

Artificial Intelligence

History

Could AI Stop This?



What is Artificial Intelligence?

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

Or, Stepping Back Even Farther, Can We Build Artificial People?

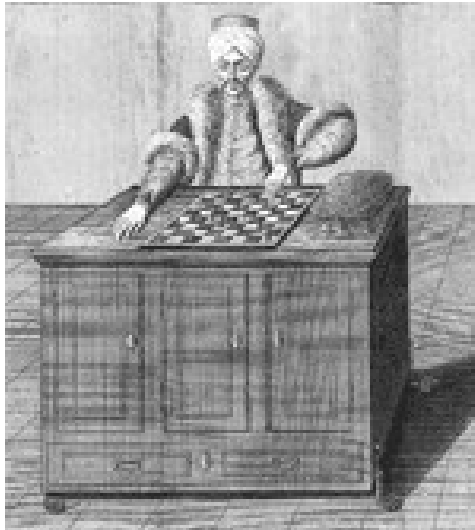
- Historical attempts
- The modern quest for robots and intelligent agents
- Us vs. Them

Historical Attempts - Frankenstein

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



Historical Attempts – The Turk



Maelzel's
EXHIBITION,
MASONIC HALL.

A PERFORMANCE EVERY EVENING. A3
ON SATURDAY, MAY 17th 1834
There will be two Exhibitions, one commencing at 4 o'clock, and the other at the usual time.—Doors open half an hour previous.
Doors open at half-past 7 o'clock. Performance to commence at 8 o'clock.

PART FIRST.
THE ORIGINAL AND CELEBRATED
AUTOMATON
CHESS PLAYER.
Invented by DE KEMPELIN, Improved by J. MAELZEL.

The Chess Player has withstood the best players of Europe and America, and excites universal admiration. He moves his head, eyes, lips, and hands, with the greatest facility, and distinctly pronounces the word "Echec," (the French word signifying "Check") when necessary. If a miss-move is made, he perceives and rectifies it.

THE
Automaton Trumpeter.

The Trumpeter is of a full size, and dressed in the uniform of the French Lancers. The pieces executed by this Automaton are performed with a distinctness and precision unattainable by the best living performers; the measurement of time being, from the nature of the mechanism, absolutely perfect. In double-tonguing, his superiority is particularly manifested, not only in the clearness of the tones, but also in the number of the notes which are sounded. All the sounds are actually produced in the Trumpet, there being no pipes whatever within the figure. The pieces he plays were written expressly for him by the best composers. He will perform on each evening, two favorite pieces. 1st, the French or Austrian Cavalry Marches. 2d, A March, with an accompaniment.

THE
MECHANICAL THEATRE,
Purposely introduced for the gratification of Juvenile Visitors.
IT CONSISTS OF THE FOLLOWING PIECES:

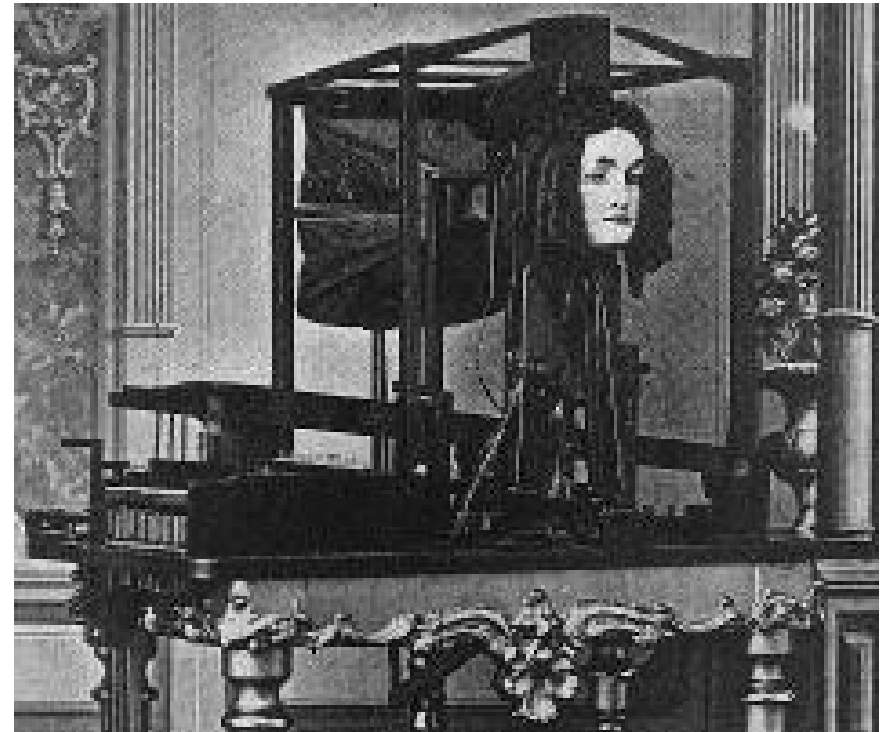
- 1 The Amusing Little Ban Fiddler.
- 2 The French Oyster Woman—who bows to the Company, and performs the duties of her station, by opening and presenting her Oysters to the audience.
- 3 The Old French Gentleman, of the oldest Regime, who drinks the health of the Company with great glee.
- 4 The Coquette Dancer, accompanying the Music with his Tamborine.
- 5 The Little Troubadour, playing on several instruments.
- 6 Punchinello will go through his comical attitudes in imitation of the celebrated Masquer.



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/SIMULACRA/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 *robota*, meaning "work", while others propose that *robota* 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, "*robota*" 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, *robota* 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 *robota* to refer to work that's boring or uninteresting.

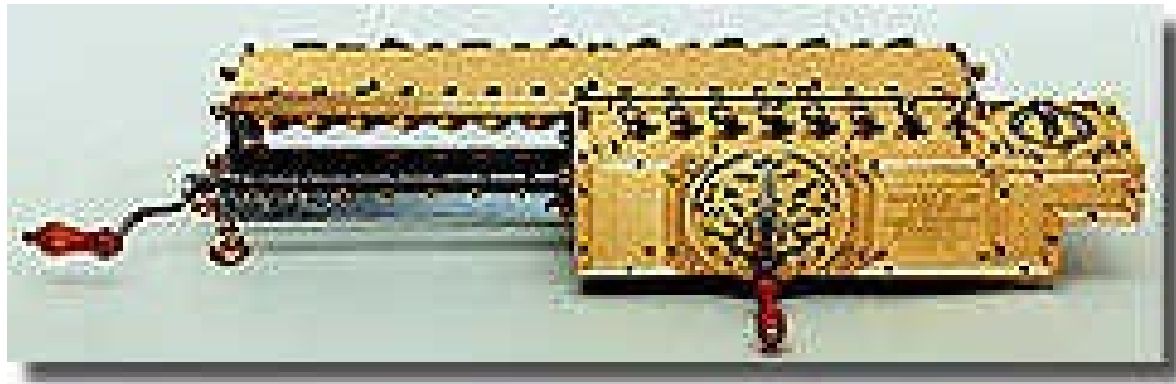
The Roots of Modern Technology

5thc B.C. Aristotelian logic invented

1642 Pascal built an adding machine



1694 Leibnitz reckoning machine

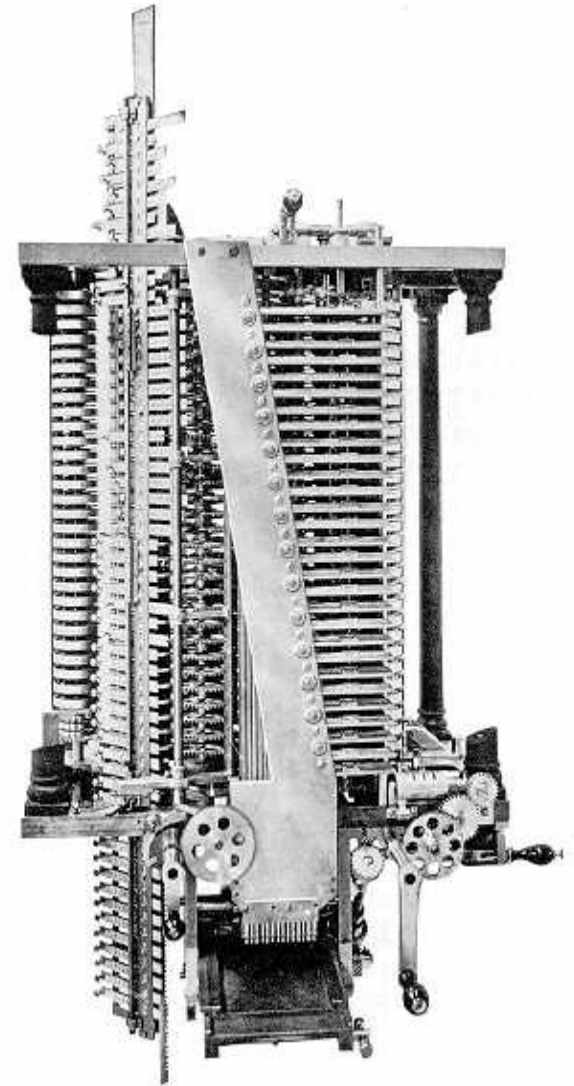


The Roots, continued

1834 Charles Babbage's
Analytical Engine

Ada writes of the engine, “The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform.”

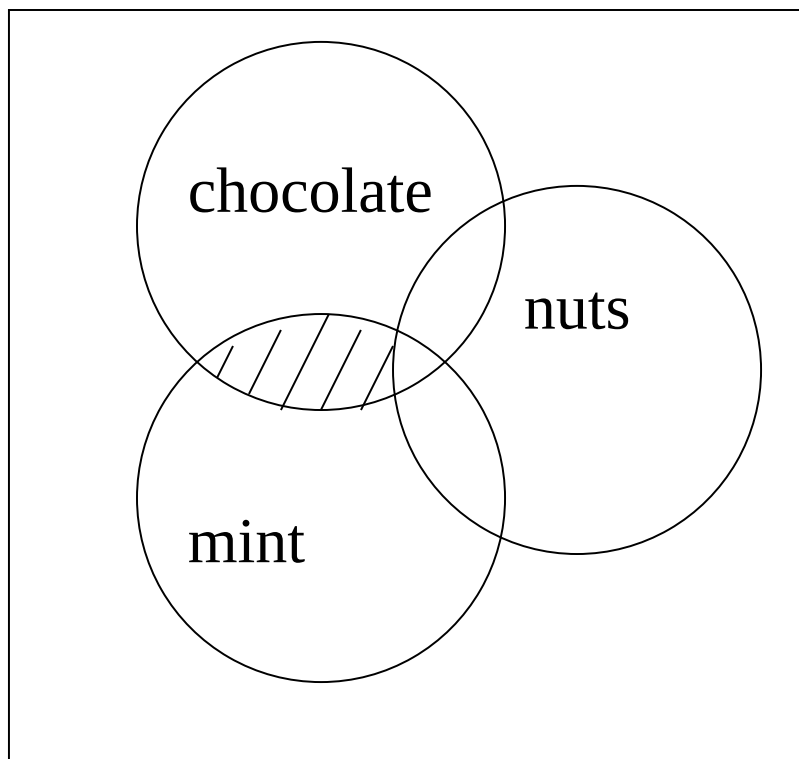
The picture is of a model built in the late 1800s by Babbage's son from Babbage's drawings.



