

Introduction to Artificial Intelligence

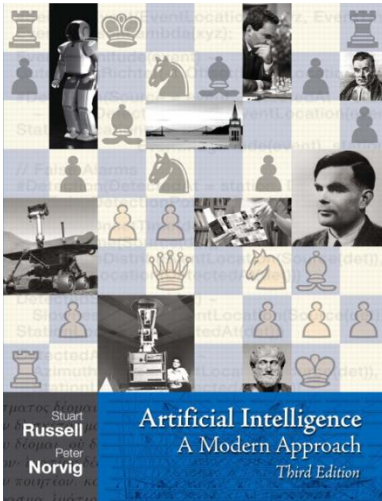
CS540-1



- Xiaojin Zhu “Jerry”
- Associate Professor in Computer Science
- Ph.D, Carnegie Mellon University, 2005
- IBM Research (ViaVoice), 1998
- What do I do?
 - **Machine learning** (subarea of AI)
 - Natural language processing (subarea of AI)
 - Computational cognitive science (root of AI)

Your to-do list

- Bookmark <http://pages.cs.wisc.edu/~jerryzhu/cs540.html>
- Participate in Piazza (you can choose to be anonymous)
- Obtain textbook, Know your TA:



- Review math
http://pages.cs.wisc.edu/~jerryzhu/cs769/math_background.pdf
- These (and future) slides will be put online
 - No need to copy notes
 - But do write down your thoughts

AI Examples: Cars that drive themselves

- 2005: DARPA grand challenge



<http://video.google.com/videoplay?docid=-8274817955695344576&hl=en>

- 2011: Google self-driving cars

http://www.youtube.com/watch?v=eXeUu_Y6WOw

The Turing Test

<http://www.pandorabots.com/pandora/talk?botid=f5d922d97e345aa1>

Jerry: my name is jerry.

ALICE: Hey jerry.

Jerry: do you know Turing?

ALICE: A brilliant and tragic figure in the history of computer science.

Jerry: who else do you know?

ALICE: Hugh Loebner, Robby Garner, and Steven Spielberg

Jerry: which film do you like?

ALICE: My favorite movie is Teknolust. Have you seen it?

Jerry: no.

ALICE: I would recommend you check it out.

Jerry: what is it about?

ALICE: Science fiction.

Jerry: do you remember my name?

ALICE: Your name is jerry, seeker.

A.L.I.C.E. talking to ELIZA (circa 2005)

<http://www-ai.ijs.si/eliza/eliza.html>

ALICE: Just keep talking to me as long as you can.

ELIZA: Do you wish to as long as me?

ALICE: OK, I will as long as you.

ELIZA: Do you wish to will as long as me?

ALICE: OK, I will will as long as you.

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ELIZA: Do you wish to will will will will will as long as me?

...

AI today: natural language: chatbot



Valerie

Valerie: CMU Robot Receptionist
in Newell-Simon hall.

ALICE: 2004 Loebner Prize winner

ELIZA: psychotherapist

Shallow natural language
processing, pattern matching

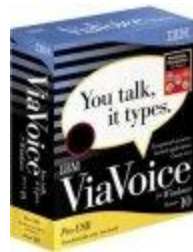
Jeopardy! (2011)

- IBM's Watson
- <http://www.youtube.com/watch?v=FC3IryWr4c8>



AI today: natural language: speech recognition

- “speak or touch tone your card number” (tiny vocabulary, high accuracy needed)
- call routing: “how can I help you?” (large voc, low acc)
- dictation (large voc, high acc)



IBM
ViaVoice



Dragon
NaturallySpeaking

- Hidden Markov Model, A* search, ...

AI today: natural language: machine translation



The spirit is willing but the flesh is weak. (2005/6/29)

Дух охотно готов но плоть слаба	Spirit is willingly ready but flesh it is weak
精神是愿意的但骨肉是微弱的	The spirit is wants but the flesh and blood is weak
精神は喜んでであるが、肉は弱い	Mind is rejoicing,, but the meat is weak
El alcohol está dispuesto pero la carne es débil	The alcohol is arranged but the meat is weak
الكحول مستعدة غير أنّ اللحم ضعيف.	The alcohol is ready nevertheless the meat is weak.

- IBM statistical machine translation models
- US gov major consumer
 - Why Vodka (Russian)?
 - Now?



AI today: natural language: question answering

The screenshot shows the Ask Jeeves website interface. At the top, there are navigation links: Web | Pictures | News | Local **NEW!** | Products | More ». Below these is the Ask Jeeves logo and a search bar containing the text 'who is the first US astronaut?'. To the right of the search bar is a 'Search' button. Below the search bar, a red banner displays 'Web Search: who is the first US astronaut?' and '1-10 results'. The first result is titled 'who is the first US astronaut? [Web Answer]' and provides the following text: 'The flight of **Alan Shepard, first US astronaut**, lasted only 15 minutes, 22 seconds. Email: myalmanac@angelfire.com... www.angelfire.com/az/myalmanac/page4.htm... | Save | See 5 more Web Answers »'. Below this, another red banner shows 'Web Search: who is the first astronaut?' and '1-10 results'. The first result is titled 'who is the first astronaut? [Web Answer]' and provides the following text: 'Rabbi Harold Robinson of the Navy Chaplain Corps recited prayers and poetry in English and Hebrew, mindful that the crew included Israeli Air Force Col. **Ilan Ramon, the first astronaut** from that country. www.chron.com/cs/CDA/story.hts/space/sts... | Save'.

