# Selected Issues of Artificial Intelligence

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# Outline

- AI history
- Expert systems
- Robotics
- Processing of speech and natural language
- Heuristics and research strategies
- Cognitivistics
- Intelligence of ants
- Artificial life
- Bots

# Before We Start

- How about the definition of intelligence?
  - "The ability to adapt to new tasks and living conditions or a way in which humans process information and solve problems"
- Human intelligence
  - Learning and using knowledge
  - Ability to generalize
  - Perception and cognitive abilities

# Man-made Intelligent Machines?

- Machine programmed to imitate human intelligence
  - Only in a very limited scope
  - A long way to go…

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# Artificial Intelligence, AI

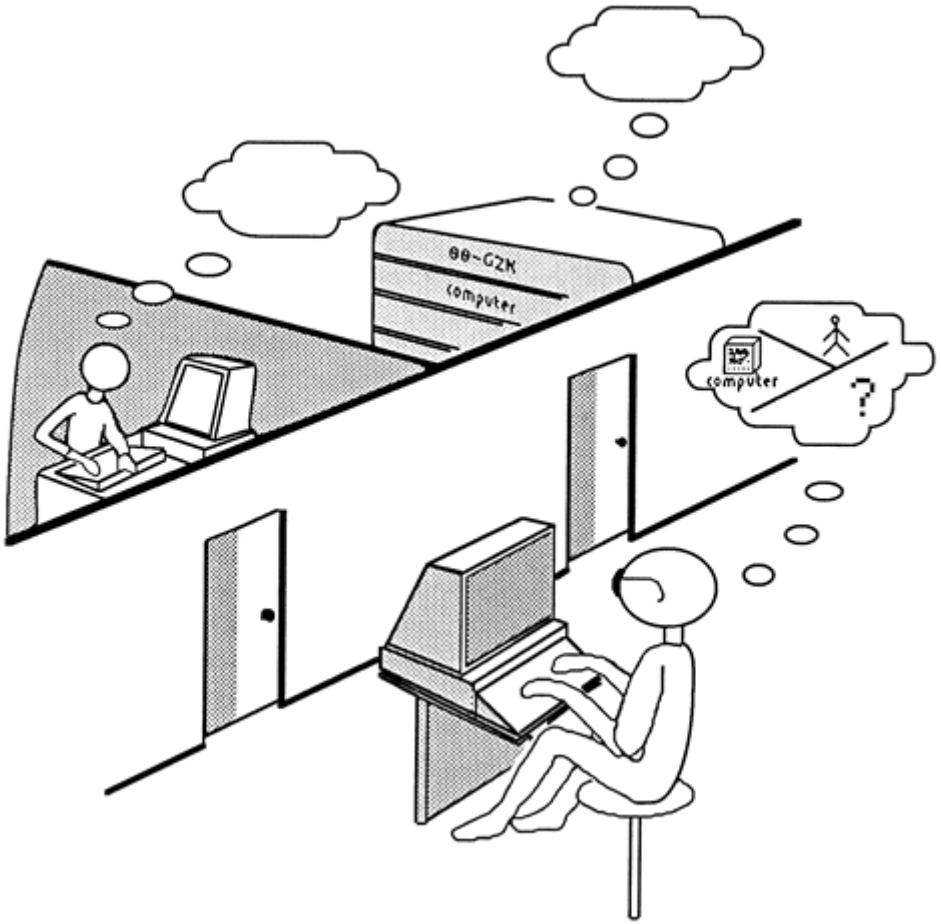
- Proposed by John McCarthy in 1956
- At that time, the example research of AI: chess algorithms
- Logical reasoning is the second
  - An algorithm imitating the way of inference occurring in the human brain
- Other fields
  - Natural language processing
  - Automatic translation
  - Voice recognition and capture semantics
  - Predicting, forecasting, planning

# Artificial Intelligence, AI

- AI is considered a domain of the informatics
- Other fields of interests
  - Philosophers
  - Psychologists
  - Medical doctors
  - Mathematicians
  - etc…
- An interdisciplinary science!
  - Aims to study human intelligence and implement it in machines