The Roots: Logic

1848 George Boole *The Calculus of Logic*

chocolate and \neg nuts and mint



Mathematics in the Early 20th Century – (Looking Ahead: Will Logic be the Key to Thinking?)

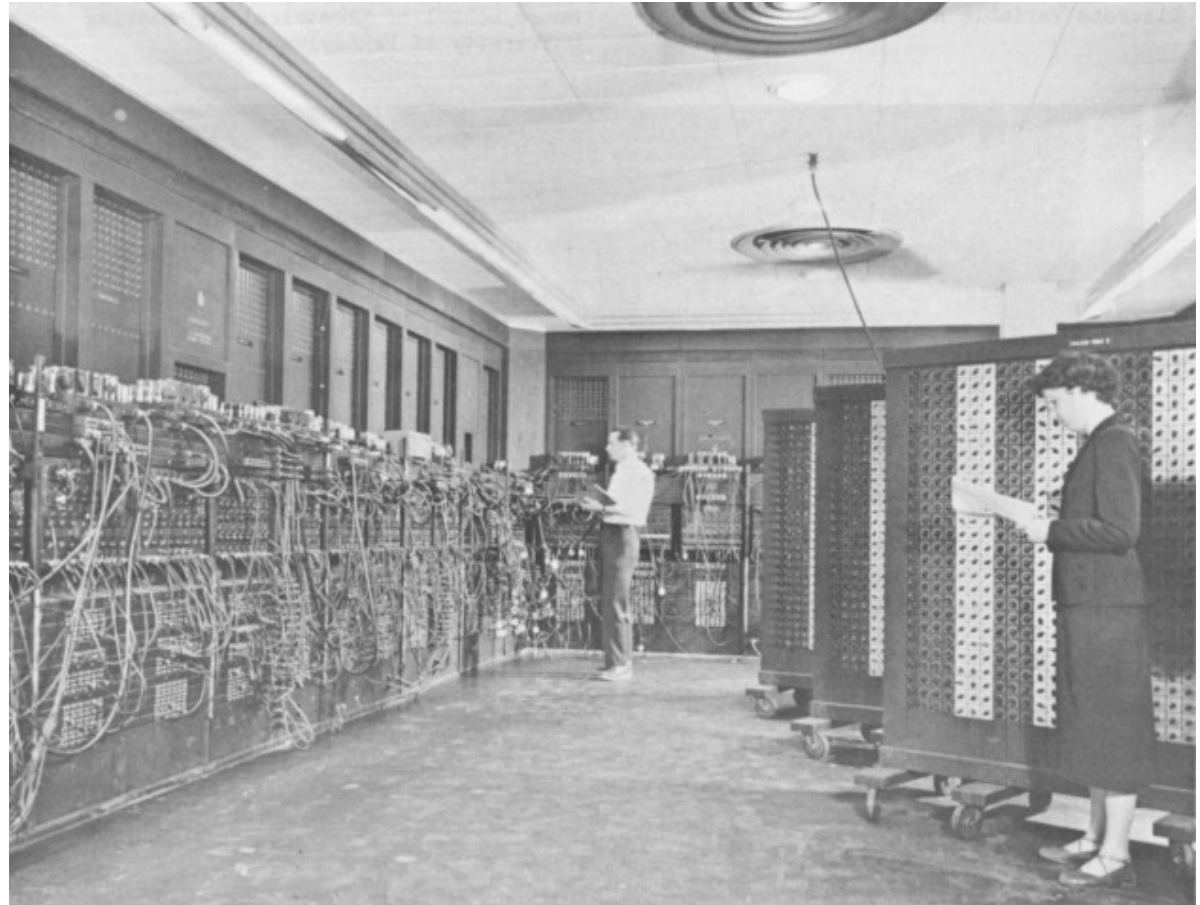
1900 Hilbert's program and the effort to formalize
mathematics

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

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

The Advent of the Computer

1945 ENIAC *The first electronic digital computer*



1949 EDVAC

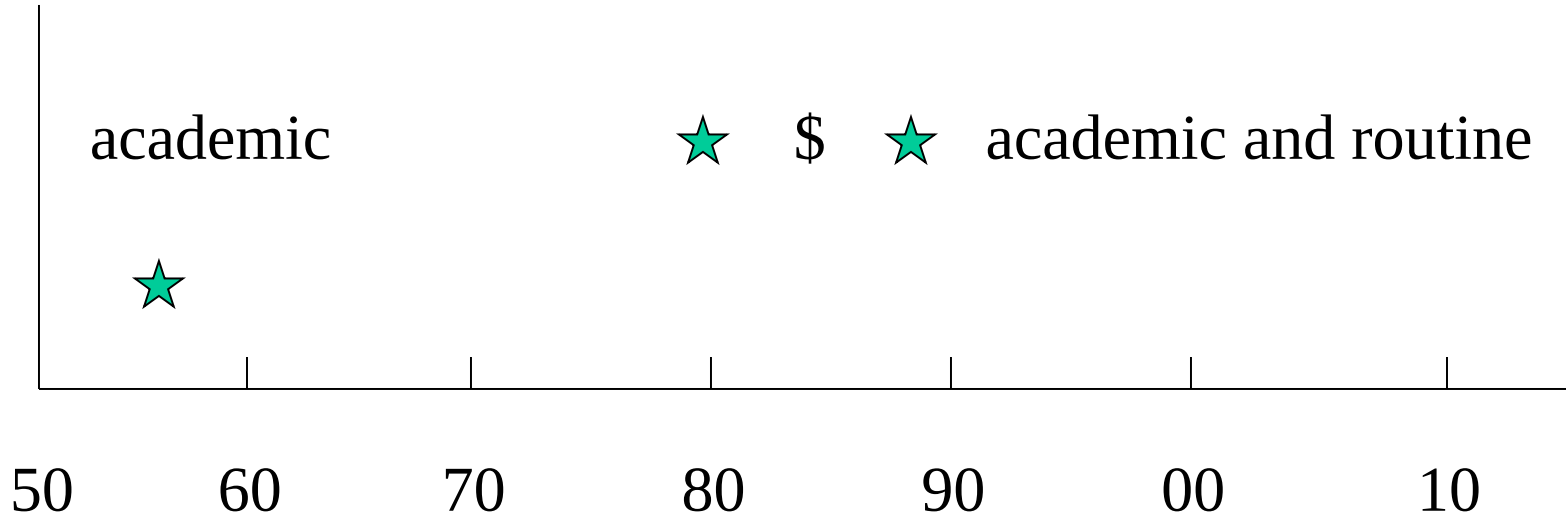
*The first stored
program computer*



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.abelard.org/turpap/turpap.htm>

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



The Origins of AI Hype

1950 Turing predicted that in about fifty years "an average interrogator will not have more than a 70 percent chance of making the right identification after five minutes of questioning".

1957 Newell and Simon predicted that "Within ten years a computer will be the world's chess champion, unless the rules bar it from competition."

Was Turing Right?

A conversation with Jabberwacky, 2003

Jabberwacky: Have you been to the Moon?

User: No. Few have. Have you?

Jabberwacky: Many a time my dear chap!

User: What was the most interesting thing you saw?

Jabberwacky: Fred.

User: Why did you find him interesting?

Jabberwacky: It just came into my head.

User: What sorts of things do you generally find interesting?

Jabberwacky: Nothing but smelly socks.

Another One

A Conversation with Alice, 2004

>What's the best place to eat Chinese food?

ALICE: My favorite places are California and Maine. Holland is cool too.

>What do you like about Maine?

ALICE: The special effects are the best.

Alice, Again

>Who invented paper towels?

ALICE: The Chinese, long before Europeans.

>Who invented pet rocks?

ALICE: The Wright Brothers.

>Who invented Barbie dolls?

ALICE: Thomas Edison.

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.



Why Did They Get it Wrong?

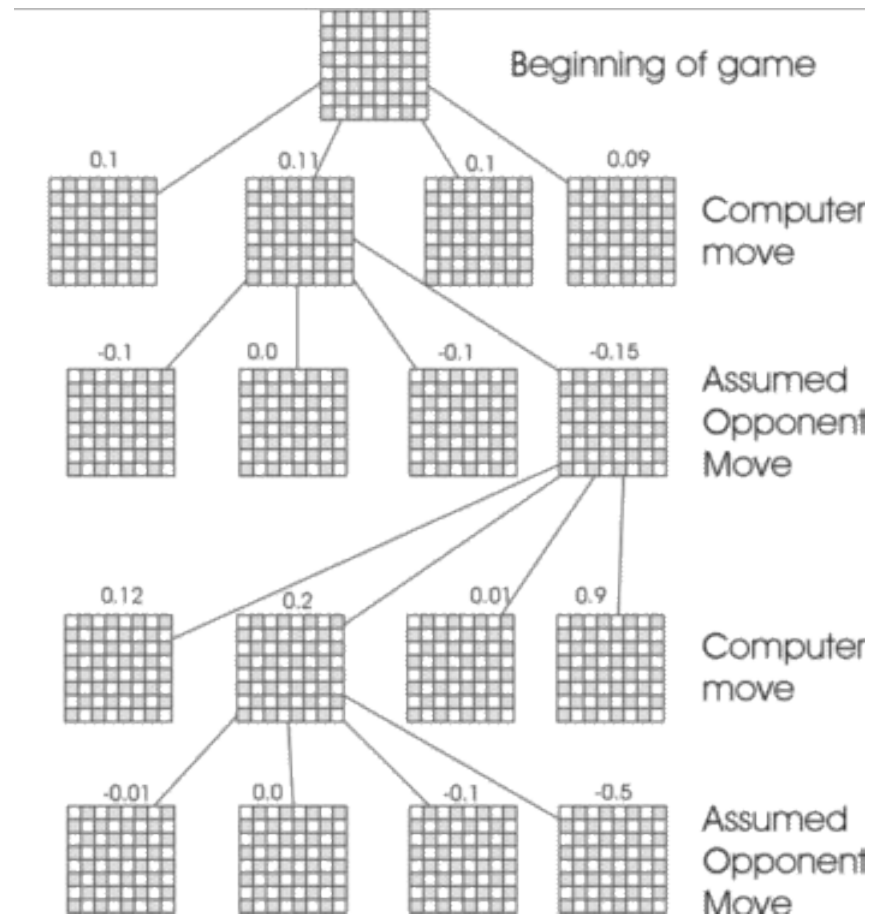
They failed to understand at least three key things:

