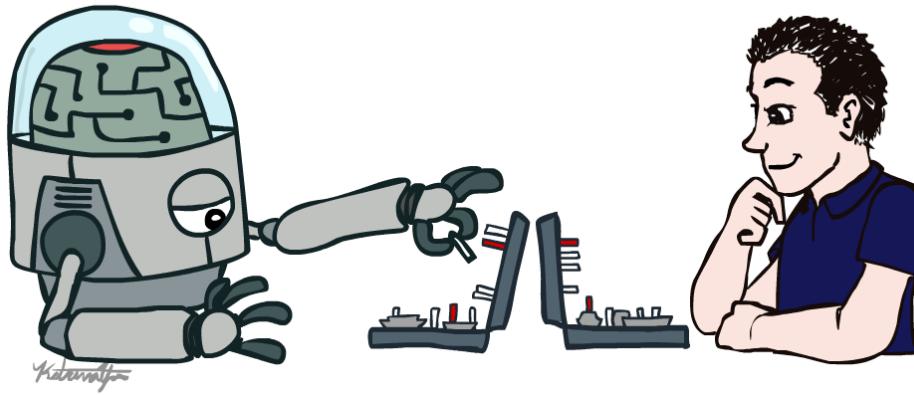


CS 188: Artificial Intelligence

Introduction

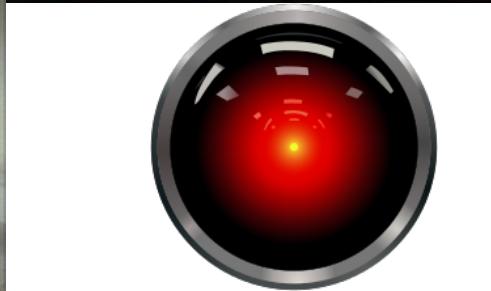
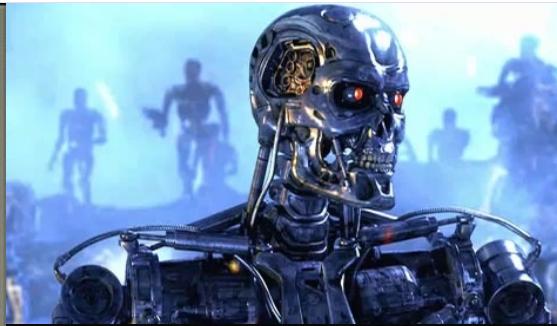


Instructors: Anca Dragan, Pieter Abbeel

University of California, Berkeley

(slides adapted from Dan Klein, Pieter Abbeel)

AI





TUG
CAUTION
MAY CONTAIN
CHEMOTHERAPY DRUG

CAUTION
MAY CONTAIN
CHEMOTHERAPY DRUG



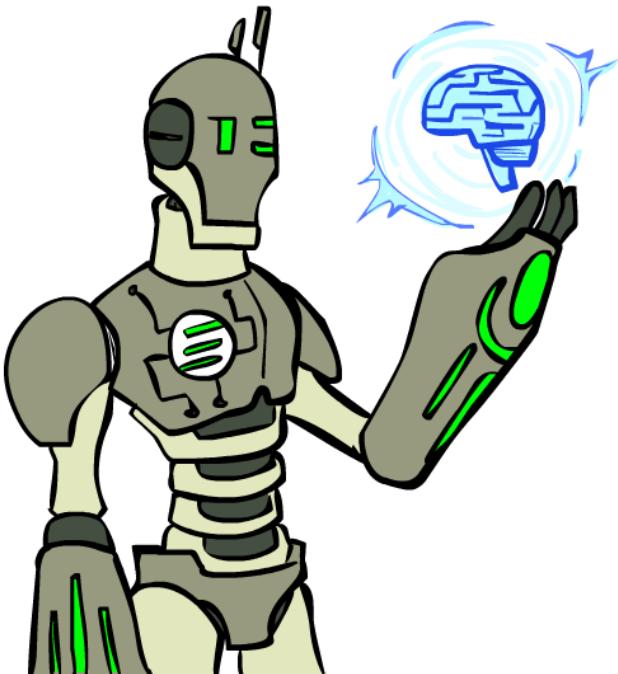


AI



Today

- What is artificial intelligence?
- Where did it come from / What can AI do?
 - What should we and shouldn't we worry about? What can we do about the things we should worry about?
- What is this course?



This lecture:

- What is it / what are the basics of how it works?
- What are things we should and should not worry about?
 - How might we fix the things we should worry about?

What is AI?

The science of making machines that:

Rational Decisions

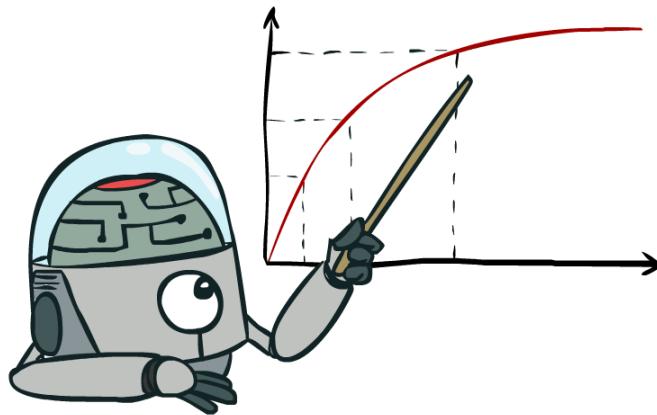
We'll use the term **rational** in a very specific, technical way:

- 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**

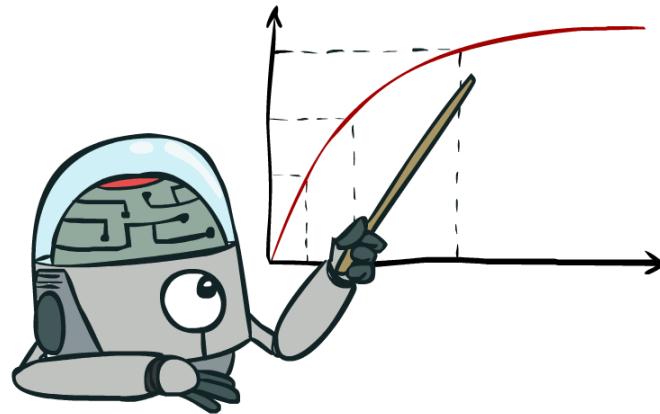
A better title for this course would be:

