

CSC 665: Artificial Intelligence

Introduction

Instructor: Pooyan Fazli

San Francisco State University

Course Information

- **Instructor:** Pooyan Fazli
 - Office Location: SCI 246A
 - Email: pooyan@sfsu.edu
- **Meeting Times:** Mon 4:00pm-6:45pm
- **Location:** TH 327
- **Office Hours:** Mon 7:00pm-8:00pm (Please email me in advance if you plan to meet)
or by appointment

Course Information

- TA: Aditya Bod
 - Email: abodi@mail.sfsu.edu



Course Information

- Course Website: <http://pooyan.perlab.info/courses/csc665-spring20/>
- iLearn: <https://ilearn.sfsu.edu/>
 - **Discussion boards** for each assignment and the course overall
 - PLEASE post questions on course material (don't be shy)
 - Answer others' questions - if you know the answer ;-)
 - Learn from others' questions and answers
 - Check it Often

Course Information

- Prerequisites:
 - There will be a lot of math and programming.
 - Prior computer programming experience is required. Additional background in data structures and algorithms, linear algebra, and probability will all be helpful.
 - You should be prepared to review basic probability on your own if it is not fresh in your head.

Course Information

- Programming Language: Course programming assignments will be in Python.
- Assignment 0 is designed to teach you the basics of Python (**Due: Feb 5, 1pm**)

Assignment 0

- Due on **Feb 5, 1pm**
- To be done **alone**
- Submission via iLearn (Check the submission instructions on the website)

- Python 3.6
- Autograder: We have provided a local autograder and a set of test cases for you to evaluate your code. The local autograder is a file called `autograder.py`.

Course Information: Evaluation

Assignments	40 %
Final	50 %
Participation in Discussions; Attendance	10 %

A	[90 - 100]%
A-	[85 - 90]%
B+	[80 - 85]%
B	[75 - 80]%
B-	[70 - 75]%
C+	[66 - 70]%
C	[63 - 66]%
C-	[60 - 63]%
D+	[56 - 60]%
D	[53 - 56]%
D-	[50 - 53]%
F	[0 - 50]%

Course Information: Assignments

- There will be programming and written assignments
- You will have a total of 5 late days for these assignments, *up to two of which can be used for each assignment.*
 - To allow you the flexibility to manage unexpected issues
 - Additional late days will not be granted except under truly exceptional circumstances
 - If you've used up all your late days, you lose 20% per day
(see details on the course website)

Course Information: Exams

- Final Exam: May 18, 2020, 5:00pm-7:00pm
- For the final exam, you will be allowed to bring one double-sided handwritten 8.5"x11" aid sheet. You can put anything you want on your aid sheet as long as it is handwritten.

Course Information: Email and iLearn Policies

- Please **use email for personal matters** only. For email, always include the course number. A good practice is to start your subject as "CSC 665: ...".
- For **general questions about the course material or assignments or exams, iLearn is the default place to ask questions.** Many of your fellow students may have the exact same question in mind and will appreciate it if they see the question asked (and already answered) on their next visit to the board. I strongly encourage students to participate in discussions, ask, and answer questions through this site.

Course Information: Feedback

- Please give feedback (positive or negative) as often as and as early as you can.

CSC 665: Anonymous Feedback

Name (Optional)

Email Address (Optional)

Any Feedback on CSC 665?

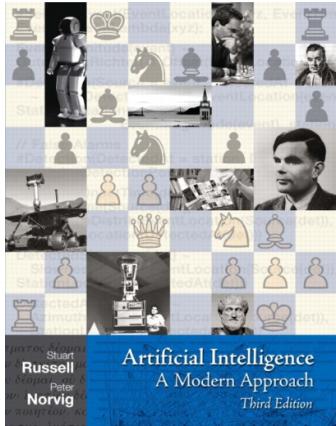
Submit

Never submit passwords through Google Forms.

<https://forms.gle/jeuK3BNmGW7vRaGW7>

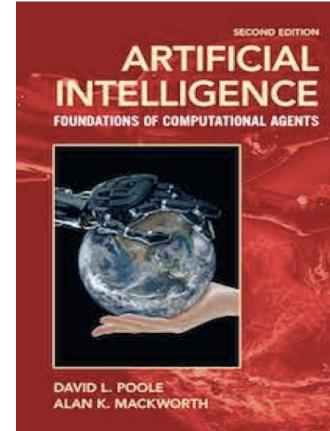
Textbooks

Russell & Norvig, Artificial Intelligence: A Modern Approach, 3rd Ed.