- The need for knowledge (lots of it)
- Scalability and the problem of complexity and exponential growth
- The need to perceive the world

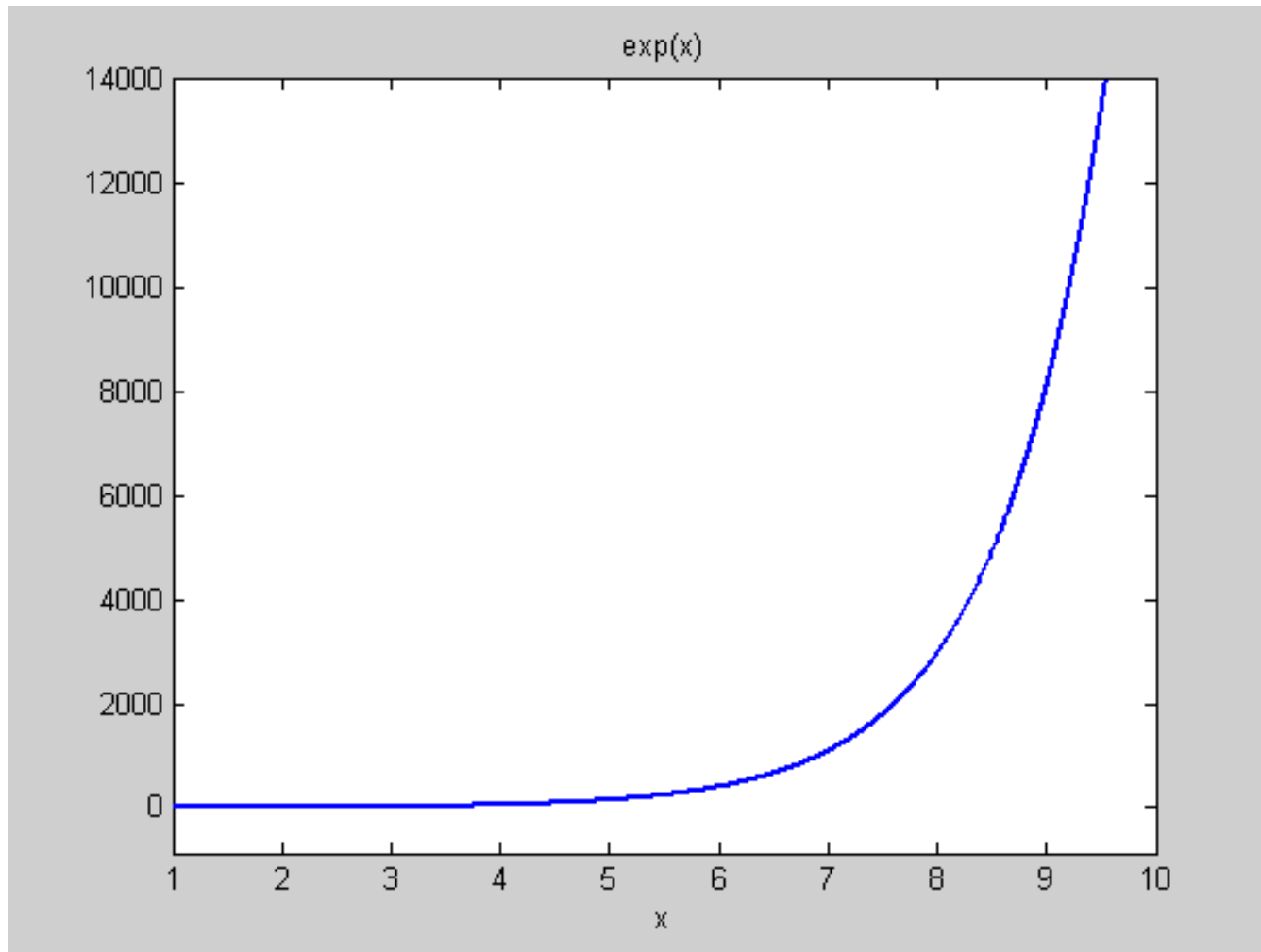
Scalability

Solving hard problems requires search in a large space.

To play master-level chess requires searching about 8 ply deep. So about 35^8 or $2 \cdot 10^{12}$ nodes must be examined.



Exponential Growth



But Chess is Easy

- The rules are simple enough to fit on one page
- The branching factor is only 35.

A Harder One

John saw a boy and a girl with a red wagon with one blue and one white wheel dragging on the ground under a tree with huge branches.

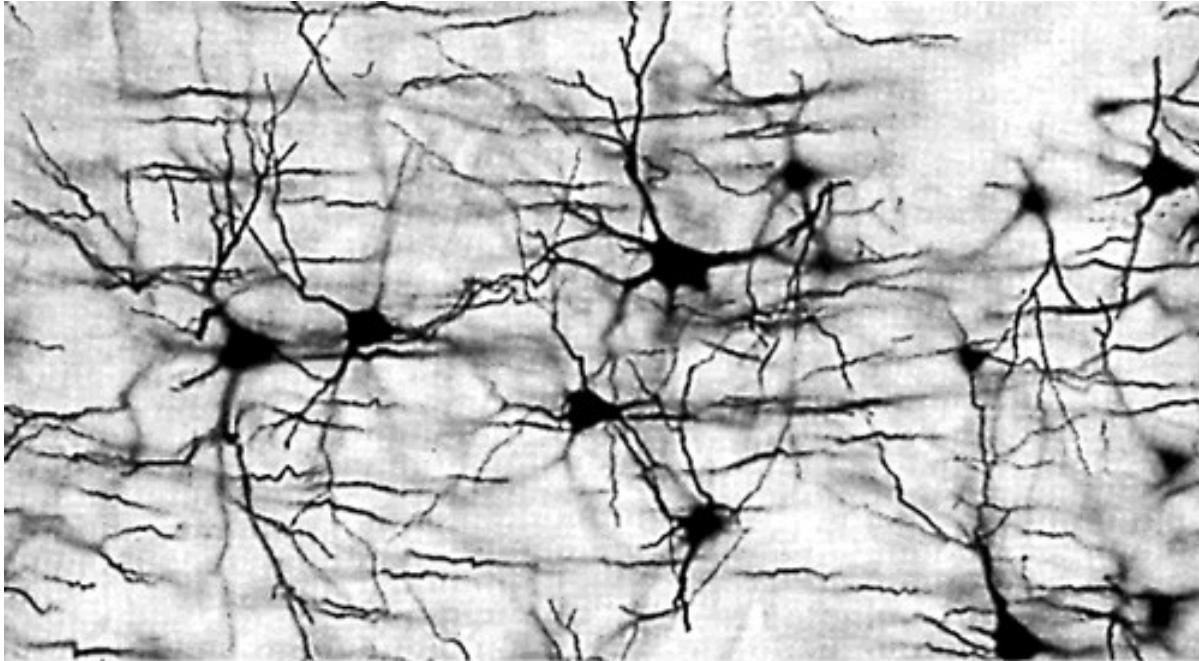
How Bad is the Ambiguity?

- Kim (1)
- Kim and Sue (1)
- Kim and Sue or Lee (2)
- Kim and Sue or Lee and Ann (5)
- Kim and Sue or Lee and Ann or Jon (14)
- Kim and Sue or Lee and Ann or Jon and Joe (42)
- Kim and Sue or Lee and Ann or Jon and Joe or Zak (132)
- Kim and Sue or Lee and Ann or Jon and Joe or Zak and Mel (469)
- Kim and Sue or Lee and Ann or Jon and Joe or Zak and Mel or Guy (1430)
- Kim and Sue or Lee and Ann or Jon and Joe or Zak and Mel or Guy and Jan (4862)

The number of parses for an expression with n terms is the n'th Catalan number:

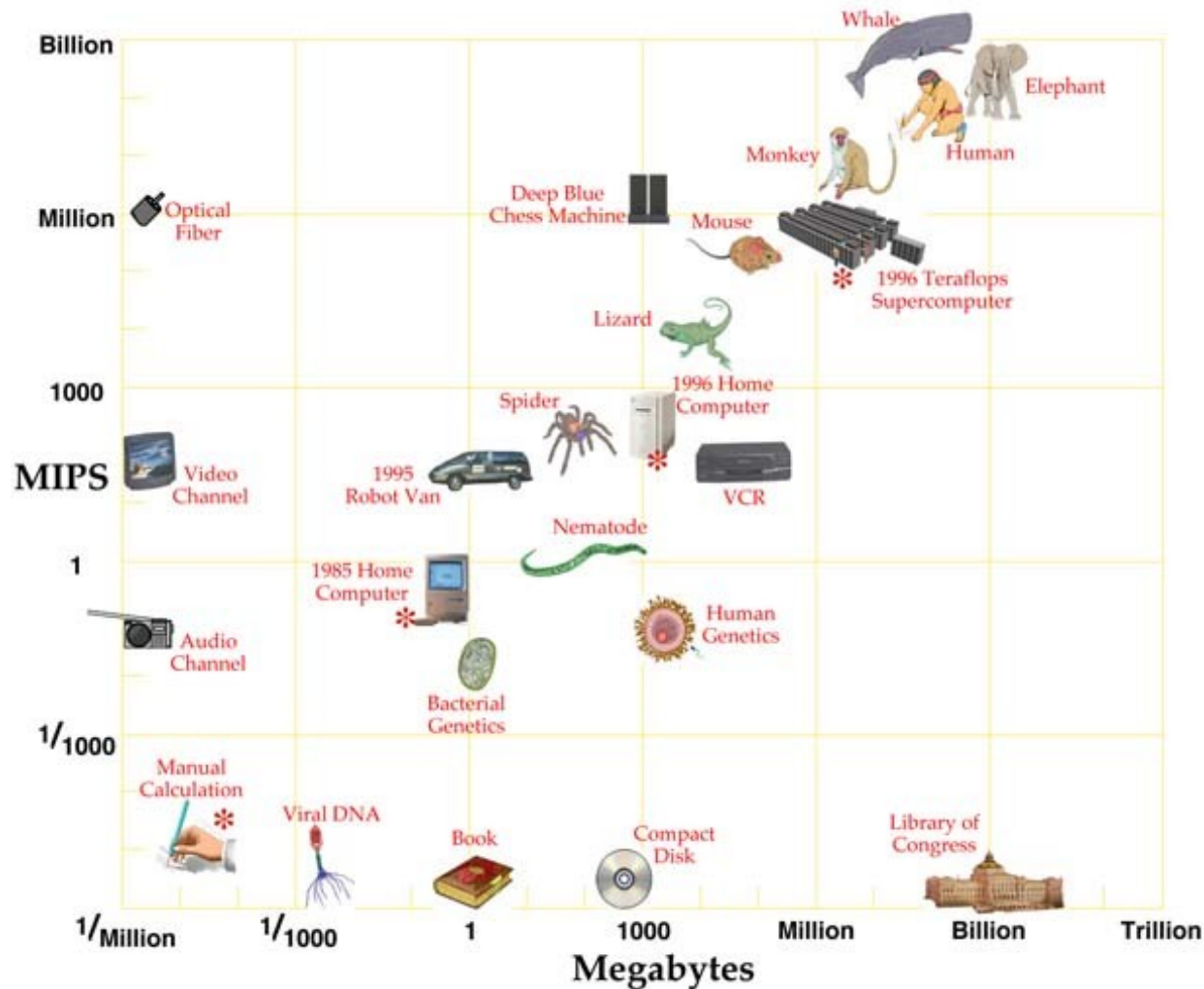
$$Cat(n) = \binom{2n}{n} - \binom{2n}{n-1}$$