Computational Rationality

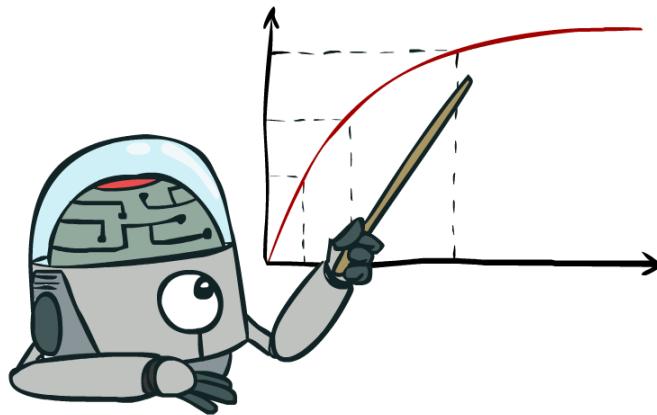
Maximize Your Expected Utility



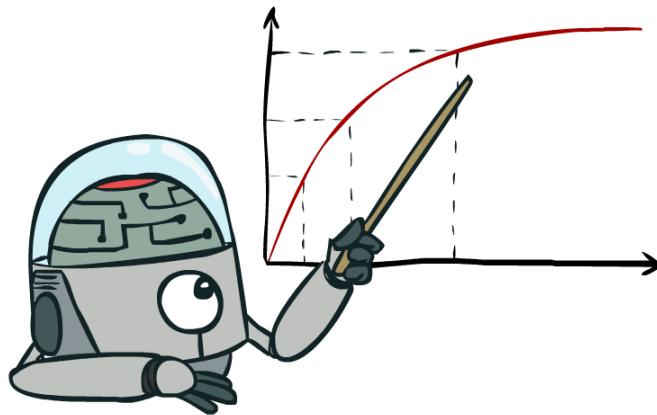
Maximize Your Expected Utility



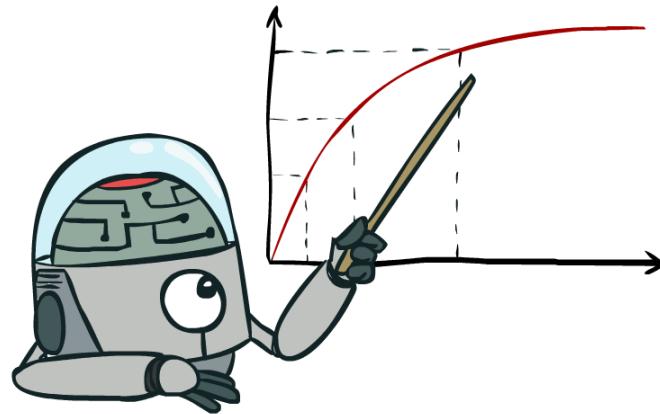
Maximize Your Expected Utility



Maximize Your Expected Utility

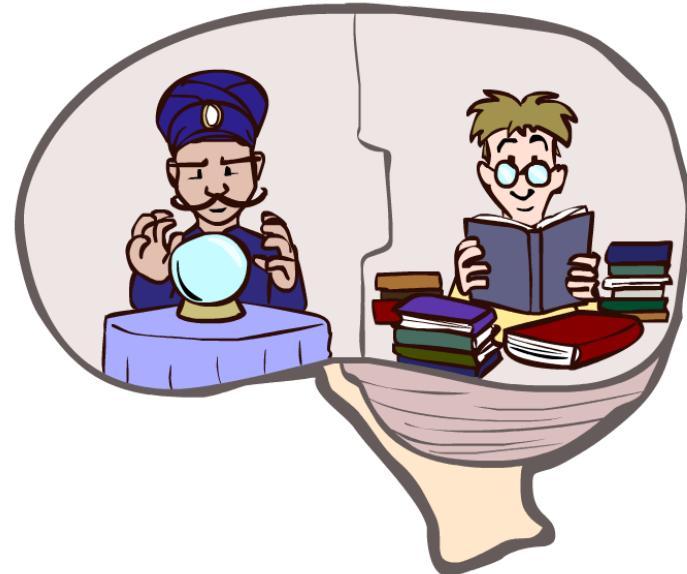


Maximize Your Expected Utility



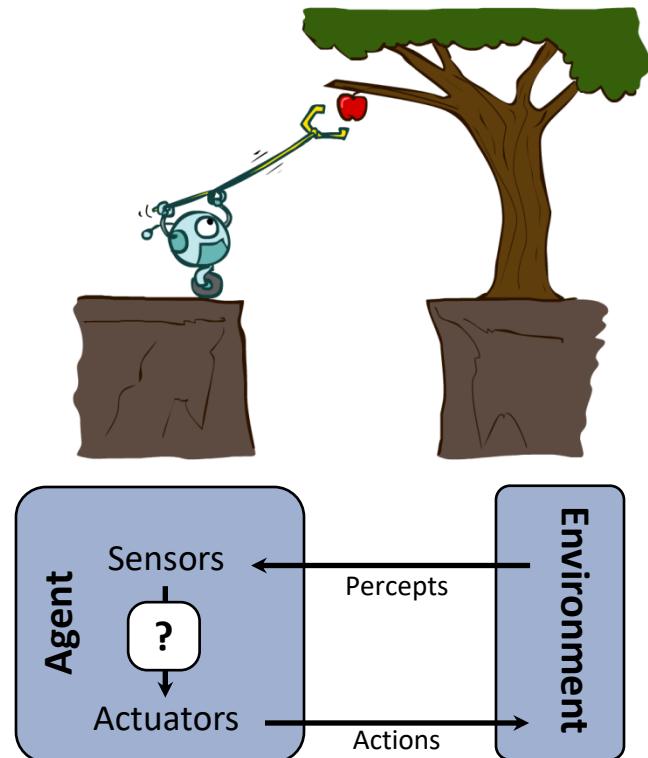
What About the Brain?

