15-780 – Graduate AI:
Lecture 1: Introduction and Logistics

J. Zico Kolter (this lecture), Nihar Shah
Carnegie Mellon University
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Outline

What is Artificial Intelligence?

A brief history of AI

Course logistics

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What is “AI”?

Some classic definitions

Building computers that

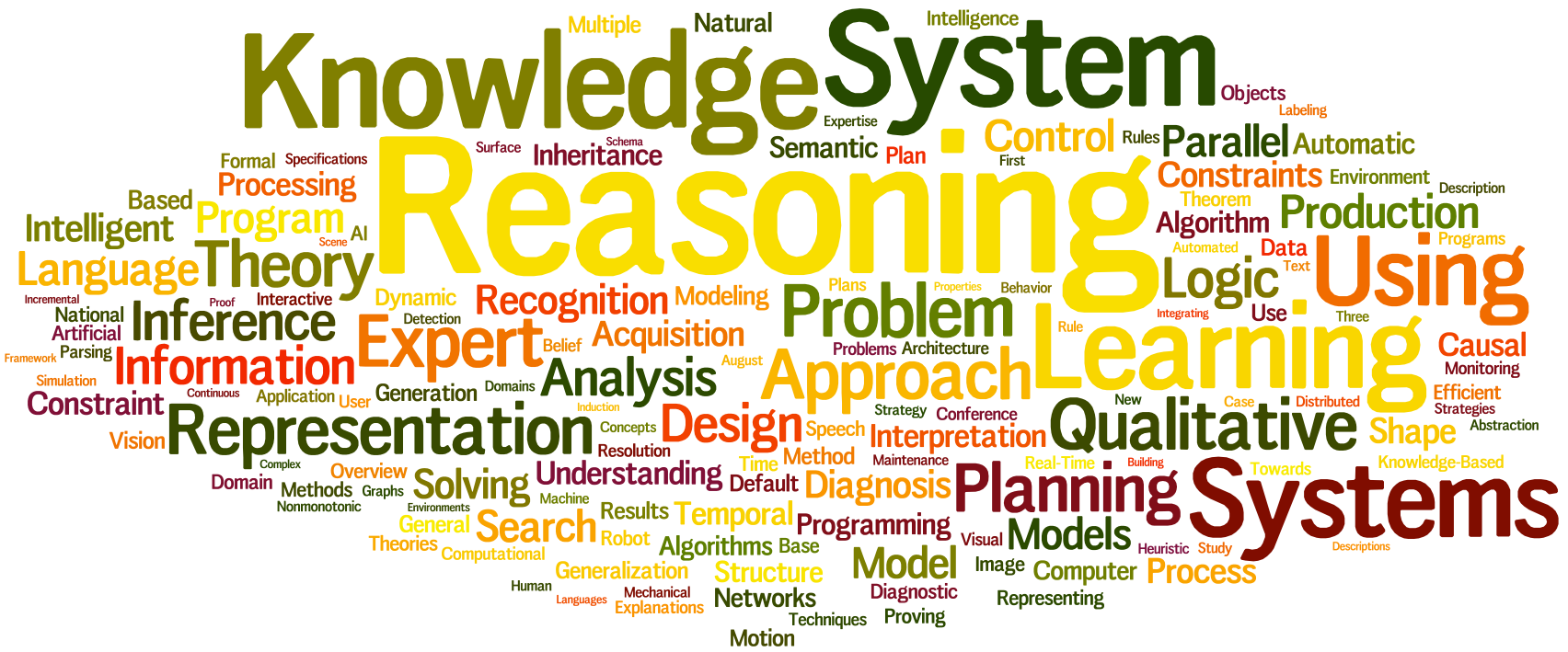
Think like a human	**Think rationally**
- Cognitive science / neuroscience - Can't there be intelligence without humans?	- Logic and automated reasoning - But, not all problems can be solved just be reasoning
Act like a human	**Act rationally**
- Turing test - ELIZA, Loebner prize - "What is 1228 x 5873?" … "I don't know, I'm just a human"	- Basis for intelligence agents framework - Unclear if this captures the current scope of AI research

The pragmatist's view

"AI is that which appears in academic conferences on AI"