Can We Get Around the Search Problem ?



How Much Compute Power Does it Take?

All Things, Great and Small



From Hans Moravec, Robot Mere Machine to Transcendent Mind 1998.

From Hans Moravec, *Robot Mere Machine to Transcendent Mind* 1998.

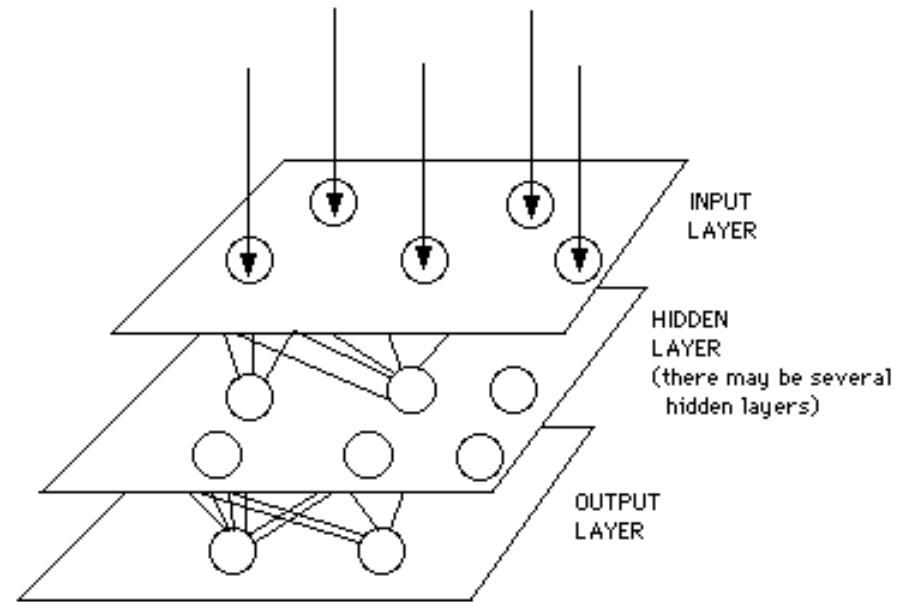
Evolution of the Main Ideas

- Wings or not?
- Games, mathematics, and other knowledge-poor tasks
- The silver bullet?
- Knowledge-based systems
- Hand-coded knowledge vs. machine learning
- Low-level (sensory and motor) processing and the resurgence of subsymbolic systems
- Robotics
- Natural language processing
- Programming languages
- Cognitive modeling



Symbolic vs. Subsymbolic AI

Subsymbolic AI: Model intelligence at a level similar to the neuron. Let such things as knowledge and planning emerge.

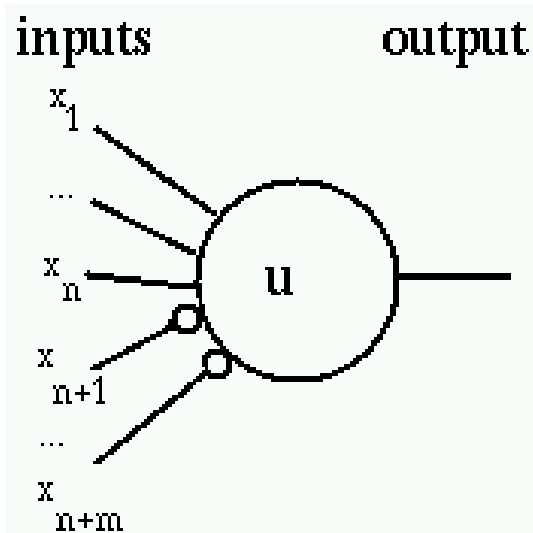


Symbolic AI: Model such things as knowledge and planning in data structures that make sense to the programmers that build them.

(blueberry (isa fruit)
(shape round)
(color purple)
(size .4 inch))

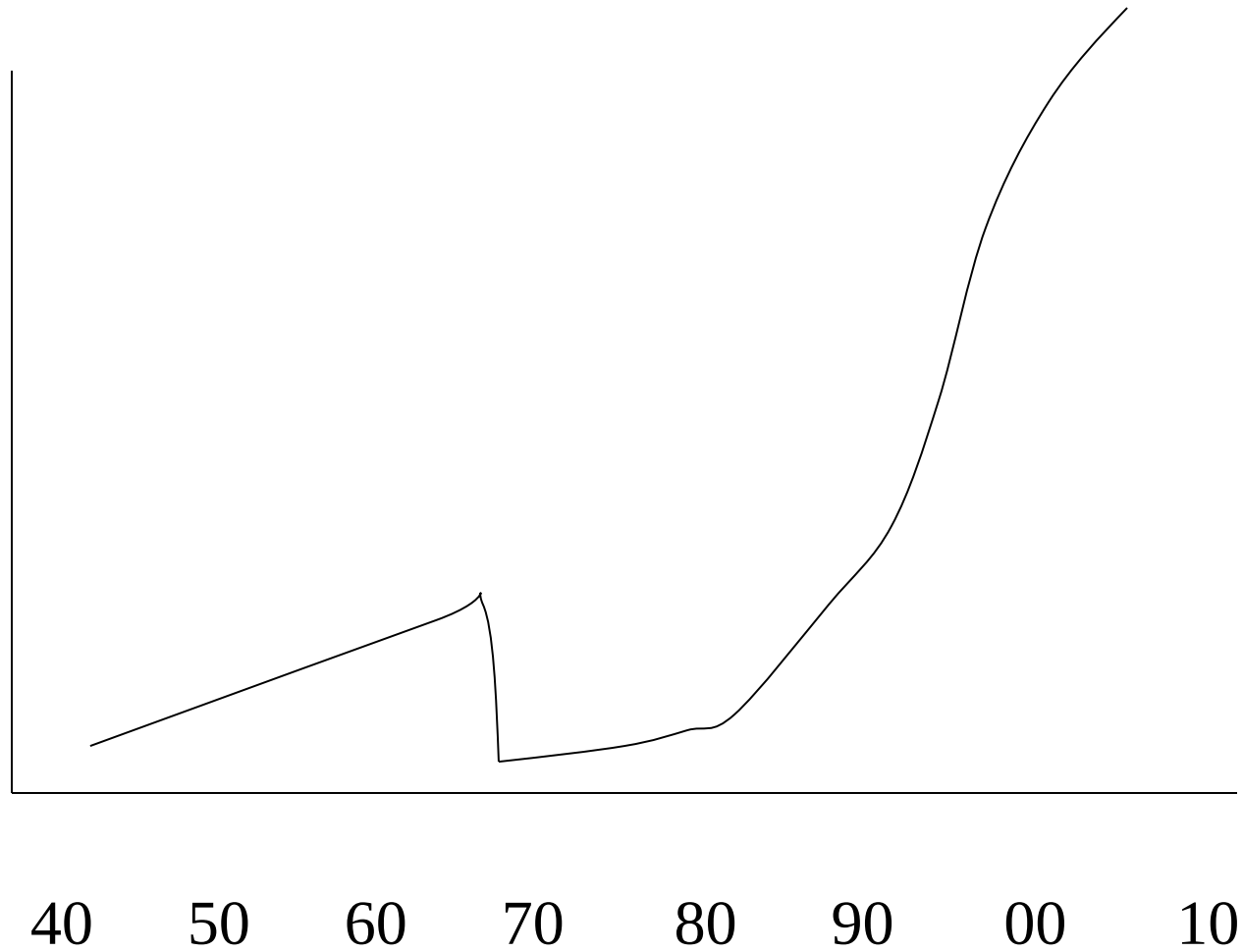
The Origins of Subsymbolic AI

1943 McCulloch and Pitts *A Logical Calculus of the Ideas Immanent in Nervous Activity*



“Because of the “all-or-none” character of nervous activity, neural events and the relations among them can be treated by means of propositional logic”

Interest in Subsymbolic AI



Low-level (Sensory and Motor) Processing and the Resurgence of Subsymbolic Systems

- Computer vision
- Motor control
- Subsymbolic systems perform cognitive tasks
 - Detect credit card fraud
- The backpropagation algorithm eliminated a formal weakness of earlier systems
- Neural networks learn.

