with a new area. In this case, it can be solved in two ways. First, if proper rewards for teaching such a course are offered within the computer science departments, technically able people will be encouraged to broaden their horizons. Second, the use of team teaching methods might bring in the assistance of members of other university departments such as political science, sociology, psychology, law and philosophy.

Thus, the format of the course is directed at giving the student a chance to develop and articulate his own thoughts on the relationships between computers and society, while at the same time building those opinions on the technical knowledge he has accumulated in his computer science courses.

Conclusions

Computers and society are interacting in many ways, and we feel that it is essential that computer science students become aware of these interactions. For this to happen, a course such as the one proposed here must become a serious part of the computer science curriculum. Courses in this
area are now being offered at a number of institutions, including the University of Toronto, University of California at Berkeley, and the University of Wisconsin, and also by the authors at Cornell University. While variation to fit the pattern of different schools is necessary, we feel strongly that the concept of a standard course (e.g. 3 hours per week) mandatory if it is to be taken seriously. We as computer scientists, have a responsibility to the society in which we live, and this must be made clear to our students if we are to avoid suffering the crisis of conscience which has plagued the nuclear physicists over the last 25 years.

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Appendix

Computers and Society (1-2-3)

Approach

The course is designed to bring the perspectives of the sciences, social sciences and humanities to the question of the impact of computers on society. Lectures are used to present factual material and provide a forum for guest lecturers to motivate the students. Small group discussions give the student the opportunity to voice his opinions. Projects, papers, and surveys may be used to channel the students exploration of these areas.

Content


*The format of this appendix conforms to that used in the Curriculum 68 report. The authors, however are in no way connected with the ACM Curriculum Committee on Computer Science.


BIBLIOGRAPHY

We have not compiled an exhaustive list of references since the purpose of this paper is not to survey the field but to present a practical course outline. Each item below was selected either because it is suitable as a text for the course e.g. [10], or because it contains a thorough treatment of some important topic, e.g. [12].


