A.I History

Introduction
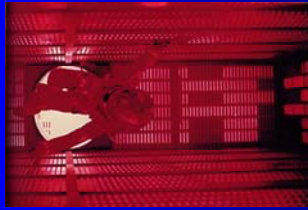Assoc. Prof Ian Watson

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A Short History of AI

- The origins of Artificial Intelligence
- General Purpose Problem Solvers
- Expert Systems - a solution ?
- The early years
- The hype
- The AI Winter
- Where are we now?

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Science Fiction

- we are all familiar with the concept of intelligent machines: *2001, Bladerunner, the Terminator*

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Science Fiction

- Movies you should see this semester:
  - *2001*
  - *Bladerunner*
  - *the Terminator*
  - *A.I.*
  - *Dark Star*

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The Origins of AI

- Lady Ada Lovelace hypothesises in 1842 that Charles Babbage's Analytical Engine could manipulate symbols other than numbers and hence perhaps could compose music
- The programming language ADA is named after her
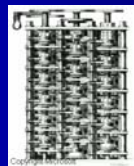
Babbage's Analytical Engine

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The Frankenstein myth

- An enduring myth
- Brought to life by Mary Shelly in her gothic novella *Frankenstein*
- echoed in 2001, Terminator, etc….
- Interesting relationship to the origins of computing & AI

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The Frankenstein myth

- Mary Shelley was married to Percy Shelly
- Best friend of Lord George Byron
- Ada Countess of Lovelace was Byron's daughter
- Ada patronised Charles Babbage
- Babbage built the 1st programmable computer (mechanical not digital)
- Ada hypothesized about AI

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The Frankenstein myth

- Ada must have read Frankenstein
- The idea of creating a conscious entity that may turn upon us was already in popular culture around 150 years ago
- At the birth of computing & AI

www.sdsc.edu/ScienceWomen/lovelace.html

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The Origins of AI

- Alan Turing in the 30's is the person first credited with proposing that a computer could exhibit "intelligence"
- Turing was a brilliant mathematician, he worked cracking German codes during WW-2
- He worked on the development of the 1st computer that could store a program at Manchester University
- Turing committed suicide in the 50's

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The Turing Test

- Can you decide which answers come from the person and which from the computer?
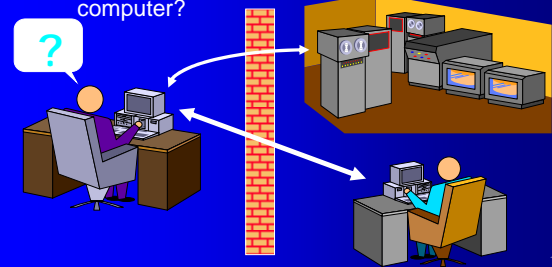
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The Turing Test

- this measure of intelligence does not assume
  - consciousness or feelings
  - emotions or any of the other characteristics of people
- AI programs "mimic" intelligence
- we leave the arguments as to the nature of intelligence to philosophers
- however, the metaphor of the brain as a computer has become dominant

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Artificial Intelligence

- AI can be defined as an attempt to emulate the behaviour of people by a computer
- AI was invented by "the gang of four" at Dartmouth University
- areas of research include:
  - vision & natural language understanding
  - speech recognition, robotics
  - knowledge-based systems
  - machine learning, artificial life & neural nets

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AI vs. conventional programs

- conventional applications process data deterministically
- they give a definite solution to definite inputs
- AI systems are frequently non-deterministic
- they can handle uncertainty, incompleteness, and dynamic environments

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Symbol Systems

- AI programs reduce problems to symbols
- these symbols can be manipulated
- the manipulation of these symbols can seem intelligent
- the computer does not "know" what the symbols mean

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Representing Problems as Symbols

A farmer has a problem, he has to cross a river by boat taking with him his dog, goose and a sack of corn. The boat is small and can only hold one item with the farmer.
He can't leave the dog alone with the goose - the dog will eat the goose. He can't leave the goose alone with the corn - the goose will eat the corn.

What is the order in which the farmer transfers his property across the river?

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A Symbolic Representation

- Dog = d
- Goose = g
- Corn = c
- At the start of the problem all are on the left back of the river = L(d,g,c)
- The right bank is empty = R()
- ->(d) = row the dog to the right bank
- <-(c) = row the corn to the left bank

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A Symbolic Representation

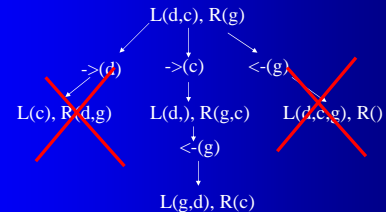- Starting State = L(d,g,c), R()
- Goal State = L(), R(d,g,c)

