

# Mind, Evolution, and Computers

Joseph R. Abrahamson

■ Science deals with knowledge of the material world based on objective reality. It is under constant attack by those who need magic, that is, concepts based on imagination and desire, with no basis in objective reality. A convenient target for such people is speculation on the machinery and method of operation of the human mind, questions that are still obscure in 1994. In *The Emperor's New Mind*, Roger Penrose attempts to look beyond objective reality for possible answers, using, in his argument, the theory that computers will never be able to duplicate the human experience. This article attempts to show where Penrose is in error by reviewing the evolution of men and computers and, based on this review, speculates about where computers might and might not imitate human perception. It then warns against the dangers of passive acceptance when respected scientists venture into the occult.

**S**cience is defined as systematic knowledge of the physical or material world. Such study and understanding are the province of a minority of humankind and are under constant attack by those who want or need magic to give purpose and meaning to their lives. Such people attack science even in areas where a vast body of evidence supports a scientific position (for example, the theory of evolution). However, they press their strongest attacks in those areas where objective knowledge is limited, and definitive answers are not yet available. A prime example of an area where such answers are not yet available is the mind—what it is and how it works. Many such magical thinkers would like to separate mind from matter, and they develop odd concepts in

which consciousness can exist without intrinsic material structure. With this vision of reality, they state that it will not be possible for humans to build a computer that can duplicate the consciousness of a human mind. I submit that such thinking is in error, even though some of its proponents are men of scientific training and great accomplishment.

A few years ago, a book by Roger Penrose, one of the world's most eminent physicists, was published. On the first page of chapter 1 of his book *The Emperor's New Mind*, Penrose (1989, p. 3) asks a few amazing questions:

The question of whether a mechanical device could ever be said to think—perhaps even to experience feelings, or to have a mind—is not really a new one. But it has been given a new impetus, even an urgency, by the advent of modern computer technology. The question touches upon deep issues of philosophy. What does it mean to think or feel? What is mind? Do minds really exist? Assuming that they do, to what extent are minds functionally dependent upon the physical structures with which they are associated? Might minds be able to exist **quite independently** of such structures? (emphasis mine).

To be fair to Penrose, he does state that his point of view “is an unconventional one among physicists and is consequently one which is unlikely to be adopted, at present” (p. 4). Penrose is a renowned physicist. His book is a tour de force in both the writing and the reading because it attempts to define *mind* and then

show how it will not be possible to build and program a computer to duplicate it. In this endeavor, he deals with many tools of science, including quantum theory, cosmology, mathematics, and algorithms. However, after reading his long and difficult book, I am left with the conviction that this scientist is not entirely comfortable with objective reality, the basis of science and reason, but is looking for some nonobjective, nontangible something to explain aspects of reality that are not yet understood. It is a method of thought that I refer to as *magical*.

**H**is opening questions are astounding, particularly when one considers that they come from an esteemed scientist. Can any one question that attributes must have, at their core, a physical object? Can mind exist without a central nervous system? Can motion exist without an automobile, an airplane, an atomic particle—something that does the moving? Unless Penrose can cite one example of an attribute existing in a vacuum and without a physical object as its basis, his question is one of magic or theology—but not science. He states, “I take the word ‘consciousness’ to be essentially synonymous with ‘awareness’... whereas ‘mind’ and ‘soul’ have further connotations which are a good deal less clearly defined at present” (p. 407). I submit that the word *soul* is a concept of theology and magic and has no place in a book of science. His suggestion that quantum theory is incomplete is reasonable, even though minds as great as Einstein's agreed but were never able to prove it. The theory that our description of the quantum world is incomplete, although even probably correct, still has no objective evidence to support it, nor do we have any knowledge about what a complete quantum theory might prove to be. It is, therefore, folly to speculate about what one might be able to say about macroscopic reality if current quantum theory ultimately does

# AAAI Conference Proceedings

AAAI PROCEEDINGS PROVIDE ARCHIVAL-QUALITY PAPERS summarizing the research advances made in artificial intelligence. Published annually, the series provides the researcher, librarian, or scientist with a record of scientific thinking in all areas of this fascinating field.