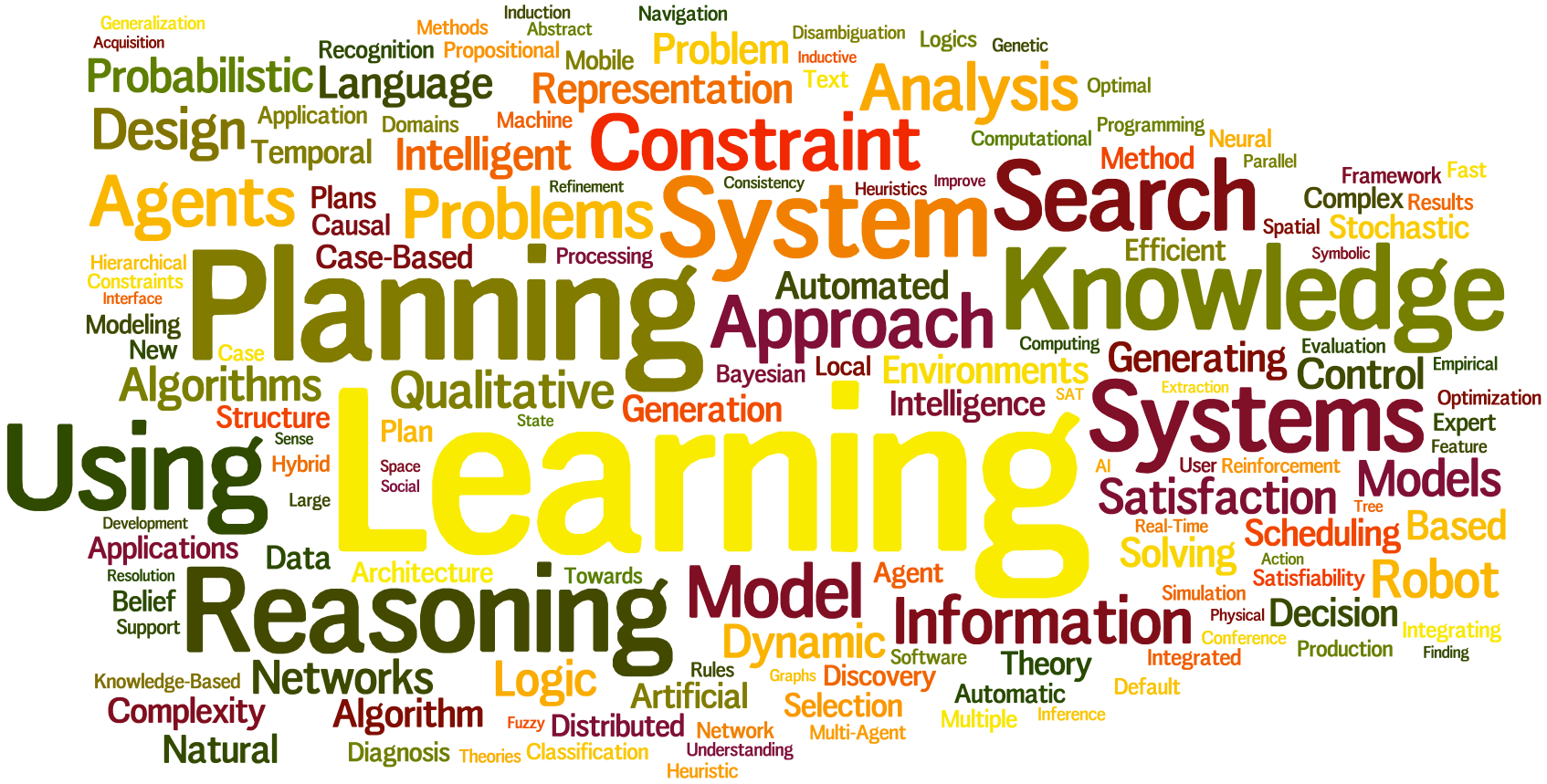
(Let's not discuss the possibility of "AI is that which marketing departments call AI")

Paper titles in AAAI



1980s

Paper titles in AAAI



1990s

Paper titles in AAAI

2000s

Paper titles in AAAI

2010s

A broader definition

We won't worry too much about definitions, but I personally like this one:

Artificial intelligence is the development and study of computer systems to address problems typically associated with some form of intelligence

