University of **BRISTOL**
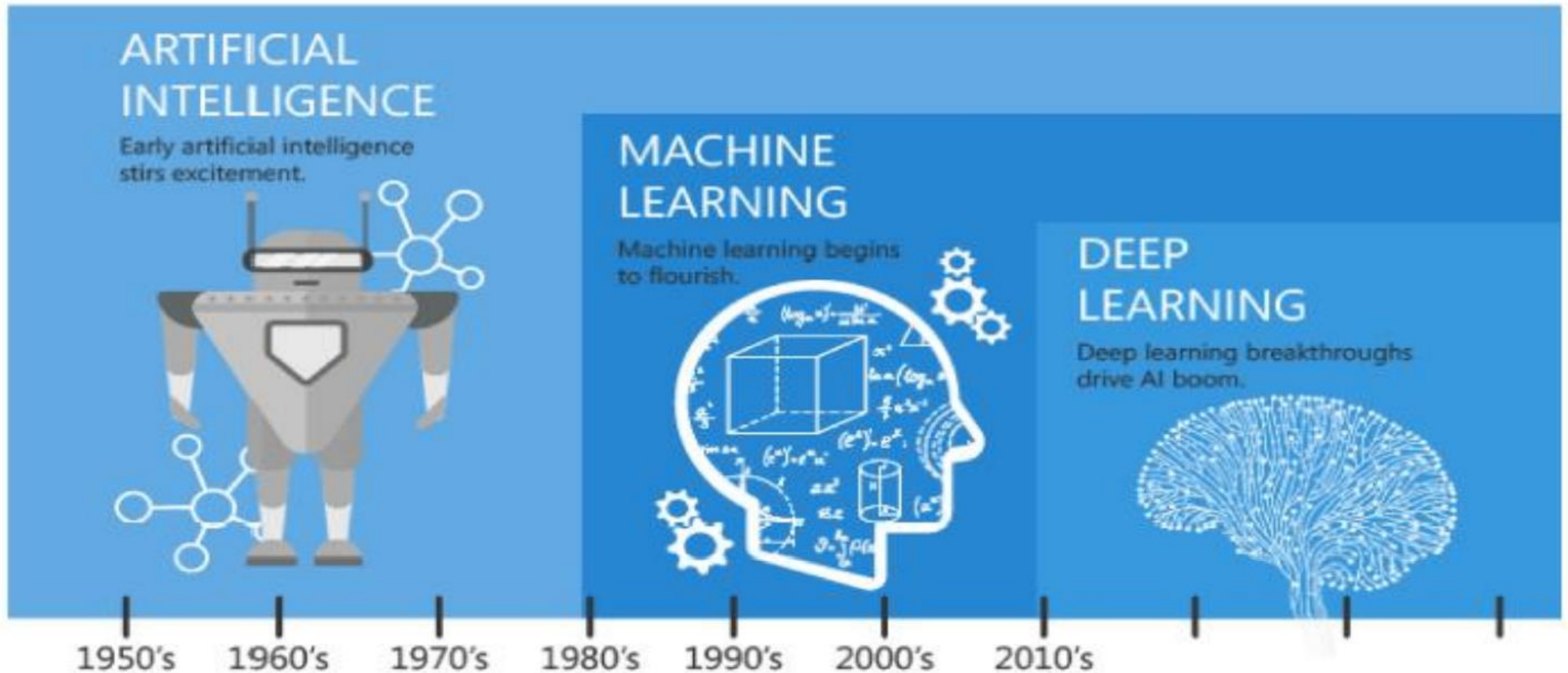
- AI involves the use of machines to understand and reproduce and enhance all aspects of intelligent behaviour ranging from
  - Strong AI - addressing abstract general-purpose problem solving
  - Weak AI - addressing concrete domain-specific task performance
- We subscribe to an Embodied, Declarative, Intelligent Agent perspective which views AI as a synthesis of two key traditions
  - Knowledge-driven AI - symbolic, local, white-box (GOFAI)
  - Data-driven AI - connectionist, distributed black-box (DEEP-X)
- While AI currently has a strong focus on data-driven deep learning, this is covered in other courses (NOT HERE!)
- We believe a combination of the above dimensions is necessary to address contempory issues within AI:
  - Transparency, Explainability, Interactivity, …

Turing's 1950 (pre)classification of AI

(After proposing the Turing Test as a means of POSTPONING the need for a formal definition of AI in order to circumvent pointless philosophical discussion that would impede progress on the real purpose of the paper:)

- **Direct Programming**
    - Code learnt concepts of the adult mind
    - Realised 1960s-1980s in the field of expert systems (as per Machine Intelligence series)
- **Ab initio Learning**
    - Code learning mechanisms of the child mind and allow it to learn autonomously from data
    - Realised 1980s-1990s in the field of ML (as per Machine Learning journal)
- **Learning by (unemotional) punishment and reward in symbolic language of logic and probabilities**
    - Inspired reinforcement learning and inductive logic programming
    - Motivated recent Human-Like Computing Network (just taking off)

TuringAI.dvi (ic.ac.uk)   Explainable AI | Administration and support services | Imperial College London   HLC (ic.ac.uk)   https://epsrc.ukri.org/newsevents/pubs/human-like-computing-strategy-roadmap/

University of BRISTOL

ARTIFICIAL INTELLIGENCE
Early artificial intelligence stirs excitement.

