

Intelligence in Animals and Machines

Seminar, Week 1

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1. About this module

2. What is a model?

3. How to read academic papers

4. Small-group discussion

About the module

Module structure

- Lectures are shared with UGs and MSc students
- MSc students come from MSc AIAS and Life Sciences MRes

Lecturers



Paul Graham



Andy
Philipedes

Module convenor, seminars & labs



Maxine
Sherman

About the module

An **interdisciplinary** module:

- How should we define intelligence?
- What is the simplest way to build an intelligent system?
- What can we learn about the above from the natural world?

If you study AI this is important for developing strong ideas on how to think about intelligence in artificial systems

Classes

- Weekly lecture
 - *Do the reading! Before or after is fine (after is often better)*
- One fortnightly 2hr seminar (weeks 1, 3, 5, ...)
 - *Do the reading **before***
- One fortnightly 2hr lab (weeks 2, 4, 6, ...)
 - *Sometimes there's reading. If so, do it **before***
 - *Finish any incomplete work **after***

Assignments

1000 words, 20% of grade

Due in Week 9 (subject to change – always check Sussex Direct!)

Option 1: modelling collective behaviour (study/adapt a pre-existing model)

Option 2: critical review of a paper of your choice (or choose from a selection)

Assignments

1000 words, 20% of grade

**More on this later in the term.
You will receive plenty of support with Assignment 1**

Option 2: critical review of a paper of your choice (or choose from a selection)

Assignments

2500 words, 80% of grade

Due mid Jan (subject to change – always check Sussex Direct!)

Option 1: modelling project

Choose a paper

If it has a model, implement & extend it; if it doesn't, design and implement a model

Discuss how your model/extensions add to the paper's conclusions

Option 2: essay discussing a module topic of your choice

e.g. “What is the study of tool use in animals contributing to our understanding of animal cognition”

Lectures

- Present core module content
- Highlight important concepts, theories, ideas and findings
- Structures your **self-study** – lectures aren't enough on their own

Labs

- Every fortnight
- Guided tasks (the 3rd & 4th are assignment related) with code provided to you
- Hands-on practice learning about how to model and run simulations, and why we do so
- PALS are here to help you:
<https://www.sussex.ac.uk/ei/internal/forstudents/informatics/undergraduate/pal>

Seminars

- Questions & clarifications (models can be hard to understand)
- Understanding models: construction & how they're used
- Discussion & critique of papers
- Help with assessments

Seminars

- Reading will be on Canvas at least 1 week in advance (most are already up)
- Questions about previous labs/lectures
- Group discussion about the reading
- Guided small-group discussions on the reading
- Structure may vary later on, but we will always take a ~10-15 min break half-way through

About the seminars

Nobody will be called on to speak in front of the whole group (ever)

Seminars aren't recorded

Please do contribute to large-group discussions if you're comfortable

Often we will also have small-group discussions

Canvas

[I'm going to show you how to access materials on Canvas now]

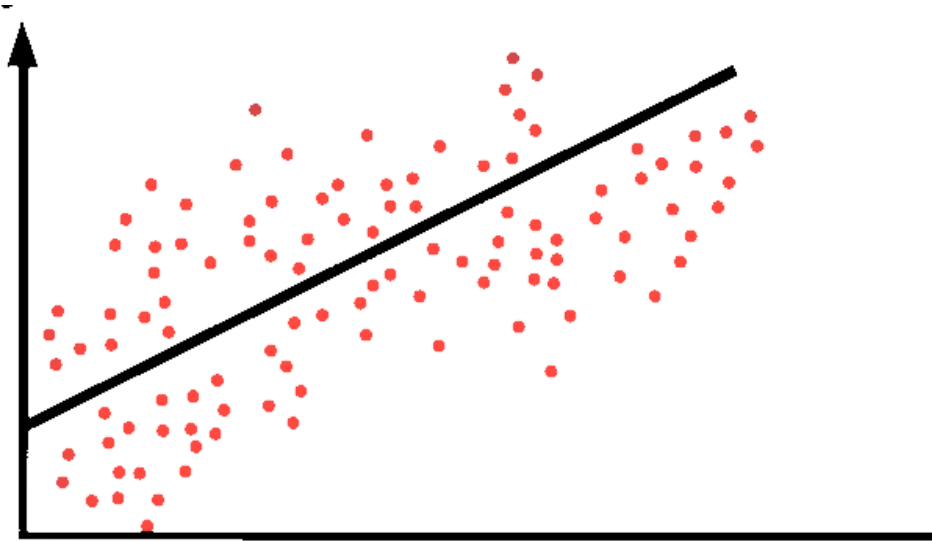
Questions?

