Sharon Kasper, "Artificial neural networks model the human brain,"
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# Artificial neural networks model the human brain

*by Sharon Kasper*

The problems of the traveling salesman have long been a subject of considerable speculation and humor. But one such problem, that of mapping out a minimum-distance route among 30 or 40 cities, is part of the serious research effort in the field of optical computers. The Traveling Salesman Problem (TSP) represents the type of puzzle that a computer modeled on the neural network of the brain could solve with ease.

Robert J. Marks II, professor, and Les Atlas, assistant professor, both of electrical engineering, are combining their skills in optical computers and speech recognition to help uncover the secrets of neural networks. One possible outcome of their work might be a computer which could deal with problems of even greater complexity than the TSP.

Developing a computer that can deal with such complexity requires an understanding of the human (biological) brain and the way in which its billions and billions of neurons interact. Each neuron is connected to a large number of other neurons that make up individual neural networks. And the operation of the network is based on the changing status of each individually functioning neuron and its ability to sense changes in those neurons to which it is connected.

Professors Marks and Atlas, working with a team of graduate students, have developed and are training an artificial neural network in their Interactive Systems Design Lab (ISDL). Their model is called the APNN or Alternate Projection Neural Network. Marks points out that much conventional training is based on sets of rules, "but if you had to give rules by which something was a bush or a tree, it would be very, very difficult." It is necessary, then, to program a neural network in the same way that humans are programmed. "You show the neural network a bush and you say, 'That's a bush,' and you show it a tree and you say, 'That's a tree,' and you show it another tree and you say, 'That's another tree,' and after a while the neural network begins to learn to distinguish all by itself; it learns by example as opposed to learning by rules."

The motivation for developing an artificial neural network computer model of the biological network is plain. Every day the scientist can observe the results of human neural networks in action—a human can identify a tree or a bush in a picture that contains both trees and bushes. And, although we are naturally equipped with the ability to classify in this way, a non-biological neural network must be trained to make such distinctions.

