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Jasmine Deng

CS 188: Artificial Intelligence

Introduction

Pieter Abbeel & Dan Klein

University of California, Berkeley

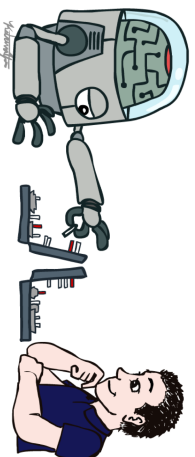
Course Information

- Prerequisites:
  - (CS 61A or CS 61B) and (CS 70 or Math 55)
  - Recommended: CS 61A and CS 61B and CS 70
  - There will be a lot of math (and programming)

- Work and Grading:
  - 5 programming projects: Python, groups of 1 or 2
    - 5 late days for semester, maximum 2 per project
  - 11 homework assignments:
    - Electronic component: Online, interactive, solve alone/together, submit alone
    - Written component: On paper, solve alone/together, submit alone, self-asses
  - Two midterms, One final
  - Fixed scale
  - Participation can help on margins
  - Academic integrity policy

- Contests!

Course Information

CS 188 | Fall 2018

| Syllabus | Staff | Schedule | Policies | Projects |

CS 188 | Introduction to Artificial Intelligence

Fall 2018

Lecture Tu/Th 2:00-3:30 pm, Wheeler 150

Description

This course will introduce the basic ideas and techniques underlying the design of intelligent computer systems. A specific emphasis will be on the statistical and decision-theoretic modeling paradigm.

By the end of this course, you will have built autonomous agents that efficiently make decisions in fully informed, partially observable and adversarial settings. Your agents will draw inferences in uncertain environments and optimize actions for arbitrary reward structures. Your machine learning algorithms will classify handwritten digits and photographs. The techniques you learn in this course apply to a wide variety of artificial intelligence problems and will serve as the foundation for further study in any application area you choose to pursue.

See the syllabus for slides, deadlines, and the lecture schedule.

- Communication:
  - Announcements on Piazza
  - Questions? Discussion on Piazza
  - Staff email: cs188@berkeley.edu

- Course technology:
  - Website
  - Piazza
  - Gradescope
  - This course is webcast (= Fa18 videos)
    + edited videos from past semester

Discussion Section (Optional Attendance)

- Topic: review / warm-up exercises
- Currently, none of you are assigned to sections
- You are welcome to attend any section of your preference
- Piazza survey later this week to help keep sections balanced
- From past semesters' experience we know sections will be (over)crowded the first two weeks of section, but then onwards section attendance will be lower and things will sort themselves out
- There will be a webcast of section
- There is no section in the current week (8/20-8/24).

Laptops in Lecture

- **Laptops can easily distract students behind you**
  Please consider sitting towards the back if using your laptop in lecture

Exam Dates

- Midterm 1: October 9th, 7:30-9:30pm
- Midterm 2: November 15th, 7:30-9:30pm
- Final Exam: December 11th, 8-11am
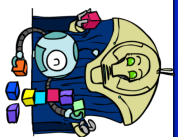- There will be no alternate exams

Textbook

- Not required, but for students who want to read more we recommend
  - Russell & Norvig, AI: A Modern Approach, 3rd Ed.

- *Warning: Not a course textbook, so our presentation does not necessarily follow the presentation in the book.*

Instruction vs. Assessment

Instruction
Grow knowledge, collaborate, work until success

Assessment
Measure knowledge, each student on their own, stopped before success
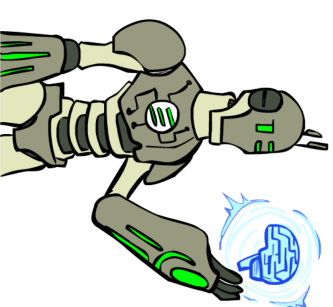
Our experience: these two goals don't mix

- Lecture / Section / OH / Piazza / Homework / Projects are instruction
  - collaborative, work until success (but please no spoilers)
- Exams are assessment
  - on your own

Today

- What is artificial intelligence?

- What can AI do?

- What is this course?

Announcements This Week

- Important this week:

- **Check out website:** https://inst.eecs.berkeley.edu/~cs188/fa18

- **Register** on **Gradescope and Piazza** (check your email for links)

- **HW0: Math self-diagnostic** is online now (due on Monday 8/27 at 11:59pm)

- **P0: Python tutorial** is online now (due on Monday 8/27 at 11:59pm)

- **One-time (optional) P0 lab hours** (Friday 3–6pm, 330 Soda Hall)

- **Inst accounts:** not needed, but if you want one, check instructions on Piazza

- Also important:

- **Sections** will be loosely assigned via Piazza poll (check the cs188 Piazza page)

- **Sections** start next week. You may go to any section that has space.