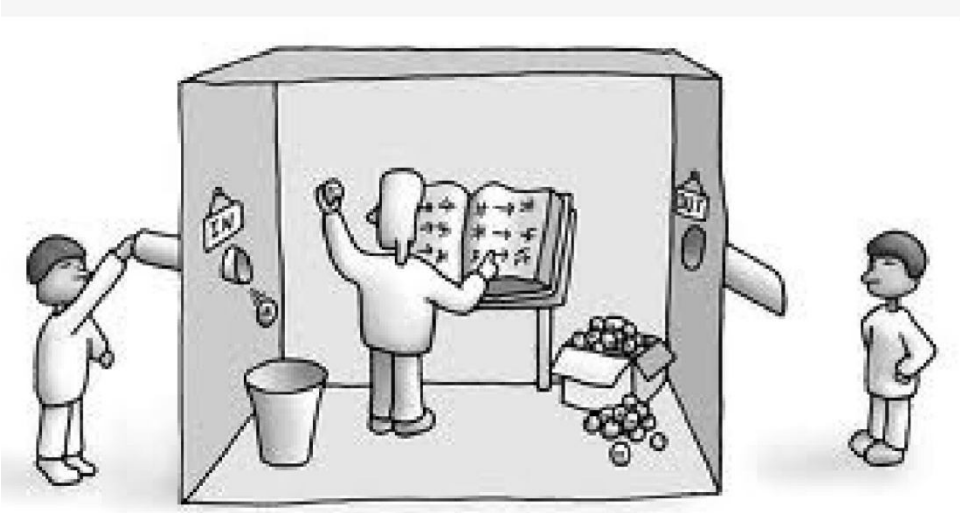
# When is Program/Machine Intelligent?

- First by Alan Turing, 1950 – Turing test



# “Chinese Room”

- A known critic of the Turing idea
  - Computers cannot be intelligent, because even though they are using symbols according to certain rules, they do not understand their meaning



# Turtle's Happiness

- An electronic turtle built by Grey in the early 1950s
  - The device moved around the room using power from a battery
  - The voltage dropped below a certain level => search for socket and charge the battery
  - Similar to the search and consumption of food
  - Low power => turtle unhappy
  - Solar battery will make it really "enjoys" sunbathing

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# Definition of Expert Systems

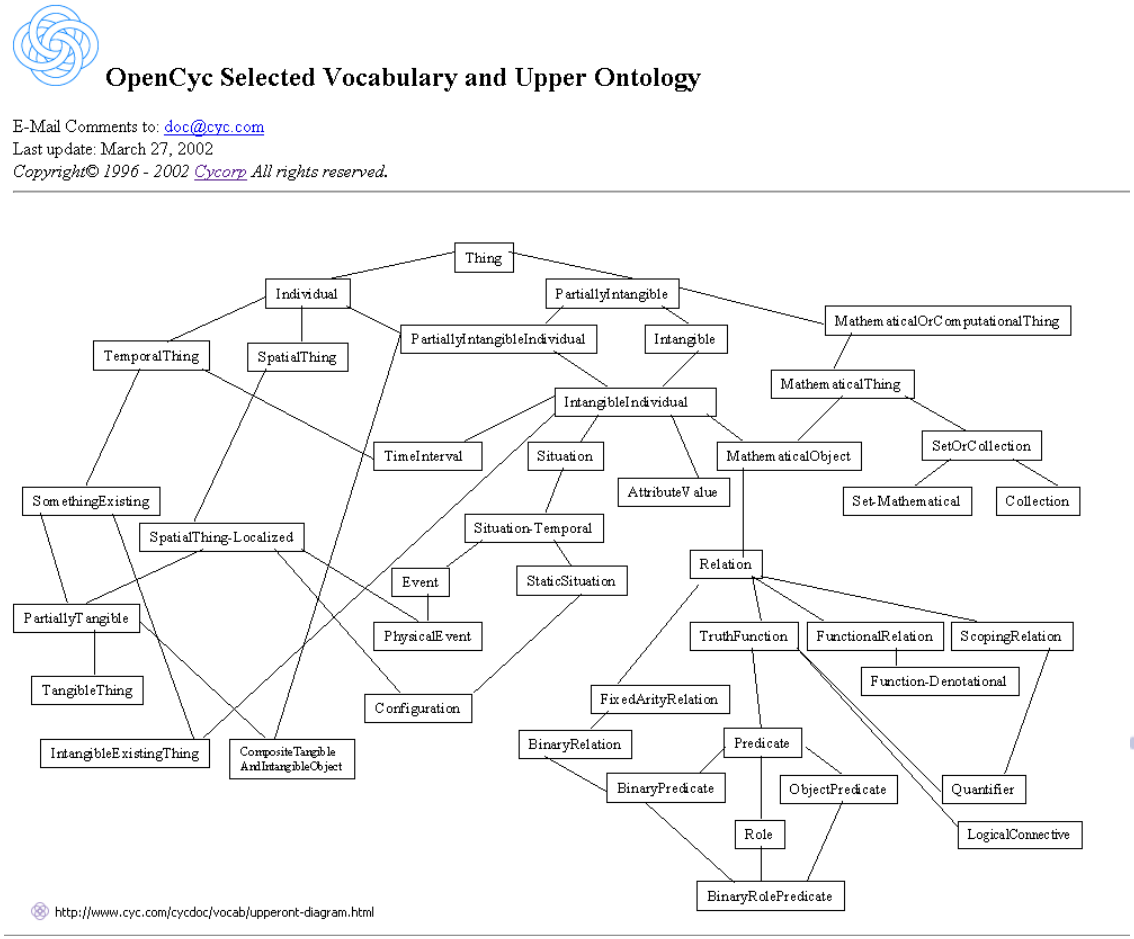
- An “intelligent” computer program
- Applies knowledge and reasoning (inference) procedures
- Solve problems which require human experience (expert)
- Experience is acquired by many years of activity in a given domain
- Domain knowledge base + inference machine + user interface