- 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 and simulation are key to decision making

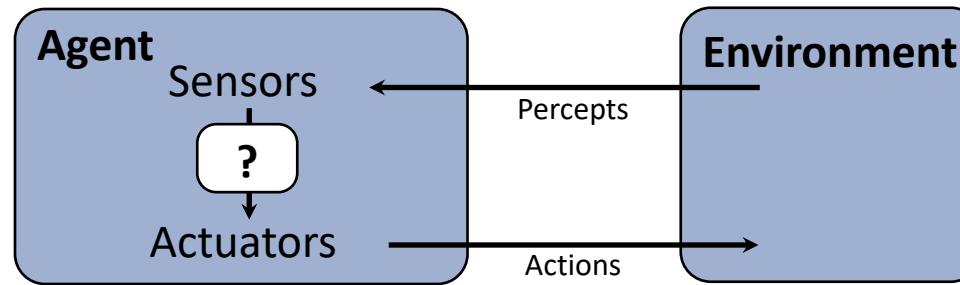
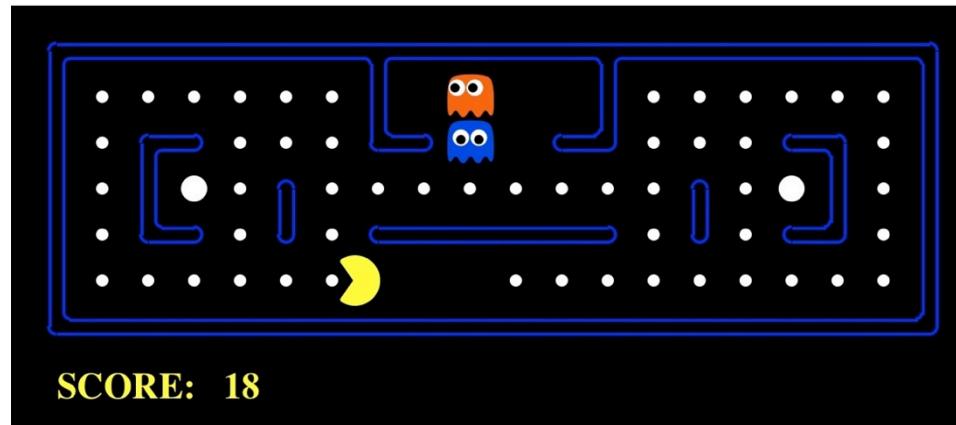


Designing Rational Agents

- 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



Pac-Man as an Agent





Logistics!

Instructors



Anca Dragan

Note: Please do not email logistics questions about enrollment, etc, to the professors. Please direct these questions to piazza or cs188@.

Office hours: TBD.

Email: anca@



Pieter Abbeel

Note: Please do not email logistics questions about enrollment, etc, to the professors. Please direct these questions to piazza or cs188@.

Office hours: TBD.

Email: pabbeel@



Ryan Koh

Head TA

Email: Admin cs188@, Personal ryan_koh@

Hi, I'm a CS student from SoCal, looking forward to meeting you all this semester! CS188 is a great class, where you not only learn about AI, but also develop a love-hate relationship with Pacman. Feel free to reach out about anything, and let's have a great semester! We stan robots <3 (Website: kaipinryankoh.github.io)



Alina Trinh

Email: tutrinh@

Hi y'all! I'm Alina and I'm a rising third-year studying EECS and business admin. My academic interests lie in NLP and autonomous vehicles. In my free time, I like to go hiking, play piano, read, and binge watch shows. Looking forward to a great semester!



Angela Liu

Email: aliu917@

Hey! I'm Angela and currently a fourth year studying CS. I've lived in the Bay Area my entire life and I love it here! When I'm not studying, I like to read, play golf, travel, and eat Asian desserts. I'm really excited to be teaching 188 again and hope you all have a great semester!



Ayush Kamat

Email: akamat@

Hi there! I'm a senior CS and Math major from the Los Angeles area. Outside of school I love to listen to and play music, and I also love to cook and make food! I'm super excited to teach y'all and I'm looking forward to a great semester!



Daniel Filan

Email: daniel_filan@

Hi! I'm Daniel, a 6th year PhD student in CS. After growing up in Australia, I moved to the US to work with Stuart Russell and the Center for Human-Compatible AI, and now I work on trying to understand neural networks by breaking them into pieces. My hobbies include playing go and going on walks. I look forward to helping you all learn about AI this semester!



Dimitris Papadimitriou

Email: dimitri@

Hi everyone, my name is Dimitri. I am a PhD student and this is my second time being a TA for CS188. In my free time I pretend to know how to swim and take nice photos. Feel free to contact me regarding the course or anything else. I hope we all have a great semester. Cheers.



Hamza Qadeer

Email: hamza.qadeer@

Hi! I'm a fourth-year CS/Stats major interested in ML and systems. In my free time, I like watching shows and exploring new neighborhoods/cities/places on foot (or, sometimes, on Google Maps). Looking forward to a fun semester :)



Jason Wang

Email: jasonw-sy@

Hi everyone! I'm a Junior student majoring in CS. This is my second semester TAing CS 188, and I'm very excited to get to know you all. I sometimes (RaReLY) play guitar and make music, and have a taste of making weird [projects](#). Looking forward to this amazing semester!



Jeffrey Tao

Email: jtao@

Hi, I'm Jeffrey! Feel free to talk to me if you're interested in RL research.



Jocelyn Chen

Email: jocelynchen1246@

Hello! I'm Jocelyn, a fourth year CS major from the Bay Area. In my free time, I like to dance, watch Netflix, and play video games (mostly genshin and league). Feel free to reach out to me to talk about anything. I'm looking forward to a great semester!



