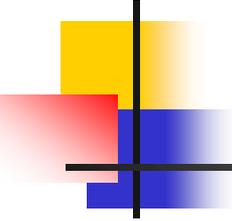


L1:

Overview of AI and its Application Areas

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# Contents

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- What is AI?
- AI History
  - Turing (Who?)
  - Turing test (What?)
- Overview of AI application areas



# What is AI?

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## Our Attempt to Build Models of Ourselves

From when? 1000 years ago? 2000 years ago?

A.I. is the study of how to make computers do things at which, at the moment, people are better.

From when? since having computer? in 30's?

# Historical Attempts

## - Frankenstein

The original story, published by Mary Shelley, in 1818, describes the attempt of a true scientist, Victor Frankenstein, to create life.

<http://members.aon.at/frankenstein/frankenstein-novel.htm>

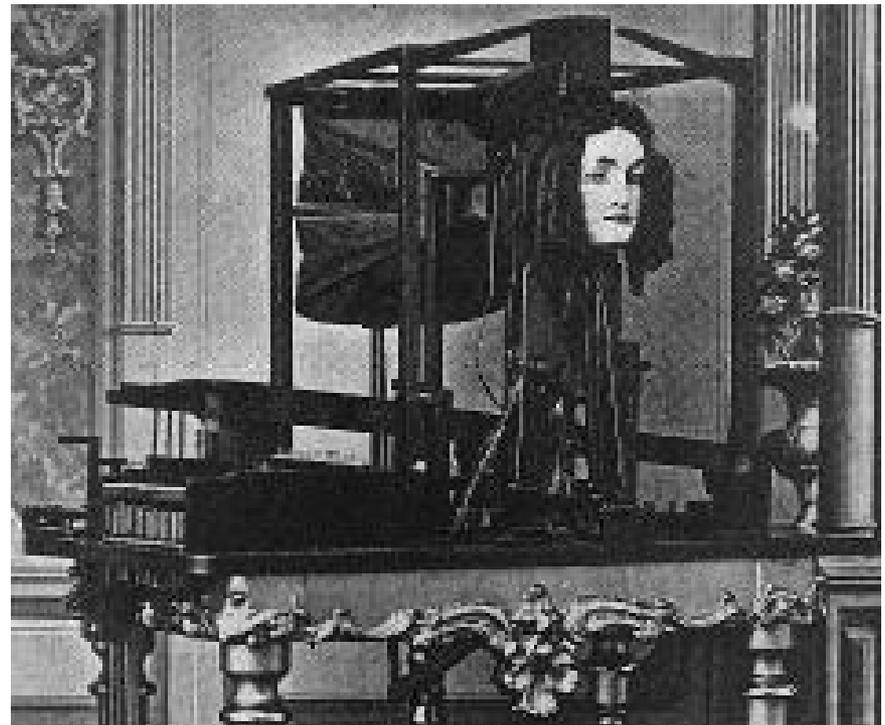


Frankenstein creates the fiend - illustration by Bernie Wrightson (© 1977)

# Historical Attempts - Euphonia

Joseph Faber's Amazing Talking Machine (1830-40's). The Euphonia and other early talking devices are described in detail in a paper by David Lindsay called "Talking Head", *Invention & Technology*, Summer 1997, 57-63.

About this device, Lindsay writes: It is "... a speech synthesizer variously known as the Euphonia and the Amazing Talking Machine. By pumping air with the bellows ... and manipulating a series of plates, chambers, and other apparatus (including an artificial tongue ... ), the operator could make it speak any European language. A German immigrant named Joseph Faber spent seventeen years perfecting the Euphonia, only to find when he was finished that few people cared."



From <http://www.haskins.yale.edu/haskins/HEADS/SI MULACRA/euphonia.html>

# Historical Attempts - RUR

In 1921, the Czech author Karel Capek produced the play *R.U.R.* (*Rossum's Universal Robots*).