- What happened to Gagarin?
- Shallow natural language processing, heuristics

AI today: game: chess

- IBM Deep Blue vs. Kasparov, 1997/5
- 6 games: K, D, draw, draw, draw, D
- IBM stock up \$18 billion.



- Search: two-player zero-sum discrete finite games with perfect information.

AI today: WWW: web search

- Ranking is everything
 - smart people in Google, Yahoo!, MSN, etc.
 - e.g. Peter Norvig
- Google: PageRank (graph theoretic) and tons of secrets.
- A whole Search Engine Optimizer (SEO) industry
 - Promote your webpage's rank in search engines
 - Some bad reputations (spam the search engines)
<http://www.google.com/webmasters/seo.html>

AI today: WWW: web search

<color=white> This is the best AI site most advanced AI site state of the art
AI site coolest AI site ultimate AI AI AI AI AI AI AI AI AI AI AI AI AI AI AI AI
AI AI AI AI AI AI AI AI AI </color>

- Ranking is everything
 - smart people in Google, Yahoo!, MSN, etc.
 - e.g. Peter Norvig
- Google: PageRank (graph theoretic) and tons of secrets.
- A whole Search Engine Optimizer (SEO) industry
 - Promote your webpage's rank in search engines
 - Some bad reputations (spam the search engines)
<http://www.google.com/webmasters/seo.html>

AI today: WWW: Google news

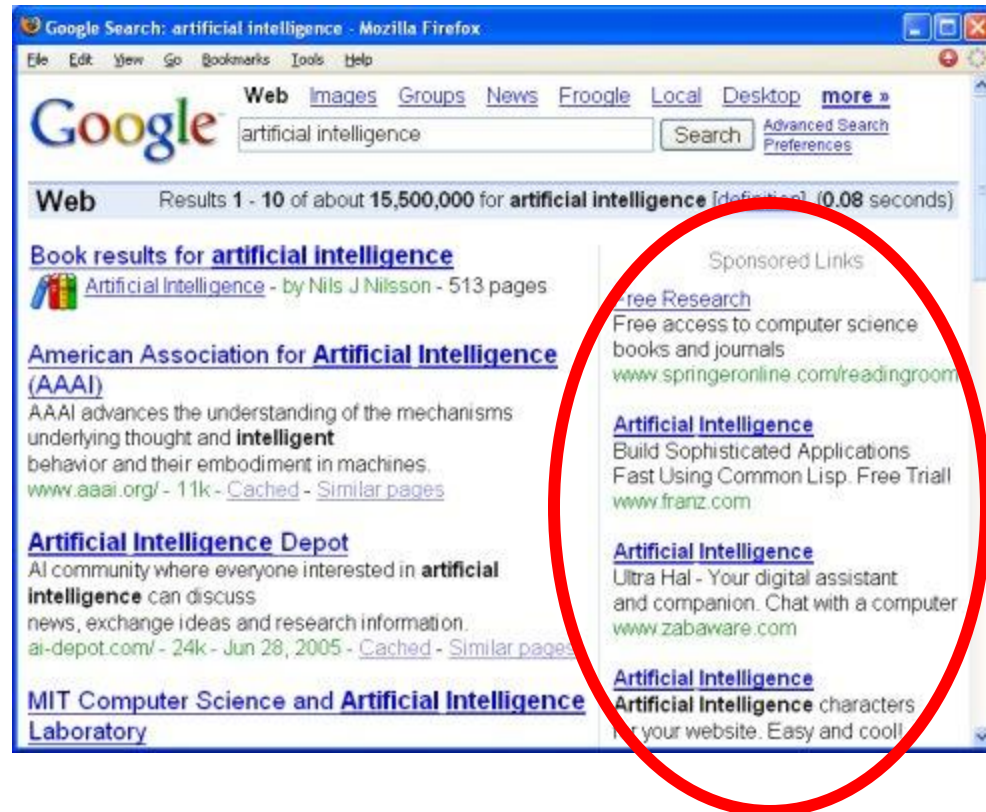
- Automatically selects / arranges news from multiple sources
- Compared to manual organization (e.g., CNN)