Jonathan Yang

Email: jy2370@

Hi everyone! I am a 4th year EECS undergrad who loves artificial intelligence. My research is in reusing large, past datasets in order to enable efficient generalization and lifelong learning in robotics. My hobbies include tinkering with drones, playing clarinet in a wind ensemble, and watching good tv shows/anime. I'm excited to get to know all of you!



Lexy Li

Email: lexyyxl@

Hey! I am a Senior studying Computer Science and Data Science. CS188 has been my favorite class at Cal; hope you enjoy it as well! Other than AI/ML, I'm also interested in font-end design/engineering. Outside of school, I like going out on photo shoots and exploring coffee shops. Looking forward to meeting you all :)



Regina Wang

Email: rhwang@

I'm a fourth year majoring in CS and minoring in Political Economy, and I absolutely love CS188 (taking it and teaching it). I'm also super excited to meet all of you this term! My current research interest is in human-robot interaction and in my free time, I love baking, playing tennis, and clicking around Wikipedia. Feel free to reach out to talk about anything!



Reina Wang

Email: reinawa1012@

Hi! I'm a junior studying EECS. In my spare time, I like exploring new restaurants, binge-watching singing competitions, and huddling up in a comfortable beanbag with a mug of hot cocoa and a good sci-fi novel.



Saagar Sanghavi

Email: ssanghavi404@

I like puzzles. All of life is just one giant puzzle to solve. Let's solve [some fun puzzles](#) together this semester :)



Srishti Agarwal

Email: srishti@

Hi everyone! I'm a senior majoring in EECS. This is my second time teaching CS188. Within EECS, I'm interested in Machine Learning and Robotics, and I'm currently working at a start up on enhancing an NLP report generation model. I'm also a foodie, love watching TV shows and movies, playing board games and dancing. Feel free to drop by my OH to drop movie recs/discuss anything ML or AI related! I'm super excited to get to know you all!



Yanlai Yang

Email: yyang22@

Hello! I'm a fourth-year CS and applied math major from Shanghai. My research is currently focused on robot learning. This is my fourth time being a TA for this course and I am really excited to meet everyone! Outside of work, I love to play card games (especially contract bridge) and watch Formula races.

Reader



Evgeny Pobachienko

Email: evgenyp@

Hi! I'm a sophomore majoring in CS. I really enjoyed CS 188, especially the fun projects, and I'm excited to help teach it. Besides CS, I like going on longish runs, hiking, and playing video games (Elden Ring hype). I look forward to meeting you (in person now :))!

-
- Extensions czar: Michael David Sasson



Website

- Website
 - tentative schedule
 - lecture slides and notes
 - course policies, etc.

<https://inst.eecs.berkeley.edu/~cs188/fa21>

Piazza

- Communication:
 - piazza – ask and answer questions; announcements
 - private matters – private messages
 - if your message is not answered promptly enough, here is the staff email:
cs188@berkeley.edu
 - Exceptional circumstances and DSP extensions: fill out the form <https://forms.gle/KqsWouKUhpvVKipXA> that goes to the course manager; email eeecs-course-management@eecs.berkeley.edu if you want to reach out to them directly with questions

Course Format

- Lectures TuTh
 - I'd love for you to show up and actively engage; participation credit
 - If you're comfortable, consider turning your camera on.
 - Raise your hand to ask question (preferred; chat also ok; use chat to ask each other questions)
 - Recorded, will upload to bdrive
 - Slides will be posted after lecture (preliminary slides before)
 - We'll have lecture notes too
 - There are also pre-pandemic webcasts available

Course Format

- Discussion Sections
 - schedule on piazza
 - Pick 1 to go to; show up to it consistently; participation credit
 - Some videos/walkthroughs will also be posted
 - Start 9/1
 - Some sections are “extended” to give more of a chance for recap

Course Format

- Exam prep sections
 - Exams are super hard. We try to prep you for them throughout.
 - Schedule on piazza
 - Some videos/ walkthroughs will be posted

Course Format (continued)

- Homework (autograded portion)
 - Due Tuesdays at 10:59pm (except for HW0) (grace period up to 11:59pm)
 - Exercises based on class material
 - Get you comfortable with the basics
 - Solve together, submit alone
 - Academic integrity!
 - Autograded, multiple submissions!
 - I expect you to get 100% on electronic homework
 - You get to drop 1. *No slip days* -- use drop instead.

Course Format (continued)

- Homework (challenge question)
 - To enable a deeper understanding, we will also include a challenge (exam-level) question
 - Need to show your work on paper or tablet
 - graded for correctness, but you will be able to regain up to 75% of the points by resubmitting after the deadline with a “reflection”
 - Solve together, submit alone
 - Academic integrity!

Course Format (continued)

- Projects

- Due Fridays at 10:59pm
 - Grace period to 11:59pm
- 5 projects, groups of 1-2
 - Academic integrity!
- Python
- Give you hands-on experience with the algorithms
- Also autograded
- I expect you to get 100% on projects
- 5 slip days, max 2 per project
 - After that, loose 20% per day turned in late

Course Format (continued)

- Contests
 - Submit your own agents to do cool creative things!!
 - Give you a chance to exercise going from a problem statement to devising your own solution based on algorithms you know
 - Give your agents cool names!
 - AlphaGhost
 - myTeam.py
 - extracredit plz try 2
 - Eh
 - Shotsandgoggles
 - Pieter <3 Anca 4 Life

Course Format (continued)

- Exams
- Thursday, Oct 14 7-9pm Midterm
- Thursday, Dec 16 11:30am-2:30pm Final Exam
- **Exams are the main assessment tool, so they are hard**
 - Exam practice sessions!
 - Written homework, exam style!