David Poole, Alan K. Mackworth. Artificial Intelligence: Foundations of Computational Agents 2nd Ed.

<http://artint.info/>



Academic Honesty

- Plagiarism is a serious offence and will be dealt with harshly. I consider plagiarism to be the unattributed use of an external source (e.g., another student, a web site, a book) in work for which a student takes credit, or the inappropriate use of an external source whether or not attribution is made. The seriousness of the offence depends on the extent to which the student relied upon the external source. All code and written responses must be your own. All work ideas, quotes, and code fragments that originate from elsewhere must be cited according to standard academic practice. **Students caught cheating will automatically fail the course.**

Acknowledgements

- Alan Mackworth
- David Poole
- Stuart Russell
- Dan Klein
- Pieter Abbeel

Today

- What is artificial intelligence?
- What can AI do?
- What is this course about?

AI in the Movies



AI in the News

TECH • ARTIFICIAL INTELLIGENCE

United Kingdom Plans \$1.3 Billion Artificial Intelligence Push

France to spend \$1.8 billion on AI to compete with U.S., China

European Union To Invest 20 Billion Euros in AI

Topics

China Is Quickly Becoming an AI Superpower

By Peter H. Diamandis, MD - Aug 29, 2018 21,877

AI in the News

A CONVERSATION WITH...

Toby Walsh, A.I. Expert, Is Racing to Stop the Killer Robots

Autonomous weapons, capable of acting without human oversight, are closer than we think, Dr. Walsh believes, and must be banned.



AI in the News



Deepfake Videos

What is AI?

The science of making machines that:

Think like people

Think rationally

Act like people

Act rationally

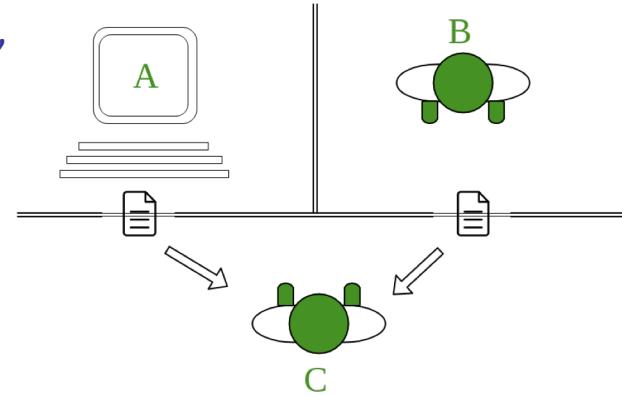
Thinking Like Humans

Model the cognitive functions and behaviors of humans

- Human beings are our best example of intelligence
- We should use that example!
- But ... how do we measure thought?
 - We would have to spend most of our effort on studying **how people's minds operate** (e.g. IQ tests cover very narrow range of ability)
 - Rather than thinking about what intelligence ought to mean in various domains

Acting Like Humans

- Turing test (1950) “Computing Machinery and Intelligence”
 - Can a human interrogator tell whether (written) responses to her (written) questions come from a human or a machine?
- No system has yet passed the test
 - Yearly competition: <http://www.loebner.net/Prizef/loebner-prize.html>
- Is acting like humans really what we want?
 - Humans often think/act in ways we don't consider intelligent



Thinking Rationally

- Is rational thought enough?
 - A system that only thinks and doesn't do anything is quite useless
 - Any means of communication would already be an **action**
 - And it is hard to measure thought in the first place ...

Acting Rationally

We will emphasize this view of AI

- It's easier to define rational action than rational thought

Rational Decisions

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

- Rational: maximally achieving pre-defined goals
- 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

AI's official birth: Dartmouth, 1956



“An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. *We think that a significant advance can be made if we work on it together for a summer.*”

John McCarthy and Claude Shannon
Dartmouth Workshop Proposal

Optimism Towards AI

- 1958, H. A. Simon and Allen Newell: "within ten years a digital computer will be the world's chess champion" and "within ten years a digital computer will discover and prove an important new mathematical theorem."
- 1965, H. A. Simon: "machines will be capable, within twenty years, of doing any work a man can do."
- 1967, Marvin Minsky: "Within a generation ... the problem of creating 'artificial intelligence' will substantially be solved."
- 1970, Marvin Minsky (in Life Magazine): "In from three to eight years we will have a machine with the general intelligence of an average human being."

