Some interdisciplinary research themes

Aaron Sloman

http://www.cs.bham.ac.uk/~axs/

Summary

Intelligent Systems, Cognition, Robotics

1: Orangutans viewed as robots?

2: Baby robot mathematicians?

3: Unraveling the mysteries of virtual machines

4: The new CogX project – just starting

Potential links with many areas of the university including

Eingineering, Mathematics, Psychology, Neuroscience, Medicine, Biosciences, Linguistics, Philosophy.

A draft university-level website in this general area:

`http://www.cs.bham.ac.uk/research/projects/xanibot/`

Next week: BCS Visions of Computer Science conference

November: RAE conference on Engineering and philosohy

1: Orangutans viewed as robots?

A new proposal in preparation for BBSRC with two people in Biosciences

Provisional title:

Variety Is The Spice Of Cognition: Cognitive Demands Of Arboreal Gap Crossing In Orangutans

[Roughly: how a roboticist/philosopher can help biologists ask new research questions. We see this as the first stage in a potential long term project that could grow large.]

Collaborators: Susannah Thorpe and Jackie Chappell

The problem:

Sumatran orangutans make what appears to be hghly intelligent use of complience of supports in travelling horizontally from tree to tree.

We hope to identify the cognitive problems unique to the tasks of arboreal locomotion making use of compliance in supports to achieve roughly horizontal movement (safer, less energy) despite being too heavy to go to the ends of long branches.

Significance:

Could shed new light on old questions about evolution of intelligence.

New questions for neuroscientists about how cognitive competences are implemented.

2: Baby robot mathematicians?

A project that could lead to various kinds of collaboration, e.g. with developmental psychology, robotics, biology philosophy.

Provisional title:

Why young robots and young children need to be young mathematicians.

[The problems of learning to interact with and manipulate objects in the environment have a structure that requires the learner to discover that some things originally learnt empirically are actually non-empirical, i.e. mathematical, and can therefore be used with complete confidence in novel contexts:

A kind of learning missed by most developmental psychologists, roboticists, educators, ... with potentially profound implications.]

The problem:

To identify the required forms of representation, architectures, algorithms.

Meanwhile starting to produce a collection of toddler theorems relating to various kinds of affordance.

Significance:

Implications for AI, psycholology, education, philosophy of mathematics, ... new foundations of mathematics?

Supports Immanuel Kant against David Hume.

3: Unraveling the mysteries of virtual machines

Provisional title:

How virtual machines link information-science, biology, psychology, neuroscience and philosophy. (BCS conference next week)

[The enormous usefulness of collections of interacting virtual machines in systems design, especially for systems that need to understand, control and modify themselves, was probably "discovered" long ago by biological evolution and deployed in ways we don't yet understand in animal brains.

Such systems also shed new light on old philosophical problems, but philosophers have been looking under the wrong lamp-post.]

The problem:

What exactly are virtual machines?

How do they work? How can they make things happen? How implemented?

Properties of networks of VMs

Significance:

Something understood intuitively by software engineers needs to be made explicit, and implications taught.

We can start looking for biological examples

4: The new CogX project – just starting

Title:

CogX: Cognitive Systems that Self-Understand and Self-Extend

... principles for building cognitive systems to handle situations unforeseen by their designers, other forms of novelty, and open-ended, challenging environments with uncertainty and change.
... creating a theory - grounded and evaluated in robots - of how a cognitive system can model its own knowledge, use this to cope with uncertainty and novelty during task execution, extend its own abilities and knowledge, and extend its own understanding of those abilities.

Partners in Stockholm (2), Freiburg, Saarbrücken, Vienna

The problem:

There are many unknowns about requirements, forms of representation, architectures, mechanisms, and forms of development (self extending).

Many problems depend on **the environment**. (Compare the orangutans.)

Significance:

Could lead to major breakthroughs in future flexible autonomous robots.

Could also lead to major new insights into human and animal development.

Led by: Jeremy Wyatt

Three RFs:

Nick Hawes (former CSAI undergrad, PhD and CoSy RF
Rustam Stolkin - just arrived
Charles Gretton - in Australia, coming soon.