Course Format (continued)

- Office hours
 - Schedule is on piazza
 - GSI and uGSI: concepts, projects, homework
 - Anca / Pieter: concepts, high level guidance

Prerequisites

- 61A and 61B and 70
- math
 - There is a math self diagnostic test on gradescope – take it! (not graded)
- programming
 - There is a 0th project (P0) – mandatory

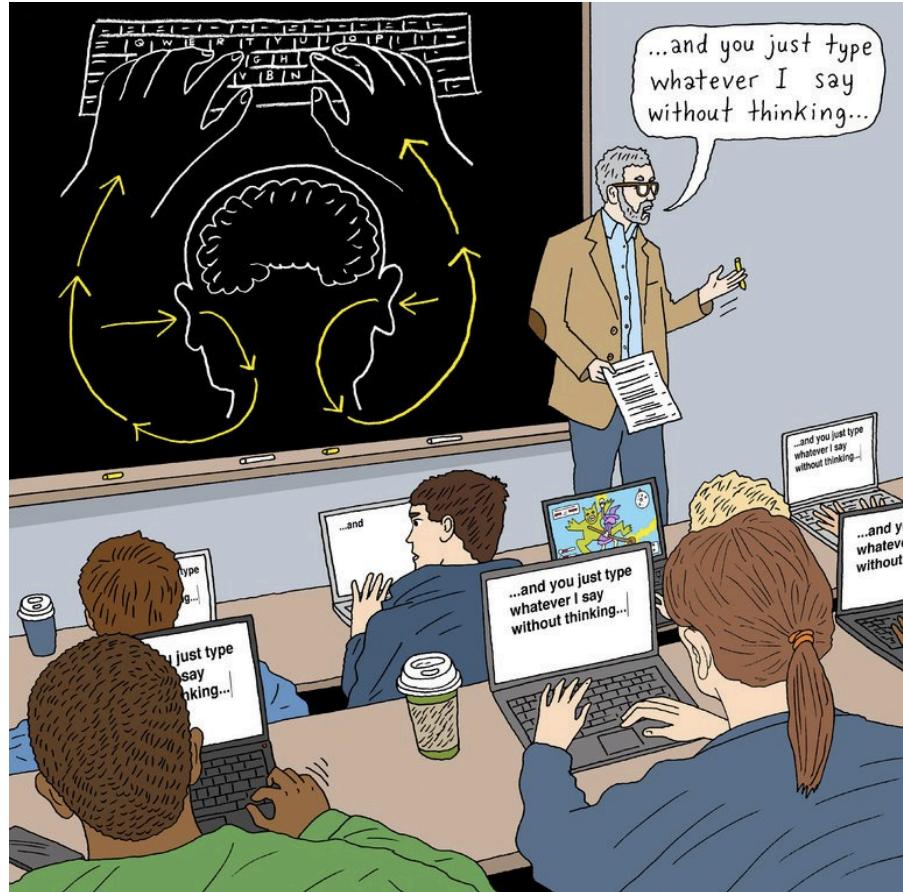
I used to say: Laptops in Lecture

The New York Times

*Laptops Are Great. But Not
During a Lecture or a Meeting.*

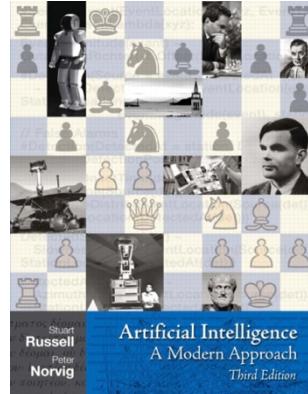
Economic View

By SUSAN DYNARSKI NOV. 22, 2017



Textbook

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



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

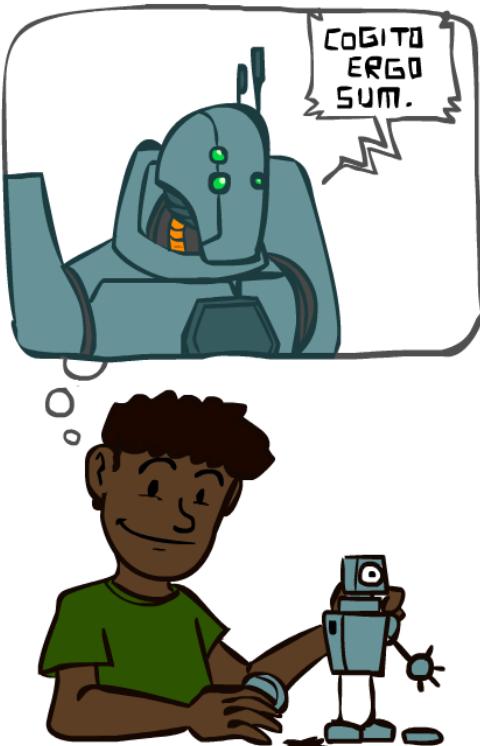
Build a great community

- Help out your peers on piazza and in meetings!
- Be mindful of the tone you use – be respectful and supportive, help everyone feel at home.
- Watch out for implicit bias.
 - Someone's gender, race, ethnicity, sexual orientation, etc. do NOT have anything to do with how awesome they will be in this class.
 - Having a ton of programming experience will help some with projects, but does NOT give anyone an edge on how well they can understand the material and how highly they can score on the exams.
- Please talk to me / Pieter if something we or the GSIs do makes you uncomfortable!

Important This Week

- Important this week:
 - **Register** for the class on gradescope
 - **Register** for the class on piazza --- our main resource for discussion and communication
 - **P0: Python tutorial** is out ; due Monday 8/30 at 10:59pm; project party Friday 3-5pm in Soda 411
 - **Math self-diagnostic** is out --- important to check your preparedness for second half
 - **Mark exam dates in your calendars**
- Also important:
 - **Sections** start next week (exam prep will cover regular session material the first week)
 - **If you are wait-listed**, you might or might not get in depending on how many students drop.
 - **Office Hours** start next week.

