

Research and teaching plan

Research interests

From a computer science perspective, I seek to describe a computer based on the brain, which will have some of the legendary properties of the brain, its parallelism, intelligence, flexibility and resilience. I have developed an intelligent parallel architecture which can be applied to computation problems of all kinds, including multiagent systems. My work is unique in developing an approach to intelligent agents which is based on the brain. The architecture should have a straightforward implementation in hardware. From a biological perspective, I seek to bring computer science concepts and methods to bear on the problem of the scientific understanding the brain.

Overall research goals

The overall problems I am trying to solve for my computational model include:

1. Behaviors: (i) how to model problem solving behavior, (ii) how to recognize natural language sentences, (iii) how to model social interaction, and (iv) how to model motivation of the system.
2. Learning: (i) how to learn problem-solving knowledge for "simple" problems using in psychological experiments and clinical diagnosis, and (ii) how to model the development of social relationships.
3. Relationship to neural nets: (i) how to find an equivalent neural representation of the model, (ii) how to model neural development, and (iii) how to model neural pathologies.
4. How to implement the model as a computer using present-day technologies such as FPGA or asynchronous VLSI.
5. How to understand the model theoretically as a computational system.

Research activities

Development of the computational model. The most important goals I have right now concern getting the model to do problem solving and learning of problem solving strategies.

Collaborations in computer science. I am interested to link up with projects and people where my work can contribute. For example, applications to virtual agents and intelligent robots.

Collaboration in life sciences. I plan to continue my existing collaborations with Doris Zumpfe of Emory University, Gerard Kempen of Leiden University, and Tim Shallice of the Institute of Cognitive Neuroscience, London University.

My programming language. I will continue developing, and will distribute my brain programming language, BAD. A key structural principle for my research is the development of a network of collaborators and the provision of a common representation and programming language by means of which scientific knowledge of brain function can be expressed and tested.

Industrial collaboration. I plan to continue my collaboration with the Fujitsu Network Agents Research Group in San Jose, California, headed by Frank McCabe.

Teaching interests

I have experience in teaching computer science, see <http://www.cs.caltech.edu/~bond/teach.html>

At Caltech I've been teaching three courses which form a year-long sequence -

CS101a, functional programming (Scheme, ML, April, lambda calculus, SECD etc.), then

CS101b, logic programming (Prolog and AI planning and belief maintenance in Prolog), and then

CS101c, intelligent multiagent programming (using Prolog on a network on unix machines)

These courses are taught entirely using the web, please see my website. I will be happy to play my part in teaching introductory computer science courses. In addition, using the BAD language, it will now be possible for me to co-teach courses in cognitive psychology in which theories are presented as programs

that can be run, and students can learn to express theories as programs and to test them against experiment. I can also teach a project course in system modeling of the primate brain. I have been doing this at Caltech, CS286, please see my website.

More detailed plans,

for research - <http://www.cs.caltech.edu/~bond/rplan.html>

for teaching - <http://www.cs.caltech.edu/~bond/tplan.html>

for funding - <http://www.cs.caltech.edu/~bond/fund.html>

and for implementation - <http://www.cs.caltech.edu/~bond/prog.html>

can be found on my website.

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