**"CHEAP LABOR. ROSSUM'S ROBOTS."**

**"ROBOTS FOR THE TROPICS. 150 DOLLARS EACH."**

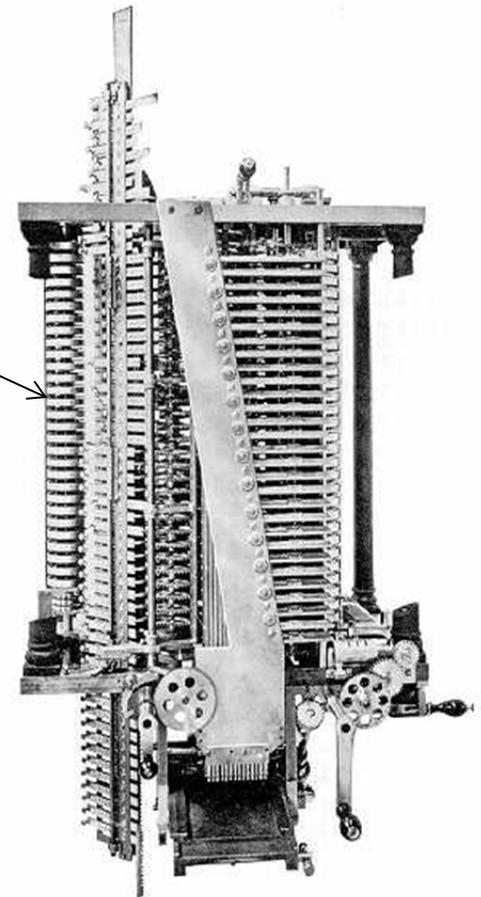
**"EVERYONE SHOULD BUY HIS OWN ROBOT."**

**"DO YOU WANT TO CHEAPEN YOUR OUTPUT?  
ORDER ROSSUM'S ROBOTS"**

Some references state that term "*robot*" was derived from the Czech word *robotá*, meaning "work", while others propose that *robotá* actually means "forced workers" or "slaves." This latter view would certainly fit the point that Capek was trying to make, because his robots eventually rebelled against their creators, ran amok, and tried to wipe out the human race. However, as is usually the case with words, the truth of the matter is a little more convoluted. In the days when Czechoslovakia was a feudal society, "*robotá*" referred to the two or three days of the week that peasants were obliged to leave their own fields to work without remuneration on the lands of noblemen. For a long time after the feudal system had passed away, *robotá* continued to be used to describe work that one wasn't exactly doing voluntarily or for fun, while today's younger Czechs and Slovaks tend to use *robotá* to refer to work that's boring or uninteresting.

# The Roots of Modern Technology

- 5<sup>th</sup> B.C. Aristotelian logic invented
- 1642 Pascal built an adding machine
- 1694 Leibnitz reckoning machine
- 1834 Charles Babbage's Analytical Engine