MACHINE LEARNING
Machine learning begins to flourish.

DEEP LEARNING
Deep learning breakthroughs drive AI boom.

1950's 1960's 1970's 1980's 1990's 2000's 2010's

- **Weak criterion** of ML (Fig.1):

  - System … uses training data … for improved performance

  - International ML meetings … operating … unspoken **community criterion** (p.107) …"satisfies weak criterion and also involves some biology"

  - Scope of ML (Fig. 2): Neural Networks / Genetic Algorithms / Symbolic Methods

- **Strong criterion** of ML (Fig.3):

  - ... and also can communicate its internal updates in explicit symbolic form

  - New dictum (p.108): Until you have figured out a way for the machine to tell you what it has learned, it is not going to be very interesting to have it learn things anyway.

- **Ultra-strong criterion** of ML (Fig.3):

  - ... and also can communicate its internal updates in explicit and operationally effective symbolic form

  - It must also show skill in the role of coach

This unit gives an intro to knowledge-based methods that (we purport) could be used in combination with currently trendy approaches to better address current issues in AI:

- **Interpretable AI ?**

- **Comprehensible AI ?**

- **Explainable AI ?**

- **Interactive AI ?**

- **Trustworthy AI ?**

- **Ethical AI ?**

We will concentrate on three key topics:

- **Logic Programming**

- **Genetic Algorithms**

- **Mult-Agent Systems**

University of
BRISTOL

Week	Topic	Lecturer	Lab
1	Logic Programming I	Oliver Ray	Datalog / Movies
2	Logic Programming II	Oliver Ray	Prolog / GridWorld
3	Logic Programming III	Oliver Ray	Metalogic / Oscars
4	Genetic Algorithms I	Seth Bullock	Simple Genetic Algorithm
5	Genetic Algorithms II	Seth Bullock	Coevolutionary Genetic Algorithm
6	READING WEEK		
7	Multi-Agent Systems I	Nirav Ajmeri	MAS Simulation I / Mesa
8	Multi-Agent Systems II	Nirav Ajmeri	MAS Simulation II / Mesa
9	Timed Coursework		
10			
11			
12	Exam Preparation	Oliver, Seth, Nirav	
XMAS	Exam Revision		
JAP	Timed Exam		

search

problem solving

COMS30062 (15CP) with practical focus

COMS30013 (10CP) with conceptual focus
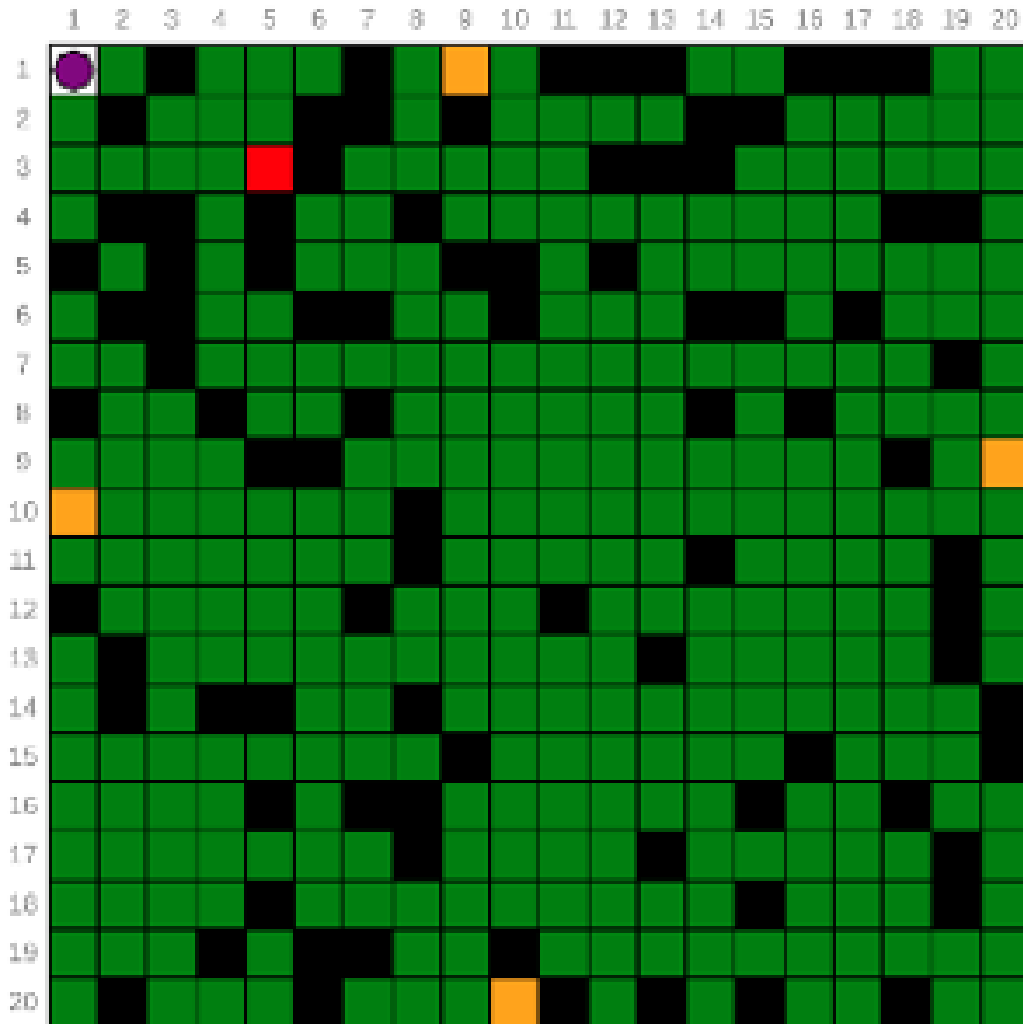
- Focus on Artificial GridWorld that **agents** must efficiently navigate by using **charging stations** to visit **oracles** and solve various **tasks**

