The computer user as toolsmith by Saul Greenberg, University Press, UK, 1993, pp 187, £27.95, ISBN: 0 521 40430 4.

Saul Greenberg has provided a worthwhile contribution to the study of human-computer interaction. From his book's title and the series on human-computer interaction to which it belongs, one may expect an analysis of the leading edge techniques and tools used in computer science today and the contexts to which they are applied. This is a fact belied by the cover of the book, the title being presented on a desktop window so familiar to a whole spectrum of computer users today.

The core theme of the book is more apparent in its subtitle, "The use, reuse, and organization of computer-based tools", as it is these aspects of the use of UNIX, which was the primary focus of Greenberg's doctoral research, on which the book is based. At first this may appear as somewhat behind the times. Computer usage as a human activity having evolved in a very short period from the domain of academics composing commands in front of a glass teletype window to the interactive experience of icon and window systems. Nevertheless, the choice of UNIX is rightly justified by the author in that it is still in heavy use; it generalizes across many other systems; there is a well founded body of knowledge on UNIX; and UNIX users are common and readily available for study. It is these last couple of points that characterize the nature of the book with it primarily being a re-evaluation of existing theories and studies on the use of UNIX through Greenberg's own empirical investigations.

Although the penultimate two chapters of the book do deal with the organization of activities of computer use and implementations of environments to support such organization, such as Henderson and Card's ROOMS and Greenberg's own WORKBENCH, it is the reporting and explanation of the empirical work on UNIX commands, their reuse and the underlying hypotheses which is particularly noteworthy.

The book has a characteristically easy style to which potentially awkward concepts are approached. In the first chapter time is invested in exploring the notion of tools, from the simplest use of a cactus spine by Galapagos finches to the human refinement of tools into the complexity of machines. By the introduction of this framework the reader is allowed to place UNIX, and its utility as a general, flexible and heterogeneous computing environment, in relation to the diverse uses of computers in terms of application and programming environments. By justifying how general purpose computer environments may be viewed in terms of tools Greenberg explores how the provision of facilities to support the natural activity of task repetition may be better supported in UNIX and similar environments.

The six core chapters of the book present a well documented exploration and investigation of UNIX command language usage and history mechanisms. The work is clearly in the vein of empirical psychological investigation. However, a background in such research is not required by the reader as the ideas and data are clearly presented and explained, as are the techniques used, such as protocol analysis. In the tradition of good empirical studies the work is presented in a way that allows the reader to test the findings for themselves, if that is their inclination. More to the point the presentation of work in this way allows the reader to follow the analysis of the reuse problem and the final recommendations and thoughts of Greenberg.

Although, at first glance, there appears to be a narrow scope for investigation with the choice of UNIX, the comprehensive presentation of the studies, the accompanying explanations and resulting generalisations provide a clear insight and justification of such work in the area of human-factors. Throughout the book thought provoking ideas are given clearly with the provision of terminology and comprehensive references where necessary. This book shows the amount of thought and study that may be required to comprehensively investigate issues that at first sight appear to be side issues in the development of human-computer interfaces. It provides useful results from empirical studies for interpretation and some guidelines. Even though most UNIX based systems are now provided with windowing environments, they are still "syntactic sugar

extensions" to a command-based system which is shown by Greenberg to be open to redesign to further empower the user.

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Neurons and symbols—the stuff that mind is made of by I. Aleksander and H. Morton, Chapman & Hall, UK, 1993, pp 256, £24.95, ISBN, 0-412-46090-4.

Heated symbols-versus-neurons debates were common in the latter half of the 1980s and their rhetoric and conviction live on. Strong polar views on matters such as representation, computation, and relative value to cognitive science continue, but there is now also an accumulating body of work concerned with hybrid models and equivalence relations. Proponents of symbolic methods have a great deal of theory to support their formalism whereas connectionism is a relatively under-developed science. It is the imbalance in science's understanding of these two subjects which drives many to gain a better understanding of artificial neural systems, and which makes *Neurons and symbols* a timely volume containing a useful common analysis of both formalisms.

The book presents a new analysis of both neural and symbolic systems in terms of automata theory and then applies this perspective to the main themes in the modern history of artificial intelligence and cognitive science. Throughout the history the authors review major issues of contention between the connectionist and symbolic camps and with the benefit of their automaton perspective and hindsight make useful observations concerning earlier positions and theoretical predictions.

The role of symbolic and sub-symbolic models of cognition is examined through the development of AI covering such topics as natural language, problem solving and vision. Along side this the role of automata theory (synchronized, asynchronous, non-deterministic, etc.) applied to connectionism is considered as a key to understanding computational possibilities in cognitive science with the need for learning continually stressed. There follows an absorbing summary of the great neurons *versus* symbols debate of the mid 1980s. Repeated reference to the impoverished nature of symbolic learning may well be justified but the omission of any counter argument, like a reference to Newell's later work on Soar, seems a little out of hand.

In early chapters we gain an analytical understanding of the micro behaviour of simple neurons which gives insight into a great deal of macro behaviour in neuronal-models, for example there is a clear description of the attractor phenomenon. A light and interesting analysis of a general neural unit, unassuming mathematically, leads on to matters of cognition with artificial neural system problem solving. Goal, state and action representations are outlined for a neural state machine.

The analysis presented is a type of equivalence relation between symbolic and neural automata which leaves the reader considering all processes as automata but with the questions, are these symbolic or neural, are they describing an abstraction of both the symbolic and neural or is their view reductionist? (but never the less useful). Igor Aleksander and Helen Morton are able to present these interesting and important ideas by having an abstract and broad view of computation which leads them to a summary of emergent artificial neural system properties with respect to cognitive science and allows them to consider, for example, vision and internal representation, lesions to a neural state machine model, internal state-learning and abstract scaling up.

The book concludes with a straightforward summation of the neural state machine model (NSMM) using the devices of simplicity and freely admitted speculation to demonstrate and explain the role and potential of an automaton-like neural system in cognitive science, with evidence that the NSMM is well suited to dealing with the symbols in current neural models. The examples can be readily absorbed and important points of detail are described step-by-step.