*AAAI-93—Washington, D.C.*

**Proceedings of the Eleventh National Conference on Artificial Intelligence**  
880 pp, index. ISBN 0-262-51071-5 \$75.00 softcover

*AAAI-92—San Jose, California*

**Proceedings of the Tenth National Conference on Artificial Intelligence**  
1000 pp, index. ISBN 0-262-51063-4 \$75.00 softcover

*AAAI-91—Anaheim, California*

**Proceedings of the Ninth National Conference on Artificial Intelligence**  
2 volumes, index. ISBN 0-262-51059-6 \$75.00 softcover

*AAAI-90—Boston, Massachusetts*

**Proceedings of the Eighth National Conference on Artificial Intelligence**  
2 volumes, index. ISBN 0-262-51057-X \$65.00 softcover

*AAAI-88—St. Paul, Minnesota*

**Proceedings of the Seventh National Conference on Artificial Intelligence**  
2 volumes, index. ISBN 0-262-51056-1 \$55.00 softcover

*AAAI-87—Seattle, Washington*

**Proceedings of the Sixth National Conference on Artificial Intelligence**  
2 volumes, index. ISBN 0-262-51055-3 \$55.00 softcover

*AAAI-86—Philadelphia, Pennsylvania*

**Proceedings of the Fifth National Conference on Artificial Intelligence**  
2 volumes, index. ISBN 0-262-51054-5 \$55.00 softcover

*AAAI-84—Austin, Texas*

**Proceedings of the Fourth National Conference on Artificial Intelligence**  
368 pp., index. ISBN 0-262-51053-7 \$45.00 softcover

*AAAI-83—Washington, D.C.*

**Proceedings of the Third National Conference on Artificial Intelligence**  
368 pp., index. ISBN 0-262-51052-9 \$45.00 softcover

*AAAI-82—Pittsburgh, Pennsylvania*

**Proceedings of the Second National Conference on Artificial Intelligence**  
441 pp., index. ISBN 0-262-51051-0 \$45.00 softcover

*AAAI-80—Stanford, California*

**Proceedings of the First National Conference on Artificial Intelligence**  
339 pp. ISBN 0-262-51050-2 \$40.00 softcover

To order any of these books, call toll free:

(800) 356-0343 or (617) 625-8569 or fax (617) 258-6779.

*MasterCard and VISA accepted.*

prove to be incomplete.

Penrose has a lucid discussion (p. 296) of quantum-level effects and their relationship to the classical-level effects that exist with the reduction of the state vector. At the end of this discussion, he states, "I believe that one must strongly consider the possibility that quantum mechanics is simply wrong when applied to macroscopic bodies...or, rather that [the various quantum phenomena] supply excellent approximations, only, to some more complete, but as yet undiscovered, theory" (p. 297). I agree with his suggestion that there is a larger or comprehensive theory that encompasses quantum theories or even general relativity and quantum theories. The fact that relativity, which is local, and quantum mechanics, which is nonlocal, have never been found to be in conflict would imply that each is part of the same larger concept. Indeed, if Einstein were correct in his view that nature is, at its base, simple, then there would have to be a larger, unified theory. However, I fail to see the logic in suggesting that the pieces of this theory that we now have are wrong as they stand.

In addition, although "descriptions of quantum theory appear to apply sensibly (usefully?) only at the so-called quantum level..." (p. 296), quantum effects do apply insensibly and for the most part nonusefully at the macroscopic level. This virtual disappearance of measurable quantum effect is explained by the vast numbers of particles that act together in forming the things such as the tables and chairs we deal with in the macroscopic world and that together cancel out almost all the "quantum weirdness" that is obvious when dealing with individual particles. A rough analogy that I use in my book (Abrahamson 1992) deals with the lack of gross movement in a large body at rest, something not seen in the individual particles that make it up. To use Penrose's analogy, we do not see a cricket ball in two places at once for this same reason.