A (Short) History of AI

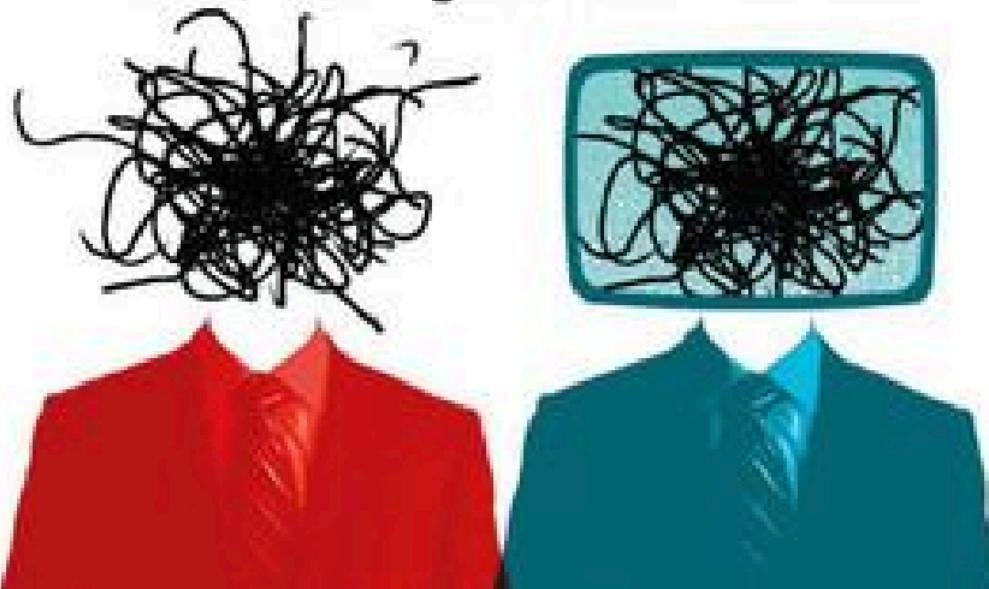
- **1940–1950: Early days**
 - 1943: McCulloch & Pitts: Boolean circuit model of brain
 - 1950: Turing's "Computing Machinery and Intelligence"
- **1950–70: Excitement: Look, Ma, no hands!**
 - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's 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**
 - Resurgence of probability, focus on uncertainty
 - General increase in technical depth
 - Agents and learning systems... "AI Spring"?
- **2012—: Where are we now?**

NewScientist

WEEKLY January 29 - February 4, 2011

THE INTELLIGENCE REVOLUTION

At last something else that thinks like us



Google buys two more UK artificial intelligence startups

Company funds new computer science research partnership with Oxford University, where three of its new artificial intelligence hires will remain lecturers

Samuel Gibbs

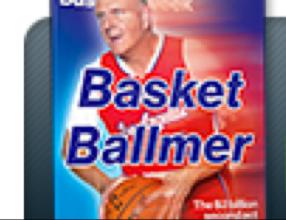
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Design

L

Inspire fresh ideas.
Question the status quo.
Shape your future.



Internet

Baidu Embraces Artificial Intelligence to Build a Better Search Engine

By Edmond Lococo and Brian Womack | October 16, 2014

Elon Musk, Silicon Valley Elite Launch 'Open' Artificial Intelligence With \$1 Billion



Eric Mack, CONTRIBUTOR

I cover science and innovation and products and policies they create. [FULL BIO](#) ▾

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Plus picture up to **\$60** when you roll over to a Merrill
And rollover support when!
MERRILL EDGE **FAC** **Lea**
Bank of America Corporation



(Photo credit: ERIC PIERMONT/AFP/Getty Images)

Elon Musk has been vocal about his anxiety over the future of artificial intelligence, and he's put his money where his mouth is in the past, but now he's going even bigger with the announcement of Open A.I., a non-profit artificial intelligence research company launching with \$1 billion in donation from Silicon Valley luminaries and Musk as co-chair.

"Our goal is to advance digital intelligence in the way that is most likely to benefit humanity as a whole, unconstrained by a need to generate financial return," reads the announcement on the [Open A.I. website](#), which is credited to Greg Brockman and Ilya Sutskever, who will serve as CEO and research director of the non-profit, respectively. Sutskever is a research scientist at Google

Mama Mia It's Sophia: A Show Robot Or Dangerous Platform To Mislead?



