THE UNIVERSITY of EDINBURGH
informatics

WHAT IS INFORMATICS?

Informatics is the study of the structure, behaviour, and interactions of natural and engineered computational systems.

Informatics studies the representation, processing, and communication of information in natural and engineered systems. It has computational, cognitive and social aspects. The central notion is the transformation of information - whether by computation or communication, whether by organisms or artifacts.

Understanding informational phenomena - such as computation, cognition, and communication - enables technological advances. In turn, technological progress prompts scientific enquiry. The science of information and the engineering of information systems develop hand-in-hand. Informatics is the emerging discipline that combines the two.

In natural and artificial systems, information is carried at many levels, ranging, for example, from biological molecules and electronic devices through nervous systems and computers and on to societies and large-scale distributed systems. It is characteristic that information carried at higher levels is represented by informational processes at lower levels. Each of these levels is the proper object of study for some discipline of science or engineering. Informatics aims to develop and apply firm theoretical and mathematical foundations for the features that are common to all computational systems.

THE SCOPE OF INFORMATICS

In its attempts to account for phenomena, science progresses by defining, developing, criticising and refining new concepts. Informatics is developing its own fundamental concepts of communication, knowledge, data, interaction and information, and relating them to such phenomena as computation, thought, and language.

Informatics has many aspects, and encompasses a number of existing academic disciplines - Artificial Intelligence, Cognitive Science and Computer Science. Each takes part of Informatics as its natural domain: in broad terms, Cognitive Science concerns the study of natural systems; Computer Science concerns the analysis of computation, and design of computing systems; Artificial Intelligence plays a connecting role, designing systems which emulate those found in nature. Informatics also informs and is informed by other disciplines, such as Mathematics, Electronics, Biology, Linguistics and Psychology. Thus Informatics provides a link between disciplines with their own methodologies and

perspectives, bringing together a common scientific paradigm, common engineering methods and a pervasive stimulus from technological development and practical application.

Three of the truly fundamental questions of Science are: "What is matter?", "What is life?" and "What is mind?". The physical and biological sciences concern the first two. The emerging science of Informatics contributes to our understanding of the latter two by providing a basis for the study of organisation and process in biological and cognitive systems. Progress can best be made by means of strong links with the existing disciplines devoted to particular aspects of these questions.

COMPUTATIONAL SYSTEMS

Computational systems, whether natural or engineered, are distinguished by their great complexity, as regards both their internal structure and behaviour, and their rich interaction with the environment. Informatics seeks to understand and to construct (or reconstruct) such systems, using analytic, experimental and engineering methodologies. The mixture of observation, theory and practice will vary between natural and artificial systems.

In natural systems, the object is to understand the structure and behaviour of a given computational system. The theoretical concepts underlying natural systems ultimately are built on observation and are themselves used to predict new observations. For engineered systems, the object is to build a system that performs a given informational function. The theoretical concepts underlying engineered systems are intended to secure their correct and efficient design and operation.

Informatics provides an enormous range of problems and opportunities. One challenge is to determine how far, and in what circumstances, theories of information processing in artificial devices can be applied to natural systems. A second challenge is to determine how far principles derived from natural systems are applicable to the development of new kinds of engineered systems. A third challenge is to explore the many ways in which artificial information systems can help to solve problems facing mankind and help to improve the quality of life for all living things. One can also consider systems of mixed character; a question of longer term interest may be to what extent it is helpful to maintain the distinction between natural and engineered systems.