The quantum effect residual in the macroscopic world is so infinitesimal that the macroscopic environment

appears to be deterministic. In addition, although quantum effect in the macroscopic environment is, therefore, insensible, its importance rests at the philosophical level that I infer interests Penrose. I propose (Abrahamson 1992) that this minute uncertainty effect eliminates the possibility of perfection or absolutes in the sensible world we inhabit. However, I cannot accept his argument that the postulated comprehensive theory will invalidate or change the necessary mechanical function of the animal brain in its production of consciousness. (He states, "I believe, also, that we shall need this new [comprehensive] law if we are ever to understand minds!" [p. 298].)

**I**venture a proposal about what mind might be (Abrahamson 1992). My description of mind is based on the fact that attributes do not exist in a vacuum and that mind is a function of the material central nervous system. It further assumes that this attribute of mind is part of the real world and is devoid of magic.

I use consciousness and mind almost interchangeably because cognition, thought, and feeling are not possible without consciousness. When one is trying to determine whether an injured human brain has any element of consciousness, the tests used always relate to whether the patient can sense; that is, is he or she able to respond to sound, touch, light, and so on. It is the afferent pathways of the brain that are used to test for this attribute. It is my theory that there is no center for consciousness but, rather, that consciousness is the by-product of the evolutionary process by which our brains integrate our various sensory input to give us our vision of the world in which we exist. Consciousness is the synthesis of our sensory input, an attribute of the functioning of our central nervous systems. The integrating area is probably at the base of the brain in the reticular substance because destruction of this area leads to permanent loss of consciousness. Consciousness ceases to

# Artificial Intelligence and Molecular Biology

**T**he enormous amount of data generated by the Human Genome Project and other large-scale biological research has created a rich and challenging domain for research in artificial intelligence. These original contributions provide a current sampling of AI approaches to problems of biological significance; they are the first to treat the computational needs of the biology community hand-in-hand with appropriate advances in artificial intelligence. Focusing on novel technologies and approaches, rather than on proven applications, they cover genetic sequence analysis, protein structure representation and prediction, automated data analysis aids, and simulation of biological systems. A brief introductory primer on molecular biology and AI gives computer scientists sufficient background to understand much of the biology discussed in the book.

Lawrence Hunter is Director of the Machine Learning Project at the National Library of Medicine, National Institutes of Health.

500 pp., \$39.95 ISBN 0-262-58115-9

**An AAAI Press Book,**

**Distributed by The MIT Press**

55 Hayward Street, Cambridge, MA 02142

To order call toll-free 1-800-356-0343

or (617) 625-8569 Fax (617) 625-6660

*MasterCard and VISA accepted*

exist when the physical machinery that creates it breaks down. There is no evidence to suggest that mind can exist without brain. The fact (commented on by Penrose) that a child might ask (p. 448), "What happens to each of our streams of consciousness after we die?" is not evidence that consciousness exists when our brains turn to dust. Poetry is wonderful, but it serves a different purpose than logic, and one cannot be substituted for the other. Childish questions are childish, and their use in this context suggests a need for magical thinking, or theology.

Again, early in his book, Penrose discusses theories concerning the possibility that computers might be developed in the future that would have human-type understanding and feeling. As I read his pages, I thought he had missed the point. I believe that to deal with this question, one must separate understanding from feeling. One must also understand the evolutionary process that created humans and computers if one is to discern their similarities and differences.

Humans have wants and needs, which evolutionary processes have

programmed into their DNA over the past three billion plus years. For example, we have hunger for food. If the original simple life form did not have a mechanism that drove it to seek sources of energy, it would not have survived as living forms today. Over the millennia, these needs and drives have been developed under evolutionary pressures to where we feel the drive to obtain food and the need to eat.