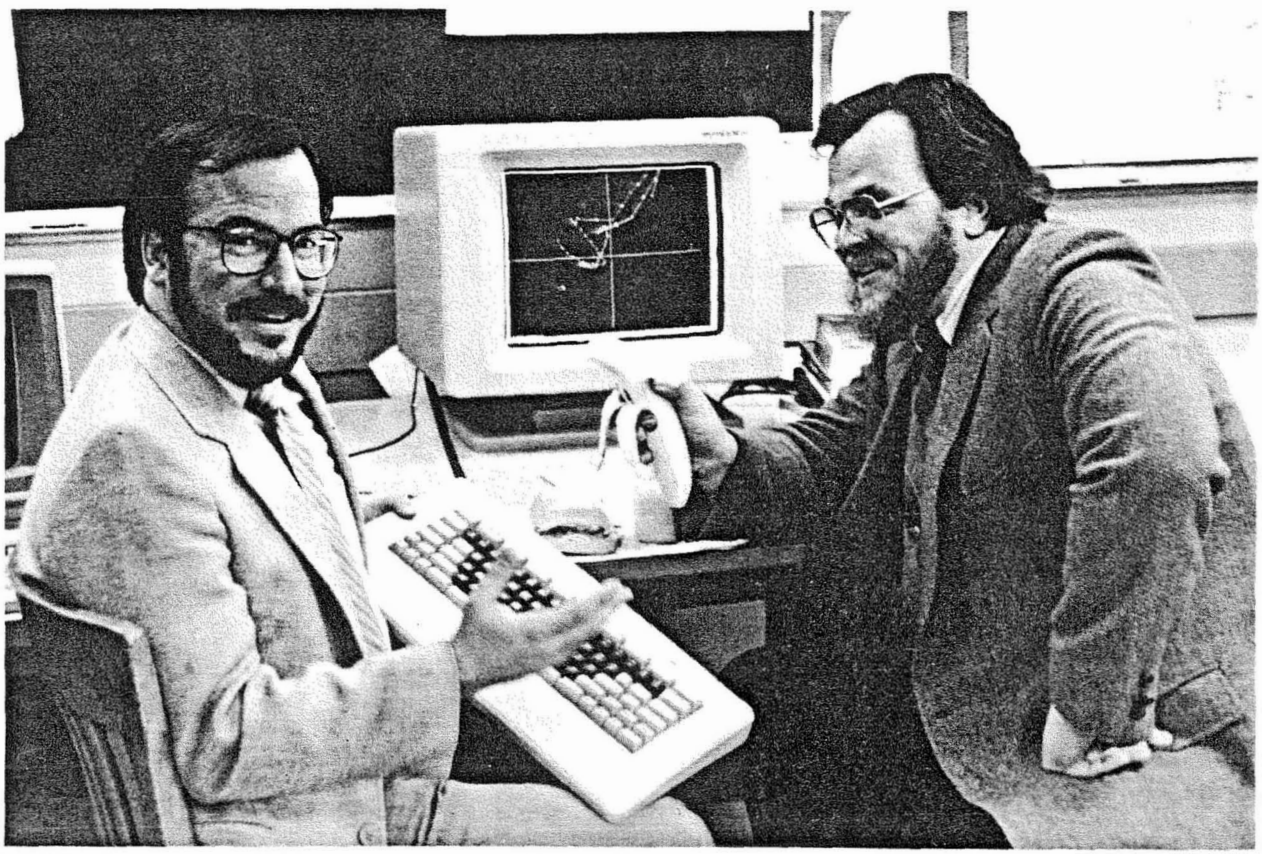

Photo David Spengler

**Working lunches led to neural network research partnership between Les Atlas and Robert J. Marks**

*Marks, continued from page 1*

recognize the Mona Lisa. The best thing about neural networks though is that, rather than being rule based, performance is based on example training data.

Together, Professors Marks and Les E. Atlas are working to train neural networks in submarine detection and speech recognition. Professor Marks is specifically interested in implementing a neural network on an optical computer. By using optical processing, which substitutes photons in place of electrons, increased speed and highly parallel architectures can be realized.

His work in optical computing has received support from the Strategic Defense Initiative via the Office of Naval Research. His work in neural networks, in a joint project with Prof. Atlas, has been funded by the Boeing High Technology Center and the Washington Technology Center. Presently, he's commanding a troop of six Ph.D. students.

On a more administrative level, Professor Marks has been involved with the MITE/MESA program which encourages minority students to excel in math and engineering. He believes that equal opportunity should be practice and enforced. He has strong doubts, however, about the effectiveness of affirmative action.

His research and administrative accomplishments have earned Professor Marks awards such as the IEEE Centennial Medal and Certificate and the IEEE Outstanding Branch Counselor/Advisor Award. He is also Chairman of the Technical Society on Neural Systems and Applications in the Circuits and Systems Society as well as the co-Founder and current President of the Puget Sound Section of the Optical Society of America.

Though born in Sutton, West Virginia, Prof. Marks was raised in Cleveland, Ohio. About his hometown Marks commented, "People make jokes about Cleveland...and the jokes are justified!" After receiving his BS and MS in EE from Rose-Hulman Institute of Technology in Terre Haute, Indiana, Professor Marks went to work for the US Navy. He received his Ph.D. in EE from Texas Tech University in Lubbock, Texas and promptly accepted his position at the UW. The collegiality and camaraderie among the EE faculty members impressed Professor Marks and convinced him to come here. Professor Jim Ritcey, one of Professor Marks' colleagues, said that not only was Marks pleasant to work with but that he was most impressed by Marks' ingenuity—his ability to come up with novel ideas in a broad array of areas.

Though he has a busy career, Professor Marks maintains a jovial Kris Kringle face and sense of humor by balancing the time he spends at work with the time he spends with his family. As a Christian, Prof. Marks considers his faith in Christ to be the most important part of his life. He participates in a weekly Bible study with other Christian EE students and faculty.

Along with research and family, Professor Marks still finds time for his own pleasures whether it's sketching cartoons during faculty meetings or putting together a trivia book on the old radio and T.V. Gunsmoke series. Hmm...if his book is ever published, maybe we'll see Professor Marks autographing books on the Ave in between graduate student appointments!

*Don't Forget!*

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