- This context will help to develop understanding for the exam and will be directly used in the course-work; and it provides a nice link between Prolog and GAs and MAS
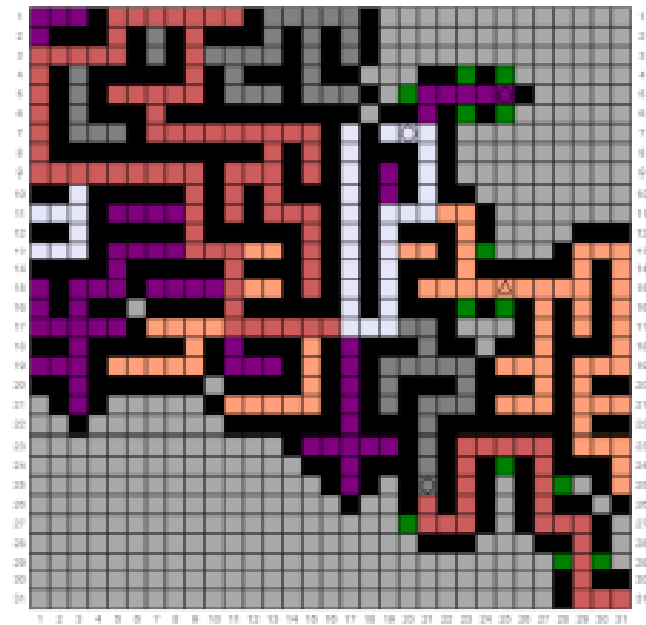
University of
BRISTOL
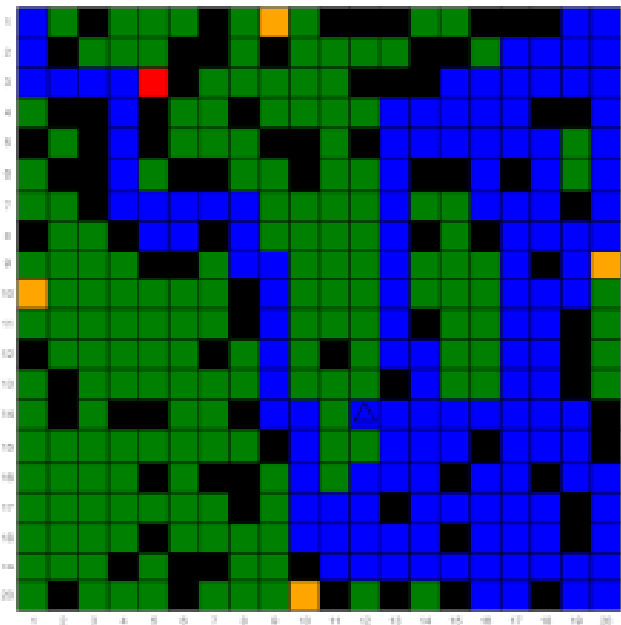
Use A* search to
solve tasks of form:
`find(Obj) ; go(Pos)`
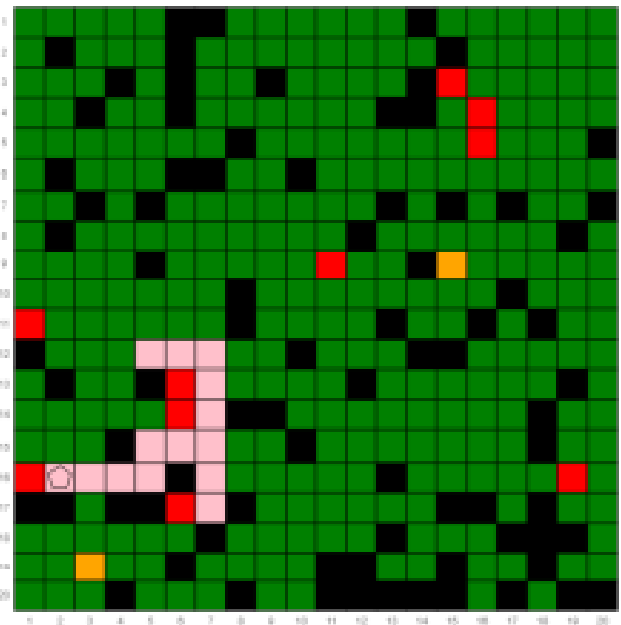
visit and query
oracles to find
secret actor id

