

# MSc Project Talk: Modelling Natural Intelligence

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Artificial Models of Natural Intelligence

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# Interests

- **Systems Artificial Intelligence**
  - Modularity & Coordination (Planning).
  - Autonomous Systems—Agency & Ethics.
  - Programmability for Pervasive AI—“**AI Plumbers**”
- **Natural Intelligence**
  - Modularity & Organization (Neuroscience).
  - Origins of Cognition (Behavioural Ecology).
  - Culture & Sociality (Biological Anthropology).

# Background

- **Artificial Intelligence**
  - PhD (MIT 2001), MSc (Edinburgh 1992).
  - LEGO (Denmark), HCRC (Edinburgh).
- **Natural Intelligence**
  - BA (Chicago 1986), MPhil (Edinburgh 2000).
  - Primate Cognitive Neuroscience Labs (Harvard 2001-2, Edinburgh 1996-7).
- **Bath Intelligent Systems (2002-now).**

# Current Work

- **Artificial Intelligence**
  - Intelligent systems development. (e.g. game characters, intelligent environments.)
  - Making AI accessible to non-experts.
- **Natural Intelligence**
  - Brain organisation: modularity & “attention”.
  - Evolution, cognition and primate social structure.
  - Evolution, sociality & public goods investment.

# Outline

- Introduction
- **Methods**
- Current Projects
- Proposed Projects

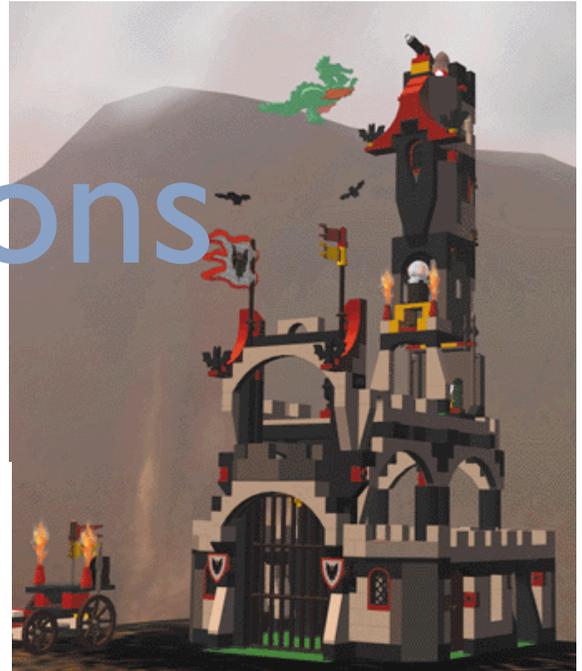
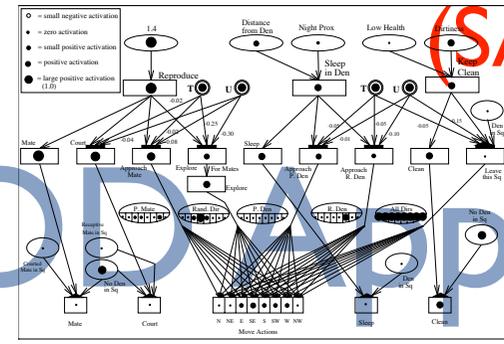
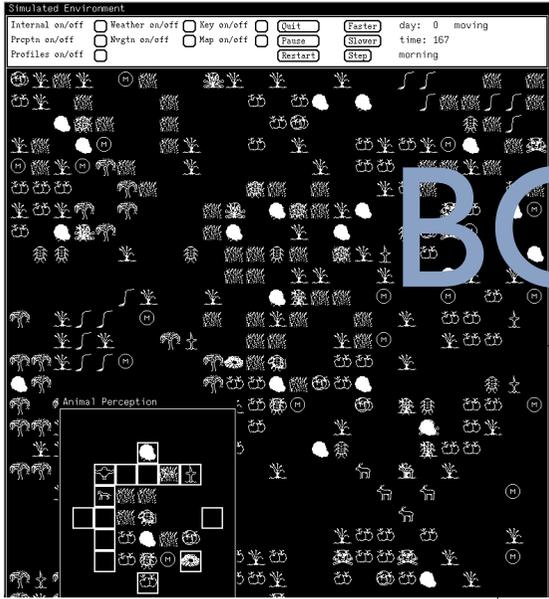
# Behavior Oriented Design

- All **search** (learning, planning) is done within modules with specialized representations.
- Specialized representations promote reliability, determine **decomposition**.
- Modules provide **perception, action**.
- Module coordination through hierarchical **dynamic plans**.