# Will **Logic** be the Key to Thinking?

**1900** Hilbert's program and the effort to formalize mathematics

**1931** Kurt Gödel's paper, *On Formally Undecidable Propositions*

**1936** **Alan Turing's** paper, *On Computable Numbers with an application to the Entscheidungs problem*

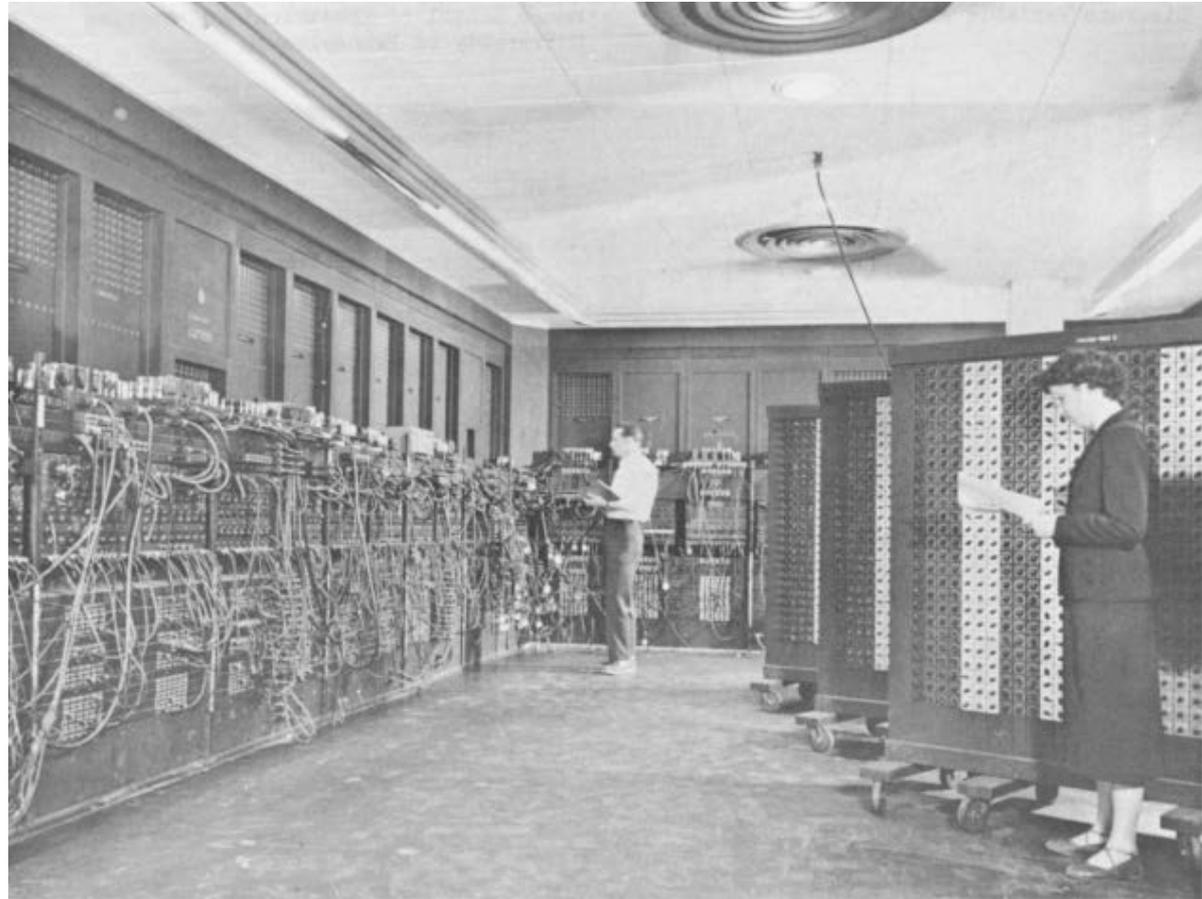
Who is **Alan Turing**?

What is **the Turing test**?

Why is 2012 **a special year** to AI?