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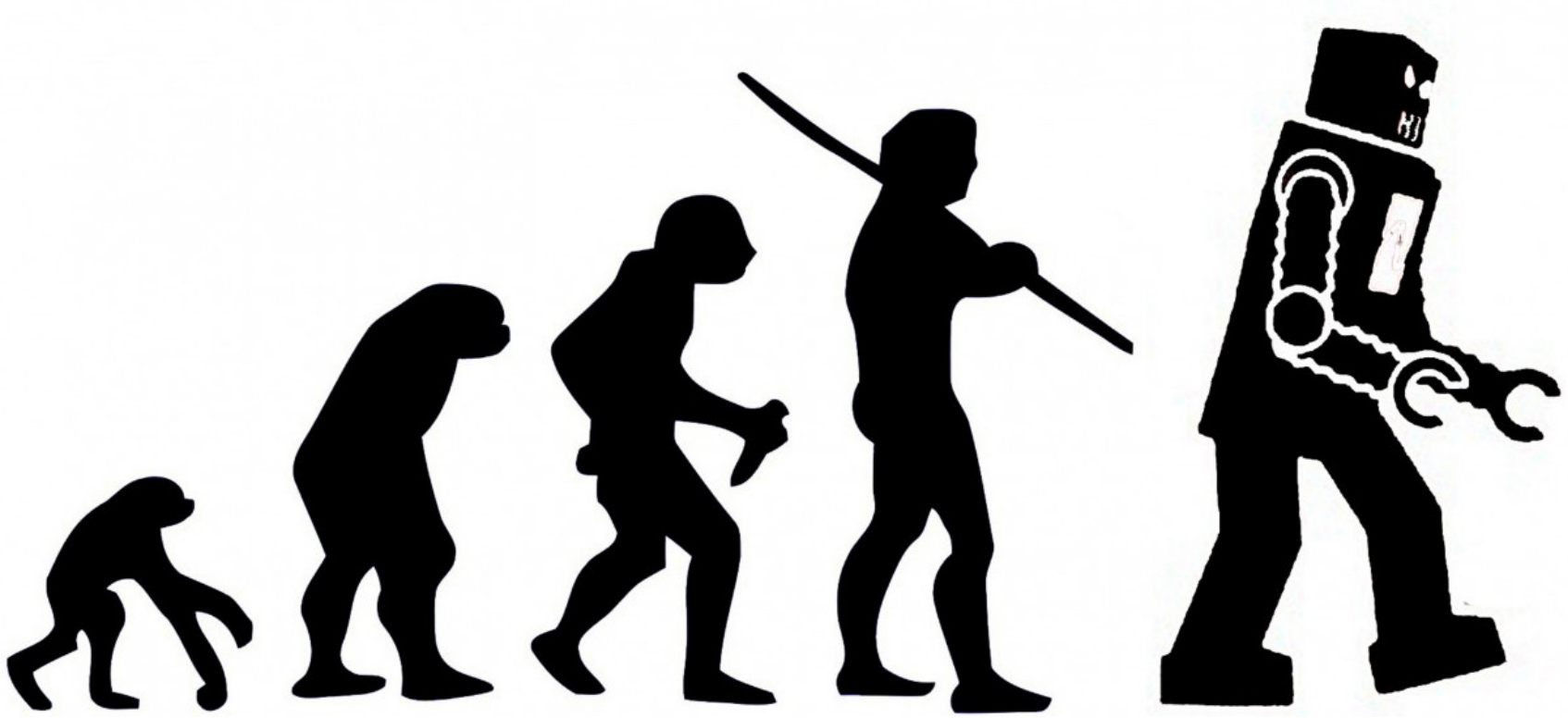
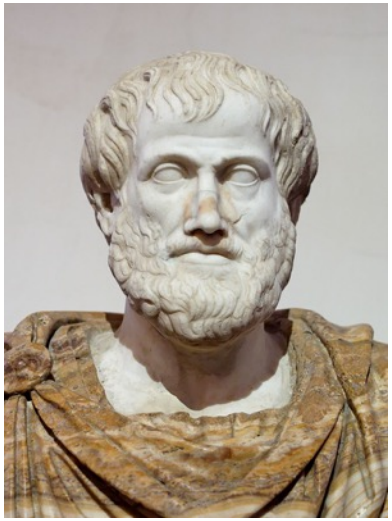
(Some) history of AI



Prehistory (400 B.C –)



Philosophy: mind/body dualism, materialism

Mathematics: logic, probability, decision theory, game theory

Cognitive psychology

Computer engineering

Birth of AI (1943 – 1956)