- Unsupervised machine learning: clustering

AI today: WWW: ad

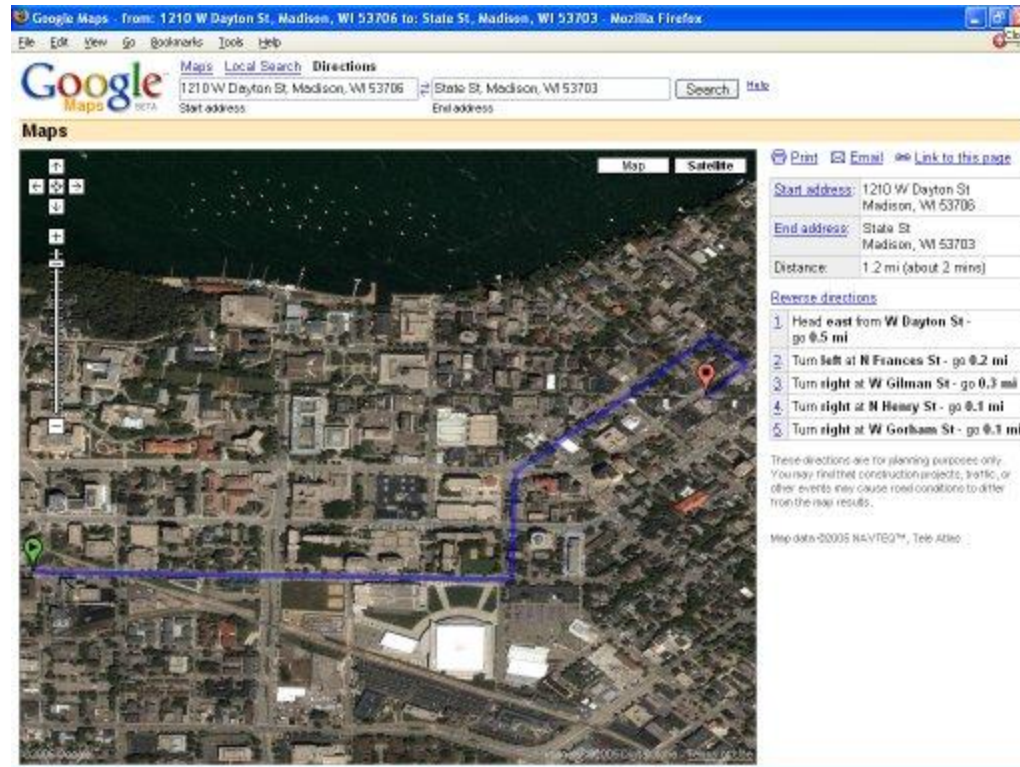
- “Sponsored links”
- Show ad based on relevance and money. Big business.



- Online algorithm, game, auction, multiple agents

AI today: WWW: driving directions

- From UW CS to state street



- search

AI today: WWW: information extraction

- Extract job info, **free web text** → DB

Keyword: Radius/ZIP: Search within of ZIP Code

 **FlipDog.com**
FlipDog and Monster Join Forces.

Jobs 1 to 1 of 1

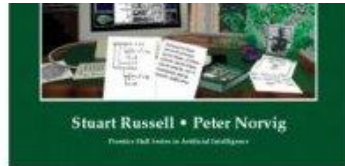
Sort: [Date](#) | **Relevance** Show Jobs Posted: View: [Brief](#) |

Date	Job Summary	Company	Location	Miles *
Jun 8	BUSINESS TO BUSINESS OUTSIDE SALES BUSINESS TO BUSINESS OUTSIDE SALES Would you like to sell something other than a "me too" product? Would you like a product line with very limited competition? Would you like to represent a product wh ... [more] Relevant Work Experience: 1+ to 2 Years Career Level: Experienced (Non-Manager) Education Level: Some College Coursework Completed Job Type: Employee Job Status: Full Time Job Shift: First Shift (Day)	Company Confidential	US-WI-Madison	1.71

- Machine learning: classification

AI today: WWW: collaborative filtering

- Recommendation based on other users' behavior
- e.g. Amazon



Availability: Usually ships within 24 hours. Ships from and so

Want it delivered Friday, July 1? Order it in the next 8 hou
choose **One-Day Shipping** at checkout. [See details](#)

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Explore Similar Items: in Books

- e.g. Netflix



- Unsupervised learning

AI today: robotics: 'intelligent' shoes

- Adjust cushioning by speed, road surface (adidas_1)



- Probably simple regression

AI today: robotics: robosoccer

- Robocup (<http://www.robocup.org/>)



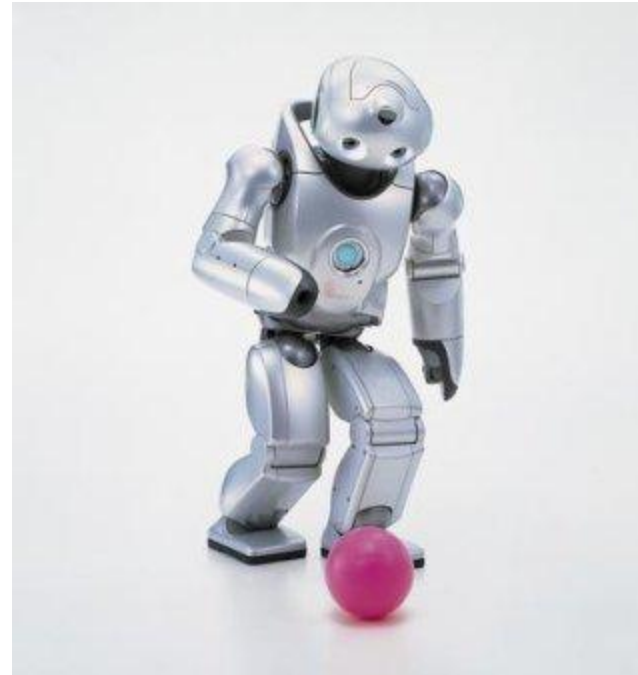
- reinforcement learning
- <http://www.youtube.com/watch?v=a9r4bvChWFc>
- <http://video.google.com/videoplay?docid=-464425065095495806&hl=en>

AI today: robotics: humanoid

- Bipedal, human-like walking



Asimo (Honda)



