

CSCE 4613/5613

Artificial Intelligence

Class Overview

Spring 2025

Prof. Khoa Luu
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Introduction

Teaching staff & background

What is A.I?

Course materials and logistics

Questions

How many students have known/used:

- Python
- Google Colab
- Latex
- AI

Instructor



Khoa Luu

Assistant Professor

(ENGR)-Engineering

(CSCE)-Computer Science & Computer Engineering

Email: khoaluu@uark.edu



Map



Dr. Luu is currently an Assistant Professor and the Director of the Computer Vision and Image Understanding (CVIU) Lab in the Department of Electrical Engineering and Computer Science (EECS) at the University of Arkansas (UA), Fayetteville, US. He is also affiliated with the Center for Public Health and Technology, UA and the MonARK Quantum Foundry. He is serving as an Associate Editor of the IEEE Access Journal and the Multimedia Tools and Applications Journal, Springer Nature. He also serves as the Area Chair in the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2023 and 2024.

He was the Research Project Director at the CyLab Biometrics Center at Carnegie Mellon University (CMU), USA. He led the team to develop successful AI products and applications, including Vision-Brain Reconstruction, AI-based Early Autism Detection, Facial Micro-Expression Recognition, 2D Quantum Material Identification, Smart Insect Monitoring System, Face Recognition (Top Ranking in NIST Face Recognition Vendor Test in 2020), Age-invariant Face Recognition, Multi-camera Multi-Object Tracking, Driver Monitoring System (DMS), Long-range Biometrics and Soft Biometrics Systems, Perception and Prediction Solutions for Autonomous Car Driving. His research has been funded by the National Science Foundation (NSF), Army Research Lab, U.S. Dept of Transportation (DOT), Arkansas Biosciences Institute (ABI), Chancellor's Commercialization and Innovation Funds at the University of Arkansas, Google Research, JB Hunt, and several industrial companies.

He teaches Introduction to Artificial Intelligence (CSCE4613/5613), Computer Vision (CSCE5703), Image Processing (CSCE 5683), Algorithms (CSCE4133/5133), and Advanced Data Structures (CSCE4263) courses in Electrical Engineering and Computer Science Department at University of Arkansas, Fayetteville. His research interests focus on various topics, including Smart Health, Precision Agriculture, Quantum Machine Learning, Multi-Object Tracking, Human Behavior Understanding, Scene Understanding, Face Recognition, Domain Adaptation, Image and Video Processing, Deep Learning and Compressed Sensing. He has received six patents and two Best Paper Awards, and coauthored 120+ papers in conferences, technical reports, and journals. He was a Vice-Chair of the Montreal Chapter of the IEEE Systems, Man, and Cybernetics Society in Canada from September 2009 to March 2011.