# The Advent of the Computer

1945 ENIAC *The first electronic digital computer*



# 1949 EDVAC

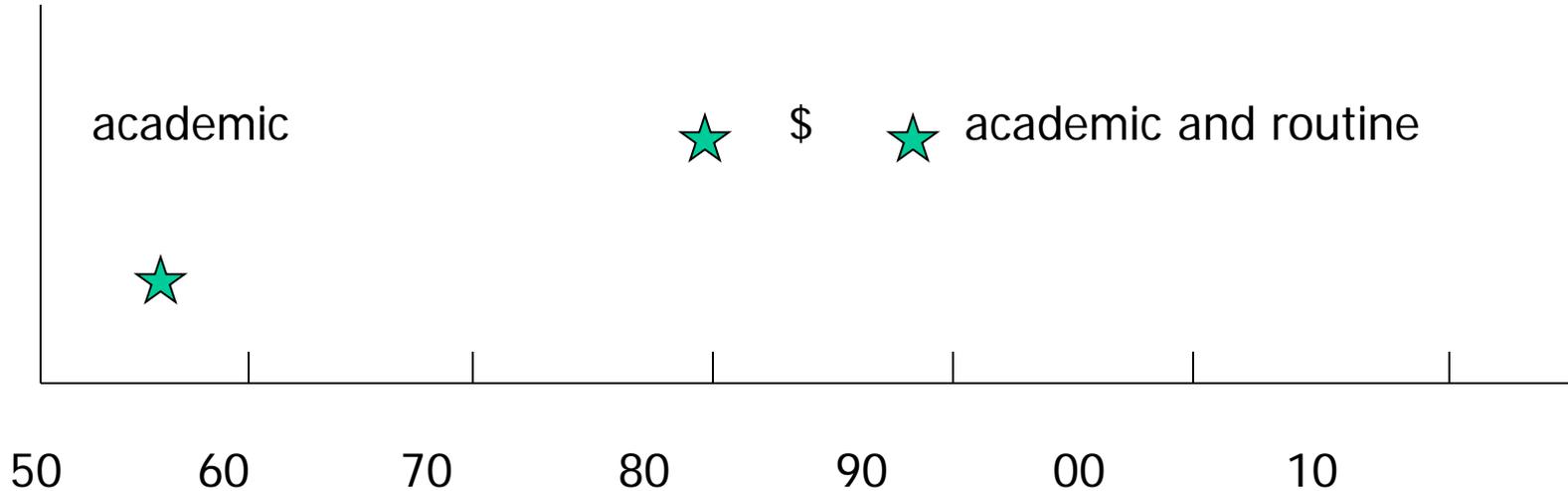
*The first stored program computer*



# The Dartmouth Conference and the Name Artificial Intelligence

J. McCarthy, M. L. Minsky, N. Rochester, and C.E. Shannon. August 31, 1955. "We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it."

# Time Line – The Big Picture



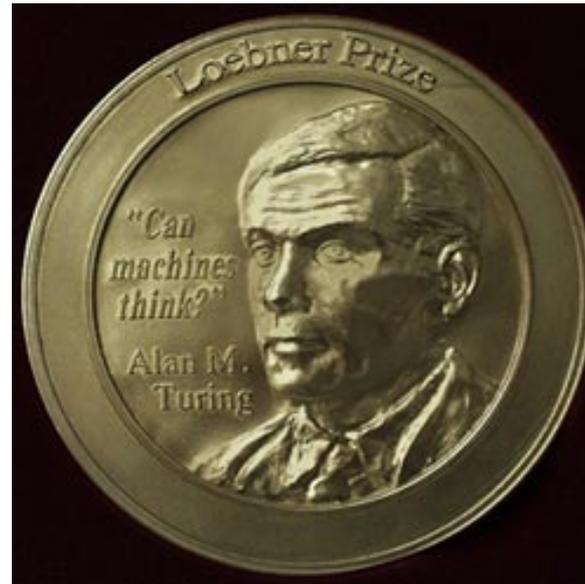
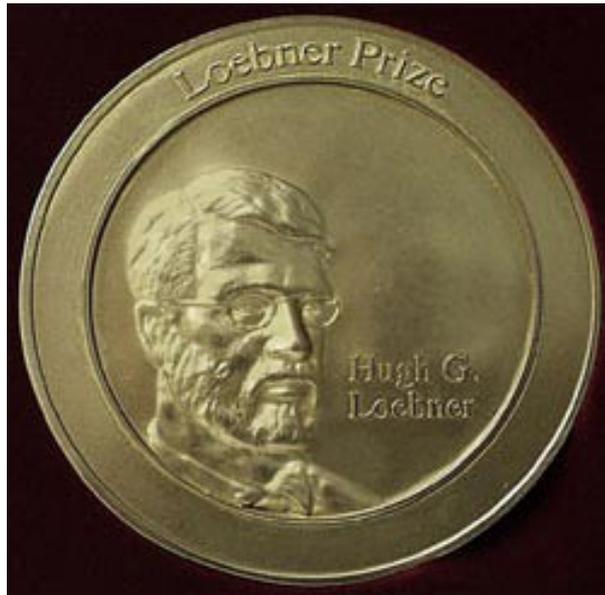
- ★ 1956 Dartmouth conference.
- ★ 1981 Japanese Fifth Generation project launched as the Expert Systems age blossoms in the US.
- ★ 1988 AI revenues peak at \$1 billion. AI Winter begins.

