CMP9132M - Advanced Artificial Intelligence

Lecture 1- Introduction

2 Assignments, each worth 50% of final mark

* Assignment 1: before Christmas
* Assignment 2: at the end of module

**Quantify uncertainty – intro to probability**

**Probability reasoning - Bayesian networks, casual interference, etc.**

**Reasoning over time - Hidden Markov models, etc.**

**Making complex decisions – Markov Decision Processes etc.**

**Links AAI <--> Machine learning**

Machine learning is a sub topic of AI

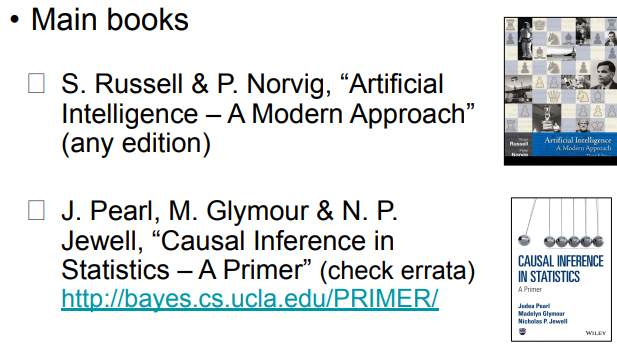
Reasoning over time

* Hidden Markov models, Kalman filter, etc.
* Recurrent Neural Networks (RNNs)

Making complex decisions

* Markov Decision Processes etc.
* Deep Reinforcement Learning (DRL)

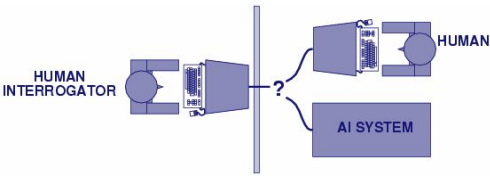
**Recommended reading:**



**Acting humanly - Turing Test**

Turing (1950) “Computing machinery and intelligence”:

Operational test for intelligent behaviour: The Imitation Game



**Thinking humanly – cognitive modelling**

1960s “cognitive revolution” information-processing & psychology.

Requires scientific theories of internal activities of the brain.

We can validate this by:

* Predicting and testing behaviour of human (top-down)
* Direct identification from neurological data (bottom-up)

Both approaches 1. Cognitive science 2. Cognitive neuroscience, are now distinct from AI.

**Thinking rationally – Laws of thought**

Aristotle – What are correct argument/ thought processes?

Several Greek schools developed various forms of logic: notation and rules of derivation for thoughts

Direct line through mathematics and philosophy to modern AI

Problems:

Not all intelligent behaviour is mediated by logical deliberation (e.g. reflex action)

What is the purpose of thinking? Which thoughts should I have?

**Acting rationally – rational agent**

Rational behaviour: doing the right thing!

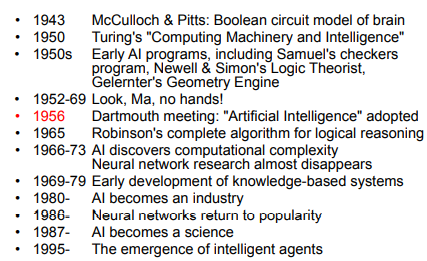
The right thing: that which is expected to maximise goal achievement, given the available information

Doesn’t necessarily involve thinking – e.g. blinking reflex – but thinking should be in the service of rational action.

AI roots

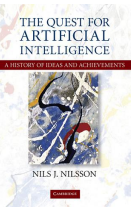
* Philosophy - Logic, methods of reasoning, mind as physical system foundations of learning, language, rationality
* Mathematics - Formal representation and proof algorithms, computation, (un)decidability, (in)tractability, probability
* Economics - utility, decision theory
* Neuroscience - physical substrate for mental activity
* Psychology - phenomena of perception and motor control, experimental techniques
* Computer engineering - building fast computers
* Control theory - design systems that maximize an objective function over time
* Linguistics - knowledge representation, grammar

AI History



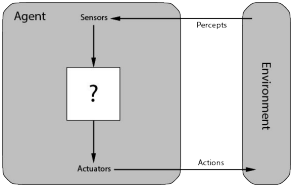


<https://ai.stanford.edu/~nilsson/>

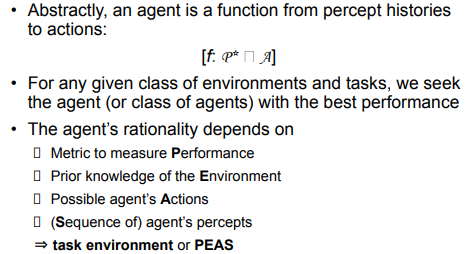


**Rational agents**

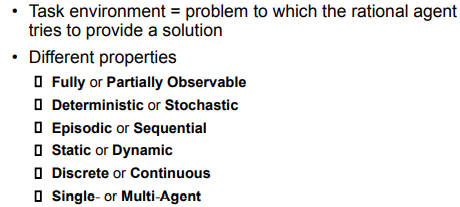
An agent is an entity that perceives and acts



Rational agents



**Task Environment**

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**Conclusions**