Noel Sharkey Contributor

AI & Big Data

I write about benefits, wrongs and hype of robots, AI, ML and new tech



INTERNATIONAL TELECOMMUNICATION UNION

A collective eyebrow was raised by the AI and robotics community when the robot Sophia was given Saudi citizenship in 2017. The AI

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 in San Francisco downtown?
- ✓ Buy a week's worth of groceries on the web?
- ✗ Buy a week's worth of groceries at Safeway?
- ✗ Discover and prove a new mathematical theorem?
- ✗ Converse successfully with another person for an hour?
- ✗ Perform a surgical operation?
- ✗ Translate spoken Spanish into spoken English in real time?
- ✗ Write an intentionally funny story?

Natural Language

- Speech technologies (e.g. Siri, Alexa)
 - 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



"When is the world going to end"
tap to edit

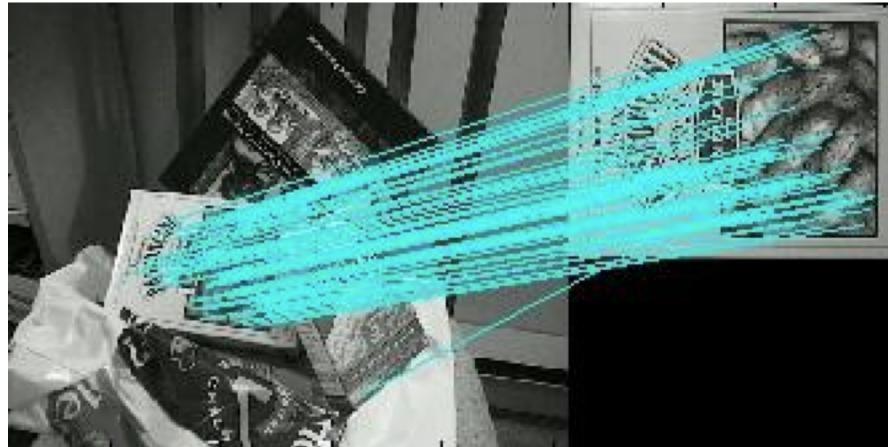
As long as you keep me charged, we should be just fine.



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

Vision (Perception)

- Object and face recognition
- Scene segmentation
- Image classification



Images from SIFT of David Lowe

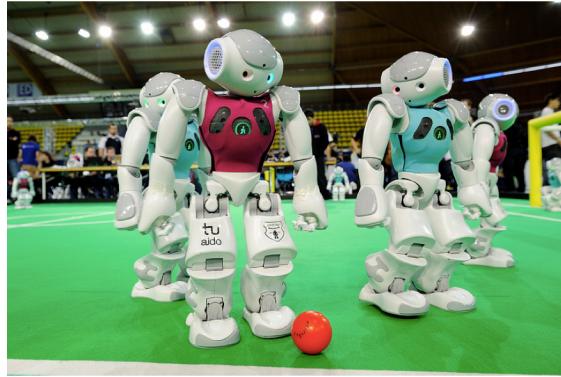
Vision (Perception)

- Image captioning

Describes without errors	Describes with minor errors	Somewhat related to the image
 A person riding a motorcycle on a dirt road.	 Two dogs play in the grass.	 A skateboarder does a trick on a ramp.
 A group of young people playing a game of frisbee.	 Two hockey players are fighting over the puck.	 A little girl in a pink hat is blowing bubbles.