# How Will We Recognize AI?

1950 Alan Turing's paper, *Computing Machinery and Intelligence*, described what is now called "The Turing Test".

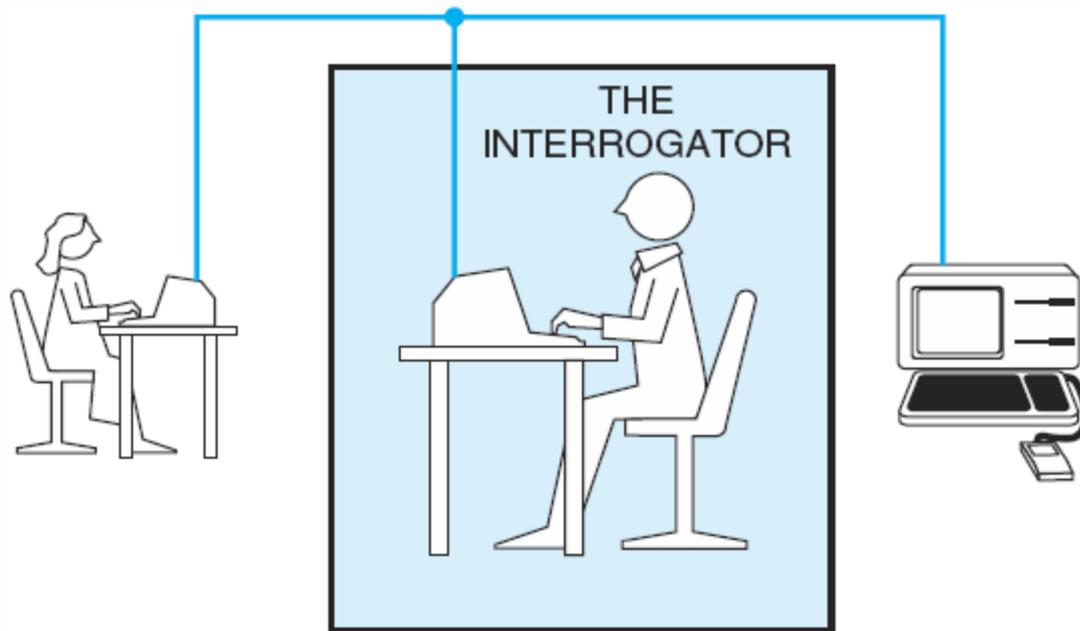
<http://www.loebner.net/Prizef/loebner-prize.html>

1990 Loebner Prize established. Grand Prize of \$100,000 and a Gold Medal for the first computer whose responses are indistinguishable from a human.



# History: the Turing Test

- The imitation game (1950)



# Were Newell and Simon Right?

- 1950 Claude Shannon published a paper describing how a computer could play chess.
- 1957 Newell and Simon predicted that a computer will beat a human at chess within 10 years.
- 1967 MacHack was good enough to achieve a class-C rating in tournament chess.



# Chess Today



In 1997, Deep Blue beat Gary Kasparov.