- The **waitlist** might take a while to sort out. We don't control enrollment. Please see https://eecs.berkeley.edu/resources/undergrads/cs/degree-reqs/enrollment-policy for information regarding enrollment into CS classes, including email contact for staff if you have additional enrollment-related questions.
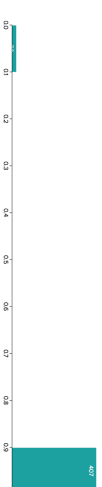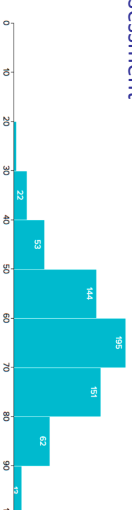

Some Historical Statistics

- Homework and projects: work alone/together, iterate/learn till you nailed it

- Exams: assessment

- New this year: written component to homework (= old exam questions)
- Suggestion: assess yourself by first spending some time working alone

News AI?

Artificial Intelligence

Stephen Hawking: "I fear AI may replace humans altogether"

Musk was speaking to US governors cnn.com ae

HEALTH AND SCIENCE
BIOTECH AND PHARMA | HEALTH INSURANCE | HOSPITALS | SCIENCE

A.I. can transform we know it. they should slow

Clardic Fug 112 113 84
Snowbonk 201 199 165
Catbabel 97 93 68
Bunflow 190 174 155
Ronching Blue 121 114 125
Bank Butt 221 196 199
Caring Tan 171 166 170

$24,000
$77,147

Sci-Fi AI?
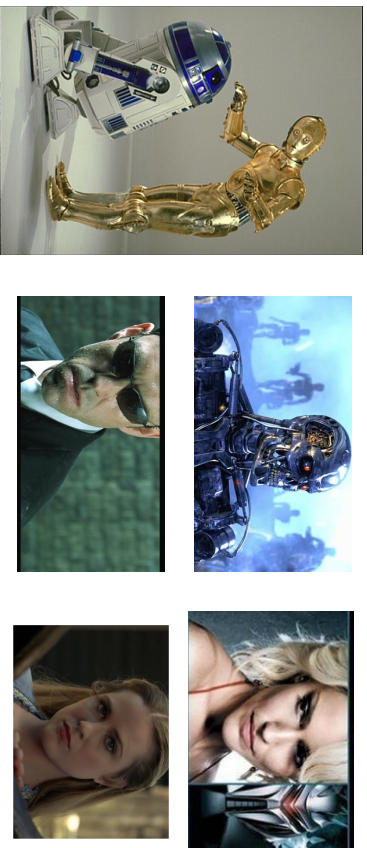

Rational Decisions

We'll use the term **rational** in a very specific, technical way:

- Rational: maximally achieving pre-defined goals
- Rationality only concerns what decisions are made
  (not the thought process behind them)
- Goals are expressed in terms of the **utility** of outcomes
- Being rational means **maximizing your expected utility**

A better title for this course would be:
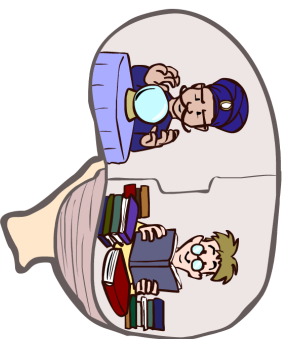
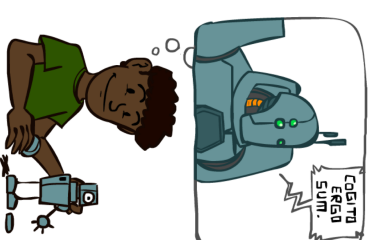**Computational Rationality**

What is AI?

The science of making machines that:

What About the Brain?

- Brains (human minds) are very good at making rational decisions, but not perfect

- Brains aren't as modular as software, so hard to reverse engineer!