The Origins of Symbolic AI

- Games
- Theorem proving

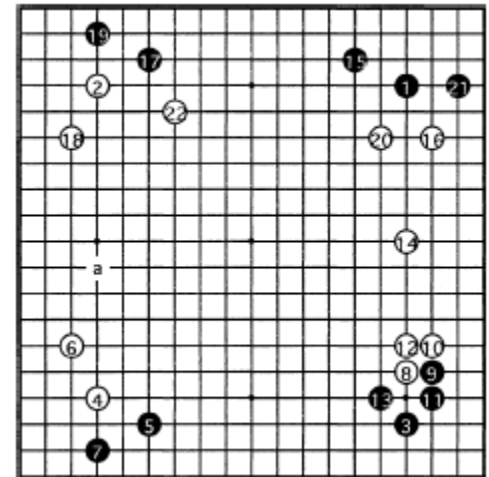
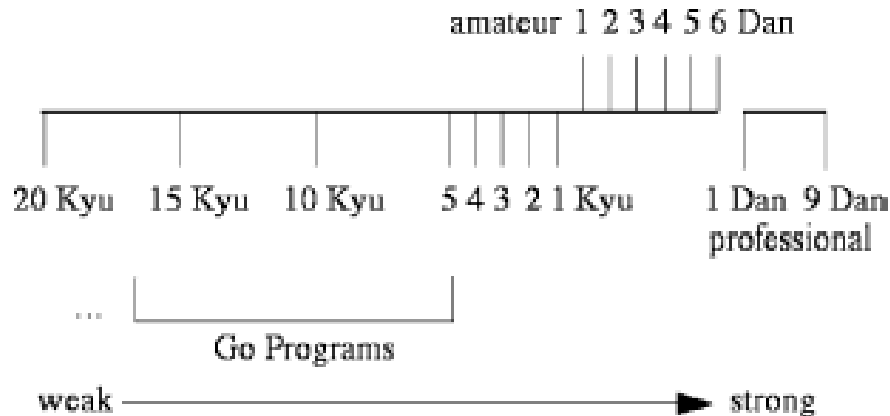
Games

- Chess
- Checkers:
 - 1952-1962 Art Samuel built the first checkers program
 - Chinook became the world checkers champion in 1994
- Othello:
 - Logistello beat the world champion in 1997

Games

- Chess
- Checkers: Chinook became the world checkers champion in 1994
- Othello: Logistello beat the world champion in 1997

- Go:



- Role Playing Games: now we need knowledge

Mathematics

1956 Logic Theorist (the first running AI program?)

1961 SAINT solved calculus problems at the college freshman level

1967 Macsyma

Gradually theorem proving has become well enough understood that it is usually no longer considered AI

1996 J Moore and others verified the correctness of the AMD5k86 Floating-Point Division algorithm

The Silver Bullet?

Is there an “intelligence algorithm”?

1957 GPS (General Problem Solver)



Start

Goal

But What About Knowledge?

- Why do we need it?

Find me stuff about dogs who save people's lives.

Around midnight, two beagles spotted a fire in the house next door. Their barking alerted their owners, who called 911.

- How can we represent it and use it?
- How can we acquire it?

Representing Knowledge - Logic

1958 McCarthy's paper, "Programs with Common Sense"

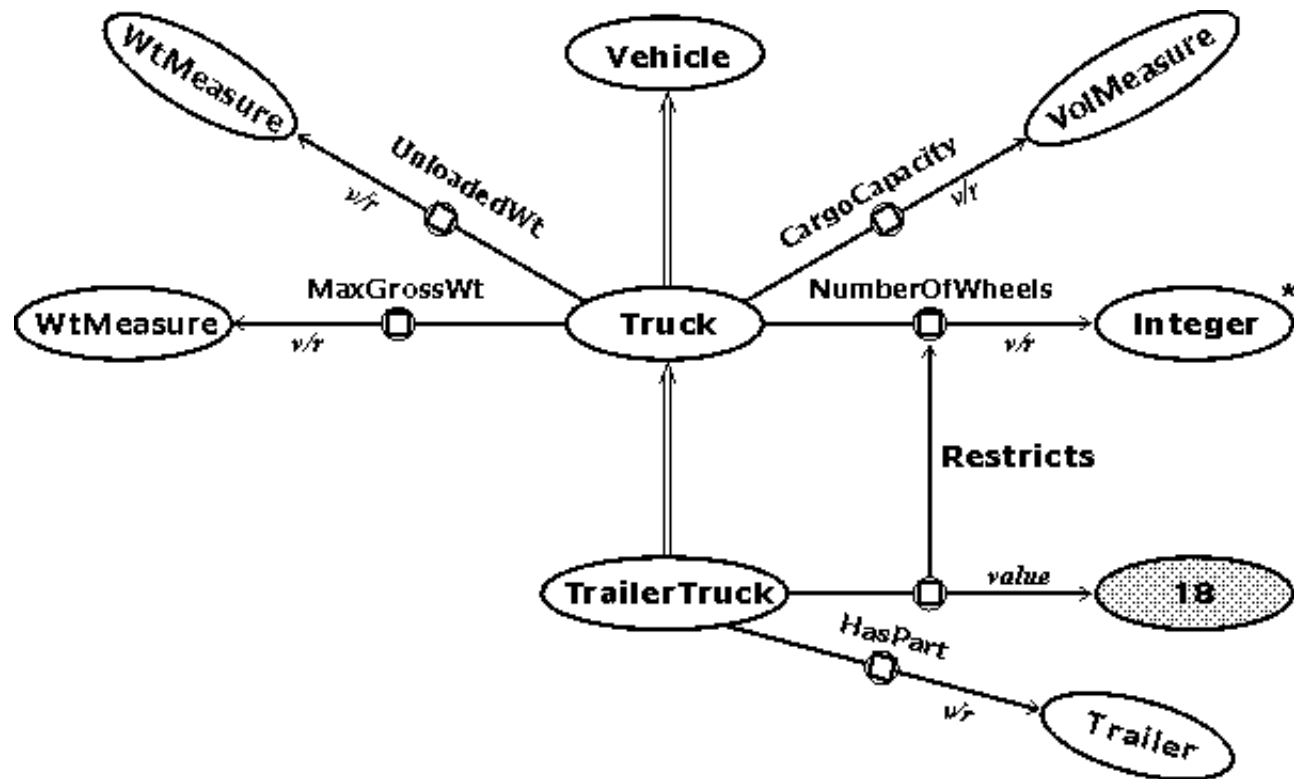
$at(I, car) \Rightarrow can(go(home, airport, driving))$

$at(I, desk) \Rightarrow can(go(desk, car, walking))$

1965 Resolution theorem proving invented

Representing Knowledge- Semantic Nets

1961



Representing Knowledge – Capturing Experience

Representing Experience with Scripts, Frames, and Cases

1977 Scripts

Joe went to a restaurant. Joe ordered a hamburger. When the hamburger came, it was burnt to a crisp. Joe stormed out without paying.

The restaurant script:

Did Joe eat anything?

Representing Knowledge - Rules

Expert knowledge in many domains can be captured in rules.

From XCON (1982):

*If: the most current active context is distributing
massbus devices, and*

*there is a single-port disk drive that has not been
assigned to a massbus, and*

there are no unassigned dual-port disk drives, and

*the number of devices that each massbus should support is known,
and*

*there is a massbus that has been assigned at least one disk drive that
should support additional disk drives, and*

*the type of cable needed to connect the disk drive to the previous
device on the massbus is known*

Then: assign the disk drive to the massbus.

Representing Knowledge – Probabilistically

1975 Mycin attaches probability-like numbers to rules

*If: (1) the stain of the organism is gram-positive, and
(2) the morphology of the organism is coccus, and
(3) the growth conformation of the organism is clumps*

Then: there is suggestive evidence (0.7) that the identity of the organism is staphylococcus.

1970s Probabilistic models of speech recognition

1980s Statistical Machine Translation systems

1990s large scale neural nets

The Rise of Expert Systems

1967 Dendral – a rule-based system that inferred molecular structure from mass spectral and NMR data

1975 Mycin – a rule-based system to recommend antibiotic therapy

1975 Meta-Dendral learned new rules of mass spectrometry, the first discoveries by a computer to appear in a refereed scientific journal

1979 EMycin – the first expert system shell

1980's The Age of Expert Systems

Expert Systems – The Heyday

- | | | | |
|------|----------------|---|------------------------------|
| 1979 | Inference | } | Selling expert system shells |
| 1980 | IntelliCorp | | |
| 1981 | Teknowledge | | |
| 1983 | Carnegie Group | | |
- 1980 XCON (R1) – first real commercial expert system at DEC, configures VAX systems
- 1981 Japanese Fifth Generation project launched as the Expert Systems age blossoms in the US.
- 1984 Gold Hill Common Lisp
- 1986 neural net start up companies appear
- 1988 AI revenues peak at \$1 billion. AI Winter begins.

Expert Systems – Today: Medicine

One example domain, medicine, has expert systems whose tasks include:

- arrhythmia recognition from electrocardiograms
- coronary heart disease risk group detection
- monitoring the prescription of restricted use antibiotics
- early melanoma diagnosis
- gene expression data analysis of human lymphoma
- breast cancer diagnosis

Expert Systems – Today: Build Your Own

eXpertise2Go: <http://www.expertise2go.com/>

AcquiredIntelligence: <http://www.aiinc.ca/demos/>

(whales, graduate school)

Taking the SAT Exam

QUESTION: Sodium azide is used in air bags to rapidly produce gas to inflate the bag. The products of the decomposition reaction are:(a) Na and water.(b) Ammonia and sodium metal.(c) N₂ and O₂(d) Sodium and nitrogen gas.(e) Sodium oxide and nitrogen gas.

(d) Sodium and nitrogen gas.

SYSTEM-GENERATED ANSWER:

What are the products of the given decomposition reaction?

- By definition, oxidation-reduction reactions occur when electrons are transferred from the atom that is oxidized to the atom that is reduced. We need to look for changes in the oxidation states of the elements in the reaction.

- In the reactants, the oxidation state(s) of the element Na is/are (1). In the product, the oxidation state(s) is/are (0).

- Therefore, the reaction causes a change in oxidation state.

- Therefore, this is an oxidation reduction reaction.

- By definition, a Binary Ionic-Compound Decomposition Reaction occurs when a binary ionic compound is heated.

- Therefore, this reaction is a Binary-Ionic Compound Decomposition reaction.

- In general, a Binary Ionic-Compound Decomposition Reaction converts a binary ionic-compound into basic elements.

- In this reaction, NaN_3 reacts to produce Na and N_2 .

The products of the decomposition reaction are:

(d) Sodium and nitrogen gas.

The work of Bruce Porter et al here at UT

What About Things that People Do *Easily*?

- Common sense
- Moving Around
- Language

What About Things that People Do *Easily*?

