Barbara Von Eckardt, *What Is Cognitive Science?* Cambridge, MA: MIT Press. x + 466pp. $45.00.

Cognitive science is the interdisciplinary study of mind and intelligence, embracing areas of psychology, philosophy, computer science, linguistics, anthropology, and neuroscience. Although its intellectual roots go much farther back, cognitive science emerged as a recognized enterprise in the mid-1970s, when the Sloan Foundation began to fund cognitive science at a handful of universities. Although Sloan funding lapsed long ago, cognitive science has continued impressive growth, evident both in the number of publications that identify themselves as belonging to cognitive science and in the proliferation of cognitive science programs at numerous universities.

At its weakest, cognitive science is just the union of the interests and approaches of researchers in the half-dozen fields concerned with the nature of mind. It becomes stronger and much more interesting if it is possible to identify intersections that constitute core assumptions concerning the interdisciplinary study of mind. Barbara Von Eckardt has attempted to identify the basic assumptions of cognitive science construed intersectively, and she has succeeded to an impressive extent. This book is not a survey of cognitive science, for she discusses only two examples of cognitive science research in any detail: Kosslyn's work on mental imagery and parallel distributed processing models. But from these works and others she has abstracted four sets of assumptions, concerning 1) the domain of cognitive science, 2) the basic questions it attempts to answer, 3) the postulated representational and computational character of the mind, and 4) the methodologies that are appropriate.

For many philosophers of mind and language, the most interesting part of the book will be chapters 4-8, which provide a thorough discussion of the nature of representation. After a useful application of Peirce's theory of representation, Von Eckardt reviews current philosophical approaches to the problem of how mental representations can have content and significance: how can thoughts mean anything? This is not a problem that cognitive science researchers from outside philosophy typically worry about, for their concern tends to be more with what kinds of representations (images, rules, schemas, distributed representations, etc.) are best suited for modelling the mind, rather than with representation in general.   Von Eckardt provides a comprehensive and interesting discussion of the philosophical issues underlying representation.

From the perspective of mainstream cognitive science research and the philosophy of science, the most interesting chapters are 1-3 and 9, which are more directly concerned with the nature of explanations given by researchers who develop computational models of mind. She recognizes that the assumption that thinking is computation is best thought of in terms of high level computational systems such as symbol processors or connectionist machines, not in terms of abstract computational notions such as the Turing machine. She describes how computational answers can be given to questions concerning basic human cognitive capacities. Her description is quite general and accurate as far as it goes, but it does not give a detailed picture of the role of computer models in cognitive science methodology. Considering the mind as a computational system has several complementary contributions. First, as Von Eckardt recognizes, the computer metaphor provides a set of explanatory ideas that can be applied to explain the results of psychological experiments. But explanations at this level are very loose. The second and more important use of computational ideas requires the development of detailed computational models whose performance can be compared with that of human subjects. Developing a running computer program requires making the explanatory ideas much more specific and often reveals holes in the initial conception. Discrepancies between the behavior of the human model and the known behavior of human subjects often leads to revision of the model. Third, computer models often suggest new psychological experiments to be performed, to see whether the model correctly predicts behavior that has not yet been observed. Computer models have various pitfalls, since care must be taken to determine that their performance genuinely tests the theoretical ideas they embody. Appreciation of the nature of cognitive science requires further understanding of this methodology.

Von Eckardt focuses on adult, normal, typical cognition. As a result, she neglects questions of development and learning that are important to current cognitive science. Theorists ranging from proponents of rule-based systems such as Allan Newell to connectionist such as Jay McClelland have emphasized the learning aspects of their approaches. Although Von Eckardt admits the relevance of neuroscience to cognitive science, she has little to say about the burgeoning lines of research that are both computational and neurological.

Another current trend that *What is Cognitive Science?* does not reflect is the increasing concern in several fields with social aspects of knowledge. Psychologists are increasingly talking of "distributed cognition", where knowledge is shared among various individuals. Similarly, in computer science there is rapidly increasing interest in distributed artificial intelligence, where intelligence is the result of multiple computers working together. In philosophy, there has been growing interest in social epistemology, considering knowledge normatively as well as descriptively in social contexts.

In concentrating on the central aspects of cognitive science in the 1980s, Von Eckardt pays little attention to the major challenges that cognitive science currently faces from various philosophical and empirical directions:

1) The phenomenological challenge. Cognitive science has not adequately considered the role of conscious experience in human thinking.

2) The ecological challenge. Cognitive science has been too much concerned with internal representations and computations and has not noticed the role that interactions with the world play in human thought.

3) The social challenge. Cognitive science has tended, until the developments described in the last paragraph, to ignore social aspects of knowledge.

4) The hermeneutic challenge. Cognitive science may be neglecting the role of narrative, interpretive explanations of human thought.

5) The dynamic systems challenge. For some purposes, it may be better to think of the mind as a nonlinear chaotic dynamic system than as a representational/computational system.

These challenges, as well as the internal developments in fields such as cognitive psychology and artificial intelligence, are likely to render obsolete many of the assumptions that Von Eckardt attributes to cognitive science.

Nevertheless, because it so insightfully presents much of the core of recent work in cognitive science, Von Eckardt's book is well worth reading. It is the best philosophical discussion of cognitive science to date.