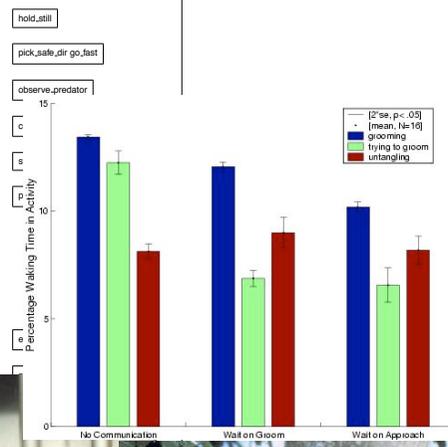
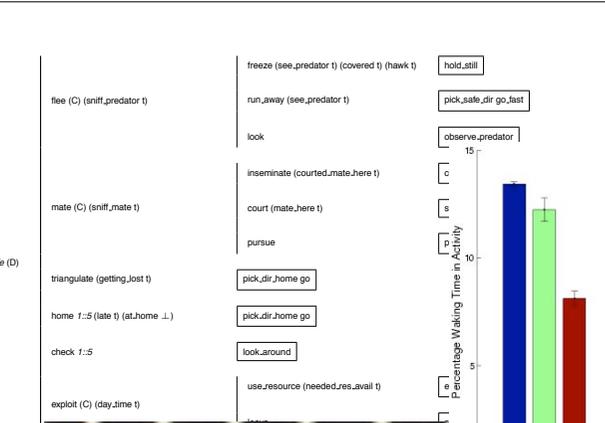
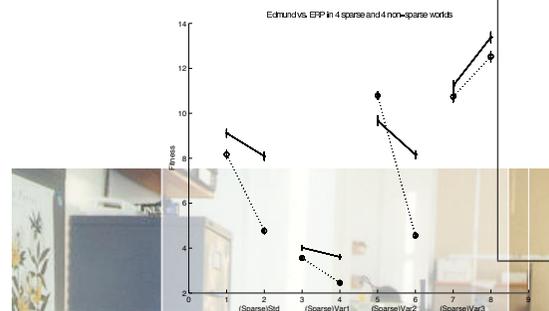
(Bryson 2001, 2003)

(SAB 2000)

# BOB Applications



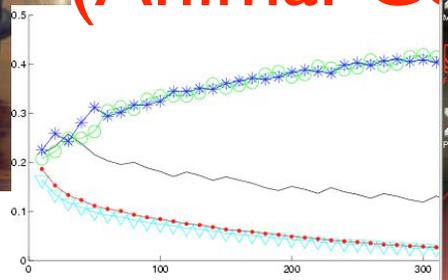
(VR(U) 2000)



(WRAC 2003, PTRS B 2007, BICA 2008)



(Animal Co)