- "Brains are to intelligence as wings are to flight"

- Lessons learned from the brain: memory (data) and simulation (computation) are key to decision making
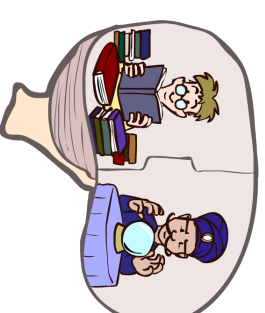

A (Short) History of AI

# Maximize Your Expected Utility
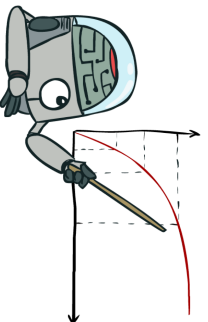

Course Topics

- Part I: Intelligence from Computation
  - Fast search / planning
  - Constraint satisfaction
  - Adversarial and uncertain search

- Part II: Intelligence from Data
  - Bayes' nets
  - Decision theory
  - Machine learning

- Throughout: Applications
  - Natural language, vision, robotics, games, …

A (Short) History of AI

- **1940-1950: Early days**
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's "Computing Machinery and Intelligence"
- **1950—70: Excitement: Look, Ma, no hands!**
  - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
  - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
  - 1965: Robinson's complete algorithm for logical reasoning
- **1970—90: Knowledge-based approaches**
  - 1969—79: Early development of knowledge-based systems
  - 1980—88: Expert systems industry booms
  - 1988—93: Expert systems industry busts: "AI Winter"
- **1990— 2012: Statistical approaches + subfield expertise**
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - Agents and learning systems... "AI Spring"?
- **2012—____: Excitement: Look, Ma, no hands again?**
  - Big data, big compute, neural networks
  - Some re-unification of sub-fields
  - AI used in many industries

"the thinking machine"
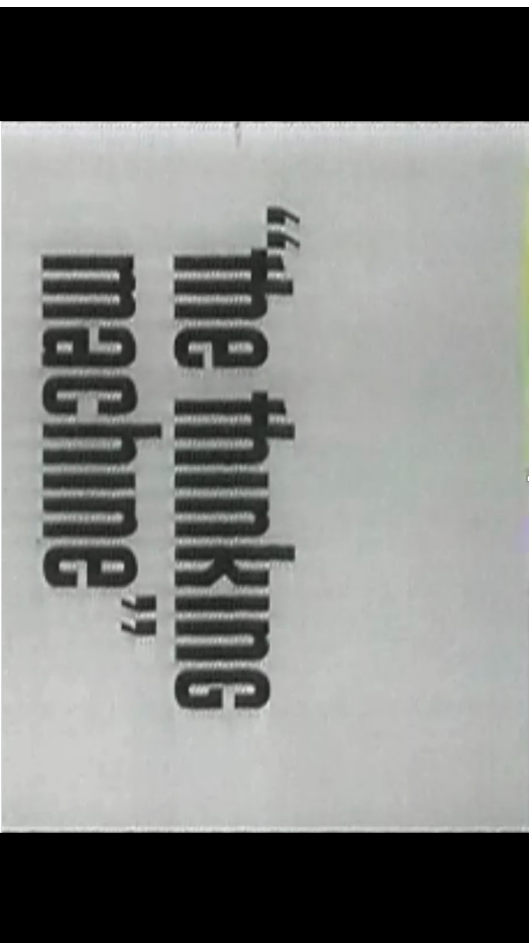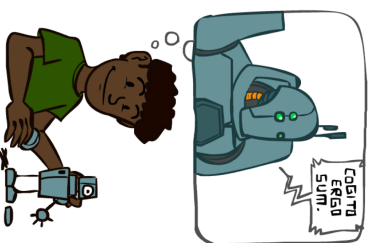
Unintentionally Funny Stories

Janelle Shane
@JanelleCShane

[Follow]

- Tried retraining the neural net on just "what do you get when you cross a X with a X?" jokes. Results did not improve. And for some reason, bungees are its favorite thing.

What do you get when you cross a dog and a vampire? A bungee

What do you get when you cross a gorilla and a bull? A spider

What do you get when you cross a cow with a rhino? A bungee with a dog.

What do you get when you cross a mountain and a bungee and a cow? A cow with a rhinocero.

What do you get when you cross a street and a bungee with a cow? A bungee and a pig with a cow.

What do you get when you cross a street and a cow? A bungee with a bungee and a mino.

What do you get when you cross a pig with a cow with a panty? Because the engineers with a dog.

What do you get when you cross a week and a rooster? I don't know that wouldn't deer.
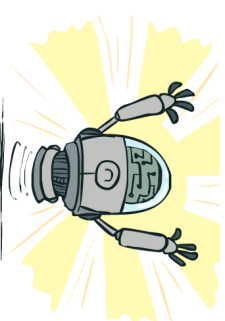

[Shank, Tale-Spin System, 1984]

What Can AI Do?