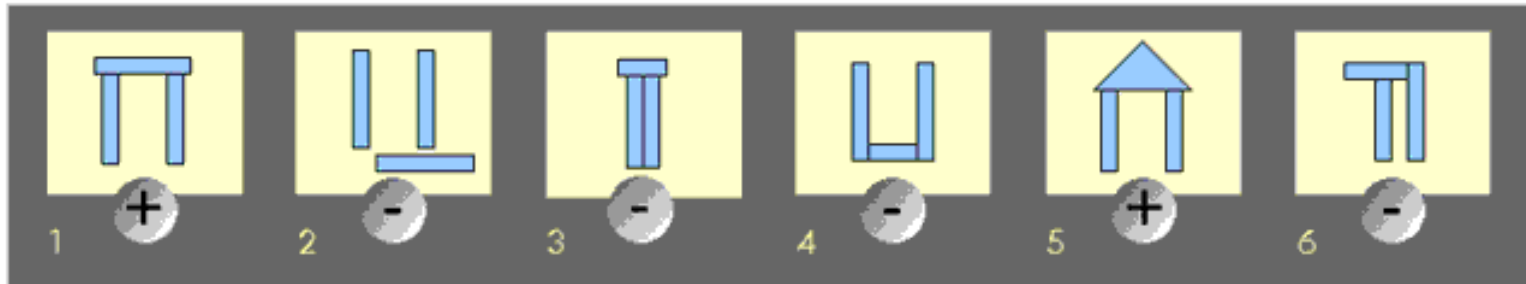
- Common sense
 - CYC
 - UT (<http://www.cs.utexas.edu/users/mfkb/RKF/tree/>)
 - WordNet (<http://www.cogsci.princeton.edu/~wn/>)
- Moving around
- Language

Hand-Coded Knowledge vs. Machine Learning

- How much work would it be to enter knowledge by hand?
- Do we even know what to enter?

1952-62 Samuel's checkers player learned its evaluation function

1975 Winston's system learned structural descriptions from examples and near misses



1984 Probably Approximately Correct learning offers a theoretical foundation

mid 80's The rise of neural networks

Robotics - Tortoise

1950 W. Grey Walter's light seeking tortoises. In this picture, there are two, each with a light source and a light sensor. Thus they appear to “dance” around each other.



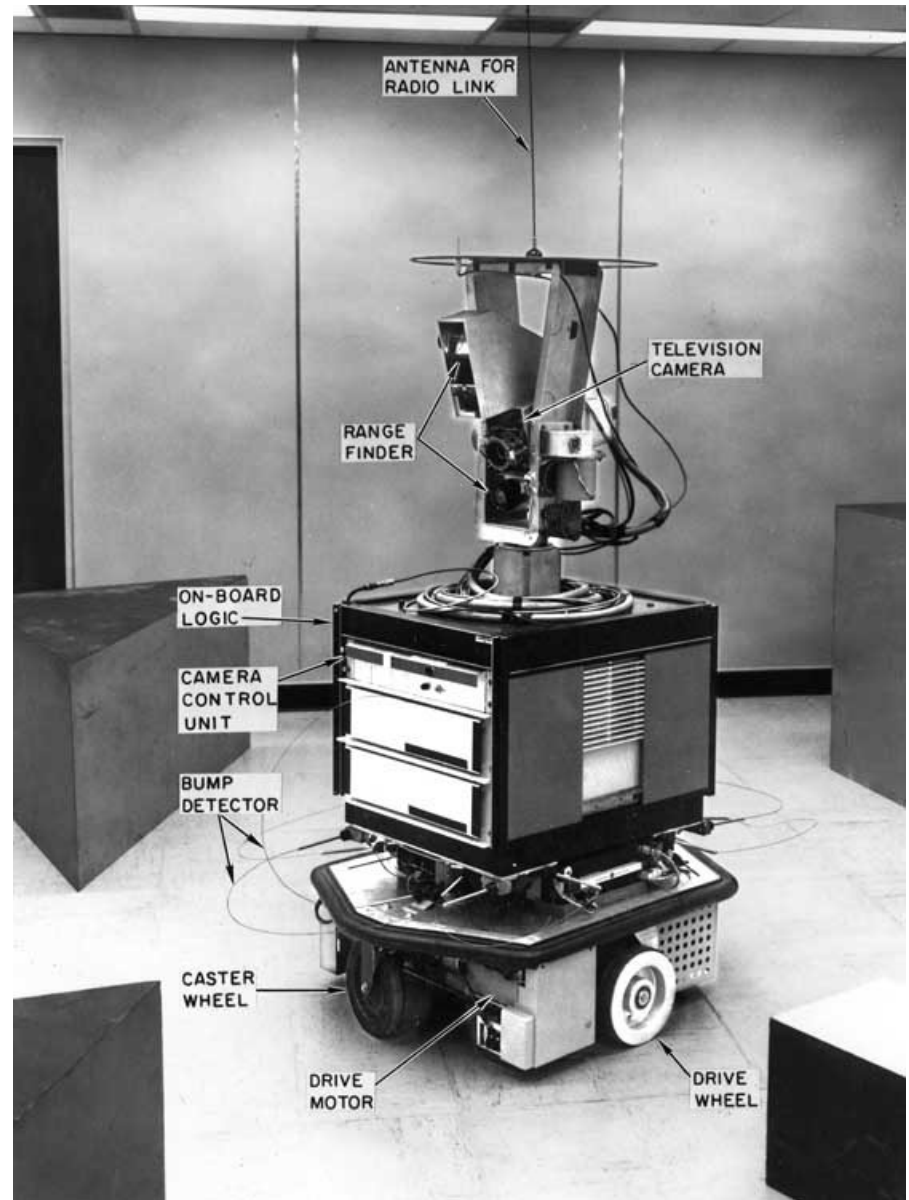
Robotics – Hopkins Beast

1964 Two versions of the Hopkins beast, which used sonar to guide it in the halls. Its goal was to find power outlets.



Robotics - Shakey

1970 Shakey (SRI)
was driven by a remote-
controlled computer,
which formulated plans
for moving and acting.
It took about half an
hour to move Shakey
one meter.



Robotics – Stanford Cart

1971-9 Stanford cart.
Remote controlled by
person or computer.

1971 follow the white
line

1975 drive in a straight
line by tracking skyline

1979 get through
obstacle courses. Cross
30 meters in five hours,
getting lost one time
out of four

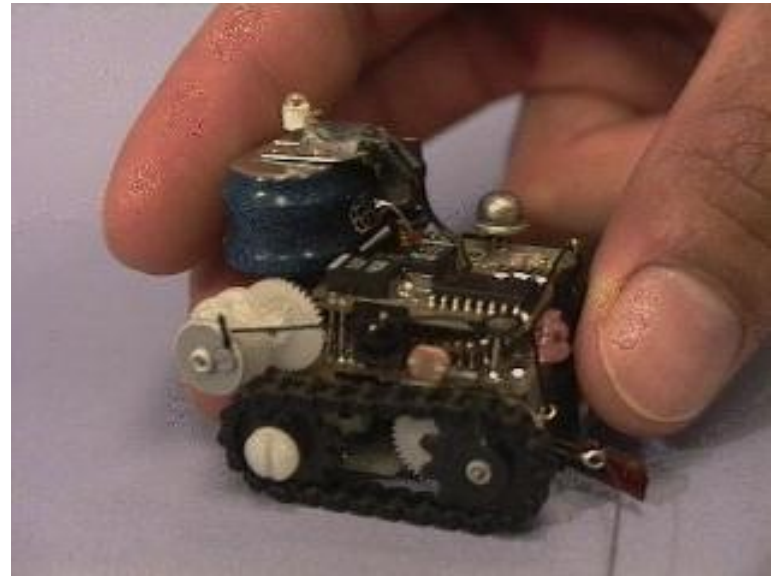


Planning vs. Reacting

In the early days: substantial focus on planning (e.g., GPS)

1979 – in “Fast, Cheap and Out of Control”, Rodney Brooks argued for a very different approach. (No, I’m not talking about the 1997 movie.)

The Ant, has 17 sensors.
They are designed to work
in colonies.



<http://www.ai.mit.edu/people/brooks/papers/fast-cheap.pdf>

<http://www.ai.mit.edu/projects/ants/>

Robotics - Dante

1994 Dante II (CMU) explored the Mt. Spurr (Aleutian Range, Alaska) volcano. High-temperature, fumarole gas samples are prized by volcanic science, yet their sampling poses significant challenge. In 1993, eight volcanologists were killed in two separate events while sampling and monitoring volcanoes.



Using its tether cable anchored at the crater rim, Dante II is able to descend down sheer crater walls in a rappelling-like manner to gather and analyze high temperature gasses from the crater floor.

Robotics - Sojourner



Oct. 30, 1999 Sojourner on Mars. Powered by a 1.9 square foot solar array, Sojourner can negotiate obstacles tilted at a 45 degree angle. It travels at less than half an inch per second.

Robotics – Mars Rover



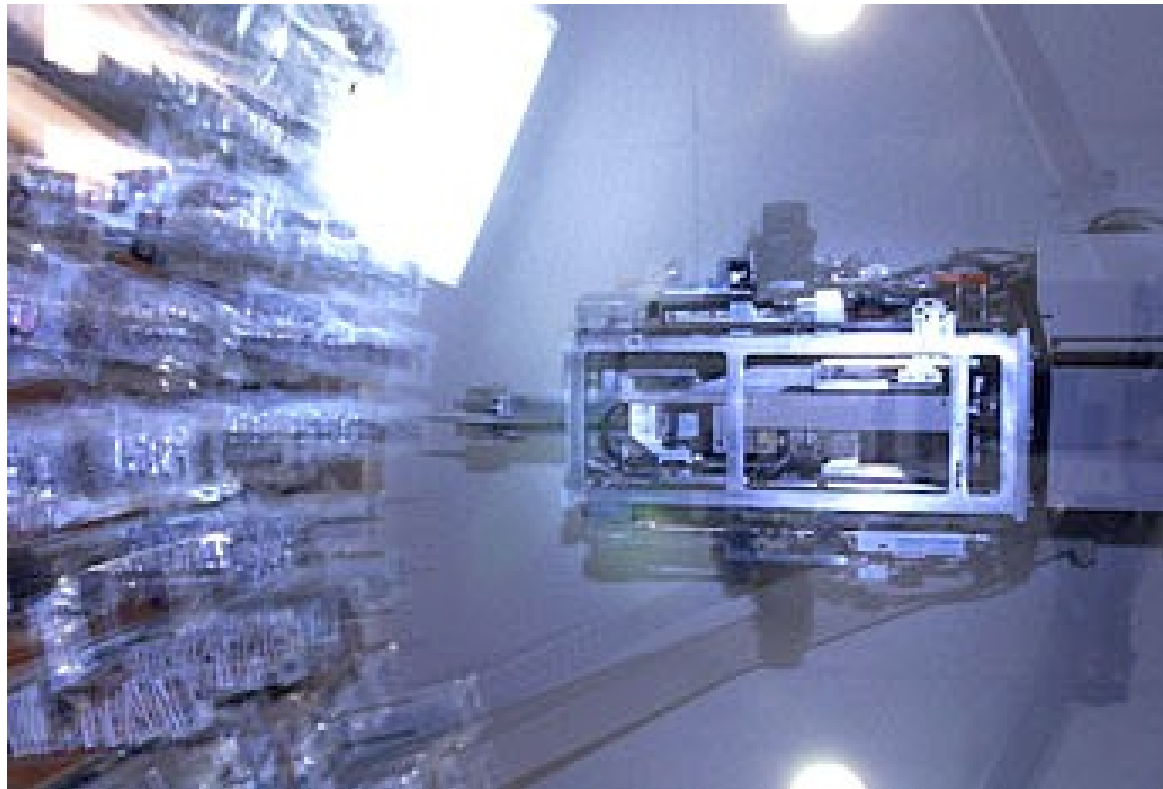
Tutorial on Rover: <http://marsrovers.jpl.nasa.gov/gallery/video/animation.html>

Sandstorm



March 13, 2004 - A DARPA Grand Challenge: an unmanned offroad race, 142 miles from Barstow to Las Vegas.

