



THE UNIVERSITY *of* EDINBURGH  
**informatics**

# Artificial Intelligence at Edinburgh

Chris Williams



- ▶ AI is concerned with the automation of perceiving, reasoning and behaving in an intelligent (i.e. rational) manner, or like humans
- ▶ Intelligence involves abilities like reasoning and problem solving, learning and memory, perception, taking actions and communicating
- ▶ Edinburgh has a long tradition of work in AI going back to the 1960s

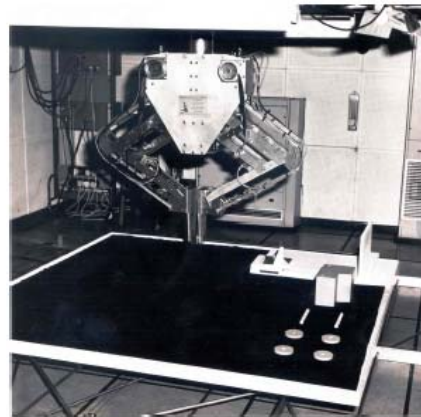


Figure credit: <http://www.aiai.ed.ac.uk/project/freddy/>



- ▶ We are arguably the leading university centre for AI in the UK
  
- ▶ 4 out of the 6 Institutes in the School of Informatics work on AI
  - ▶ Institute for Adaptive and Neural Computation
  - ▶ Centre for Intelligent Systems and their Applications
  - ▶ Institute for Language, Cognition and Computation
  - ▶ Institute of Perception, Action and Behaviour
  
- ▶ UoE is a founding partner of the Alan Turing Institute for Data Science and Artificial Intelligence
  
- ▶ Funding from UK, EU and overseas research organizations, many industrial partners, and charities.



## Overview

- ▶ Perception
- ▶ Reasoning
- ▶ Learning
- ▶ Acting
- ▶ Communicating
- ▶ Studying Natural Systems
- ▶ The Effects of AI Systems



## Perception

- ▶ Speech: turning acoustic signals into words
- ▶ Vision: Identify objects, agents and their actions from images/video
- ▶ Combining speech and video etc.

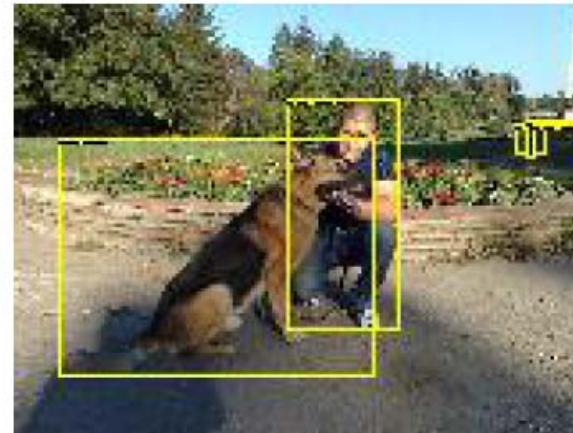
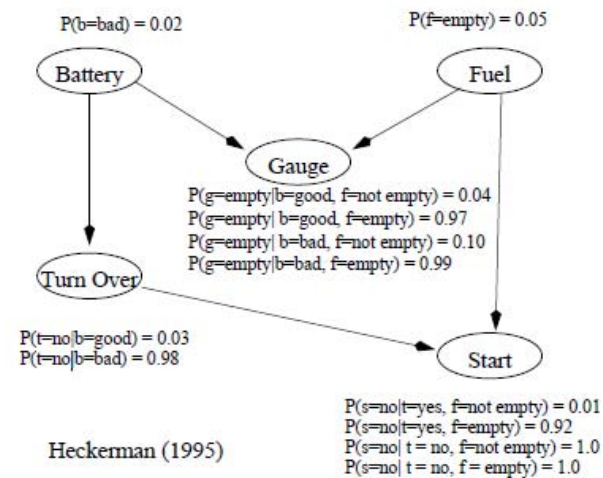


Figure credit: PASCAL VOC



# Reasoning

- ▶ Logic provides a powerful framework for reasoning, e.g. for mathematical theorem proving
- ▶ Probabilistic reasoning under uncertainty, e.g. graphical models
- ▶ Challenge of combining strengths from logic and probability





# Learning

- ▶ **Supervised Learning:**  
(input, output) pairs provided, predict output label of new inputs. Used widely in vision, language, sciences, advertising, etc
- ▶ **Unsupervised Learning:**  
Model structure in the data, e.g. clusters, factors

Detecting malaria parasites in blood samples

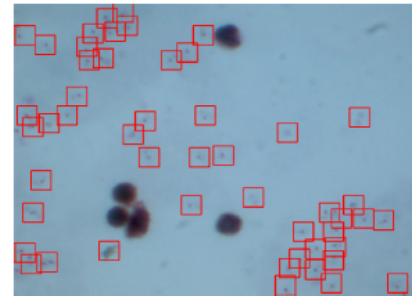
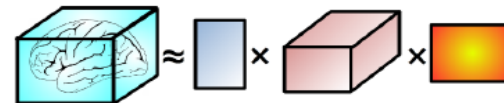


Figure credit: <http://air.ug/microscopy/>

Tensor factorization of neural activity (Onken)





## Acting

- ▶ We build agents that can act in their environment to achieve useful tasks
- ▶ Such agents need to learn, reason and plan, either autonomously or in collaboration with humans
- ▶ Acting not only in the real world, but e.g. in virtual environments



Edinburgh-NASA Valkyrie project



Figure credit: Taku Komura





## Communicating

- ▶ Language is a critical route by which we communicate and convey information to each other
- ▶ Algorithms to understand the structure of sentences, determine the meaning of linguistic input, and generate appropriate responses
- ▶ Examples of work at Edinburgh include: machine translation, document summarization, information retrieval (incl. social media)



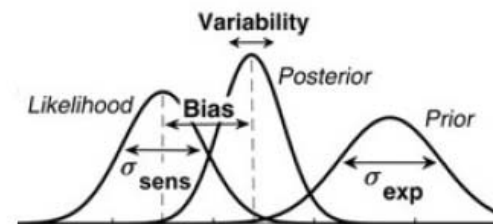


## Studying Natural Systems

Including

- ▶ Computational neuroscience
- ▶ Behavioural control of insects
- ▶ Computational psychiatry
- ▶ Behavioural experiments to underpin cognitive models

a





## The Effects of AI Systems

- ▶ Increasingly important that designers of AI systems can provide assurances about safety, trustworthiness, ethics, fairness etc.
- ▶ Beyond purely technical solutions: Design Informatics connects AI specialists with designers, cognitive scientists, and human-computer interaction experts