# DENDRAL

- The prototype of expert systems in early 1960s
- @ Stanford University
- PROSPECTOR system(1970s) for geologists
  - Defining the type of rock
  - Help to find molybdenum (鉬)
- MYCIN system
  - Diagnosing contagious diseases
  - Diagnosis and recommendations for treatment (decision-making)

# CYC Project

- The largest projects in the history of AI
- Millions of rules contained for intelligent machines



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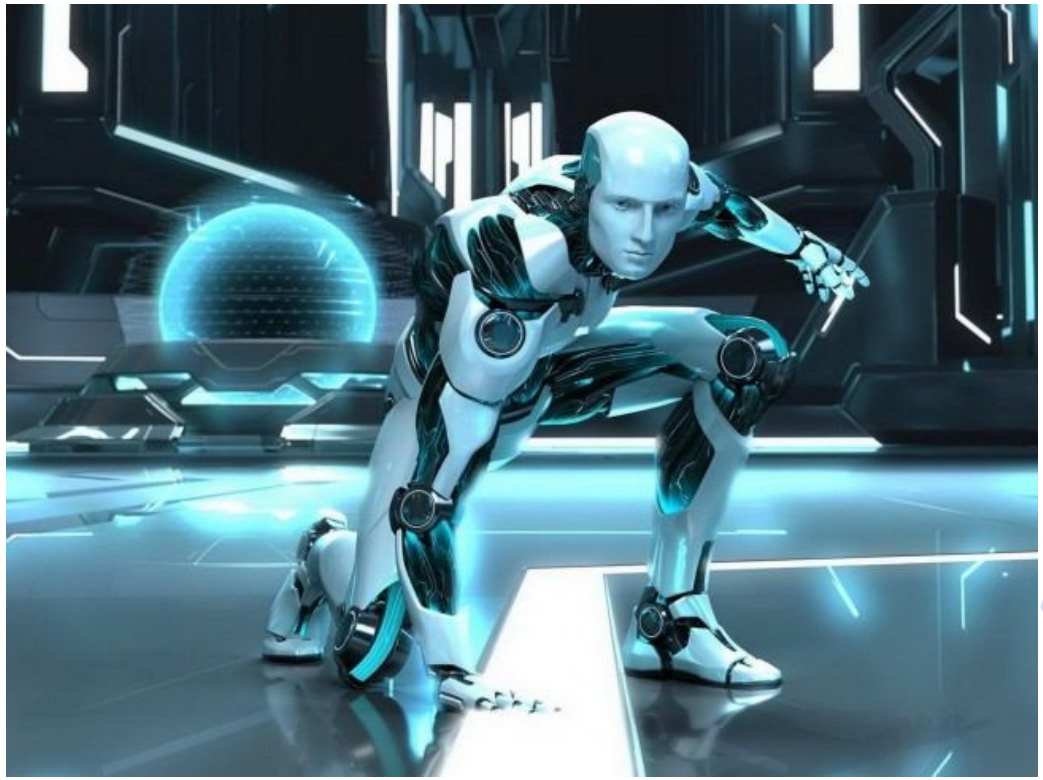
# Robot?