L(d,g,c)
->(d)   ->(g)   ->(c)
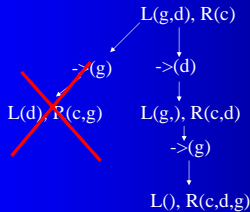L(g,c), R(d)   L(d,c), R(g)   L(d,g), R(c)
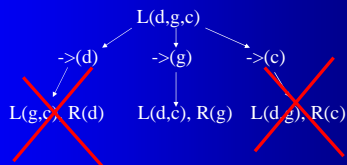
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A Symbolic Representation

- Starting State = L(d,c), R(g)
- Goal State = L(), R(d,g,c)

L(d,c), R(g)
->(d)   ->(c)   <-(g)
L(c), R(d,g)   L(d,), R(g,c)   L(d,c,g), R()
<-(g)
L(g,d), R(c)

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A Symbolic Representation

- Starting State = L(g,d), R(c)
- Goal State = L(), R(d,g,c)

L(g,d), R(c)

->(g)   ->(d)

L(d), R(c,g)   L(g,), R(c,d)

->(g)

L(), R(c,d,g)

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A Symbolic Representation

- Starting State = L(g,d,c), R()
- Goal State = L(), R(d,g,c)
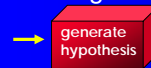- ->(g), ->(c), <-(g), ->(d), ->(g)

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General Purpose Problem Solver (GPS)

- in 1963 Newell and Simon attempted to build a program that could solve problems like people
- the program did not contain knowledge about the world
- instead it attempted to generalise problem solving methods
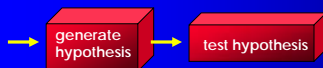
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Generate and Test

- This is an example of a problem solving technique often used in diagnosis

generate hypothesis

22

Generate and Test

- This is an example of a problem solving technique often used in diagnosis

generate hypothesis → test hypothesis

23

Generate and Test

- This is an example of a problem solving technique often used in diagnosis

generate hypothesis → test hypothesis → hypothesis correct → YES

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Generate and Test

○ **This is an example of a problem solving technique often used in diagnosis**

generate hypothesis → test hypothesis → hypothesis correct → YES

NO
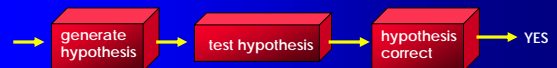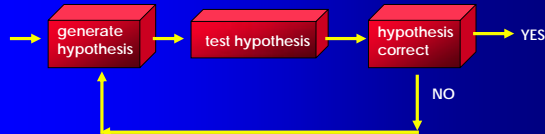
25

GPS

- GPS was not very successful
- it could solve logical expressions
- and mathematical theorems
- but not "*real world*" problems

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Expert Systems

- It was realised that to solve problems you need knowledge about the problem area
- the knowledge must be stored as symbols that a program can manipulate to solve problems
- perhaps using problem solving methods such as generate and test

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Expert Systems

- in the mid 70's several pioneering ES were built in the US
- MYCIN - diagnosed infectious diseases of the blood
- DENDRAL - analysed mass spectroscopy results
- PROSPECTOR - analysed geological survey data to find mineral deposits
- R1 - configured DEC VAX computers

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Expert Systems

- Expert System = Knowledge-Based System
- systems that embody expert knowledge in such a form that they can offer seemingly intelligent advice or decisions

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Expert Systems

- communicate with users through a one-to-one dialogue
- justify *why* a question is being asked
- detect inconsistency in users' answers
- explain *how* a conclusion was reached
- separate knowledge about a problem from the control of the system

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ES Architecture

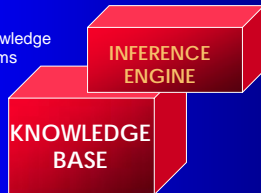31

ES Architecture

contains knowledge usually as rules

KNOWLEDGE BASE

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ES Architecture

applies the knowledge to solve problems

INFERENCE ENGINE

contains knowledge usually as rules

KNOWLEDGE BASE

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ES Architecture

obtains information & explains results

INTERFACE

applies the knowledge to solve problems

INFERENCE ENGINE

contains knowledge usually as rules
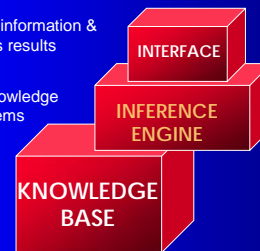
KNOWLEDGE BASE

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ES Architecture

an interface and inference engine can use many different knowledge-bases = **expert system shell**

obtains information & explains results

INTERFACE

applies the knowledge to solve problems

INFERENCE ENGINE

contains knowledge usually as rules

KNOWLEDGE BASE   **KNOWLEDGE BASE**
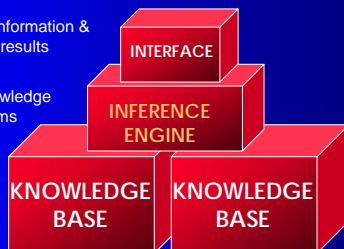
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Rule-Based Systems

- knowledge can be expressed as rules
- problems can be solved using rules
- rules are stored in the knowledge base
- the inference engine matches rules against data
- and can infer new data