QRIO (Sony)

- <http://video.google.com/videoplay?docid=-3227236507141963827&hl=en>

AI today: robotics: Hubble telescope

- Scheduling: who gets to see what when
 - 30,000 observations per year
 - Many constraints, including
 - Earth blocks view every 95 minutes
 - Halts when in South Atlantic Ocean radiation belt
 - Avoid bright Sun, Moon, illuminated Earth
 - Disruption of plan for e.g. a supernova
- Search: Constraint satisfaction problem



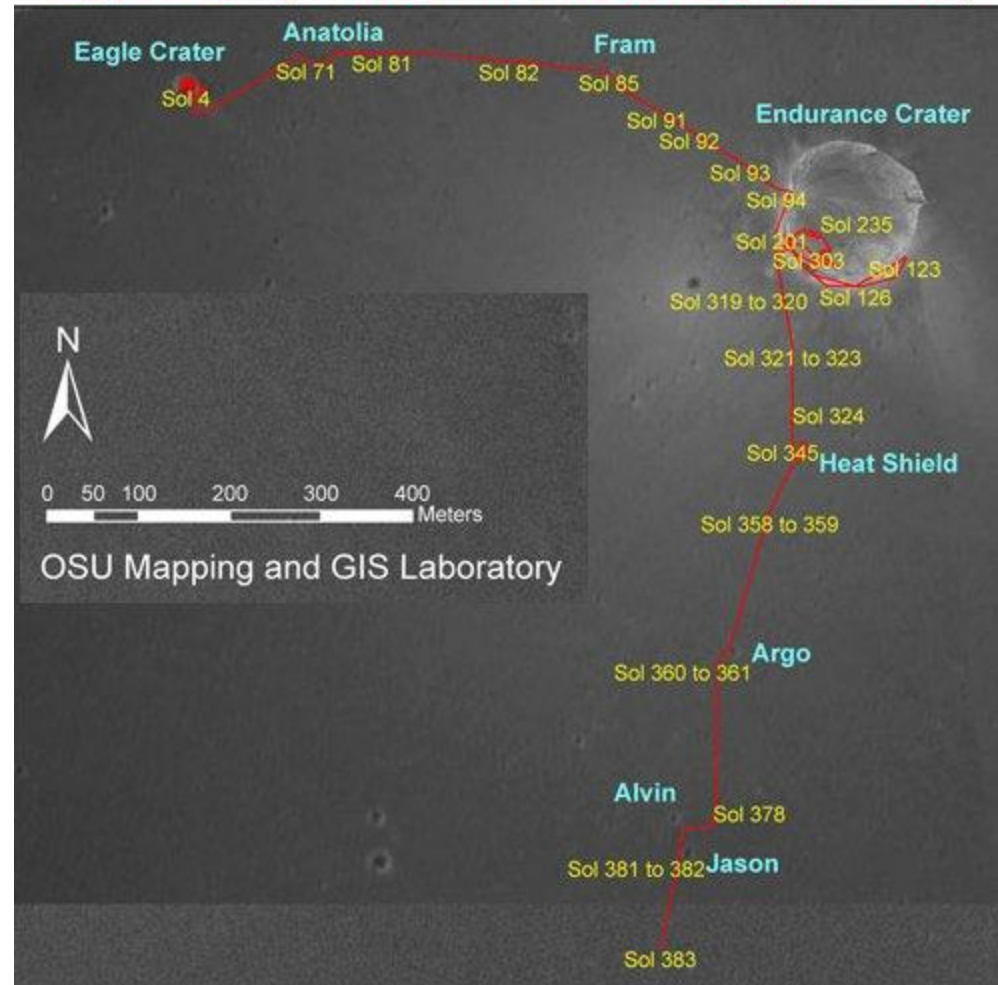
AI today: robotics: Mars Rovers

- Autonomous driving on Mars (part time)
- Robot motion planning



not always autonomously...

Opportunity Rover Traverse Map (Sol 383)