TA/GA

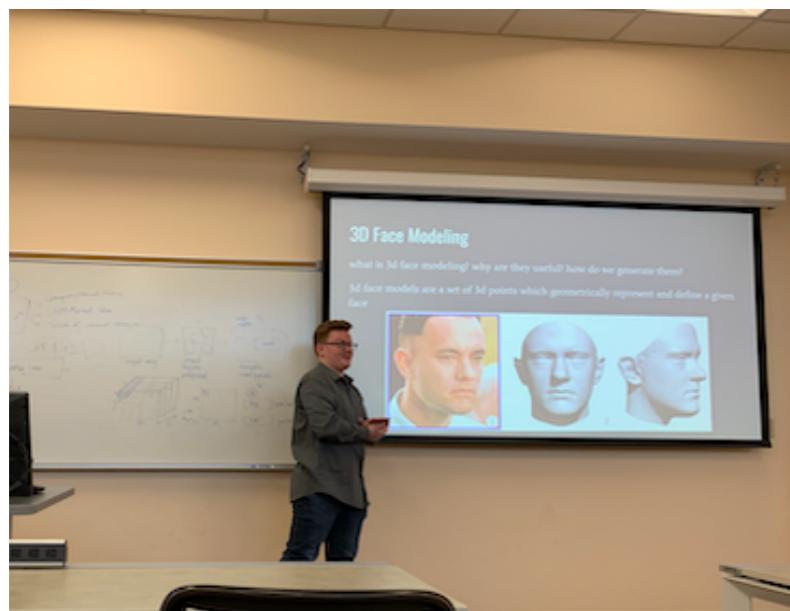
Manuel Serna-Aguilera: mserna@uark.edu

Gladys Gawugah: ggawugah@uark.edu

CVIU Overview

<https://uark-cviu.github.io/>

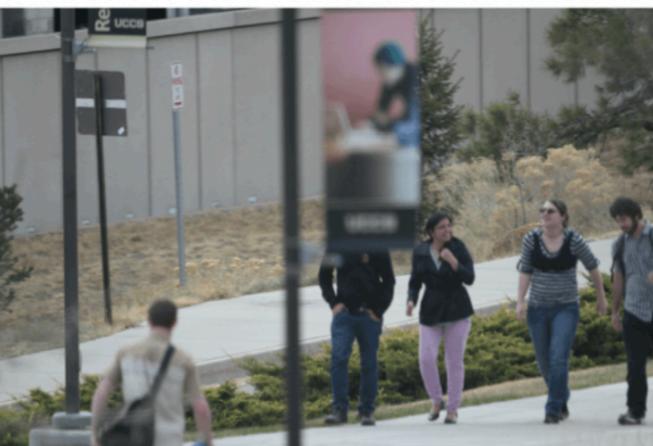
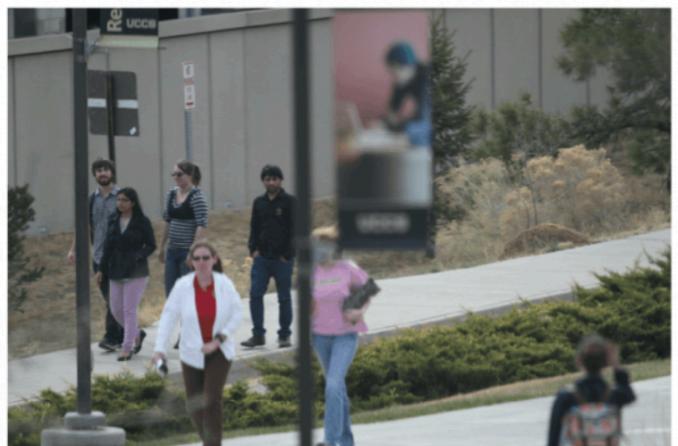
The screenshot shows the CVIU GitHub page. At the top is the University of Arkansas logo and the text "Computer Vision And Image Understanding Lab". Below the logo is a navigation bar with links: Home, People, Research, Publications, Contact, Achievement, and a search icon. On the left, there's a sidebar with "[Lab Activity- Presentation Schedule]", "[CVIU-Git]", and "[CVIU-Slack]". The main content area features a post titled "Quantum Computer Vision" dated JAN 2015, number 10. It includes an image of a quantum circuit, the author's name "By khoaluu", and the project title "A. Dendukuri and K. Luu, "Image Proc Quantum Computers", [arxiv], Jan....".



CVIU Overview

ECCV 2018 – 2nd Unconstrained Face Detection and Open Set Recognition Challenge [\(link\)](#)

We are the Winner #1 in both two tracks: Face Detection and Face Recognition



Example images of the UCCS dataset. Note that not a single face in these two images is frontal and without occlusion – some have small occlusion, others large; some have significant yaw and pitch angles; and many are blurred.