lead all agents
out of the maze

- For Disseminating content, clarifying expectations, and giving you the opportunity to ask questions in person

- Tuesdays at 4-6pm in 1.11 in teaching weeks 1-5 & 7-8

- Mandatory for ALL students (both Exam and Coursework)

- Usually comprising two integrated lecture/Q&A sessions

- Lectures are **not assessed** but **vital** for all students

- Lectures are **recorded** on Mediasite (to aid revision)

- You are strongly encouraged to ask questions

University of BRISTOL

- For consolidating taught content with self-study and giving you the opportunity to obtaining feedback from unit staff

- Fridays at 9-11 in 2.11 in teaching weeks 1-5 & 7-8

- Mandatory for ALL students (both Exam and Coursework)

- Comprising predefined TA-supported tutorial exercises

- Labs are **not assessed** but are **vital** for all students

- Labs are **not recorded** (so you must attend live)

- Work individually or in small groups (you need self-organise)

- Raise your hand to get help from the TAs

- No Lectures/Labs in week 6 (Reading Week)

- No Lectures/Labs in weeks 9-11 (Timed Coursework weeks)

- Exam Preparation Session in week 12 (for Exam students only)

- Extra assistance for students struggling with specific issues (especially Prolog-related issues at the start of the course)

- Thursdays at 1-2pm in teaching weeks 1-5 & 7-8

- Drop-ins are **not assessed** and are 100% **optional**

- Drop-ins are **not recorded** (so you must attend live)

- There will be a limited number of TAs on hand to help

- Good opportunity to ask specific questions relating to unit content, lab exercises and related software

- The best way to ask questions outside the live sessions

- Monitored by unit staff who will try to respond within 24hrs

- All students can benefit from seeing the answers

- You can post anonymously if you want

- You can get automatic email notifications (please enable)

- Keeps all information together in one convenient place

- Students are strongly encouraged to try and answer questions as well as asking them!
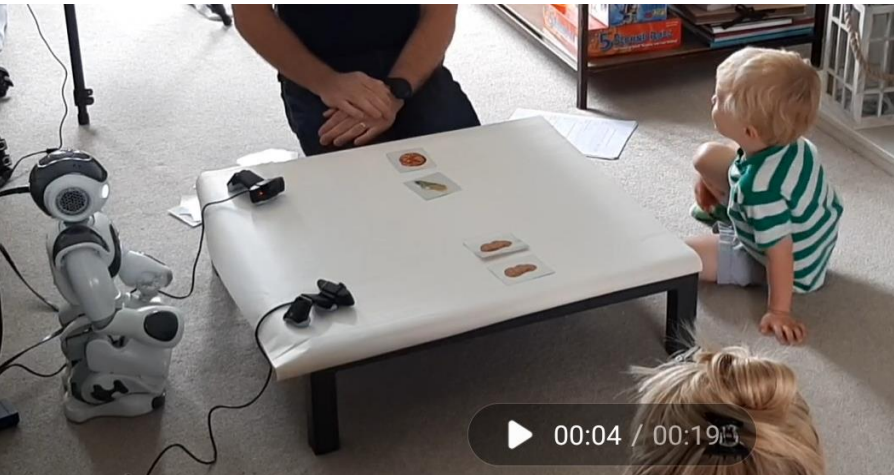
This unit is taught by three academics:

- **Oliver Ray** (director)

- **Seth Bullock**

- **Nirav Ajmeri**

And it is supported by a team of Teaching Assistants:

- Alexander Quessy; George Brayshaw; Oliver Deane; Charli Posner; and Matthew Nagy

Please contact us in class or via the Unit Discussion Forum!