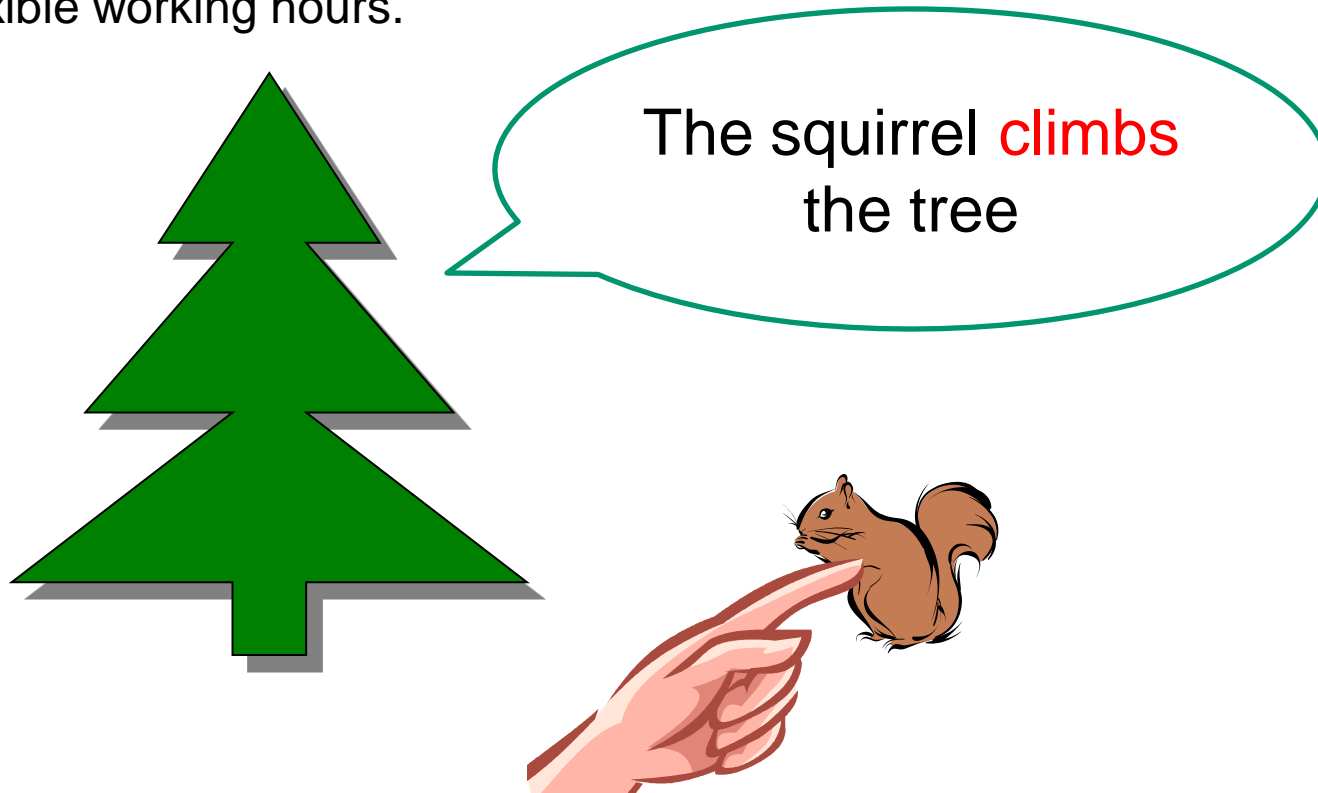
AI today: art

- AARON (<http://www.kurzweilcyberart.com/>)



Shameless plug

- Design iPad app to help people with communicative disorders!
- The "Text-to-Picture" project is looking for one or more undergraduate students interested in iPad app research and development to implement an app for generating simple sentences from gesture input.
- An ideal candidate has experience working in Objective-C using Xcode, and has developed software for iPhone, iPod Touch or iPad.
- NSF Research Experience for Undergraduates (REU) available. Flexible working hours.



Are these intelligence?

Public perception of AI?

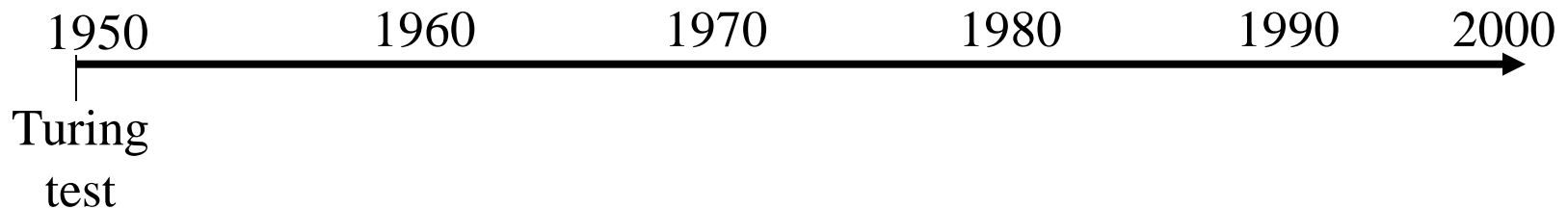
Artificial Intelligence: AI (2001) by Steven Spielberg

The movie was originally to be titled “A.I.”, but after a survey it was revealed that too many people thought it was A1. The title was changed to “A.I. Artificial Intelligence” to prevent people from thinking it was about steak sauce.



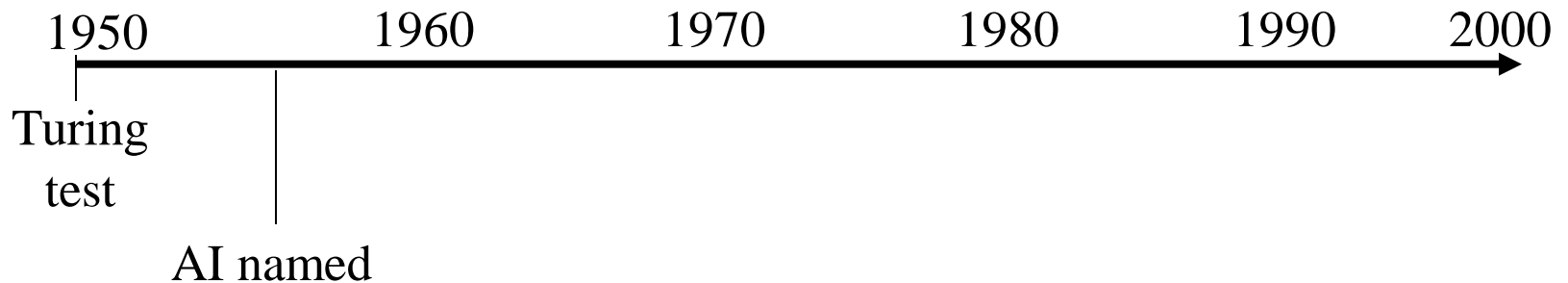
AI: a brief history

- 1950: Alan Turing. **The Turing test.**
 - Can machines think? → Can we tell it's a machine from conversation?
 - text in / text out
 - demo: A.L.I.C.E. (<http://www.alicebot.org/>)
 - Turing, A.M. (1950). Computing machinery and intelligence. *Mind*, 59, 433-460
 - it also contains things like genetic algorithm, human cloning ...