- Appeared for the first time in 1920 by the Czech author, Karel Čapek
- Slaves which are to replace humans in heavy tasks and difficult work



# Industry Robots

- General Motors factory (1950s): assemble cars
- Distant surgical operation (2002): professor Louis Kavoussi
- Honda: ASIMO robot, speaks two languages, climb stairs, avoid obstacles

# AI Hypothesis

- Weak hypothesis
  - Simulate the human cognitive process
  - Cannot experience any mental states by itself
- Strong hypothesis
  - Be able to reach cognitive mental states
  - “thinking robot”

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# Issues Covered

- Speech synthesis
  - Great for blind people
- Automatic speech recognition
  - Accept oral commands, etc.
- Natural language recognition
  - Part-of-speech tagging, etc.
- Automatic translation
  - Cross language processing

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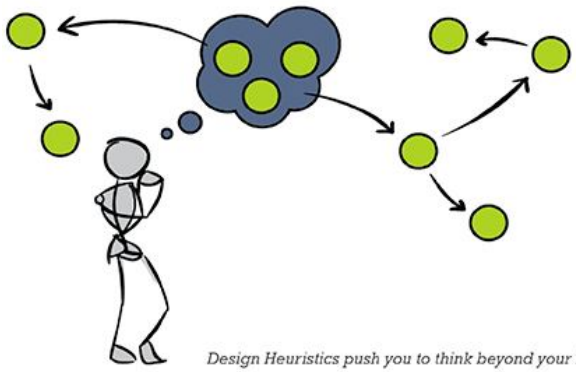
# Heuristics

- From the Greek words *heurisco*
  - Means to discover, to find
- "creative solution of problems"
- By way of experiment, trial-and-error method or by using analogies
  - May decrease computation costs
  - May speed up the discovery of solution



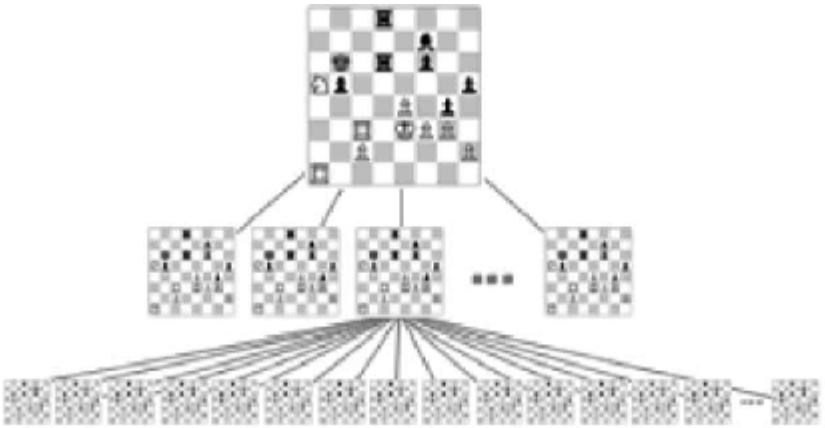
Design Heuristics push you to think beyond your initial ideas