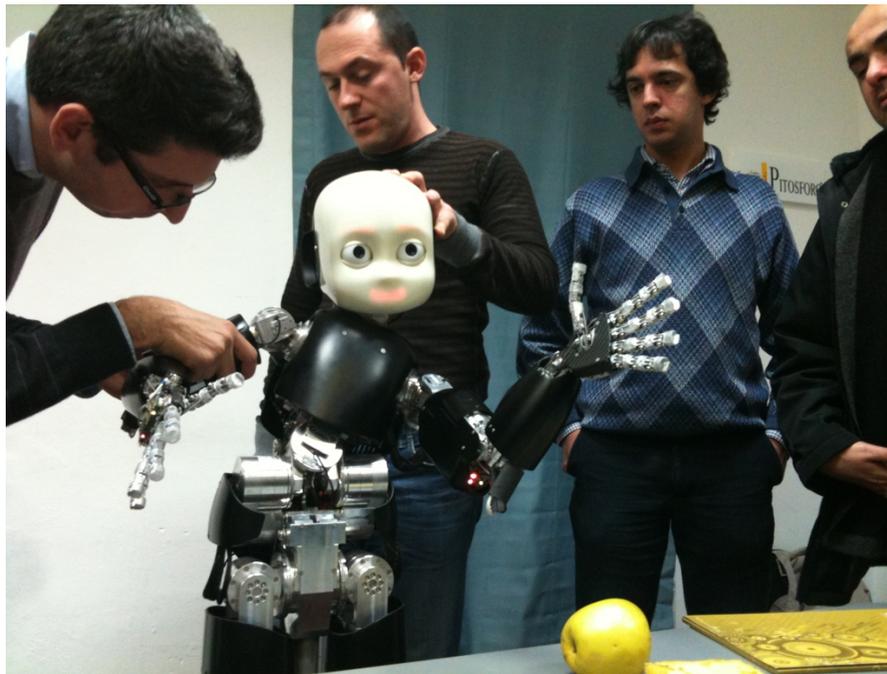


(IVA 2005, CGames 2006 IEEE SMC 2008)

(ATAL 1997)

# A POSH plan in ABODE Advanced BOD Environment

## in ABODE



The screenshot displays the A.B.O.D.E. (Advanced BOD Environment) software interface. The main window shows a logical view of a POSH plan, with various elements like Trigger Elements, Competence Elements, and Action Patterns connected by arrows. A red dashed box highlights a specific section of the plan. Below the main window, there are several smaller windows: 'jyPOSH call' for agent configuration, 'Unreal Tournament' for the game engine, and a console window showing game logs. The interface includes a menu bar (File, View, Tools, Window, Help) and a toolbar with icons for file operations and execution.

**Logical View Elements:**

- respond-to-atta... Drive Element
- respond-to-attack Competence Element
- attack-with... Competence Element
- find-attacker Competence Element
- try-to-find-att... Action to Trigger
- attack-enemy-wi... Drive Element
- attack-enemy-ca... Action Pattern
- take-enemy-flag... Drive Element
- respond-to-atta... Drive Element

**Agent Configuration (jyPOSH call):**

- Behaviour Library: bodbot
- World Initialisation Script: Choose...
- Agent Initialisation File: h:\jyPOSH\jyposh\trunk\library\bodbot\init\_agent Choose...
- Load Agent Init File
- Agents: 1: attackbot
- Attributes: Behaviour Bot
- [attackbot] Bot.ip = 127.0.0.1, Bot.port = 3000, Bot.botname = Tom, Bot.team = 0