Quiz: Which of the following can be done at present?

- ✓✓ Play a decent game of table tennis?
- ✗ Play a decent game of Jeopardy?
- ✓✓ Drive safely along a curving mountain road?
- ✓ Drive safely along Telegraph Avenue?
- ✗ Buy a week's worth of groceries on the web?
- ✗ Buy a week's worth of groceries at Berkeley Bowl?
- ✓ Discover and prove a new mathematical theorem?
- ✗ Converse successfully with another person for an hour?
- ✗ Perform a surgical operation?
- ✓ Translate spoken Chinese into spoken English in real time?
- ✗ Fold the laundry and put away the dishes?
- Write an intentionally funny story?

Vision (Perception)

PIXELS -> INFO/DECISION

E.g.:

Face detection and recognition

Source: TechCrunch

Semantic Scene Segmentation

[Caesar et al, ECCV 2017]

3-D Understanding

[DensePose]

Natural Language

- Speech technologies (e.g. Siri)
  - Automatic speech recognition (ASR)
  - Text-to-speech synthesis (TTS)
  - Dialog systems

Natural Language

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  - Dialog systems
- Language processing technologies
  - Question answering
  - Machine translation

Natural Language

- Speech technologies
  - Automatic speech recognition (ASR)
  - Text-to-speech synthesis (TTS)
  - Dialog systems
- Language processing technologies
  - Question answering
  - Machine translation
  - Web search
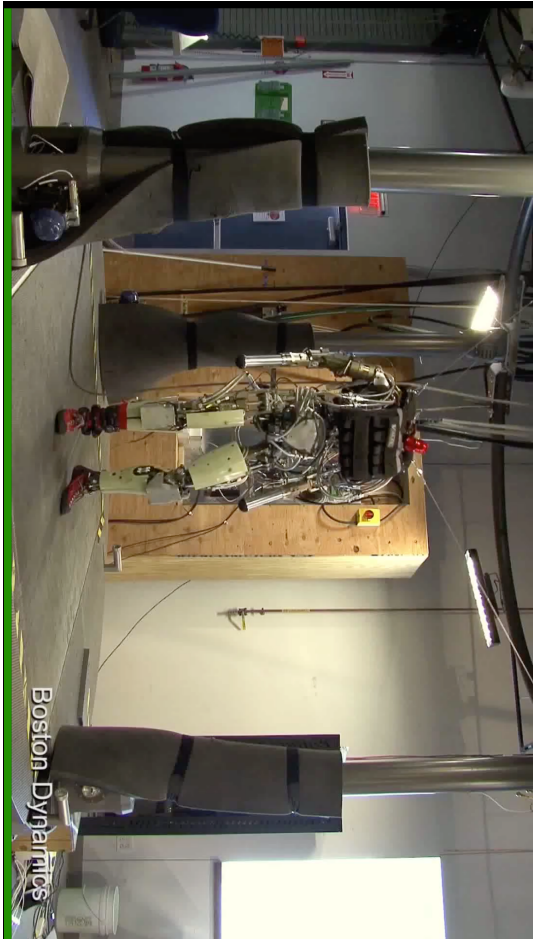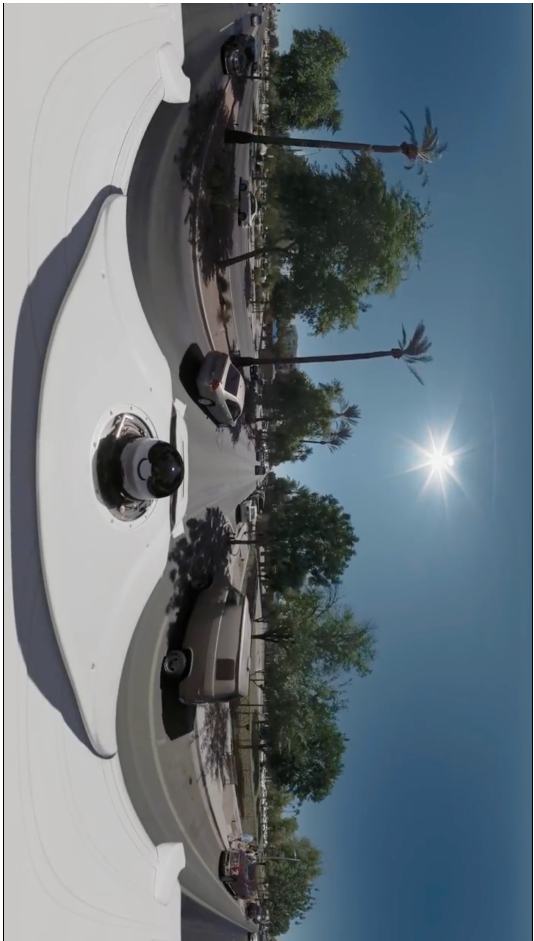 - Text classification, spam filtering, etc...