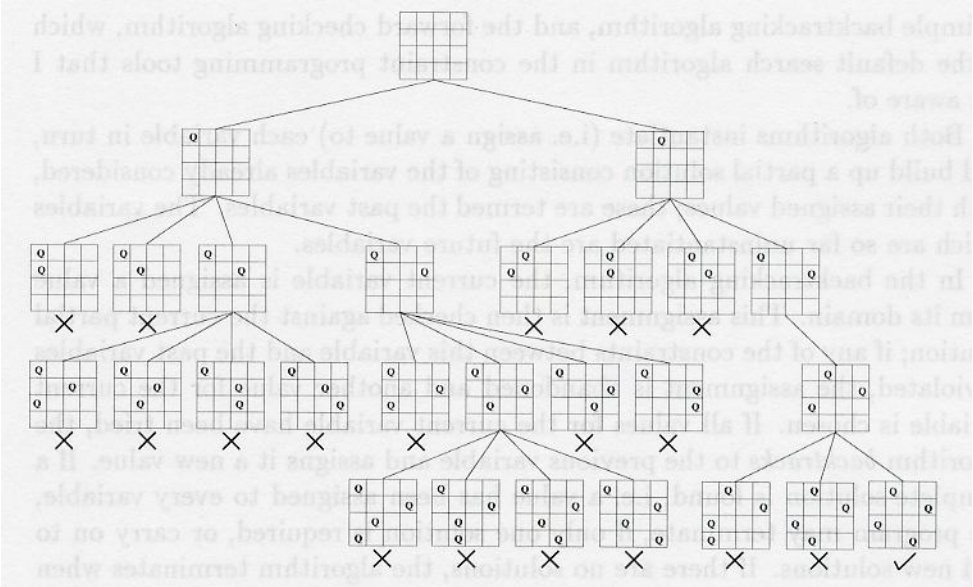
# Well Known Example of Heuristics

- Someone dropped a contact lens…
  - Blind search
  - Methodical search: expanding the space of research methodically
  - Analytical search: requires the solution of a mathematical equation (air resistance, wind power, gravitation, …)
  - Lazy search: purchasing a new lens?
  - Heuristic search: define the approximate direction of the fall, presume how far the lens could fall

# How About Chess?

- IBM Deep Blue: lost
- IBM Deep Blue II: won
  - 256 processors, each processor allowed to analyze 200 million positions on the board in one second





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# Cognitive Science?

- Issued in 1976
- The discipline of science which tries to understand the nature of the mind
- Analysis of our method of perceiving the world
  - Attempt to understand what is going on when we perform basic mental operations
  - Studies on the functioning of the brain
  - Relates to neurobiology and psychology
  - Extremely difficult research problem: description of the functioning of the mind

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# Swarm Intelligence

- Ants algorithms, etc.
- Used to solve difficult problems of combinatorial optimization
- Solve optimization problems, find best cost

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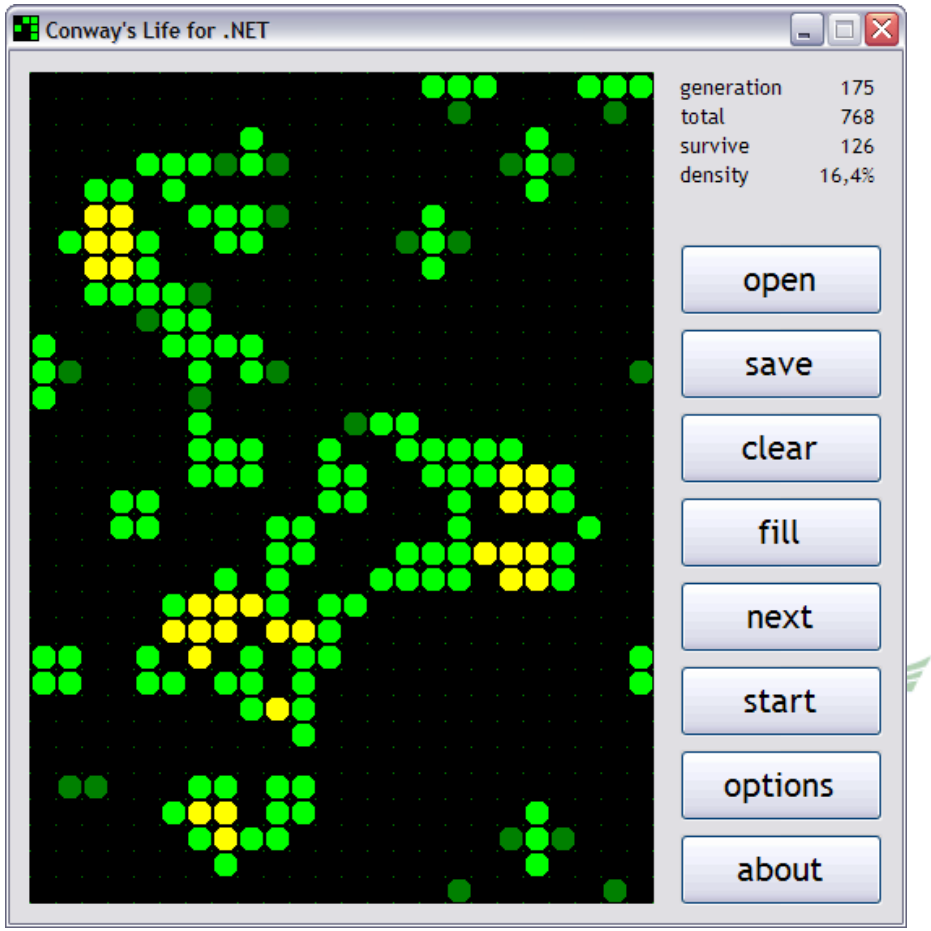
# Artificial Life