A (Short) History of AI

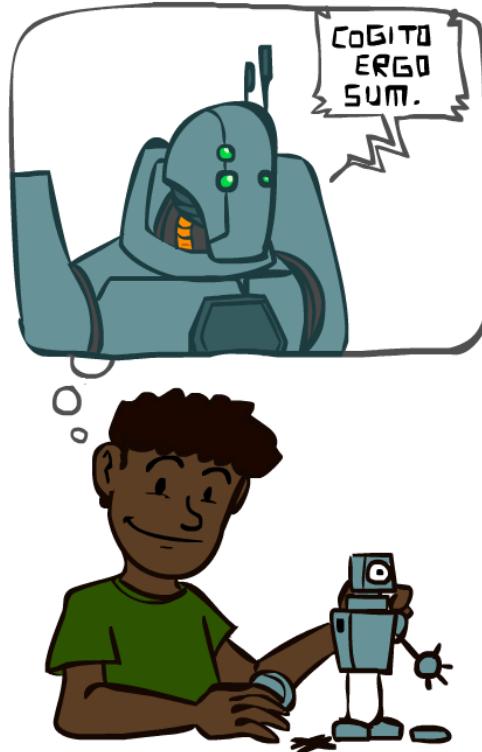


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A (Short) History of AI

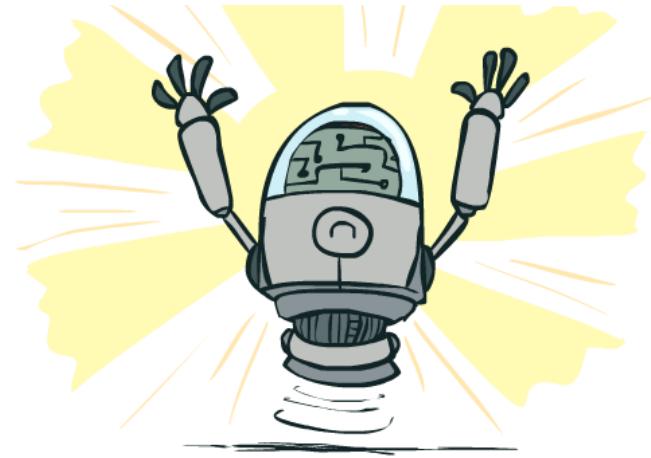
- 1940-1950: Early days
 - 1943: McCulloch & Pitts: Boolean circuit model of brain
 - 1950: Turing's "Computing Machinery and Intelligence"
- 1950—70: Excitement: Look, Ma, no hands!
 - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry 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—: Statistical approaches
 - Resurgence of probability, focus on uncertainty
 - General increase in technical depth
 - Agents and learning systems... "AI Spring"?
- 2000—: Where are we now?



What Can AI Do?

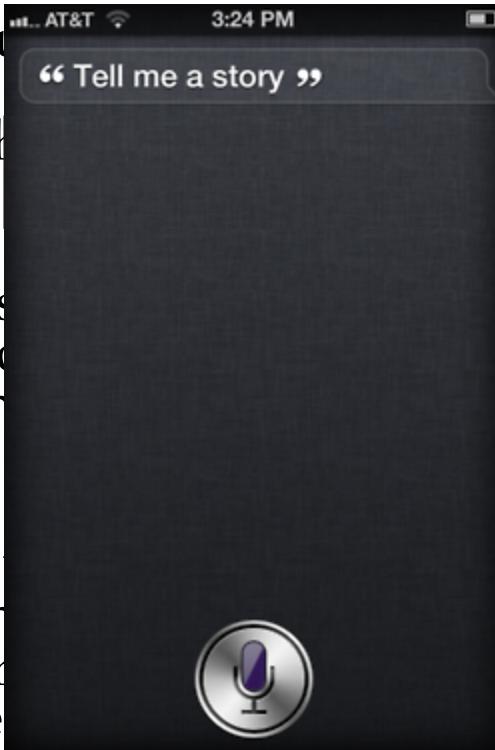
Quiz: Which of the following can be done at present?

- Play a decent game of Jeopardy?
- Win against any human at chess?
- Win against the best humans at Go?
- Play a decent game of tennis?
- Grab a particular cup and put it on a shelf?
- Unload any dishwasher in any home?
- Drive safely along the highway?
- 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?
- Perform a surgical operation?
- Unload a know dishwasher in collaboration with a person?
- Translate spoken Chinese into spoken English in real time?
- Write an intentionally funny story?



Unintentionally Funny Stories

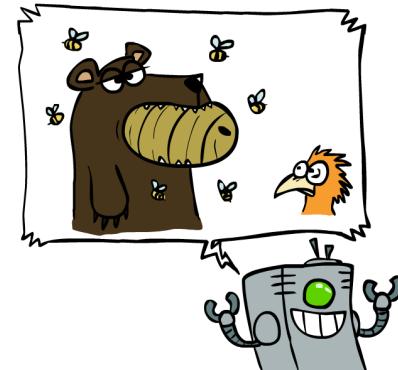
- One day Joe Bear was hit by Irving Bird where some bees were flying. Joe Bear said there was a beehive in the tree. He ate the honey from the tree.
- Henry Squirrel was thirsty. He was sitting on a river bank where his good friend Henry Squirrel slipped and fell into the water. Henry Squirrel drowned.
- Once upon a time there was a crow. The crow was sitting in a tree. He noticed that he was hungry. He swallowed the cheese.



friend
ld him
ed to

to the
s sitting.
gravity drowned.

and a vain crow. One day
the cheese in his mouth.
cheese. He became hungry,
ever to the crow. The End.





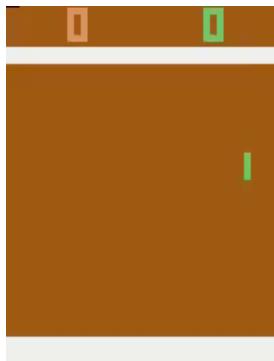
Game Agents

- 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 a PC cluster
- 1996: Kasparov Beats Deep Blue
"I could feel --- I could smell --- a new kind of intelligence across the table."
- 1997: Deep Blue Beats Kasparov
"Deep Blue hasn't proven anything."