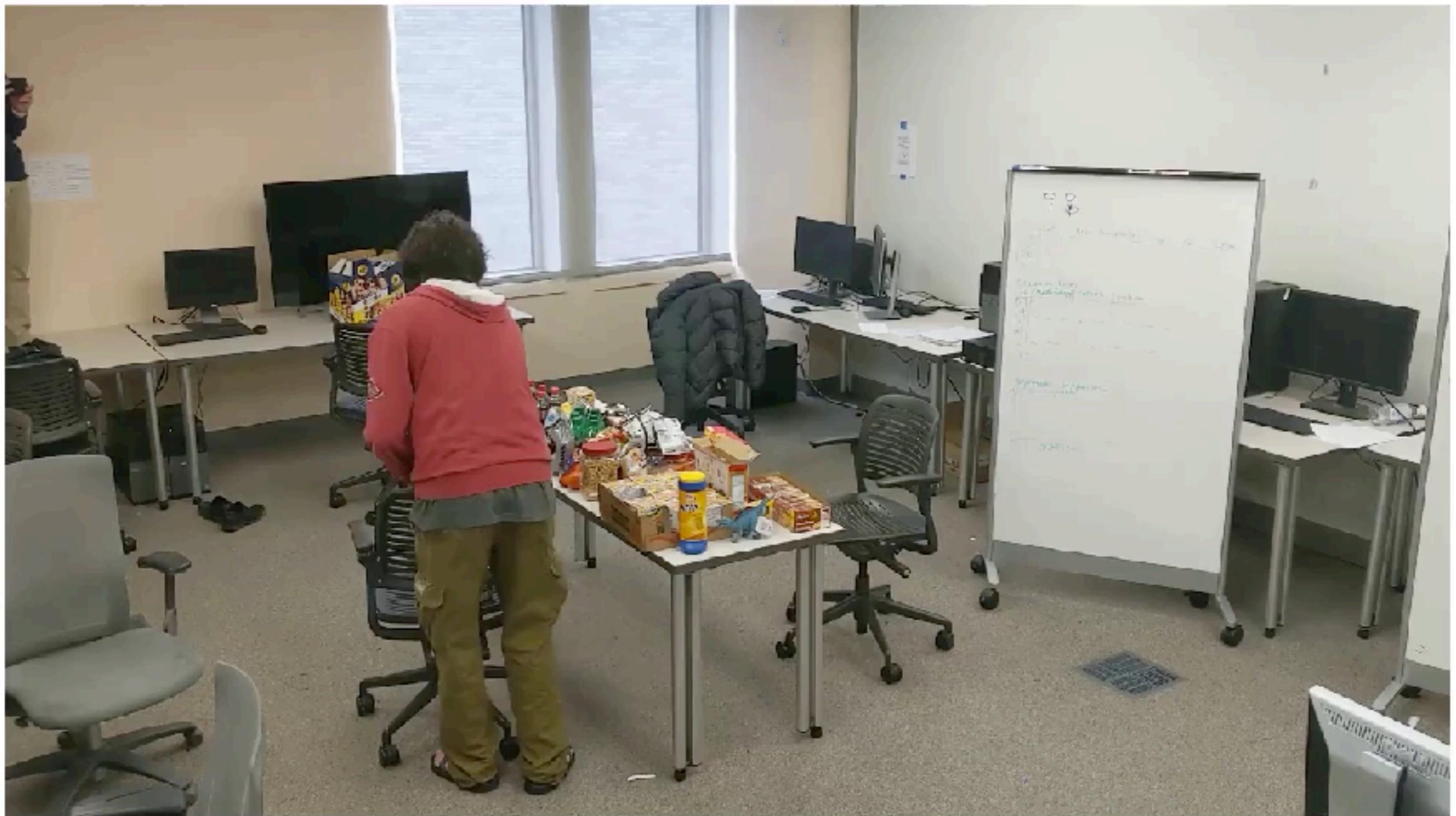
EmotioNet Challenge 2018 [\(link\)](#)

We are the 3rd in Track #2!