What is a model?

What is a model?

Ideas?

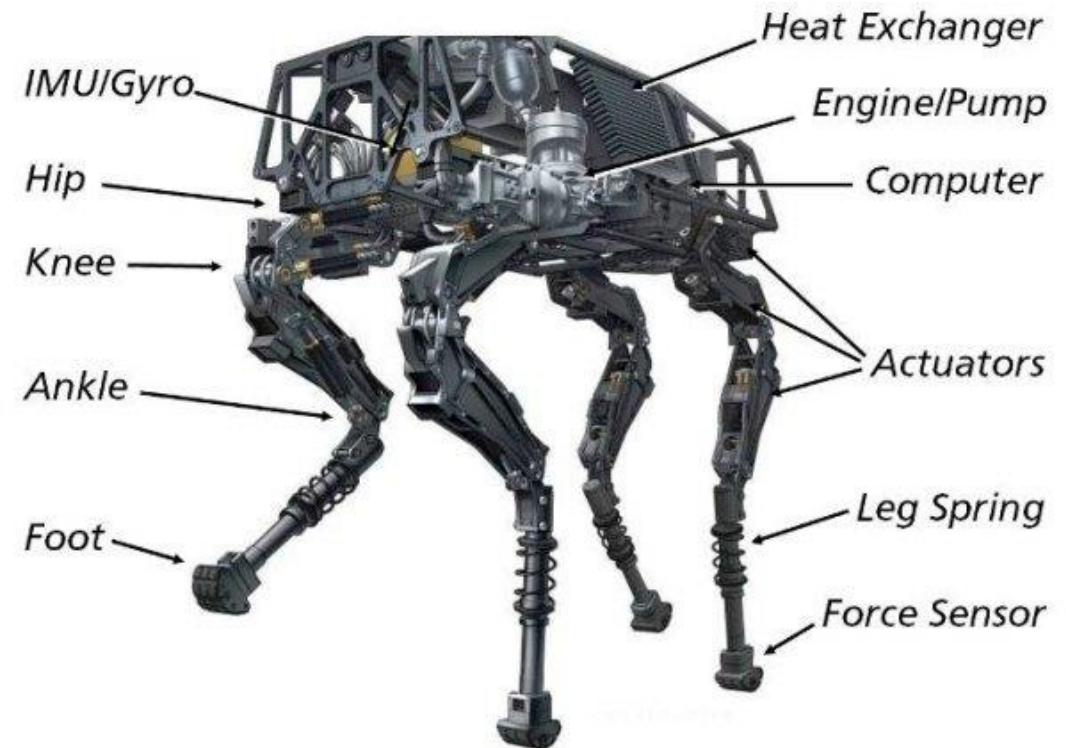
Statistical models



ChatGPT

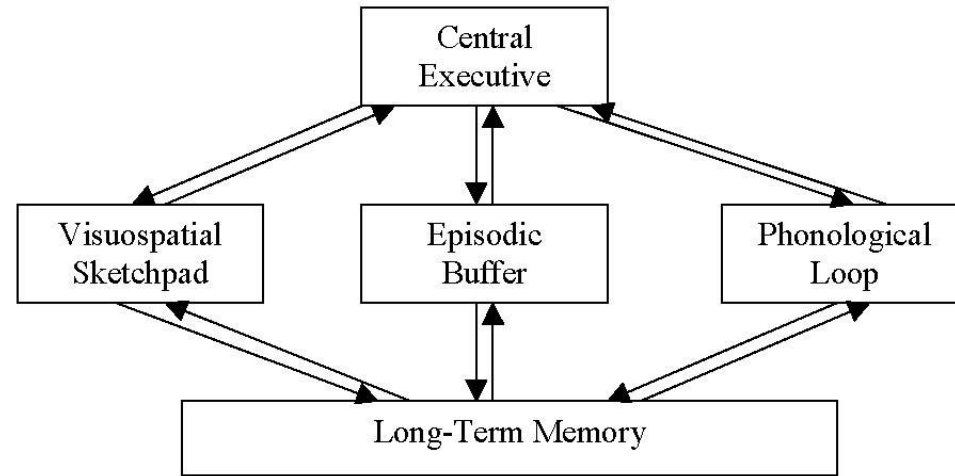
Represent relationships between **variables**