Oliver - Research Interests

- PhD, Imperial College
  - Abductive Logic Programming (PrologIcA, efficiency)
  - Inductive Logic Programming (HAIL, completeness)
- Research Fellow, University of Bristol
  - Answer Set Programming (XHAIL, non-monotonicity)
  - Machamer-Darden-Craver theory (Huginn, Robot Scientist)
- Senior Lecturer, University of Bristol
  - Event Calculus (XEC, temporal conflict resolution)
  - Cyber Security (Acuity, human-in-the-loop learing)
  - Normative Agents (InstAL+, round-trip revision)
  - Relational Frame Theory (Artomis, theory of mind)
  - Legal Informatics (SUMO, majority opinion in UKSC)
  - Research Director Interactive AI CDT (IAI)

Oliver - Personal Interests

- Dance
  - Latin: Salsa, Bachata, ChaCha, (Son, Tango)
  - Cajun: Zydeco, Two-step, Waltz, Blues
  - Swing: West Coast Swing, (Charelston, Lindy)
  - Jive: Ceroc, Silc, (Rockabilly)

- Drumming
 - Bongos, Congas, (Djembe, Timbales)

- Sport
  - Tag Rugby, Kickboxing, Tennis
  - Bouldering, Weightlifting, Swimming
  - Dog walking!

Artificial Life: Evolution, Collective Behaviour, Neuroscience, Agent Based Modelling, Robotics, Interdisciplinarity, Complex Systems Simulation, etc.

Evolving Collective Construction

- A swarm of termite-like robots
- Collectively build a specific kind of structure
- No global communication
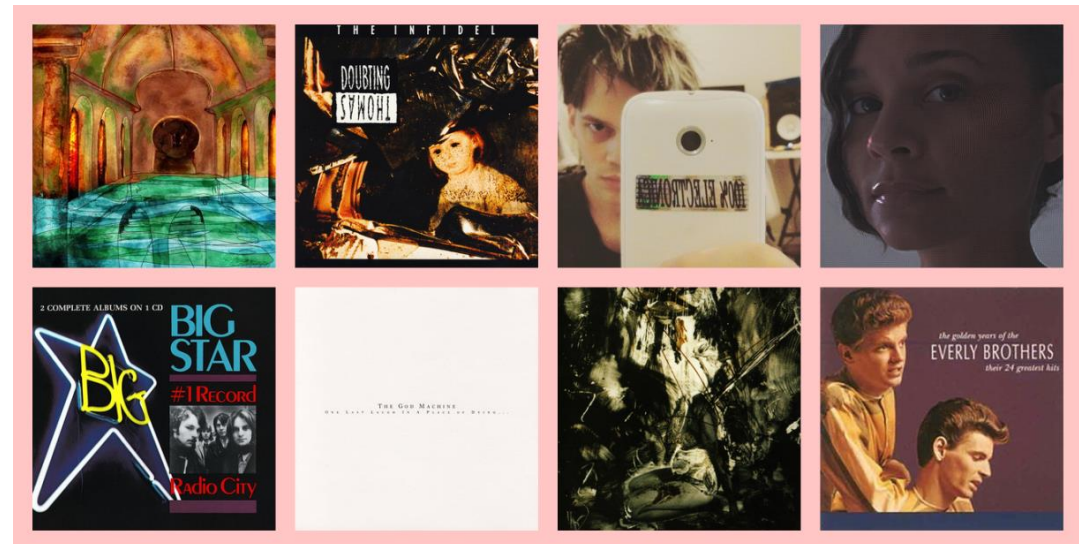- No blueprint
- Just artificial pheromones
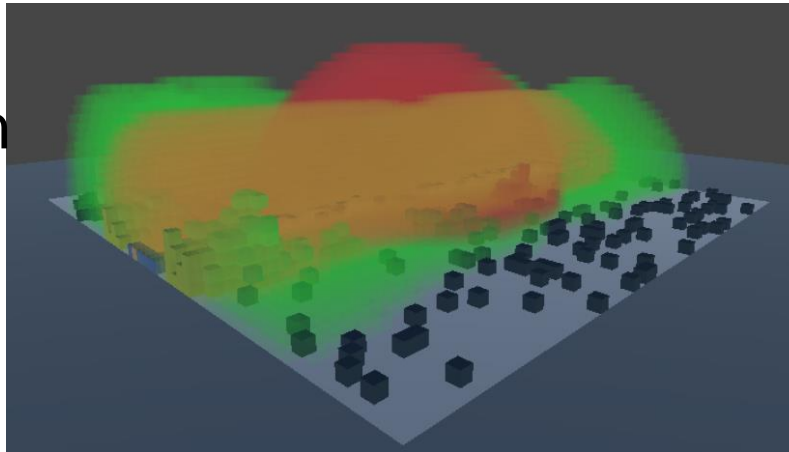
Evolving Robot Communication