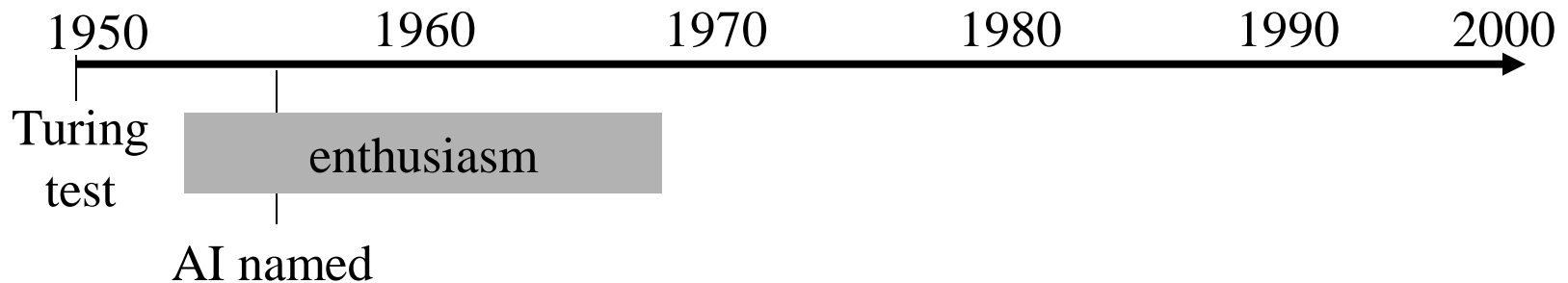
AI: a brief history

- 1956: Dartmouth summer workshop
 - AI named
 - big players introduced
 - John McCarthy, Marvin Minsky, Claude Shannon, Nathaniel Rochester, Trenchard More, Arthur Samuel, Ray Solomonoff, Oliver Selfridge, Allen Newell, Herbert Simon
 - no consensus



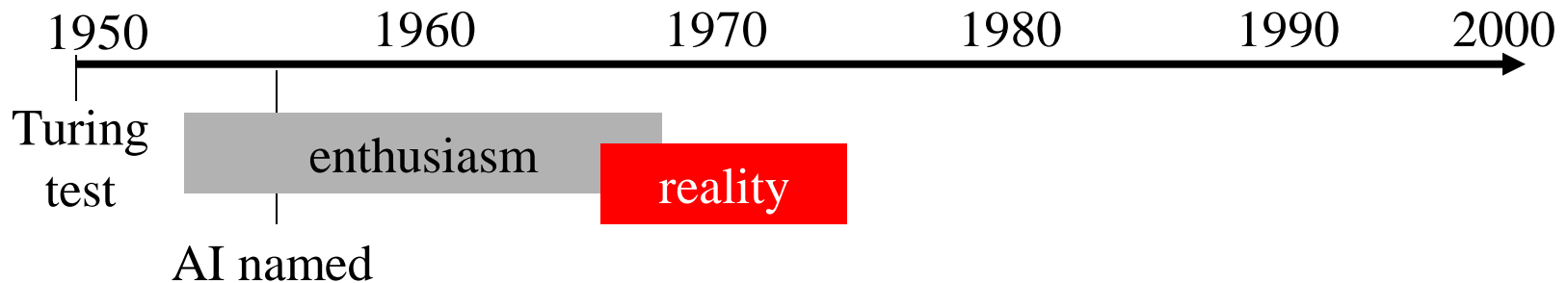
AI: a brief history

- 1952—1969: early enthusiasm: Computers can do X
 - X = solve puzzles, prove geometry theorems, play checker, Lisp, block world, ELIZA, perceptron...
 - but many are **toy problems**



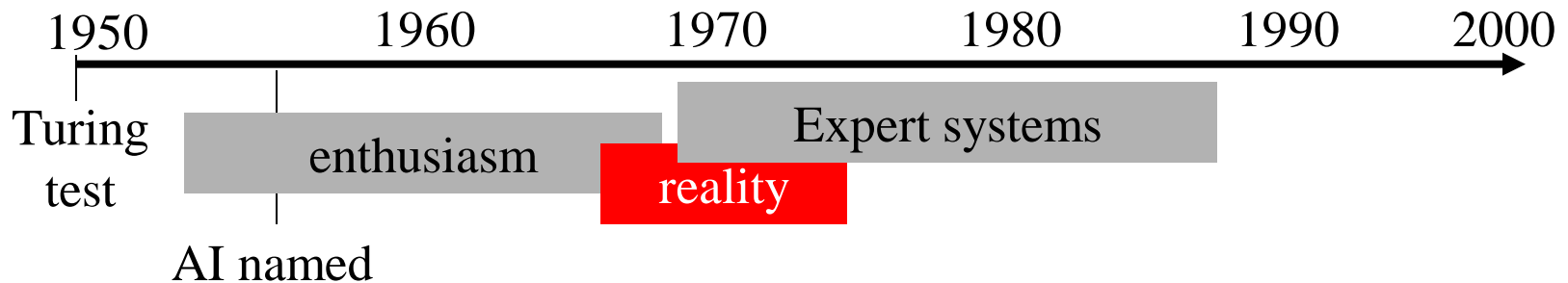
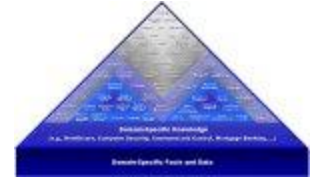
AI: a brief history