1943 – McCulloch and Pitts: simple neural networks

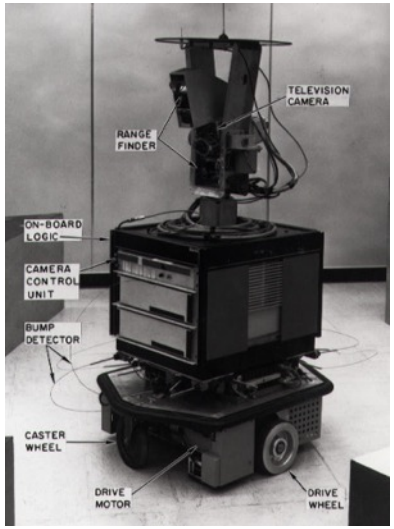
1950 – Turing test

1955-56 – Newell and Simon: Logic Theorist

1956 – Dartmouth workshop, organized by John McCarthy, Marvin Minsky, Nathaniel Rochester, Claude Shannon

"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. … We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer."

Early successes (1950s – 1960s)



1952 – Arthur Samuel develops checkers program, learns via self-play

1958 – McCarthy LISP, advice taker, time sharing

1958 – Rosenblatt's Perceptron algorithm learns to recognize letters

1968-72 – Shakey the robot

1971-74 – Blocksworld planning and reasoning domain

First "AI Winter" (Later 1970s)

Many early promises of AI fall short

1969 – Minky and Pappert's "Perceptrons" books shows that single-layer neural network cannto represent XOR function

1973 – Lighthill report effectively ends AI funding in U.K.

1970s – DARPA cuts funding for several AI projects

Expert systems and business (1970s – 1980s)

Move towards encoding domain expert knowledge as logical rules

1971-74 – Feigenbaum's DENRAL (molecular structure prediction) and MYCIN (medical diagnoses)

1981 – Japan's "fifth generation" computer project, intelligence computers running Prolog

1982 – R1, expert system for configuring computer orders, deployed at DEC

Second “AI Winter” (Late 1980s – Early 1990s)

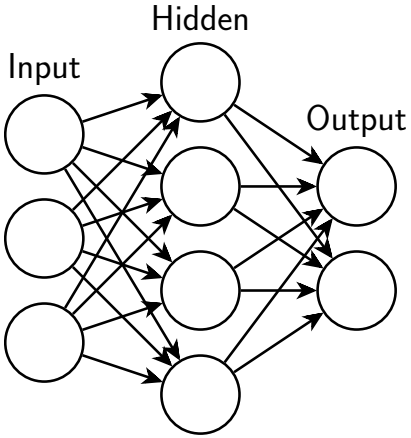
As with past AI methods, expert systems fail to deliver on promises

Complexity of expert systems made them difficult to develop/maintain

1987 – DARPA cuts AI funding for expert systems

1991 – Japan’s 5th generation project fails to meet goals

Splintering of AI (1980s – 2000s)



Much of AI focus shifts to subfields: machine learning, multiagent systems, computer vision, natural language processing, robotics, etc

1982 – Backpropagation for training neural networks popularized by Rumelhart, Hopfield, Hinton (amongst many others)

1988 – Judea Pearl's work on Bayesian networks

1995 – NavLab5 automobile drives across country steering itself 98% of the time

Focus on applications (1990s – Early 2010s)

Meanwhile, AI (sometimes under a subfield), achieves some notable milestones

1997 – Deep Blue beats Gary Kasparov

2005, 2007 – Stanford and CMU respectively win DARPA grand challenge in autonomous driving

2000s – Ad placement and prediction for internet companies becomes largely AI-based

2011 – IBM's Watson defeats human Jeopardy opponents

“AI” Renaissance (2010s – ??)

“AI” is a buzzword again; Google, Facebook, Apple, Amazon, Microsoft, etc, all have large “AI labs”

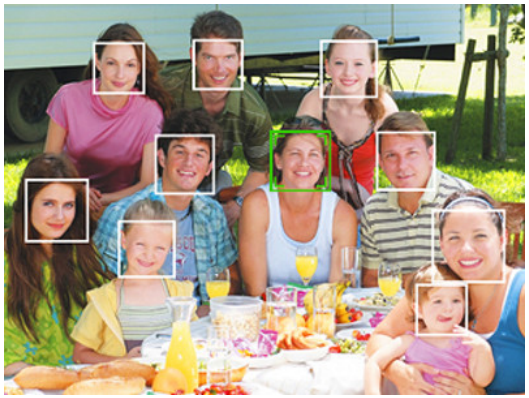
2012 – Deep neural network wins image classification contest