- 2 robots controlled by the same evolved artificial neural network
- Each knows about 1 location
- Only 1 is the best
- They both need to get to it
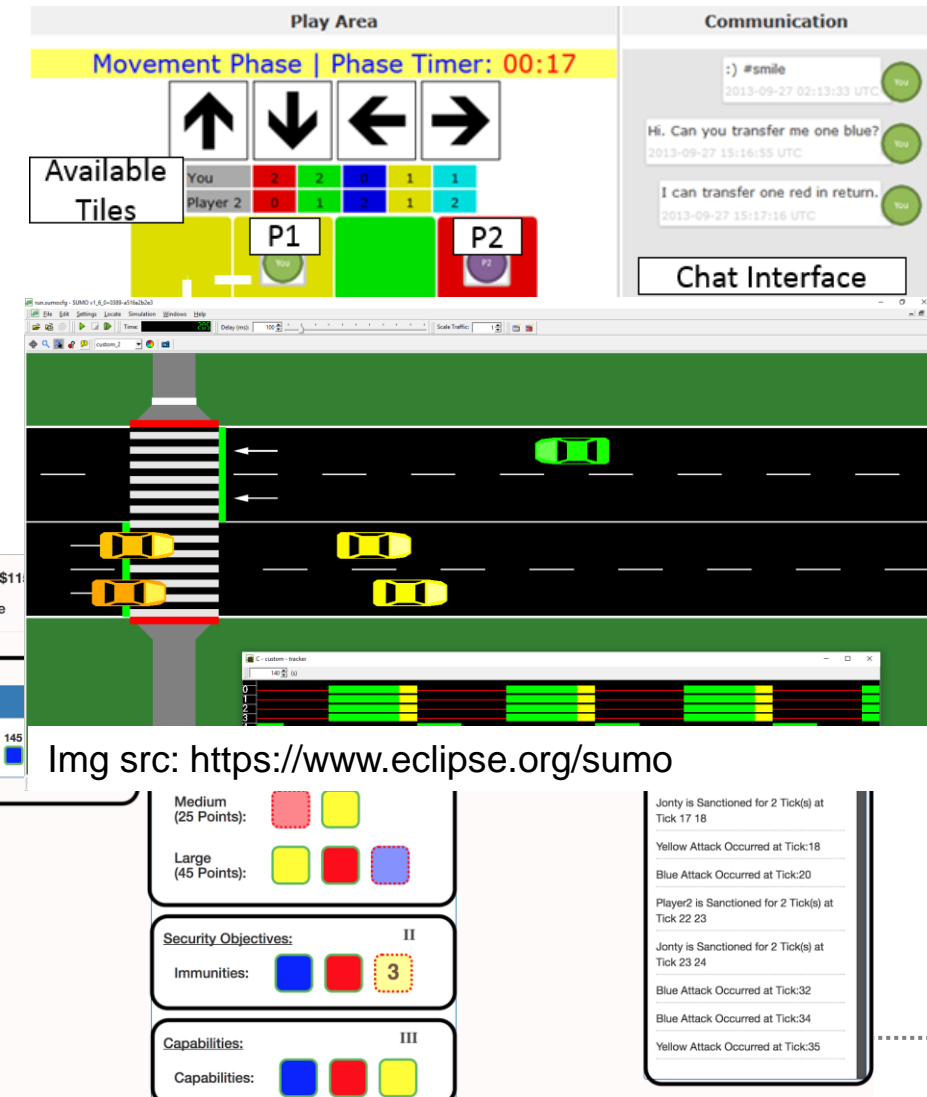- They can see each other
- They only have three neurons