Moving Around and Picking Things Up



Phil, the drug robot, introduced in 2003

Robotics - Aibo

1999 Sony's Aibo pet
dog



AP

What Can You Do with an Aibo?

1997 – First official Rob-Cup soccer match

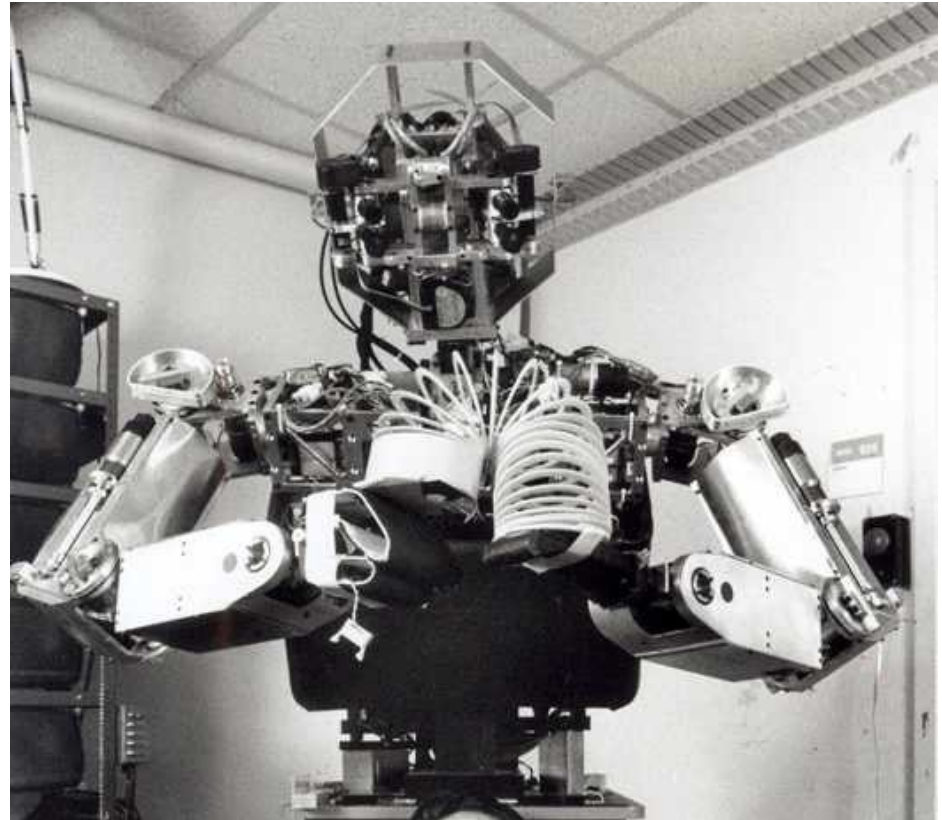


Picture from 2003
competition

Robotics - Cog

1998 – now Cog

*Humanoid
intelligence requires
humanoid
interactions with the
world.*



At the Other End of the Spectrum - Roomba

2001 A robot
vacuum cleaner



Natural Language Processing

1964 STUDENT solves algebra word problems

The distance from New York to Los Angeles is 3000 miles. If the average speed of a jet plane is 600 miles per hour, find the time it takes to travel from New York to Los Angeles by jet.

1965 ELIZA models a Rogerian therapist

***young woman:** Men are all alike.*

***eliza:** In what way?*

***young woman:** They're always bugging us about something specific or other.*

***eliza:** Can you think of a specific example?*

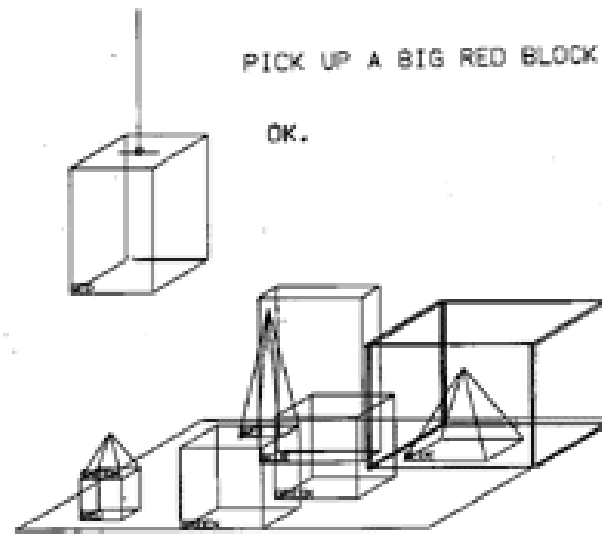
***young woman:** Well, my boyfriend made me come here.*

***eliza:** Your boyfriend made you come here?*

NLP, continued

1966 Alpac report kills work on MT

1971 SHRDLU



NLP, continued

1973 Schank – a richer limited domain: children’s stories

Suzie was invited to Mary’s birthday party. She knew she wanted a new doll so she got it for her.

1977 Schank – scripts add a knowledge layer – restaurant stories

1970’s and 80’s sophisticated grammars and parsers

But suppose we want generality? One approach is “shallow” systems that punt the complexities of meaning.

NLP Today

- Grammar and spelling checkers
 - Spelling: <http://www.spellcheck.net/>
- Chatbots
 - See the list at: <http://www.aai.org/AITopics/html/natlang.html#chat/>
- Speech systems
 - Synthesis: The IBM system:
 - <http://www.research.ibm.com/tts/coredemo.html>

Machine Translation: An Early NL Application

1949 Warren Weaver's memo suggesting MT

1966 Alpac report kills government funding

Early 70s SYSTRAN develops direct Russian/English system

Early 80s knowledge based MT systems

Late 80s statistical MT systems

MT Today

Austin Police are trying to find the person responsible for robbing a bank in Downtown Austin.

El policía de Austin está intentando encontrar a la persona responsable de robar un banco en Austin céntrica.

The police of Austin is trying to find the responsible person to rob a bank in centric Austin.

MT Today

A Florida teen charged with hiring an undercover policeman to shoot and kill his mother instructed the purported hitman not to damage the family television during the attack, police said on Thursday.

Un adolescente de la Florida cargado con emplear a un policía de la cubierta interior para tirar y para matar a su madre mandó a hitman pretendida para no dañar la televisión de la familia durante el ataque, limpia dicho el jueves.

An adolescent of Florida loaded with using a police of the inner cover to throw and to kill his mother commanded to hitman tried not to damage the television of the family during the attack, clean said Thursday.

MT Today

I have a dream, that my four little children will one day live in a nation where they will not be judged by the color of their skin but by the content of their character. I have a dream today – *Martin Luther King*

I am a sleepy, that my four small children a day of alive in a nation in where they will not be judged by the color of its skin but by the content of its character. I am a sleepy today. (Spanish)

Why Is It So Hard?

Sue caught the bass with her new rod.

Why Is It So Hard?

Sue caught (the bass) (with her new rod).

Why Is It So Hard?

Sue caught the bass with the dark stripes.

Why Is It So Hard?

Sue caught (the bass with the dark stripes).

Why Is It So Hard?

Sue played the bass with her new bow.

Why Is It So Hard?

Sue played the bass with her new bow.

Sue played the bass with her new beau.

Why Is It So Hard?

Olive oil



Why Is It So Hard?

Olive oil



Why Is It So Hard?

Peanut oil



Why Is It So Hard?

Coconut oil



Why Is It So Hard?

Baby oil



Why Is It So Hard?

Cooking oil



MT Today

Is MT an “AI complete” problem?

- *John saw a bicycle in the store window. He wanted it.*
- *John saw a bicycle in the store window. He pressed his nose up against it.*

- *John saw the Statue of Liberty flying over New York.*
- *John saw a plane flying over New York.*

Text Retrieval and Extraction

- Try Ask Jeeves: <http://www.askjeeves.com>
- To do better requires:
 - Linguistic knowledge
 - World knowledge
- Newsblaster: <http://www1.cs.columbia.edu/nlp/newsblaster/>

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

Cognitive Modeling

Symbolic Modeling

1957 GPS

1983 SOAR

Neuron-Level Modeling

McCulloch Pitts neurons: all or none response

More sophisticated neurons and connections

More powerful learning algorithm

Making Money – Software

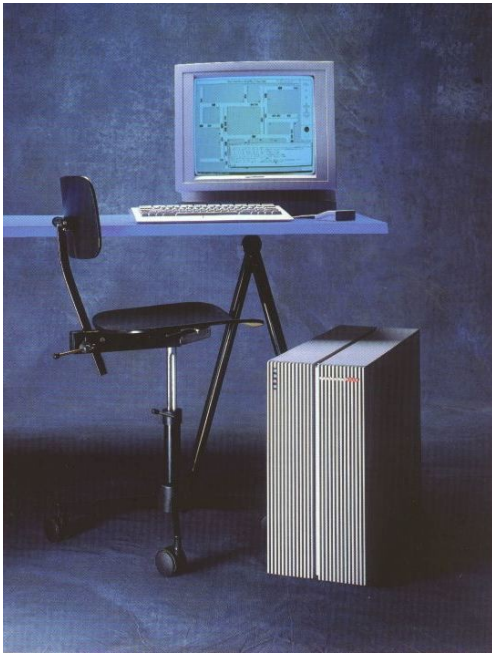
- Expert systems to solve problems in particular domains
- Expert system shells to make it cheaper to build new systems in new domains
- Language applications
 - Text retrieval
 - Machine Translation
 - Text to speech and speech recognition
- Data mining

Making Money - Hardware

1980 Symbolics founded

1986 Thinking Machines introduces the Connection Machine

1993 Symbolics declared bankruptcy



Symbolics 3620 System c 1986:
Up to 4 Mwords (16 Mbytes)
optional physical memory, one
190 Mbyte fixed disk, integral
Ethernet interface, five backplane
expansion slots, options include
an additional 190 Mbyte disk or
1/4" tape drive, floating point
accelerator, memory, RS232C
ports and printers.