2013 – Superhuman performance on most Atari games via a single RL algorithm

2016 – DeepMind’s AlphaGo beats one of the top human Go players

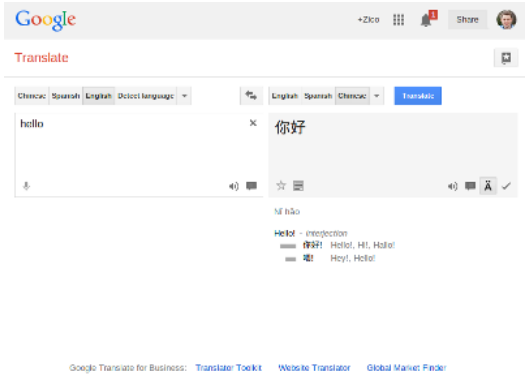
2017 – CMU’s Libratus defeats top pro players at No-limit Texas Hold’em

AI is all around us



Face detection

Personal assistants



Machine translation

Logistics planning

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Organization of course

AI at CMU is covered in two courses (plus *many* subtopic courses):

15-381: Undergrad AI, broad introduction to a wide range of topics

15-780: Grad AI, more focused on a few topics, leaving out others

The goal of this course is to introduce you to some of the topics and techniques that are at the forefront of modern AI research:

Search and continuous optimization

Integer programming

Machine learning and deep learning

Probabilistic modeling

Game theory

Social choice

Course materials

Main resource for lectures, slides, etc, is the class website (updated):

http://www.cs.cmu.edu/~15780

Virtual interaction with the course staff will happen via Piazza (may transition to Diderot during the semester):

http://www.piazza.com

Homeworks will be submitted and evaluated using Diderot (setup instructions to follow with first homework):

https://www.diderot.one

Grading

Grading breakdown for the course:

- 40% homeworks (10% each)
- 30% project
- 20% exams (10% each, midterm and final)
- 10% class participation

Final grades will be assigned on a curve (for which we don't know the thresholds), but they are guaranteed to be *lower* than the standard A = 90-100, B=80-90, etc

Homeworks

There will be four homeworks throughout the course

Homeworks each contain ~2 theory/derivation questions and ~2 programming questions

All submission done via Diderot (including writeups of written portions), programming portions are auto-graded

http://www.diderot.one

5 late days to use throughout semester, max of 2 late days for each assignment

Class project

A chance to explore an applied, theoretical, or algorithm aspect of AI in more detail

To be done in groups of 2-3

Project will require a short proposal (300 words), and a final report (<=5 pages)

Poster session presenting projects **during final exam time**

Full details to be posted to class webpage

Midterm and final

In-class midterm to be held on **3/6** (last day before spring break), and in-class final exam on **5/1** (last day of class)

Midterm will cover topics in course up to and including the lecture right before the midterm

Final will cover topics after midterm

Midterm and final will be **closed book, closed notes** (mainly for space reasons)

Class participation

Your participation grade comes through your participation in in-class polls posted to Piazza during lecture

Homework for *today*: register for the class on Piazza, find the poll below, and fill out the answer

Poll: which letter is the best letter?

A.

B.

C.

D.

Instructors and TAs

Zico Kolter

Nihar Shah

Chun Kai Ling

Ivan Stelmakh

Junjue Wang

Recommended background

Students taking this course should have experience with: mathematical proofs, linear algebra, calculus, probability, Python programming

We aren't listing specific pre-req courses (because people get this experience from different sources), but these are ***required*** prerequisites

Please come see the instructors if you have questions about your background

Academic integrity

Homework policy:

- You may discuss homework problems with other students, but you need to specify all students you discuss with in your writeup
- Your writeup and code must be written *entirely* on your own, without reference to notes that you took during any group discussion

All code and written material that you submit must be entirely your own unless specifically cited (in quotes for text, or within a comment block for code) from third party sources

See the CMU policy on academic integrity for general information

https://www.cmu.edu/academic-integrity/

Student well-being

CMU and courses like this one are stressful environments

In our experience, most academic integrity violations are the product of these environments and decisions made out of desperation

Please don't let it get to this point (or potentially much worse)

Don't sacrifice quality of life for this course: still make time to sleep, eat well, exercise

Some parting thoughts

"Computers in the future may have only 1,000 vacuum tubes and weigh only 1.5 tons."
– Popular Mechanics, 1949

"Machines will be capable, within twenty years, of doing any work a man can do."
– Herbert Simon, 1965