2. The Nature of Computer Science

We begin by surveying the field of computer science, projecting some future developments, and placing the field in context in academia and society. In Section 2.1, we describe the scope of the field we consider to be computer science. In Section 2.2 we make some projections about the kind of computing we may be doing ten years hence. On the basis of these projections, we predict some of the issues the field must face over the next decade and some of the changes we must anticipate.

2.1. Working Definition of Computer Science

There is no generally accepted definition of the field of computer science, and we do not expect to remedy that deficiency here. Nevertheless, we need a characterization of the discipline in order to focus our discussions. The curriculum design presented in this report is based on the following working definition.

Computer science is concerned with the study of computers and of the phenomena connected with computing, notably algorithms, programs, and programming. A major objective of the discipline is the formulation of a systematic body of knowledge, theories, and models to explain the properties of computers and of these related phenomena. Computer (or computational) systems often exhibit extremely complex structure and behavior; techniques for identifying, quantifying, and managing complexity are therefore central to computer science. The discipline is also concerned with producing solutions to technological (real-world) problems using a detailed knowledge of the properties and the applicability of current computing technology. Since there are usually many different ways to solve a problem, an important engineering activity is evaluating, comparing, and selecting alternatives on the basis of criteria such as cost or efficiency. Unlike the natural sciences, computer science studies objects and systems that are artificial. Since both the rules and the artifacts can be modified by the scientist, this can be both a problem and an advantage.

A description of computer science should include not only its subject matter, but also its characteristic paradigms and modes of analysis, reasoning, and problem solving. Computer science borrows heavily from mathematics, using analytic and synthetic techniques such as inductive definitions and case analysis. But it is not exclusively a formal, quantitative field, because the need for practical systems suitable for human use leads the field to rely, for example, on design and modelling techniques from engineering and on studies of human performance and behavior from psychology. In addition, the leading edge of computer science is moving rapidly. As a result, particular examples or techniques become obsolete and research results move rapidly into the body of pragmatic knowledge.
Using this working definition as a starting point, we conclude that the curriculum must deal with:

- Computers and related phenomena: machines and computations, both real and abstract.
- Algorithms, programs, and programming: techniques for creating and analyzing them.
- Complex structure and behavior of information: how to identify, quantify, and manage it.
- Engineering concerns: cost-effective solutions to technological problems and the application of current technology.
- Design tradeoffs: how to compare and select alternatives with respect to given criteria, and some appropriate criteria for such decisions.
- Human performance: the ways people use computers and the ways they manage complex problems.

Computer science is growing rapidly, and the curriculum must be able to react rapidly as well. It must be flexible enough to allow adaptation to changes in both technology and current philosophy, and it must provide students with an education of lasting value despite these changes. It must be broad enough to train computer scientists who can interpret the evolution of computer science to laymen. Further, it must make students aware of the roles of computers in society, because as professionals in a field that will so change society they must be able to make informed, responsible decisions that will affect the lives of many.

### 2.2. A View of Future Computing

The nature of computing, and hence of computer science, is changing rapidly. Many topics that now seem interesting will be obsolete or irrelevant within ten years. If the curriculum we design now is to remain effective into the 1990's, we must try to understand the forces that are shaping the field and to anticipate the roles that computing and computer science will play in the future. This section points out some of the trends that will affect the field over the next decade and describes some of the new phenomena and issues that may arise.

Computers are becoming smaller and cheaper, and they are being distributed across a wider and more varied population. Important current trends include:

- Decreasing hardware costs
- Increasing share of computing costs attributable to software
- Increasing expectations about the power and reliability of application systems
- Increasing range of applications, particularly those on which lives will depend