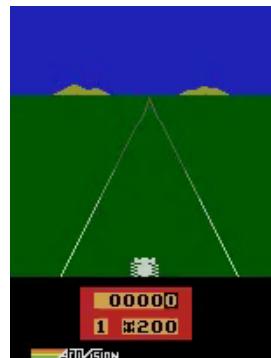


Game Agents

- Reinforcement learning



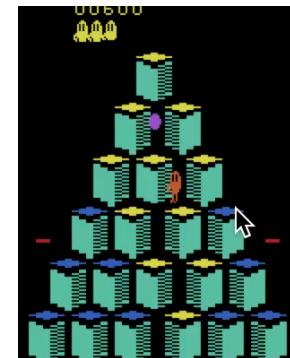
Pong



Enduro



Beamrider

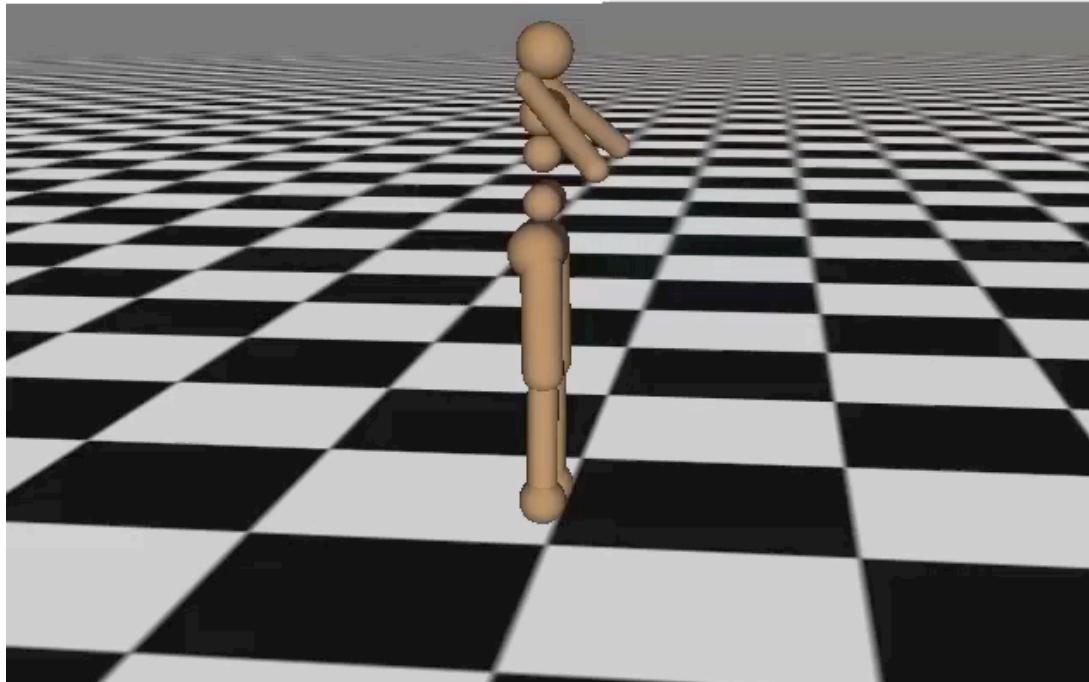


Q*bert



Simulated Agents

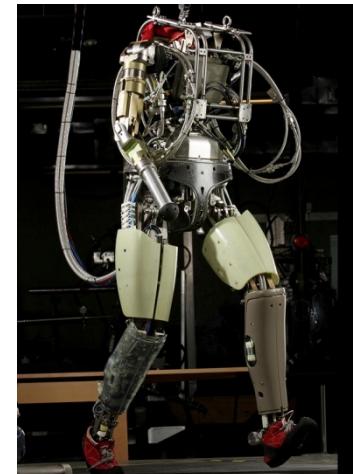
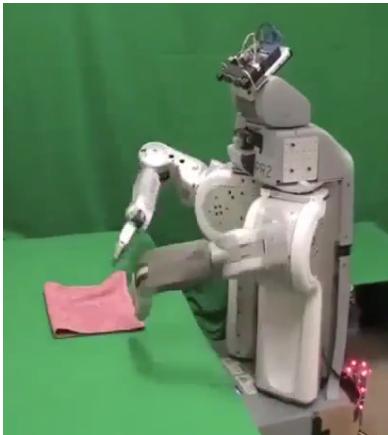
Iteration 0



Robotics

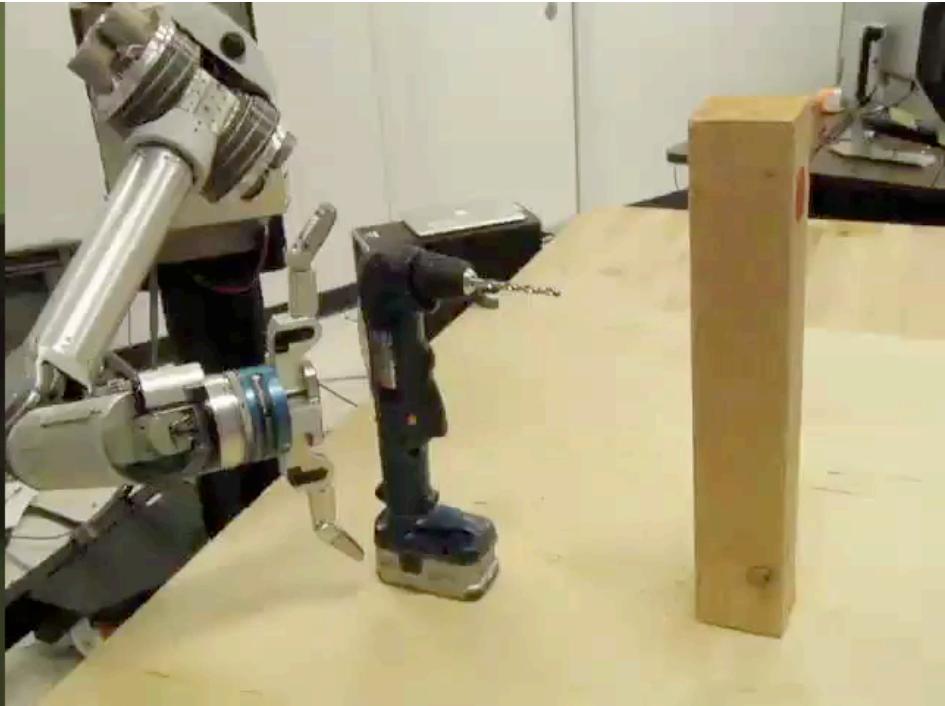
Demo 1: ROBOTICS – soccer.avi Demo 4: ROBOTICS – laundry.avi
Demo 2: ROBOTICS – soccer2.avi Demo 5: ROBOTICS – petman.avi
Demo 3: ROBOTICS – gcar.avi