Computers have been built by humans. We have given them no mechanism for evolution, and even if we did, computers would have no evolutionary pressure to seek sources of energy. Humans supply electricity for them, so there would be no survival value in their obtaining their own. Without belaboring the point, the same arguments could be made for all the drives and feelings of humans. Why would a computer develop a drive to reproduce even if some evolutionary mechanism were built into it? Humans handle reproduction for it. It is therefore absurd to comment on the fact that a computer will never feel love or that it will never be impelled to write poetry. These are human drives that are related to the need to attract a mate or to express individuality, neither of which is of any use to a computer. They are the product of physical machinery and chemical processes. For example, if one gives a cow testosterone, her maternal caring for her calf ceases. Give estrogen to a bull, and he will mimic a cow's maternal responses. These feelings in cattle and humans developed under evolutionary pressures and are obviously useful in survival of the respective species. A computer has no mechanism or need to develop such feelings. Obviously, computers will never acquire human passions.

However, what about consciousness? We have, from the beginning, been building sensors into computers, and we are vigorously working to amplify and improve this technology. We want computers that can respond to verbal commands and be able to

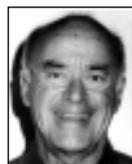
read text, even handwriting. This capacity requires sensors—eyes and ears, so to speak. With the involvement of computer technology in audiovisual projects and robotics in manufacturing, the ability to hear and see becomes more important. It is not hard to visualize sensors for smell and texture as the use of automation in industry expands.

The point is that we are building computers with ever-more sophisticated sensors and processors. We are learning to use multiple processors and are developing fuzzy logic to emulate human thought. I do not think it impossible that at some unspecified level of sophistication, the integration of this sensory input might not begin to produce in the computer something similar to human consciousness, or mind. This line of thinking is, of course, only a theory, but it is one not based on magic.

There are vast numbers of magical thinkers in the world around us, people who in the name of any one of a number of gods want to destroy rationality and science. It is important to be particularly aware when one of our own attempts, in however subtle a manner, to suggest this magic should supplant or even be used to embellish reason and logic.

### References

- Abrahamson, J. R. 1992. *M-E: The God Within*. Baltimore, Md.: Waverly Publications.
- Penrose, R. 1989. *The Emperor's New Mind*. Oxford, U.K.: Oxford University Press.



**Joseph R. Abrahamson** is a retired pathologist living in San Diego, California. Current interests include inquiring into the nature of reality as described by modern theoretical physics and probing the dangers that religious fundamentalists pose to a free democratic society. He holds academic degrees from Stanford University (B.A., 1949; M.D., 1955) and the University of Southern California (M.S., 1951).

## AUTOMATING SOFTWARE DESIGN

*Edited by Michael R. Lowry and Robert D. McCartney*

The contributions in *Automating Software Design* provide substantial evidence that AI technology can meet the requirements of the large potential market that will exist for knowledge-based software engineering at the turn of the century. They are divided into sections covering knowledge-based tools for large software systems, knowledge-based specification acquisition, domain-oriented program synthesis, knowledge compilation, formal derivation systems, and cognitive and planning approaches to software design.

### Partial Contents:

- Knowledge-Based Software Engineering: How and Why Did We Get Here?
- The Evolution of Very Large Information Systems.
- LaSSIE: A Knowledge-Based Software Information System.
- Reducing the Complexity of Formal Specification Acquisition.
- Software Reuse and Refinement in the IDEa and ROSE Systems.
- Data Relationships and Software Design.
- Scientific Programming by Automated Synthesis.
- Synthesizing VLSI Routing Software from Specification.
- A Divide-and-Conquer Approach to Knowledge Compilation (the KBSDE project).
- Program Improvement by Automatic Redistribution of Intermediate Results: An Overview.
- Concurrent Software Production.
- Design Principles for an Interactive Program Derivation System.
- Automating the Design of Local Search Algorithms.
- Automating Algorithm Design within a General Architecture for Intelligence.
- Software Engineering in the Twenty-First Century.

\$35.00, 708 pp.  
ISBN 0-262-62080-4

LOWAP

### AAAI Press

DISTRIBUTED by The MIT Press  
Massachusetts Institute of Technology  
Cambridge Massachusetts 02142

To order call toll free: (800) 356-0343  
or (617) 625-8569.

*MasterCard and VISA accepted.*

Mail Orders:  
The MIT Press,  
55 Hayward Street, Cambridge, MA 02142