Rule-Based Systems

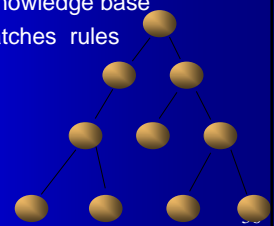- Rule-based ES worked!!!
- they were simple
- they were relatively easy to program
- they mimicked how experts worked
- they could explain how they reached a conclusion
- they could be used for commercial benefit
- this was the BREAKTHROUGH AI needed

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The Hype

- in the late 70's AI gurus started claiming that ES would become a multi-million dollar business
- ES would operate in every industry
- ES would revolutionise the workplace
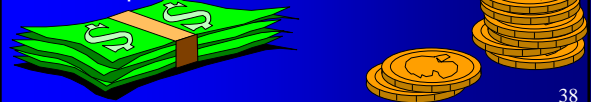
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The AI Winter

- Large companies invested in AI and caught a chill
- ES were expensive and difficult to build
- ES were hard to maintain
- people didn't like them
- few ES lived up to the hype
- companies lost money and faith
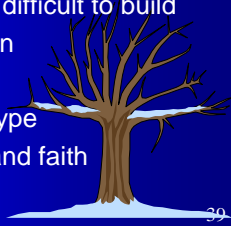
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The AI Spring

- AI techniques have entered the main stream of IT (e.g. rules, objects & agents)
- Neural Nets are delivering valuable applications
- Case-Based Reasoning is showing promise and has delivered commercial applications
- AI has become "*embedded*" it is now just another programming technique
- AI makes money

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The AI Spring

- the following management consultancy firms have large AI groups
  - ◆ Deloitte Touche,
  - ◆ Coopers & Lybrand, KPMG
  - ◆ Ernst Young
- they use AI in their core accounting business and offer AI consultancy

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Progress & IT

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Progress & IT

1840 Babbage's Analytical Engine

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Progress & IT

1842 Ada Lovelace - machines can think!

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Progress & IT

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1945 Von Neumann - EDVAC

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Progress & IT

1951 Ferranti MARK 1 and LEO - Lyon's Electronic Office

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1995 - Internet & WWW

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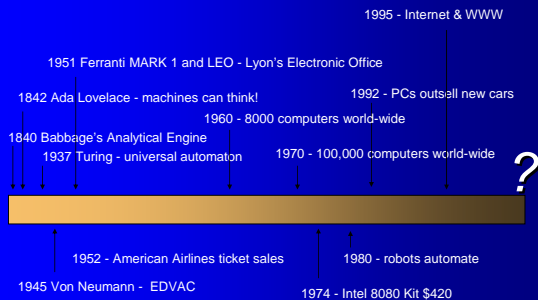1945 Von Neumann - EDVAC

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?

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Game playing

- It took more then 10 years
- But AI had us beaten before 2001
- In Feb 1996 IBM's *Deep Blue* computer beat Gary Kasparov
  - ◆ Kasparaov went on to win 4 to 2
- Rematch in May 1997
  - ◆ Deep Blues wins 3.5 to 2.5

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Game playing

- Deep Blue is an IBM RS/6000 SP*
  - ◆ Massively parallel 512 processors
  - ◆ Evaluates 200 million moves per sec
- Criticised for using "brute force"
- Not "intelligence"

www.research.ibm.com/deepblue/

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Game playing

- AI gaming has moved on
- Go – a much more complex game
- Consol games (Playstation etc…)
- AI is used to plan and learn strategy
- AI is the next big thing in gaming

http://ai.eecs.umich.edu/people/laird/gamesresearch.html

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Planning & prediction

- 2001 shows HAL controling the space ship & predicting faults
- In 1998 NASA launched Deep Space 1
- Uses AI to control the ship
  - ◆ Autonomous Navigation
  - ◆ Remote Agent
  - ◆ Beacon Monitor
- Currently 350 million kilometers away

http://rax.arc.nasa.gov/

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Planning & prediction

- Software agents routinely
- Monitor complex equipment
- Predict and diagnose faults
- Plan actions
- Robots can even play soccer!

www.robocup.org

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RoboCup

- international competition to develop soccer playing robots
- Requires vision motor skills, planning, prediction and teamwork
- Sponsored by Sony
- Aim is to field a team of robots in 2050 that can beat the World Cup champions

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Speech Recognition

- We communicated by speech
- We want to talk to our computers
- The US military have "hands-free" controls for fighter pilots
- For $150 you can talk to your PC
- NN software learns your accent

www.voicerecognition.com

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Speech Understanding ?

- Much harder
- Requires contextual knowledge and *common* sense
- "*he rowed with his wife…*
- *… on the lake*"
- The CYC ontology contains 1 million definitions of common sense terms and their usages   www.cyc.com

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The reality is

- AI is working to make machines smarter, autonomous, reactive and adaptive
- Visit us on the web at:

www.cs.auckland.ac.nz/Nikau/AIDM.html

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