Physical models



Represent the **construction** of a system

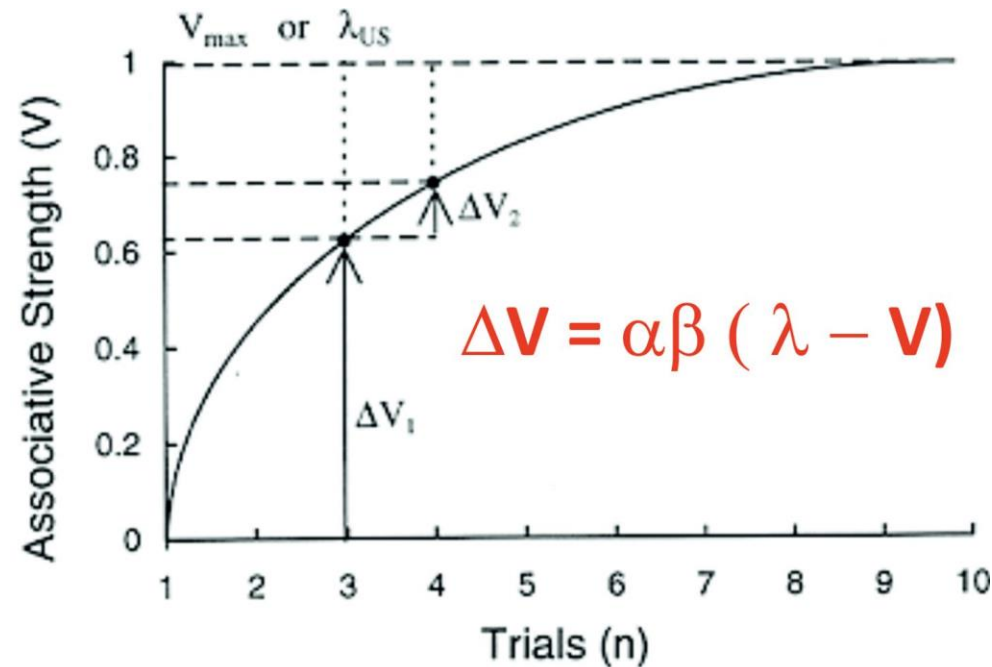
Conceptual models



Baddeley & Hitch (1974)

Represents, in abstract form, the **core concepts** of a system and their **relations**

Computational models



Represents the **behaviour** of a system mathematically by identifying mathematical functions that reproduce that behaviour

Why model a system?