University of
BRISTOL
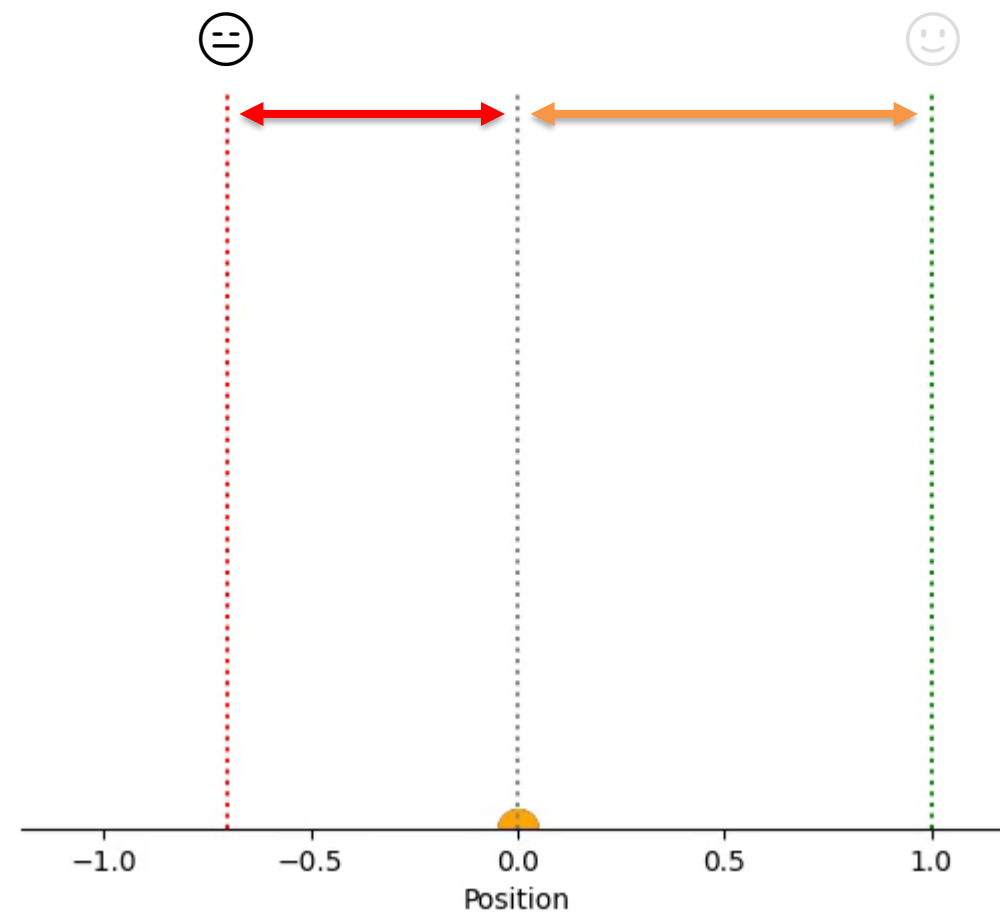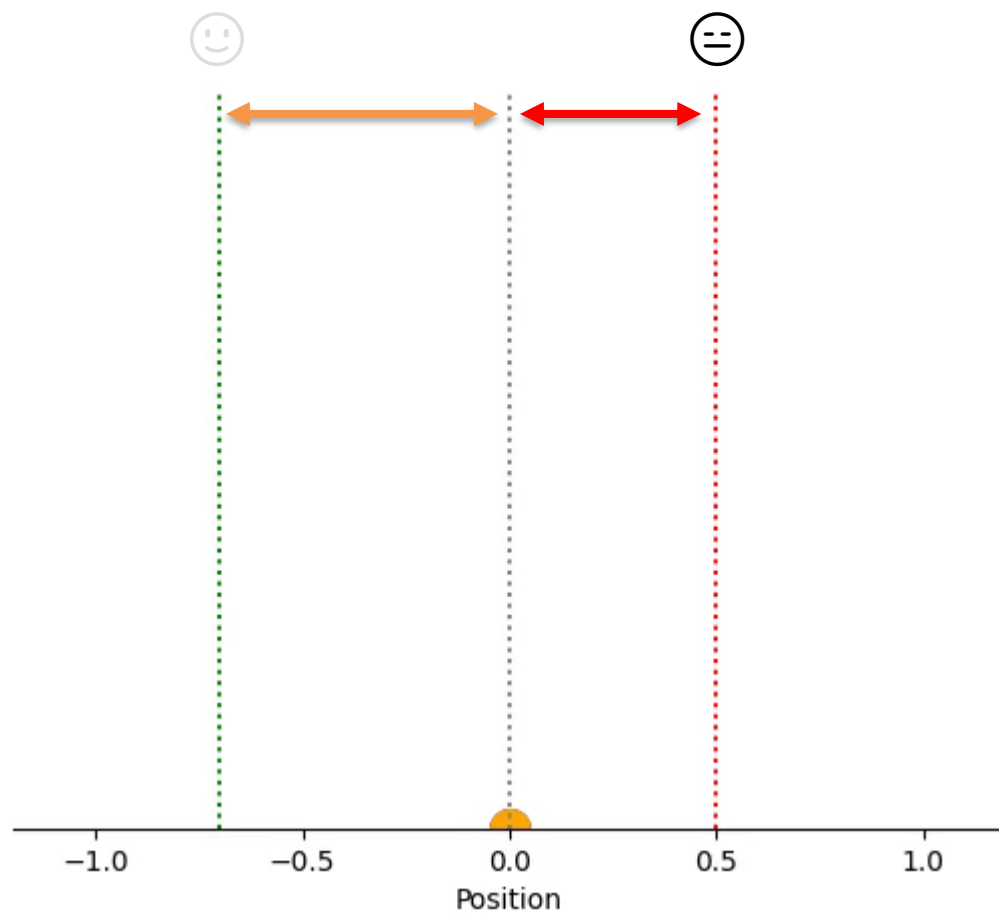
- Food – Cooking it, Eating it

- Music – Old Music, New Music

- West Ham – when we're winning..