# Programming Languages

1958 Lisp – a functional programming language with a simple syntax.

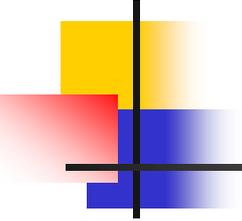
*(successor SitA ActionP)*

1972 PROLOG - a logic programming language whose primary control structure is depth-first search

*ancestor(A,B) :- parent(A,B)*

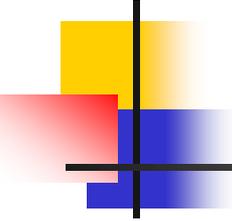
*ancestor(A,B) :- parent(A,P), ancestor(P,B)*

1988 CLOS (Common Lisp Object Standard) published.  
Draws on ideas from Smalltalk and semantic nets



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# Overview of AI application areas

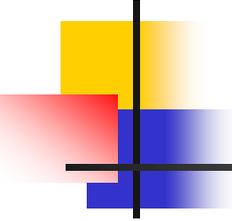


# AI application areas

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- Game Playing

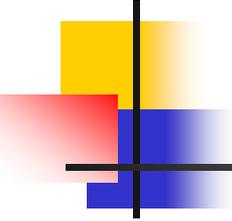
- Much of the early research in state space search was done using common board games such as checkers, chess, and the 15-puzzle
- Games can generate extremely large search spaces. These are large and complex enough to require powerful techniques for determining what alternative to explore



# AI application areas

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- Automated reasoning and Theorem Proving
  - Theorem-proving is one of the most fruitful branches of the field
  - Theorem-proving research was responsible in formalizing search algorithms and developing formal representation languages such as predicate calculus and the logic programming language

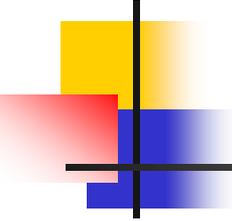


# AI application areas

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- Expert System

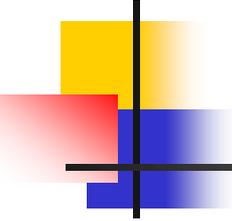
- One major insight gained from early work in problem solving was the importance of domain-specific knowledge
- Expert knowledge is a combination of a theoretical understanding of the problem and a collection of heuristic problem-solving rules



# AI application areas

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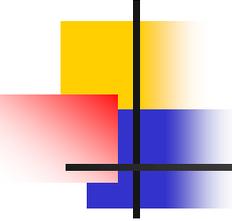
- Expert System
  - Current deficiencies:
    - **Lack of flexibility**; if human cannot answer a question immediately, he can return to an examination of first principle and come up something
    - **Inability to provide deep explanations**
    - **Little learning from experience**



# AI application areas

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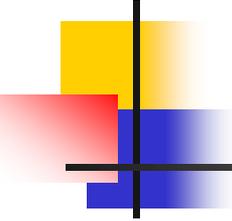
- Natural Language Understanding and Semantics



# AI application areas

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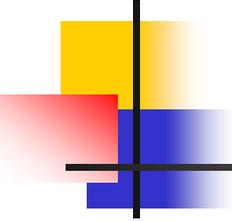
- Modeling Human Performance
  - Capture the human mind (knowledge representation)