Robotics

- Robotics
  - Part mech. eng.
  - Part AI
  - Reality much harder than simulations!
- Technologies
  - Vehicles
  - Rescue
  - Soccer!
  - Lots of automation...
- In this class:
  - We ignore mechanical aspects
  - Methods for planning
  - Methods for control
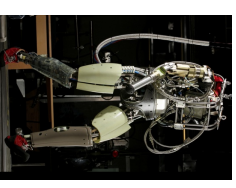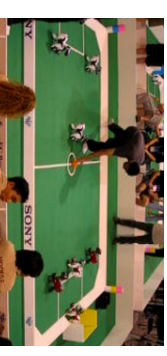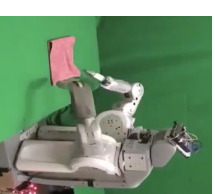
Images from UC Berkeley, RoboCup, Google/Waymo, Boston Dynamics

Logic

- Logical systems
  - Theorem provers
  - NASA fault diagnosis
  - Question answering

- Methods:
  - Deduction systems
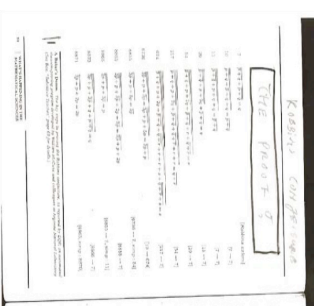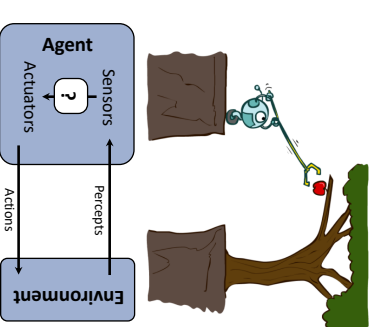 - Constraint satisfaction
  - Satisfiability solvers (huge advances!)

Image from Bart Selman

Game Playing

- Classic Moment: May, '97: Deep Blue vs. Kasparov
  - First match won against world champion
  - "intelligent creative" play
  - 200 million board positions per second
  - Humans understood 99.9 of Deep Blue's moves
  - Can do about the same now with commodity parts
  - 1996: Kasparov beats Deep Blue: "I could feel --- I could smell --- a new kind of intelligence across the table."
  - 1997: Deep Blue beats Kasparaov: "Deep Blue hasn't proven anything."

- Open question:
  - How does human cognition deal with the search space explosion of chess?
  - Or: how can humans compete with computers at all??

- 2016: AlphaGo beats Lee Sedol – huge advance: sparse rollouts and self-play

- Right now: OpenAI Five vs Team paiN (human pros) -- some caveats!
  - "[The AI play] was just something like completely different." Austin Walsh

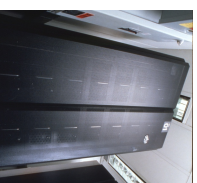Text from Bart Selman, image from IBM's Deep Blue pages

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Designing Rational Agents

- An **agent** is an entity that *perceives* and *acts*.

- A **rational agent** selects actions that maximize its (expected) **utility**.

- Characteristics of the **percepts, environment,** and **action space** dictate techniques for selecting rational actions

- **This course** is about:
  - General AI techniques for a variety of problem types
  - Learning to recognize when and how a new problem can be solved with an existing technique

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AI is starting to be everywhere…

- Applied AI automates all kinds of things
  - Search engines
  - Route planning, e.g. maps, traffic
  - Logistics, e.g. packages, inventory
  - Medical diagnosis
  - Automated help desks
  - Spam / fraud detection
  - Smarter devices, e.g. cameras
  - Product recommendations

  - … Lots more!

Pac-Man as an Agent

SCORE: 18

Agent

Sensors

?

Actuators

Percepts

Actions

Environment