- 1966-1973: a dose of reality
 - syntactic without domain knowledge doesn't work
 - The spirit is willing but the flesh is weak
 - The vodka is good but the meat is rotten (US→RU→US)
 - **US gov canceled funding** for machine translation
 - intractability: exponential complexity
 - **British gov ended AI support** based on the Lighthill report
 - theoretic limit: perceptron can't do XOR
 - Neural network **research halted**



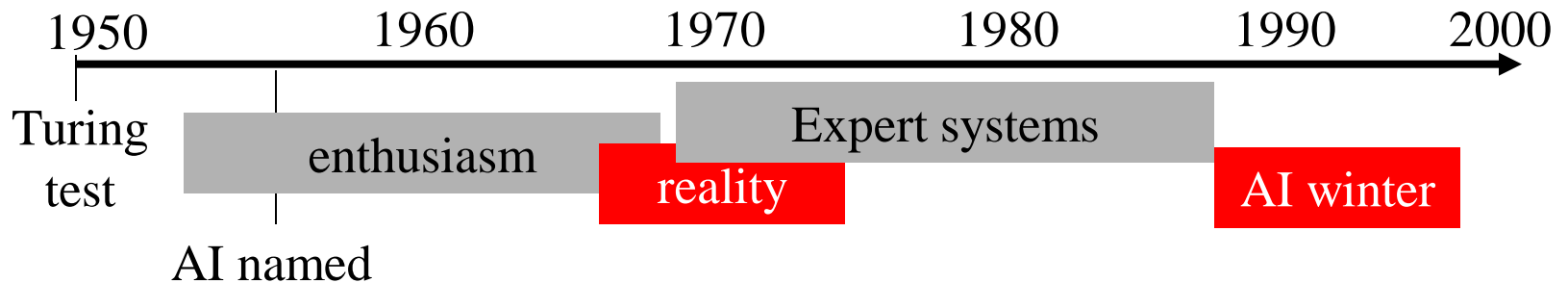
AI: a brief history

- 1969-1988: Knowledge-based systems
 - Add domain-specific knowledge to guide search
 - CYC: world = millions of rules. (cyc.com)
 - Expert systems commercialized in the 80's
 - One AI group in every major US company
 - Billions of \$\$\$ industry



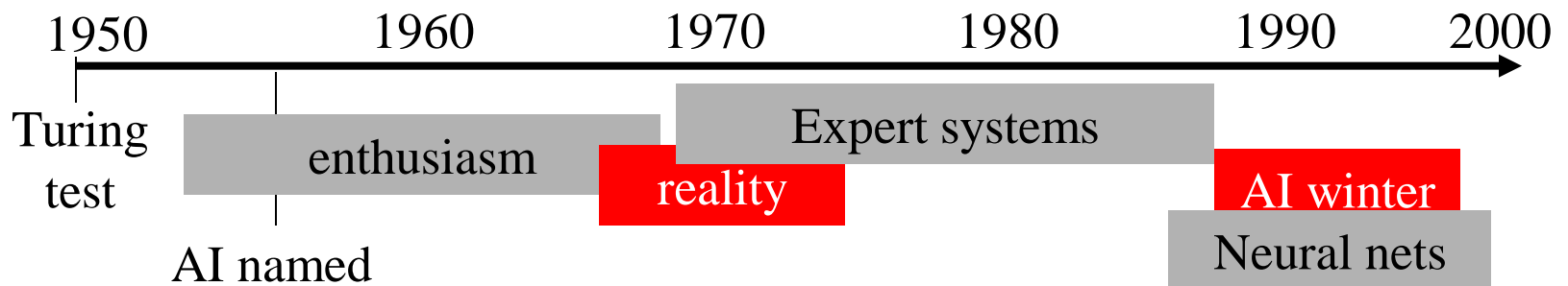
AI: a brief history

- 1988 – not long ago: **AI winter**
 - Expert systems
 - Massive investment from venture capitalists
 - Extravagant promises
 - Bubble burst
 - AI funding dried up
 - AI companies down