Img src: https://www.eclipse.org/sumo

- **Researcher, TCS-TRDDC, Pune, India**
  - Software requirements engineering; Knowledge engineering
- **PhD, NC State University, Raleigh NC, USA**
  - Socially intelligent agents and multiagent systems
  - Sociotechnical systems
    - Formal specification, reasoning, and verification
    - Privacy and security
    - Ethics and fairness
- **Postdoctoral Researcher, NC State University, Raleigh NC, USA**
  - AI, ethics, and society
  - Software security
- **Lecturer, University of Bristol**
  - AI and prosociality
  - Bias and misinformation
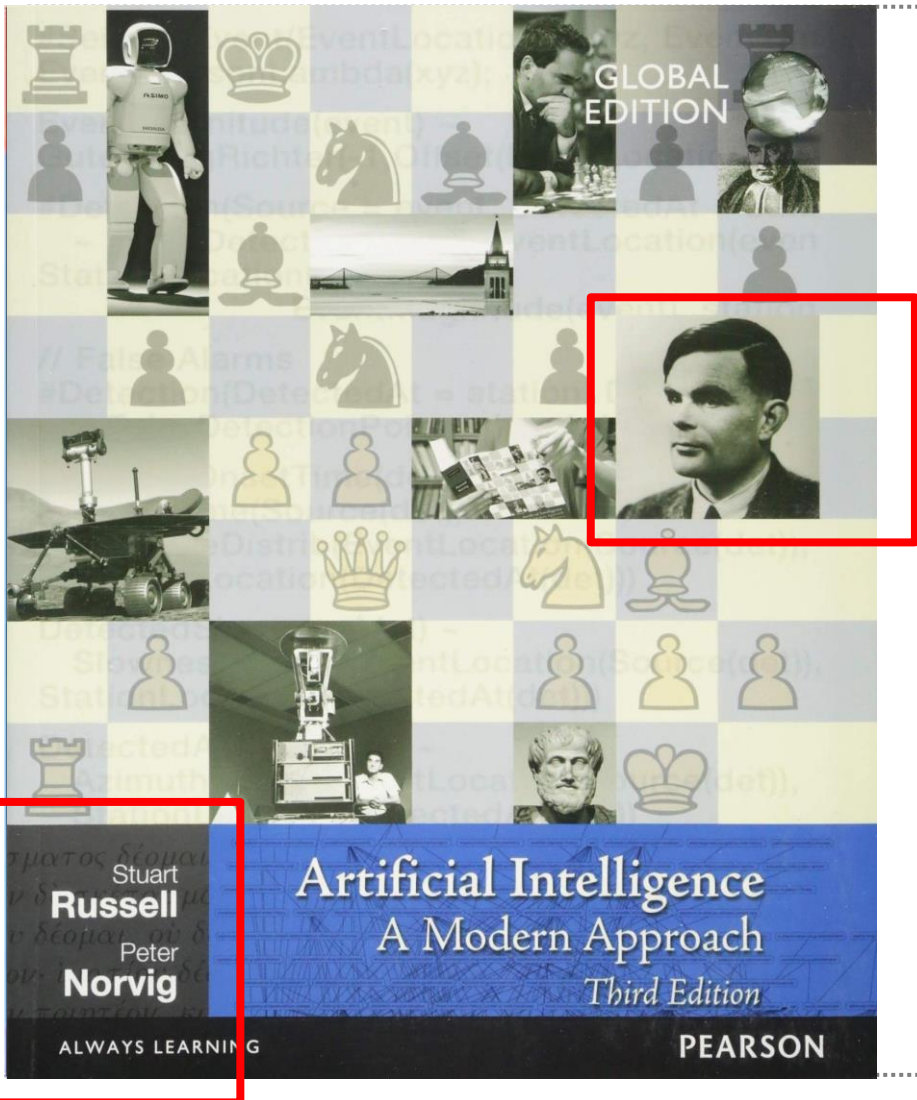 - Privacy and online harm

University of BRISTOL

- Cricket!
- Any sport
  - Badminton, Table Tennis, …

- Arcade gaming
- Board games and card games
- Travelling and trekking
  - Can't swim!
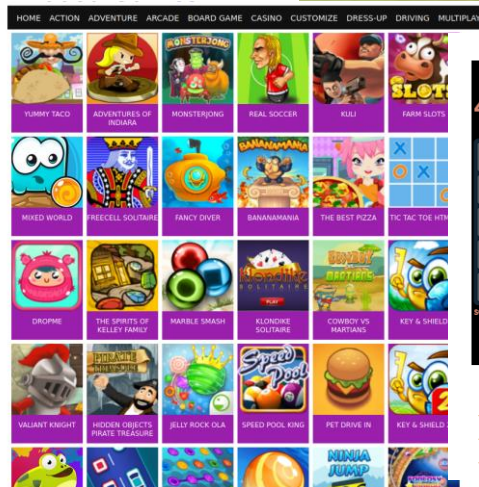
University of **BRISTOL**

Artificial Intelligence: a modern approach (by Stuart Russell and Peter

SWI Prolog

Learn Prolog Now (by …)

Simply Logical (by Peter Flach)