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

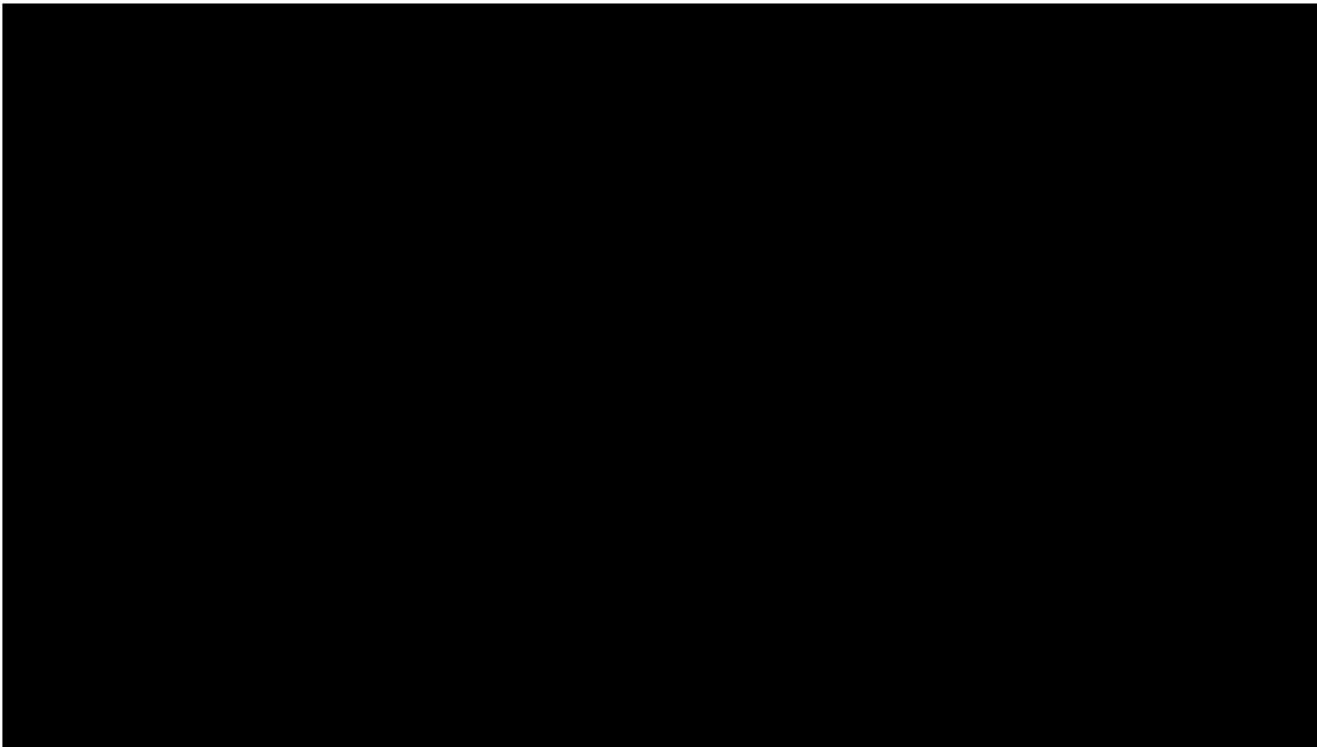


Images from Amazon Kiva, RoboCup, Google, Boston Dynamics

Amazon Kiva

Bloomberg

Autonomous Cars



Boston Dynamics



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



Images from Wikipedia

Game Playing

- AlphaGo is a computer program developed by Google DeepMind
- In March 2016, it beat Lee Sedol in a five-game match
- AlphaGo's algorithm uses a Monte Carlo tree search to find its moves based on knowledge previously "learned" by machine learning, specifically by an artificial neural network by extensive training, both from human and computer play.

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Google's historic win over Go world champion proves AI can be 'unpredictable and immoral' leading expert warns

- AI is often trained using a combination of logic and heuristics
- Explore all moves and strategies in ways humans could never do
- AIs, like sociopaths and psychopaths, can only learn to imitate empathy



Game Playing

- AlphaStar is a computer program developed by Google DeepMind.
- In January 2019, AlphaStar beat human pros at StarCraft II — a first in the world of artificial intelligence. In a series of matches, AI players beat the humans 10 games in a row. In the final match, pro player Grzegorz “MaNa” Komincz was able to snatch a single victory for humanity.

GAMING ▾ REPORT ▾ TECH

DeepMind's AI agents conquer human pros at StarCraft II

But the humans won a single match, leaving room for improvement on both sides

By James Vincent | Jan 24, 2019, 5:16pm EST

f t SHARE



The games were streamed in DeepMind's London headquarters (pictured). | Image: DeepMind

AI agents developed by Google's DeepMind subsidiary have beaten human pros at StarCraft II — a first in the world of artificial intelligence. In a series of matches [streamed on YouTube and Twitch](#), AI players beat the humans 10 games in a row. In the final match, pro

MOST READ



Serious FaceTime bug allows you to listen remotely before anyone answers — Apple to fix ‘later this week’



Apple disables Group FaceTime following major security flaw



Decision Making

- Applied AI involves many kinds of automation
 - Scheduling, e.g. airline routing, military
 - Route planning, e.g. Google maps
 - Medical diagnosis
 - Web search engines
 - Spam classifiers
 - Automated help desks
 - Fraud detection
 - Product recommendations
 - ... Lots more!

Summary

- What did we discuss?
 - Defined Artificial Intelligence as **acting rationally**
 - Discussed history of Artificial Intelligence
 - Discussed some applications of Artificial Intelligence
- For You To Do:
 - For today: read the AIMA text Chapters **1, 26.3, 27.4**