**Game Engine (Unreal Tournament):**

- RED BASE
- RED BASE
- 100
- 15

**Console Log:**

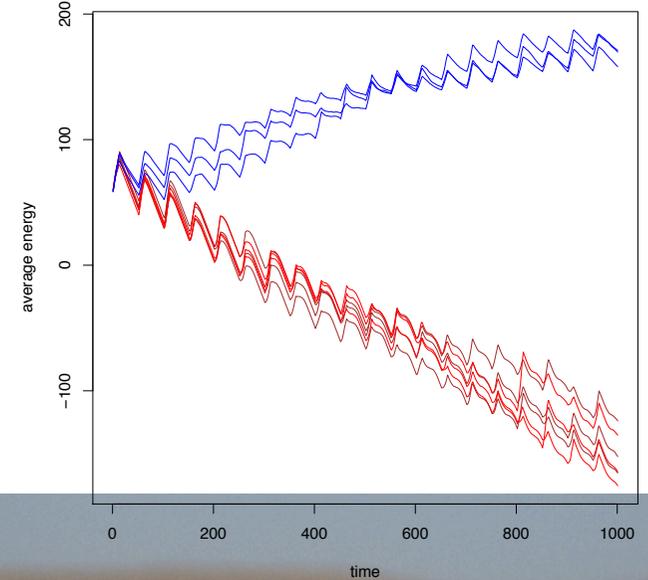
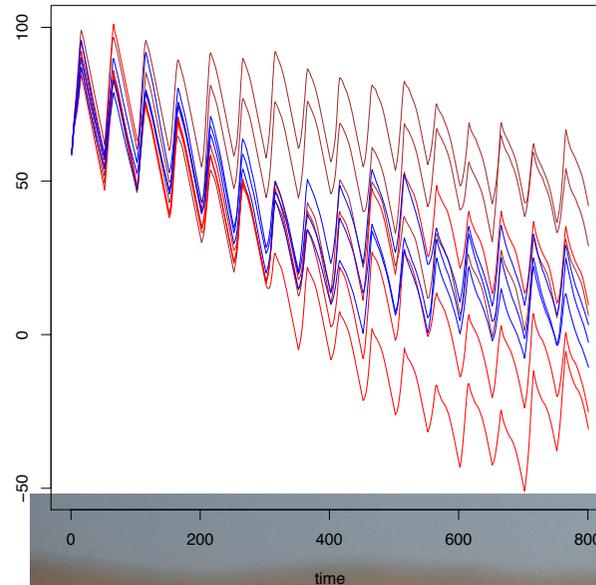
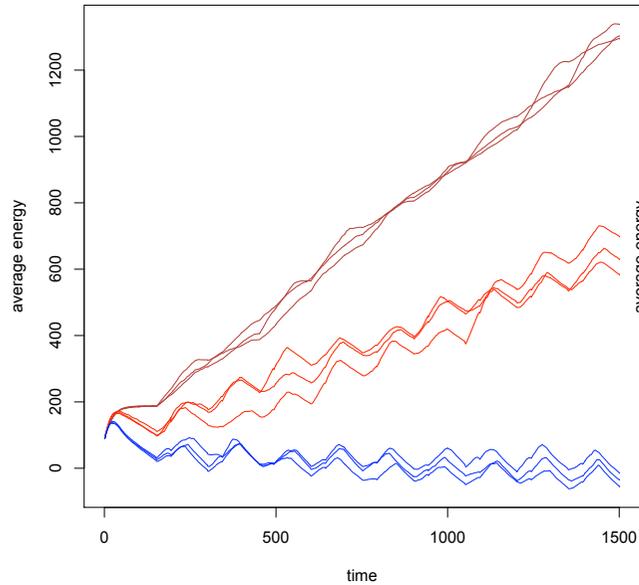
```
Reachable=True  
timeStamp=1.20637396664E9  
in receive_flag_details  
Team=0  
Id=CTF-SimpleSteve_RedT1ag1  
State=home  
Location=0, 992072, 520, 731506, -66, 821762  
Reachable=True  
timeStamp=1.20637396664E9  
armed CTF-SimpleSteve_gooward29  
4, 71240683, 772766-84, 199997  
Team=0  
Id=CTF-SimpleSteve_RedT1ag1  
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Location=0, 992072, 520, 731506, -66, 821762  
Reachable=True  
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in receive_flag_details  
Team=0  
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State=home  
Location=0, 992072, 520, 731506, -66, 821762  
Reachable=True  
timeStamp=1.206373966758E9  
armed CTF-SimpleSteve_gooward29  
4, 71240683, 772766-84, 199997  
Possible NP, returning 1  
16, 483658315, 358428-172, 405762
```

# Simulations as Science

- A simulation is a **hypothesis** like any other.
  - Thesis / model specified so completely it can be run on a computer.
- Consequences of model assessed by **sampling**.
- Model behaviour compared to target system's using standard hypothesis testing.

Joanna J. Bryson, Yasushi Ando and Hagen Lehmann “Agent-based modelling as scientific method: a case study analysing primate social behaviour”, *Philosophical Transactions of the Royal Society, B – Biology*, **362**(1485):1685–1698, September 2007.