- Robotics
 - Part mech. eng.
 - Part AI
 - Reality much harder than simulations!
- Technologies
 - Vehicles
 - Rescue
 - Help in the home
 - Lots of automation...
- In this class:
 - We ignore mechanical aspects
 - Methods for planning
 - Methods for control



Images from UC Berkeley, Boston Dynamics, RoboCup, Google

Robots



Robots

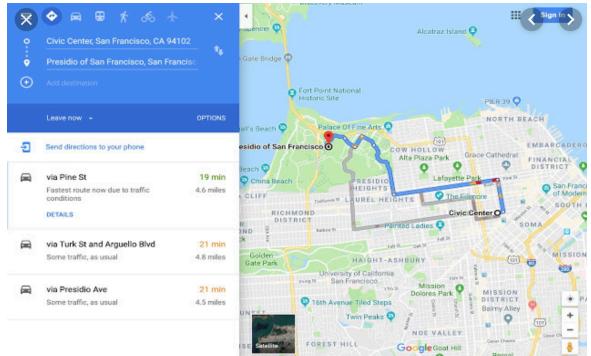


Human-AI Interaction



Personal Robotics Lab 412-758-4712

Tools for Predictions & Decisions



Natural Language

- Speech technologies (e.g. Siri)
 - Automatic speech recognition (ASR)
 - Text-to-speech synthesis (TTS)
 - Dialog systems
- Language processing technologies
 - Question answering
 - Machine translation

"Il est impossible aux journalistes de rentrer dans les régions tibétaines"

Bruno Philip, correspondant du "Monde" en Chine, estime que les journalistes de l'AFP qui ont été expulsés de la province tibétaine du Qinghai "n'étaient pas dans l'ilégalité".

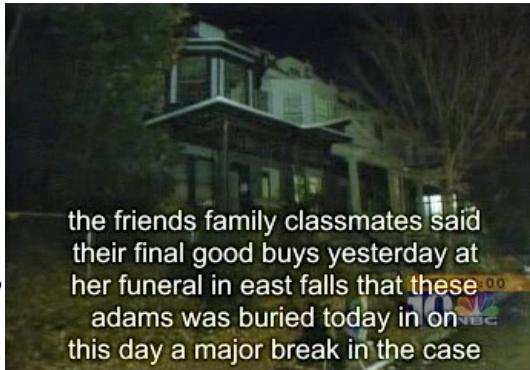
Les faits Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959
Vidéo Anniversaire de la rébellion



"It is impossible for journalists to enter Tibetan areas"

Philip Bruno, correspondent for "World" in China, said that journalists of the AFP who have been deported from the Tibetan province of Qinghai "were not illegal."

Facts The Dalai Lama denounces the "hell" imposed since he fled Tibet in 1959
Video Anniversary of the Tibetan rebellion: China on guard



- Web search
- Text classification, spam filtering, etc...

Computer Vision



"man in black shirt is playing guitar."



"construction worker in orange safety vest is working on road."



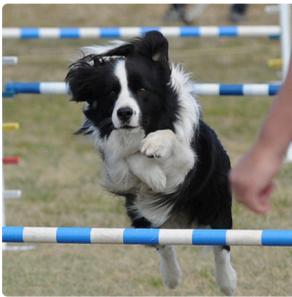
"two young girls are playing with lego toy."



"boy is doing backflip on wakeboard."



"girl in pink dress is jumping in air."



"black and white dog jumps over bar."



"young girl in pink shirt is swinging on swing."



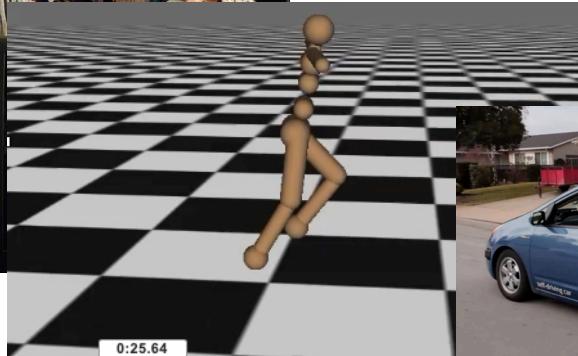
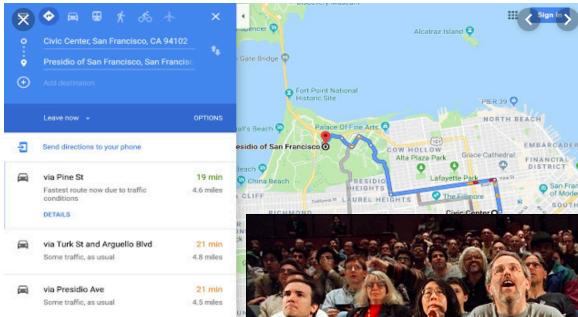
"man in blue wetsuit is surfing on wave."

Karpathy & Fei-Fei, 2015; Donahue et al., 2015; Xu et al, 2015; many more

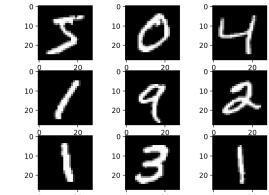
Topics

- Constraint satisfaction, e.g. scheduling
- Search, planning, reinforcement learning, e.g. routing, robot navigation
- Probabilistic inference, e.g. robot localization
- A bit of supervised machine learning, e.g. spam detection

The kinds of AI problems in 188



(*) need continuous time versions



(*)briefly in our ML topic

Should I take 188?

- Yes, if you want to know how to design rational agents!
 - 188 also teaches you a different way of thinking.
- Disclaimer: If you're interested in making yourself more competitive for AI jobs, 189 and 182 are actually much better fits.

Maximize Your Expected Utility