# AI application areas

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- Robotics

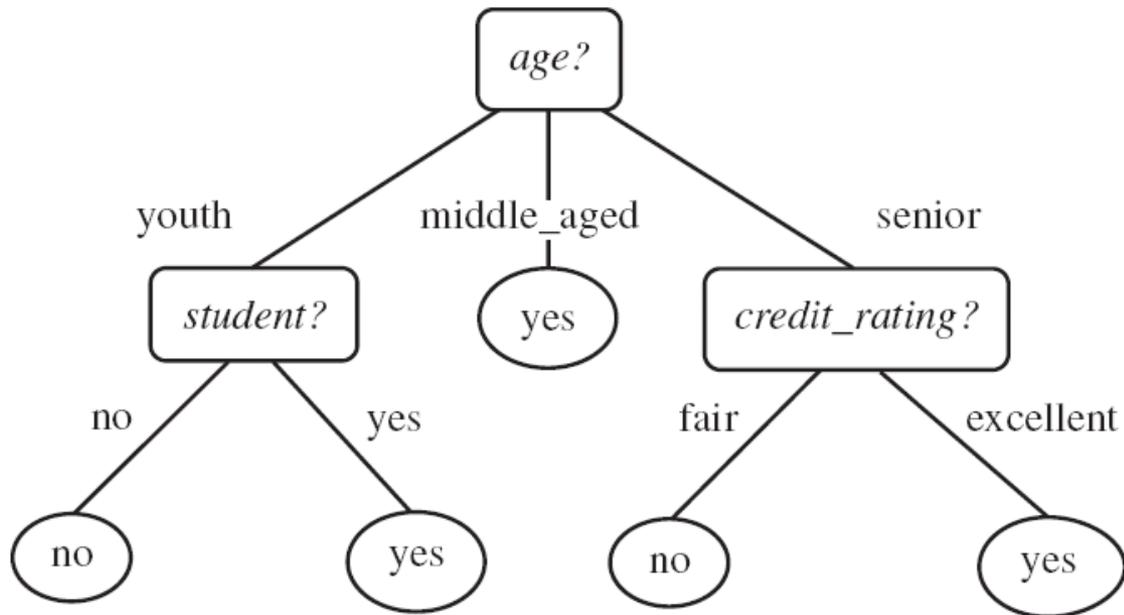


# AI application areas

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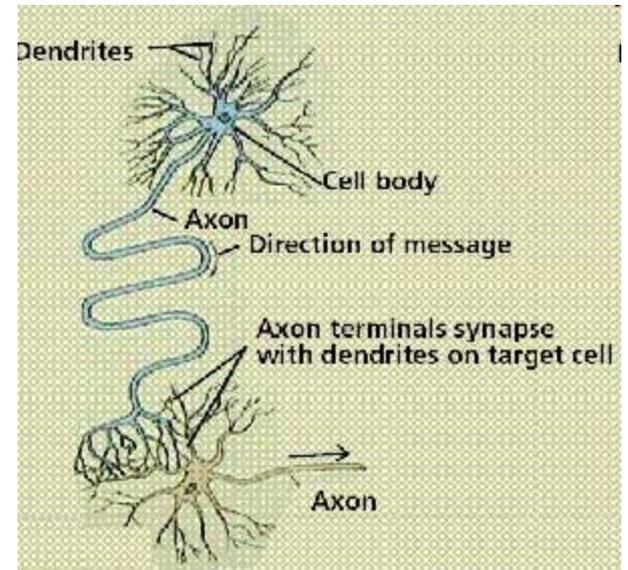
- Simon's definition of “**machine learning**”
  - “ Learning denotes **changes** in the system that are **adaptive** in the sense that they enable the system to do the same task or tasks drawn from the same population **more effectively the next time**”
  - Machine Learning I, 1993, Chapter 2.

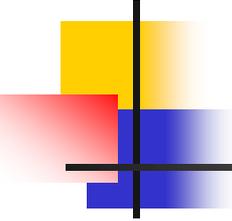
# Decision Tree Example



# AI application areas

- Optimizations
  - ACO
  - Swarm intelligence
  - Genetic Algorithm





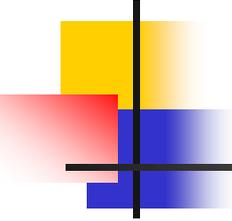
# Demos

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## Demos

<https://cis.k.hosei.ac.jp/~rhuang/>

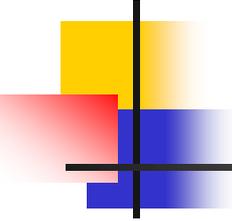
1. [Searching Algorithm](#)
2. [Game Algorithm](#)
3. [Maze Robot](#)
4. [Wumpus World](#)
5. [Smart Garden](#)
6. [Automatic Chatting](#)



# Impact applications

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1. Deep Blue was a chess-playing computer developed by IBM
2. Watson is an artificially intelligent computer system capable of answering questions posed in natural language, developed in IBM's DeepQA project.
3. Deep learning is a set of algorithms in machine learning that attempt to learn layered models of inputs, commonly neural networks



# Home work

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Please find the top 3 most impact AI applications.

## Submission:

Submit your answers in summary on **9/27** before next week class.