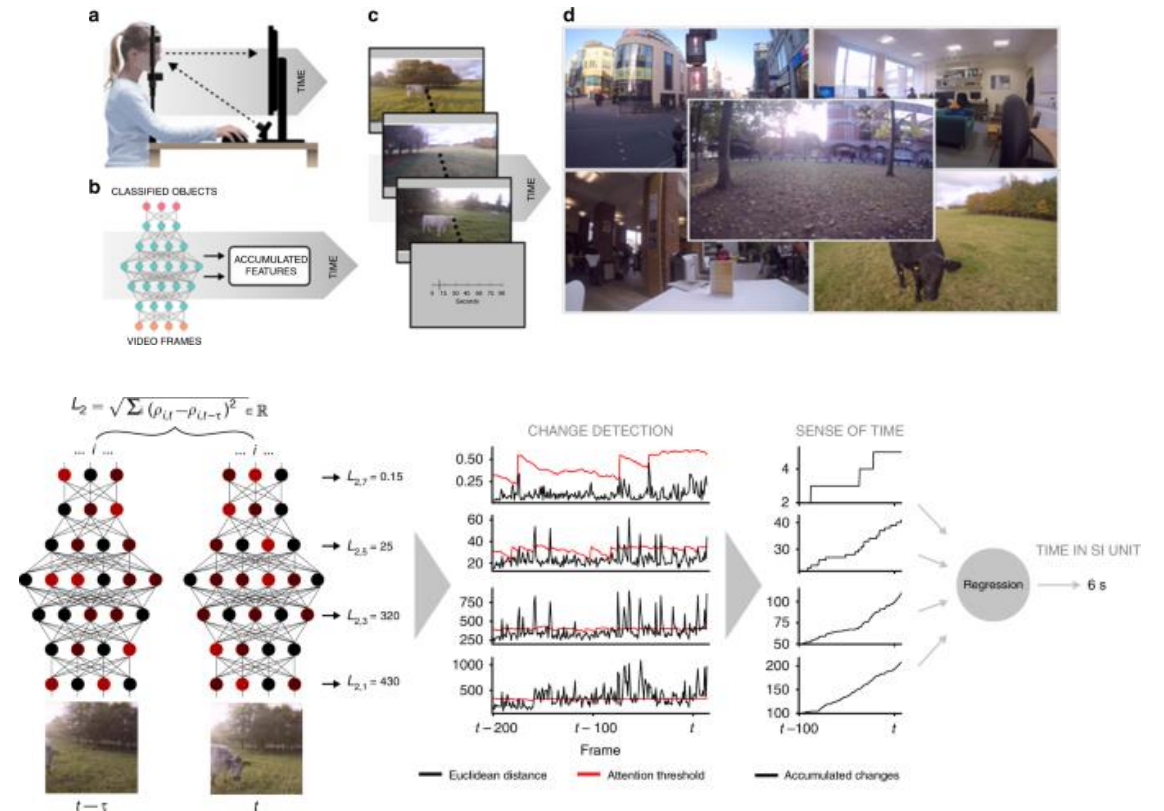
To simplify (natural systems are very complex)

