Introduction to Artificial Intelligence

CS540-1
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

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.
ELIZA: Do you wish to will will as long as me?
ALICE: OK, I will will will as long as you.
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ALICE: OK, I will will will will will will will as long as you.
ELIZA: Do you wish to will will will will will will will will as long as me?

...
AI today: natural language: chatbot

Valerie: CMU Robot Receptionist in Newell-Simon hall.

ALICE: 2004 Loebner Prize winner

ELIZA: psychotherapist

Shallow natural language processing, pattern matching
Jeopady (2011)

- IBM’s Watson
- [http://www.youtube.com/watch?v=FC3IryWr4c8](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)

- Hidden Markov Model, A* search, …

IBM
ViaVoice

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

- IBM statistical machine translation models
- US gov major consumer
  - Why Vodka (Russian)?
  - Now?
AI today: natural language: question answering

- 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: game: Go

- Google Deepmind AlphaGo vs. Lee Sedol, 2016/3
- 5 games: A, A, A, S, A
- Google stock also up
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
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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

  - **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 with...[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)

- Machine learning: classification
AI today: WWW: collaborative filtering

- Recommendation based on other users’ behavior
  - e.g. Amazon
  - 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
AI today: robotics: humanoid

• Bipedal, human-like walking

Asimo (Honda)  QRIO (Sony)

• http://video.google.com/videoplay?docid=-3227236507141963827&hl=en
AI today: robotics: humanoid

- Bipedal, even backflip

Boston Dynamics

- https://www.youtube.com/watch?v=knoOXBLFQ-s
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

M. Johnston and G. Miller 1993
SPIKE: Intelligent Scheduling of Hubble Space Telescope Observations
AI today: robotics: Mars Rovers

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

not always autonomously…
AI today: art

- AARON (http://www.kurzweilcyberart.com/)
AI today: art

• Neural Style (https://arxiv.org/abs/1508.06576)
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/)
  ▪ 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


- Turing test
- AI named
- enthusiasm
- reality
AI: a brief history

  - Multi-layer perceptron
  - Back propagation training algorithm rediscovered
  - Connectionists vs.
    - Symbolic models (Newell, Simon)
    - Logicist (McCarthy)
  - What it really is: statistical machine learning

![Timeline of AI history](image)
AI: a brief history

• 2000 – present: **statistics**
  ▪ **machine learning**
    • Hidden Markov models (HMM), support vector machines (SVM), Gaussian processes, graphical models (Bayes networks, conditional random fields)
  ▪ **data mining**
AI: a brief history

- 2009 – present: **neural networks strikes back**
  - deep learning
    - Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Autoencoder, Generative Adversarial Networks (GAN)

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Turing test  enthusiasm  Expert systems  AI winter  Neural nets  stat  Deep Learning
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

Random string oamg ➔ Distorted image ➔ What do you see?

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

[Luis von Ahn, IAAI/IJCAI 2003 keynote]
To prove that you're not a bot, please enter the characters you see in the picture below.

Submit

... well, that settles it. I guess I always had my suspicions...
This aged portion of society were distinguished from
“niis aged pntkm at society were distinguished frow.”

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

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

Type the two words:
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

[Luis von Ahn, IAAI/IJCAI 2003 keynote]
The ESP Game

Taboo Words

HAT
SUNGLASSES

Your Guesses

MAN
PERSON
GUY

Type your next guess: 

[Additional text from the slide:]

[Luis von Ahn, IAAI/IJCAI 2003 keynote]
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.

• have a rough idea of the state-of-the-art of AI
• be able to talk AI at cocktail parties
• appreciate the ideas of CAPTCHA and ESP games

And we will learn these…