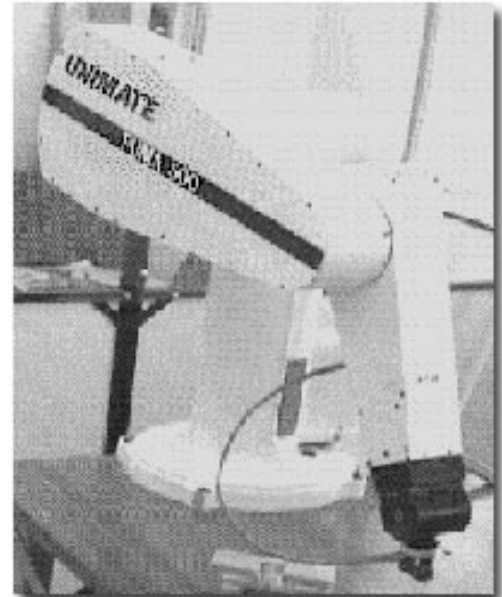
Making Money - Robots

1962 Unimation, first industrial robot company, founded. Sold a die casting robot to GM.

1990 iRobot founded, a spinoff of MIT

2000 The UN estimated that there are 742,500 industrial robots in use worldwide. More than half of these were being used in Japan.

2001 iRobot markets Roomba for \$200.



The Differences Between Us and Them

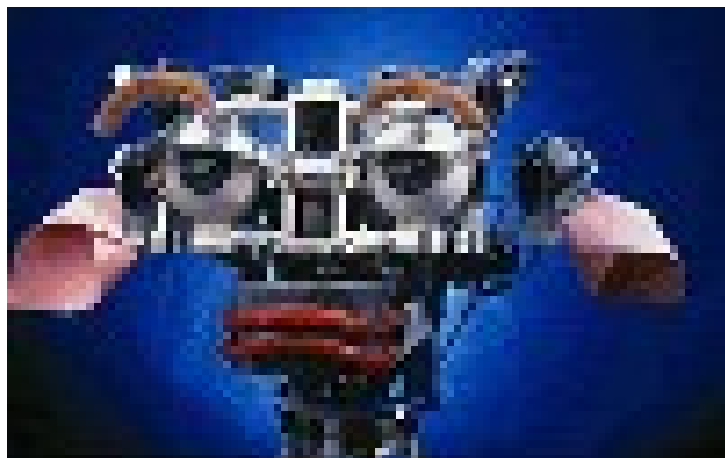
Emotions

Understanding

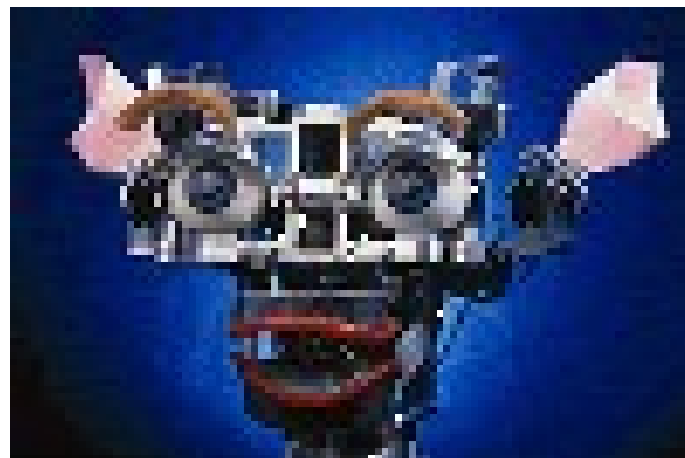
Consciousness

Emotions

The robot Kismet shows emotions



sad

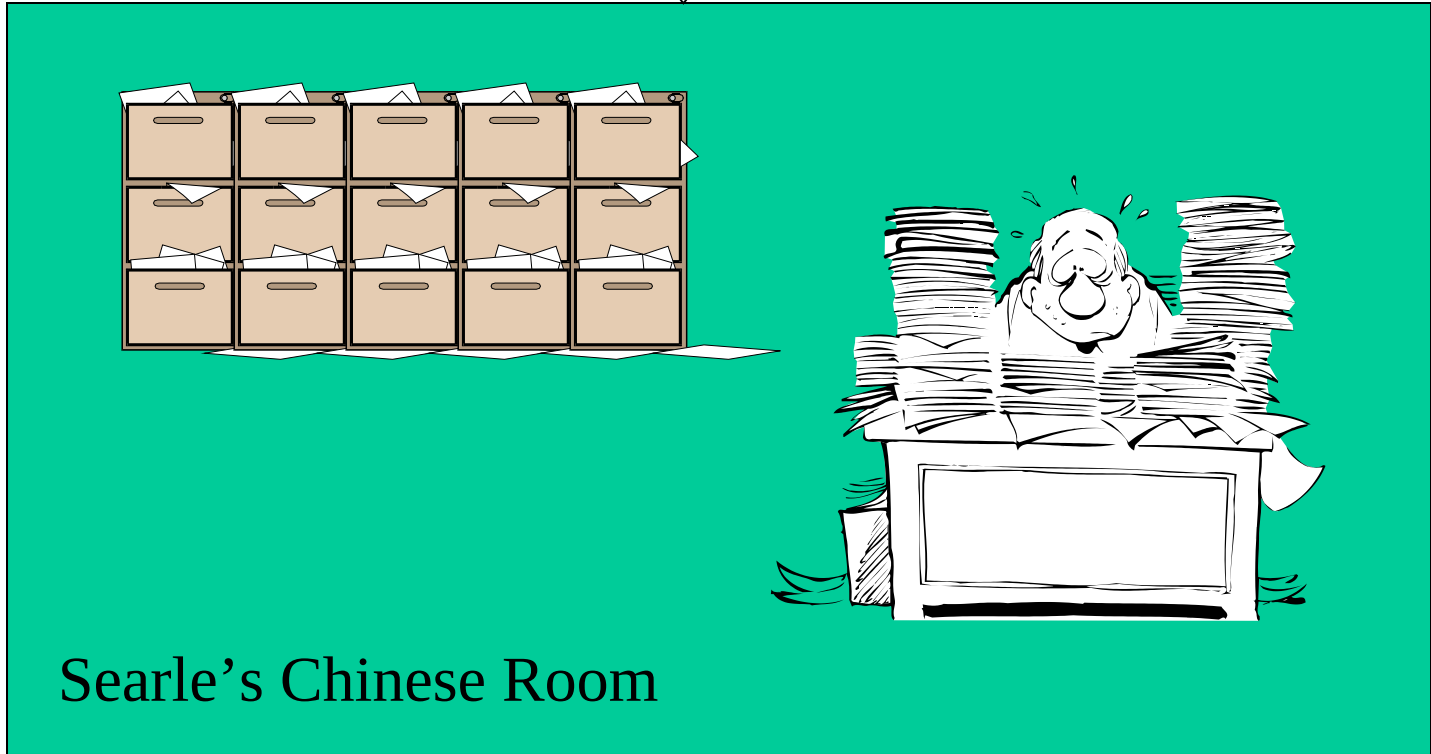


surprise

<http://www.ai.mit.edu/projects/humanoid-robotics-group/kismet/>

Understanding

登 长 城 纪 念



我 登 上 了 长 城

Consciousness

Me

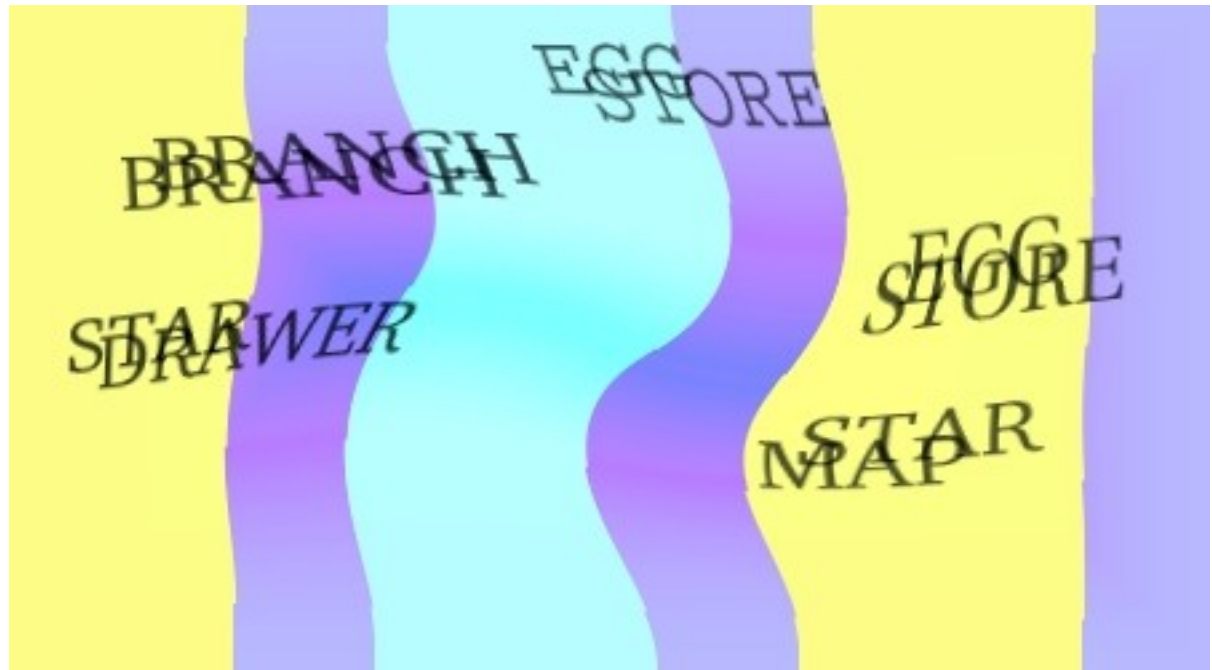


You



Today: The Difference Between Us and Them

The
CAPTCHA
Project



Today: Computer as Artist

Two paintings done by Harold Cohen's Aaron program:



Why AI?

"AI can have two purposes. One is to use the power of computers to augment human thinking, just as we use motors to augment human or horse power. Robotics and expert systems are major branches of that. The other is to use a computer's artificial intelligence to understand how humans think. In a humanoid way. If you test your programs not merely by what they can accomplish, but how they accomplish it, then you're really doing cognitive science; you're using AI to understand the human mind."

- Herb Simon