To make assumptions and logic explicit

To simulate & test hypotheses

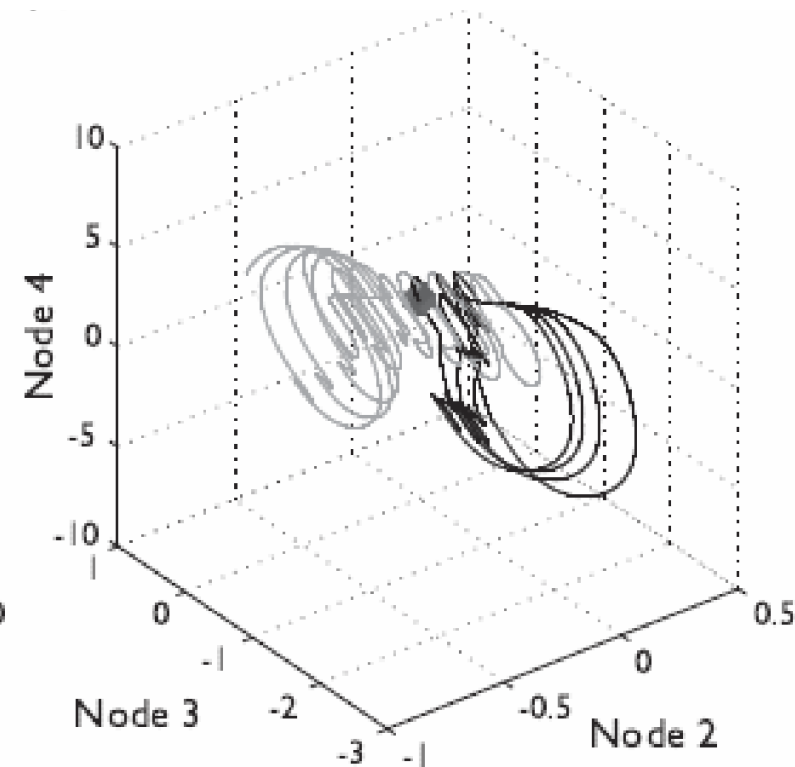
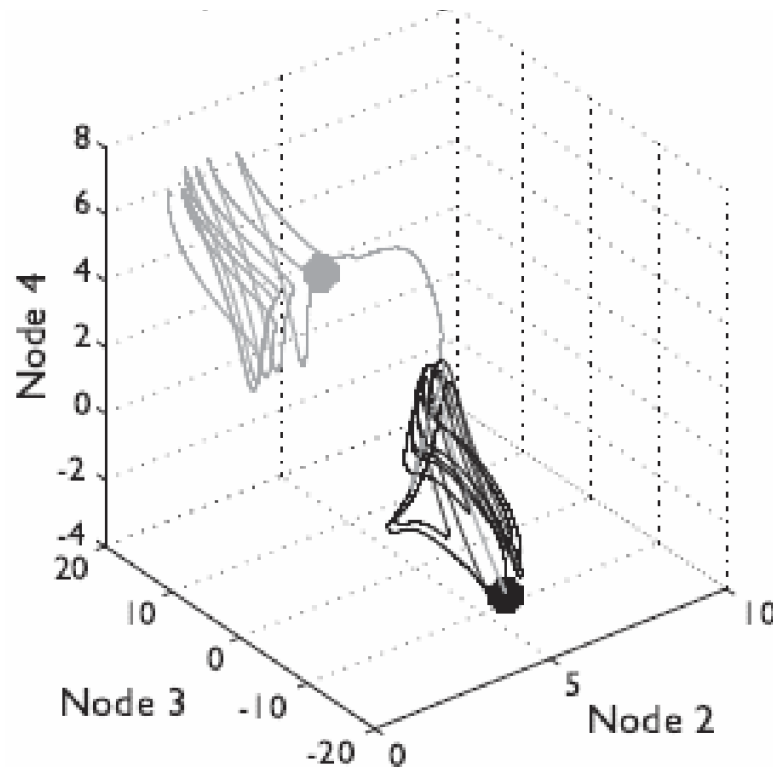
Extended thought experiments

What do I need to include in my model?



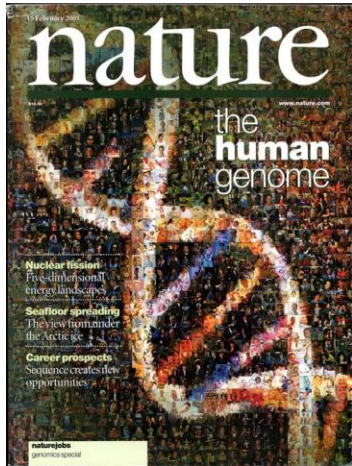
Sensitivity analysis

Under which initial conditions, assumptions, etc do we get some behaviour?



How to read academic papers

Reading empirical papers



In principle –

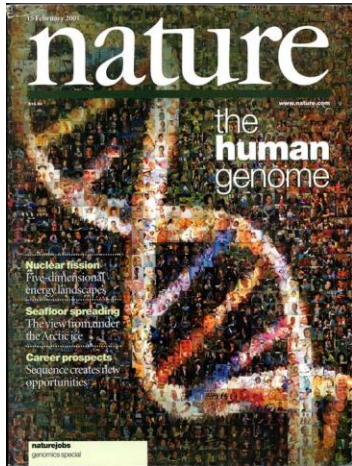
Peer-review catches problems

‘Prestige’ journals have the best work



This makes it easy to accumulate knowledge & learn

Reading empirical papers



In principle –

Peer-review catches problems

‘Prestige’ journals have the best work



This makes it ~~easy~~ to accumulate knowledge & learn
hard

Goals

Get a solid(ish) evidence base to work from

Interpret papers **independently** by reading at the methods & results

Judge whether **you think** the discussion is reasonable

(This is somewhat subjective)

Connect results to other work you've read & see how it fits with what you know already

Questions to ask yourself

Are the methods clear?