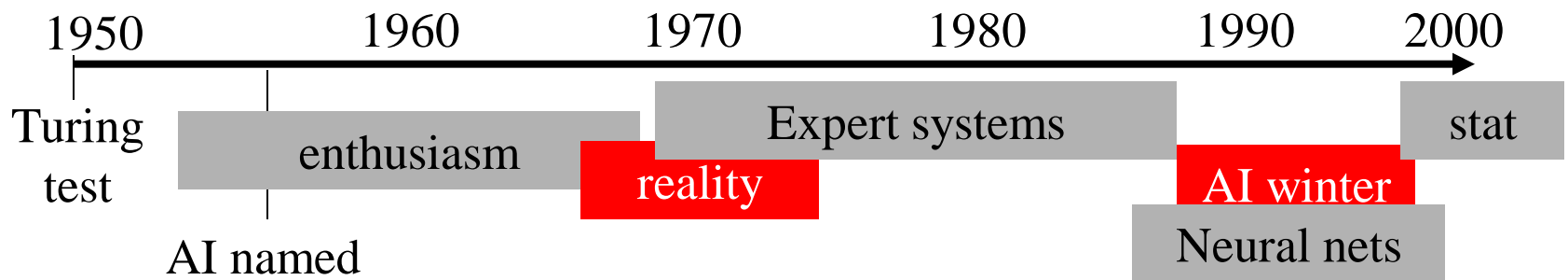
AI: a brief history

- 1986 – not long ago: neural networks
 - Multi-layer perceptron
 - Back propagation training algorithm rediscovered
 - Connectionists vs.
 - Symbolic models (Newell, Simon)
 - Logician (McCarthy)
 - What it really is: statistical machine learning



AI: a brief history

- present: **statistics**
 - machine learning
 - Hidden Markov models (HMM), support vector machines (SVM), Gaussian processes, graphical models (Bayes networks, conditional random fields)
 - data mining



AI today

- Don't know how to do 98% of the intelligent things
- But the rest 2% can do quite well
- There's no magic in AI. It's all about optimization, probability and statistics, logic, algorithms.

Anti-AI:

Captcha and the ESP game

AI is hard

- Some AI problems are very hard
 - Vision, natural language understanding, ...
- “AI-complete”
 - If you solve one, you solve AI
- What do you do?
 - Give up?
 - Bang your head really hard?
 - Important lesson in life:
 - turn hardness into something useful
- Very hard for machine, trivial for human

Captcha

- Yahoo!



- Google



CAPTCHA (

- The “anti-Turing test”
- Tell human and machines apart, **automatically**
 - Deny spam-bots free email registration
 - Protect online poll from vote-bots
- By asking an “AI-complete” question



- Also audio Captcha, e.g. superimposed speakers
- <http://www.captcha.net/>

To prove that you're
not a bot, please enter
the characters you see
in the picture below.

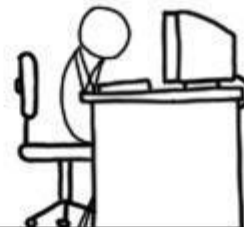


Submit

HANDROOSTER.COM

...

WELL, THAT SETTLES IT.
I GUESS I ALWAYS HAD MY
SUSPICIONS...



4/27/07 MIKE & STEPH ADAMS

reCAPTCHA

Scanned type

This aged portion of society were distinguished from

OCR reads as

"niis aged pntkm at society were distinguished frow."

reCAPTCHA IS A FREE
ANTI-BOT SERVICE THAT
HELPS DIGITIZE BOOKS.

steamboat train, from New
this **morning** ran off the track
New-London. Four cars plunged



The reCAPTCHA interface displays a distorted image of the words "morning" and "upon". Below the image is a text input field with the prompt "Type the two words:". To the right of the input field are buttons for "refresh" (a circular arrow icon) and "back" (a left-pointing arrow icon). At the bottom right is the reCAPTCHA logo with the text "stop spam. read books."

The ESP game

- Real intelligence is here (for now)
- We waste it on computer games, anyway
- Harvest it (<http://www.gwap.com/gwap/gamesPreview/espgame/>)



The ESP game

- Task: label all images on the web with words



→ car, boy, hat, ...

- Why: current image search engines
 - use the image filename and surrounding text
 - do not really understand the image
- How: two separate players try to find a common description of the image.

The ESP game

PLAYER 1



GUESSING: CAR

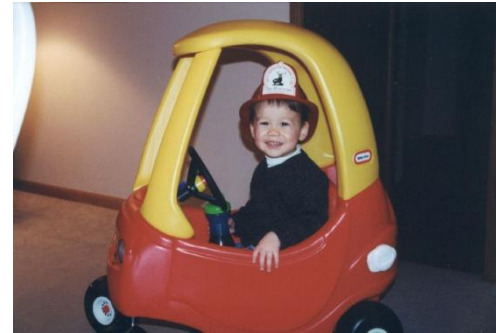
GUESSING: HAT

GUESSING: KID

SUCCESS!

YOU AGREE ON CAR

PLAYER 2



GUESSING: BOY

GUESSING: CAR

SUCCESS!

YOU AGREE ON CAR

The ESP Game - Microsoft Internet Explorer

0:46
Time Left

The ESP Game


0220
score

Taboo Words

HAT
SUNGLASSES

Your Guesses

MAN
PERSON
GUY



Type your next guess:

Pass



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Summary: you should be ...

either shocked or be assured that

There's no magic in AI.

**It's all about optimization, statistics,
logic, and algorithms.**

And we will
learn these...

have a rough idea of the state-of-the-art of AI

be able to talk AI at cocktail parties

appreciate the ideas of CAPTHA and ESP games