# Hypotheses & Validation



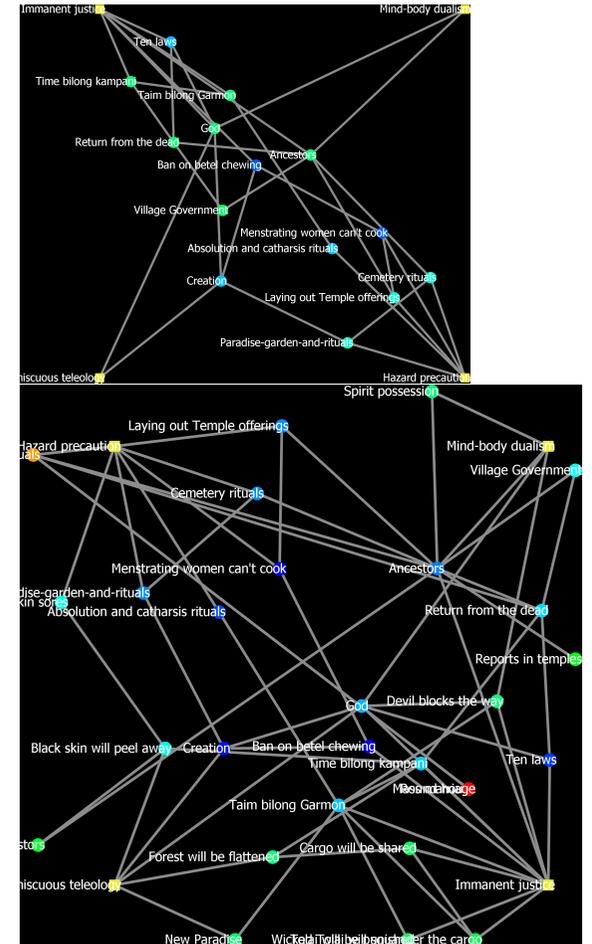
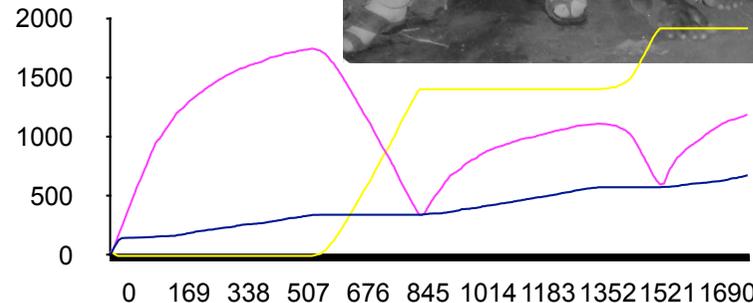
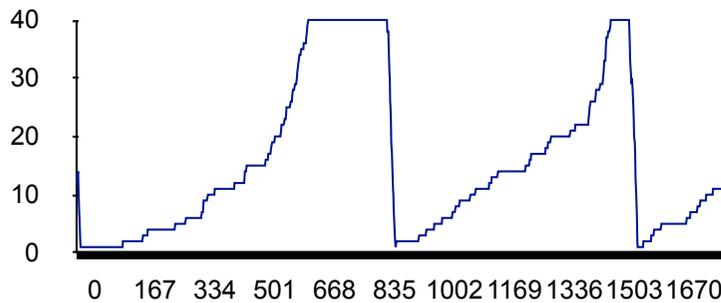
individual  
chase runners  
territory + chase

(Bryson, Kaczensky  
& Grove *in prep*)



# Specification as Theory Building

- Sometimes just the process of building a simulation finds fallacies or incompleteness in a model.



e.g. Whitehouse's Modes Theory of Religiosity (Whitehouse, Khan, Hochberg & Bryson *in review*)

# Amonl Current Projects

- Bidan Huang: Robot Learning
- Dominic Mitchell: Public Language
- Marios Richards: Rates of Evolution
- Daniel Taylor: Evolving Culture
- Gideon Gluckman: Social Dynamics
- James Mitchell & Tom Hyde:  
Improving ABODE / BOD
- Karolina Sylwester & Simon Powers  
Variation in Public Goods Investment



# Outline

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- Methodology: Behavior Oriented Design
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# Proposed projects

1. BOD & ABODE for LEGO Robots.
2. Correlation of implicit semantics and implicit social biases.
3. Amoni Reproducible Research System: new acronym & work on revision control & scientific transparency.
4. Evolutionary tradeoffs for cognition: ageing?
5. Understanding dual replicator systems: Modelling evolution of mobile elements in bacteria.