Do you agree with the model assumptions?

Any other explanations for the findings?

Are the implications sensible?

Role of the seminars

To practice all of this!

To understand models thoroughly

No need to be excessively negative about papers; just exercise skepticism

How to find papers: Boolean google scholar searches

Google Scholar

"agent-based model" AND (ants OR bee OR insect)



☒ Articles ☐ Case law

How to find papers: Boolean google scholar searches

[HTML] An **agent-based model** to investigate the roles of attractive and repellent pheromones in ant decision making during foraging

[EJH Robinson](#), [FLW Ratnieks](#), [M Holcombe](#) - Journal of theoretical Biology, 2008 - Elsevier

... Here we present an **agent-based model** based on trail choice at a trail ... **ants** to leave the stem and branches to explore the surrounding space, however in this model we assume all **ants** ...

☆ Save  Cite Cited by 74 Related articles All 8 versions

[HTML] sciencedirect.com

[HTML] An **agent-based model** of collective nest choice by the ant *Temnothorax albigenis*

[SC Pratt](#), [DJT Sumpter](#), [EB Mallon](#), [NR Franks](#) - Animal Behaviour, 2005 - Elsevier

... The **agent-based model** of emigration we present here incorporates everything learned to date about the behaviour of individual **ants**. The goals are to test the adequacy of this ...

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[HTML] sciencedirect.com

When should bees be flower constant? An **agent-based model** highlights the importance of social information and foraging conditions

[L Hayes](#), [C Grüter](#) - Journal of Animal Ecology, 2023 - Wiley Online Library

... We developed an **agent-based model** that allowed us to simulate **bee** colonies with and without communication and flower constancy in different foraging environments. By varying key ...

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[PDF] wiley.com

[HTML] Model testing and assessment: perspectives from a swarm intelligence, **agent-based model** of forest insect infestations

[L Pérez](#), [S Dragičević](#), [R White](#) - Computers, environment and urban ..., 2013 - Elsevier

[HTML] sciencedirect.com

Chasing references

(ants OR bee OR insect) AND "collective behavior" AND review



About 16,200 results (0.12 sec)

The ecology of collective behavior in ants

DM Gordon - Annual review of entomology, 2019 - annualreviews.org

... Their **collective behavior** is the result of interactions among individuals. To explain how **collective behavior** operates, we need more studies of the **collective behavior** of **ants** in the field. ...

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The ecology of collective behavior

DM Gordon - PLoS biology, 2014 - journals.plos.org

... constraints may shape the evolution of **collective behavior**: the patchiness of resources, the ... that produces **collective behavior**, and the threat of rupture of the network. The **ants** are a ...

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Collective behavior

RL Goldstone, TM Gureckis - Topics in cognitive science, 2009 - Wiley Online Library

... We consider case studies of **collective behavior** along four ... of noninteracting decision makers, **bee** swarms, groups forming ... issues surrounding **collective behavior** are then **reviewed**, ...

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A multiscale review of behavioral variation in collective foraging behavior in honey bees

NJ Lemanski, CN Cook, BH Smith, N Pinter-Wollman - Insects, 2019 - mdpi.com

... in **collective behavior** due to their high levels of individual variation and experimental tractability. In this **review**, we ... variation in behavior for honey **bee** foraging across multiple scales of ...

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Small-group discussion

Small-group discussions

1. Introduce yourselves to each other (name, a bit about your background & interests, etc.)
2. What's a "kill-joy" explanation? Explain & discuss in your group

(a few minutes)

A video

<https://www.facebook.com/reel/1115740576843181>

Small-group discussions

1. What is this video suggesting about the cognitive capabilities of the dog? What conclusions are you "supposed" to draw?
2. What's a kill-joy explanation for this behaviour?
3. Why is finding kill-joy explanations for this dog's maths skills useful for the study of animal intelligence?
4. Can you think of any other examples (from books or film, social media, the news) of particularly impressive, human-like abilities in animals? Do they require "kill-joy" explanations too? Why/why not?



Das lesende und rechnende Pferd mit seinem Lehrer HERRN VON OSTEN (Berlin)

See you next week for our first lab