- Born in 1987
- @ conference in Santa Fe in New Mexico (USA)
- Cross discipline science
- Deals with the simulation of life

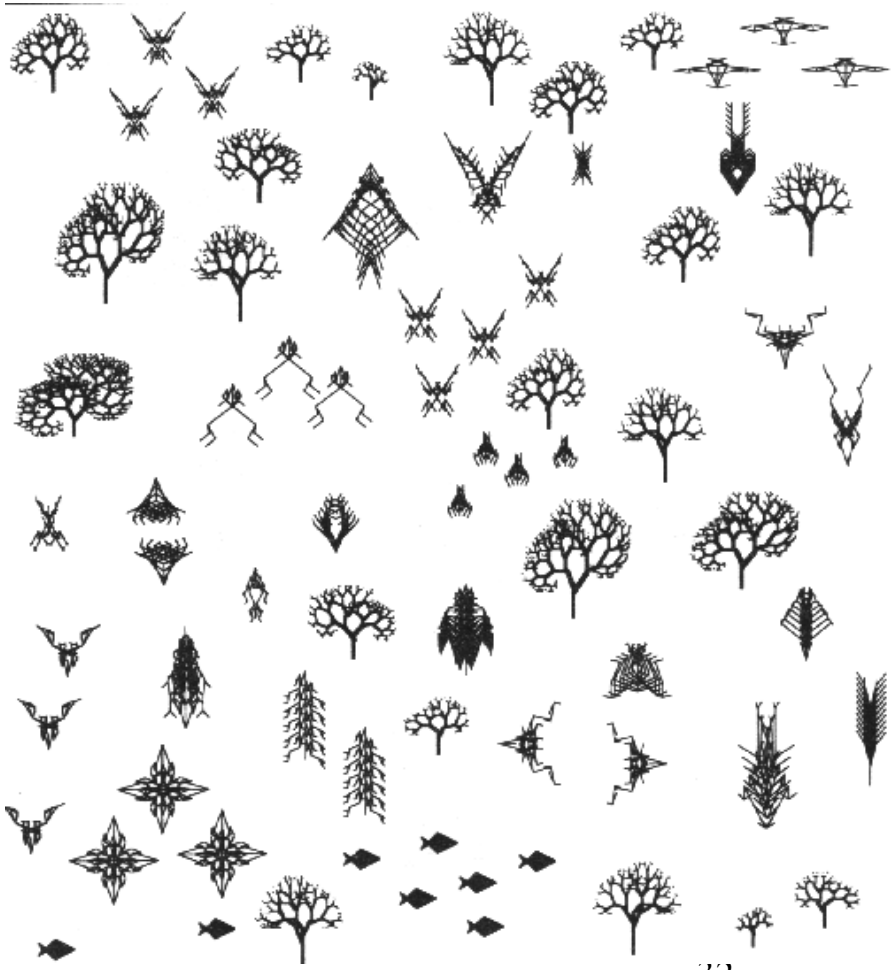
# Game of Life

- Created in 1968 by the mathematician John Conway
- Based its operation on cellular automatons



# Biomorphs

- Created by Richard Dawkins
- Graphic shapes recorded in genotypes
- Applied simple genetic operations to obtain new shapes in subsequent generations



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# Bots

- An automaton, a software tool, a program used most often to search and retrieve data
- Intelligent bots
  - Make decisions based on knowledge acquired earlier
- Chatterbot, searchbot, shoppingbot, databot, updatebot, infobot

# Computational Intelligence

- Solving AI problems with the use of computers to perform numerical calculations
- Techniques of these computation
  - Neural networks
  - Fuzzy logic
  - Evolutionary algorithms
  - Rough sets
  - Uncertain variables
  - Probabilistic methods
- They are called "soft computing" or "soft techniques"

# Societies

- IEEE Transactions on Neural Networks
- IEEE Transactions on Fuzzy Systems
- IEEE Transactions on Evolutionary Computation
- Many others

# Course Covered

- Rough sets
- Fuzzy logic
- Neural networks
- Evolutionary algorithms (optimization computing)
- Support vector machines
- Bayesian networks
- Swarm intelligences (paper study and presentations)