JOLT Hackathon 2018 Awards (1st & 3rd)

Human Behavior Understanding



Human Recognition



Human Face Precognition



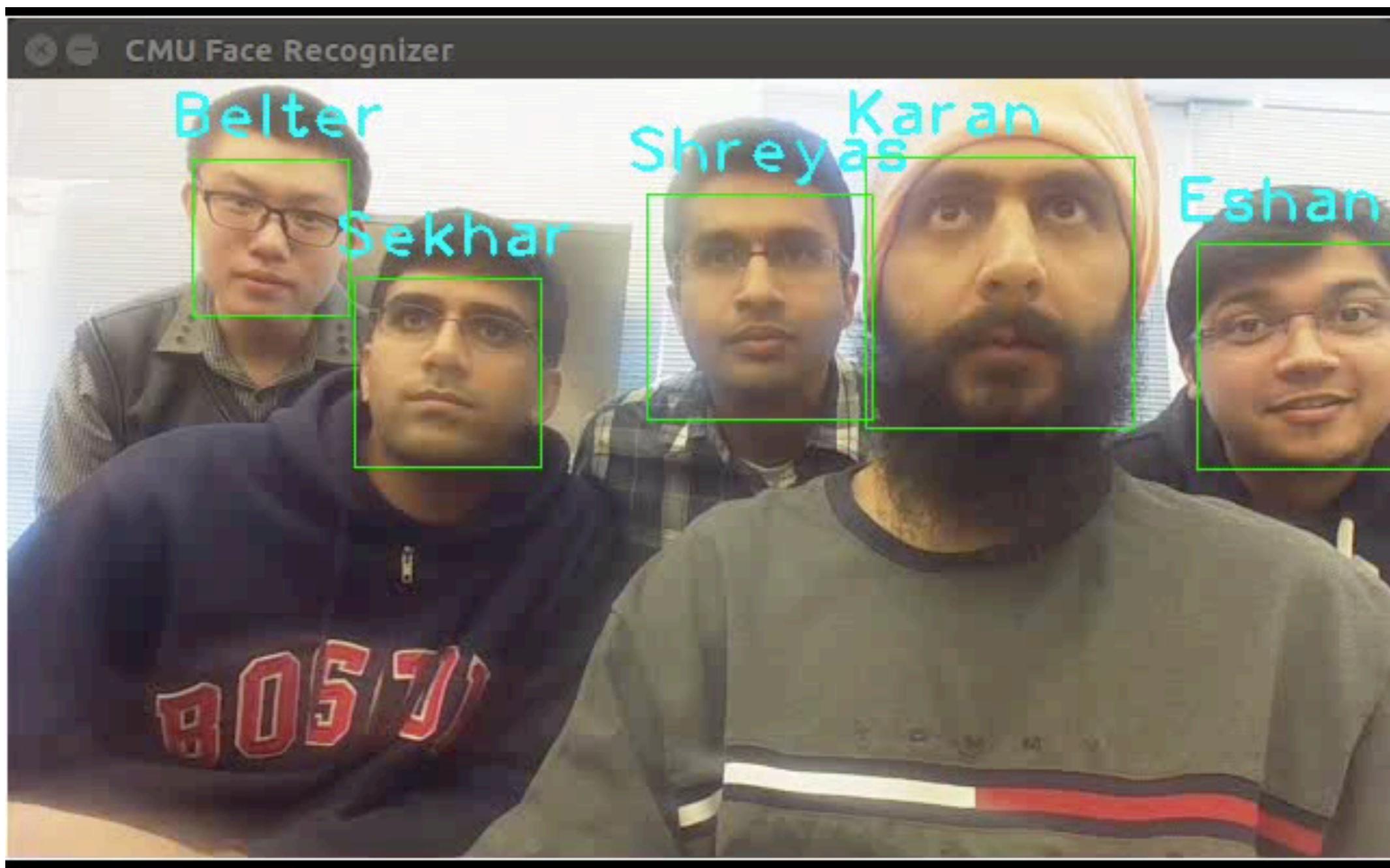
3D Face Modeling



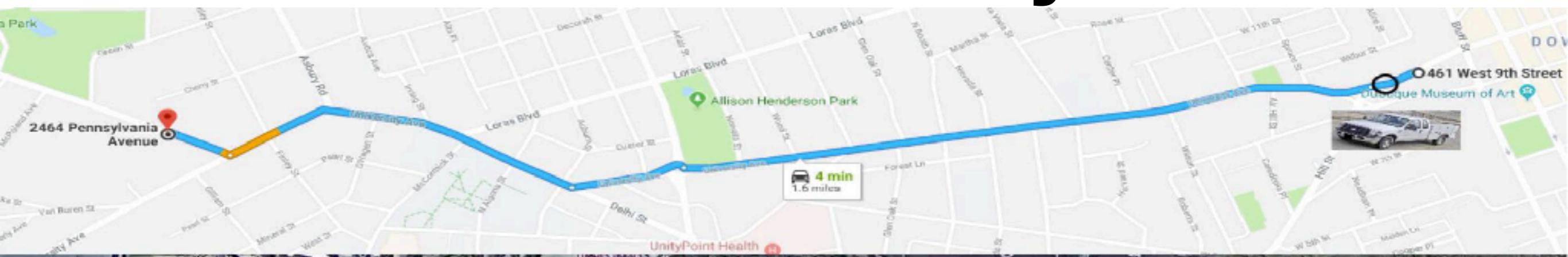
3D Face Modeling



Face Recognition



Driver Safety



Course Materials and Logistics

Reading

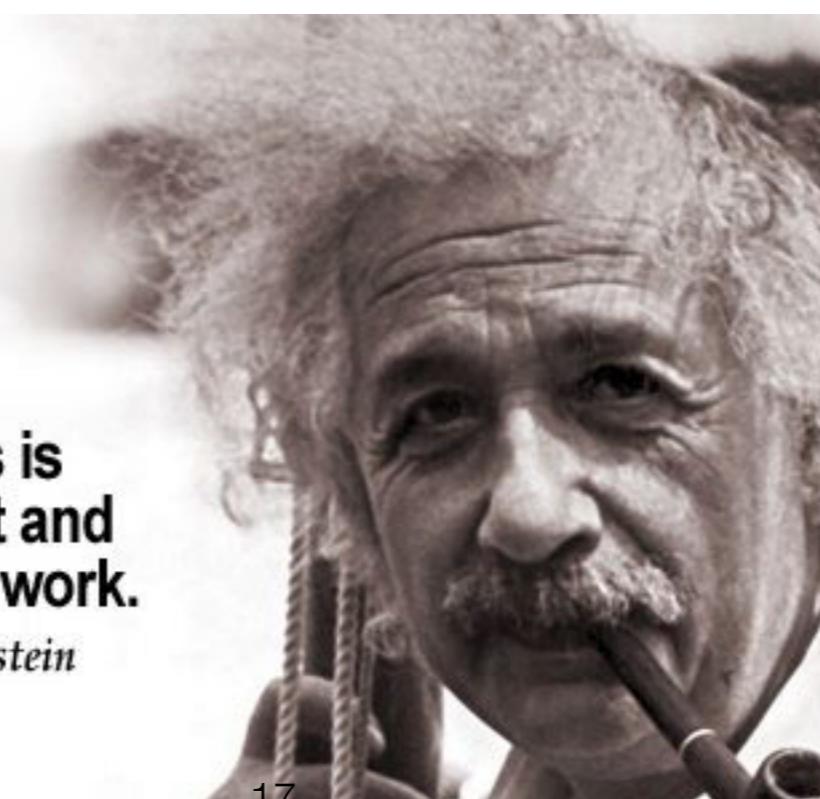
Textbook

Homework

Research Papers

Assignments - Projects

reading
programming
debugging
writing
publishing



A black and white portrait of Albert Einstein, showing him from the chest up. He has his characteristic wild, curly hair and is wearing a dark suit jacket over a white shirt. His hands are clasped in front of him, holding a pair of glasses.

**Genius is
1% talent and
99% hard work.**

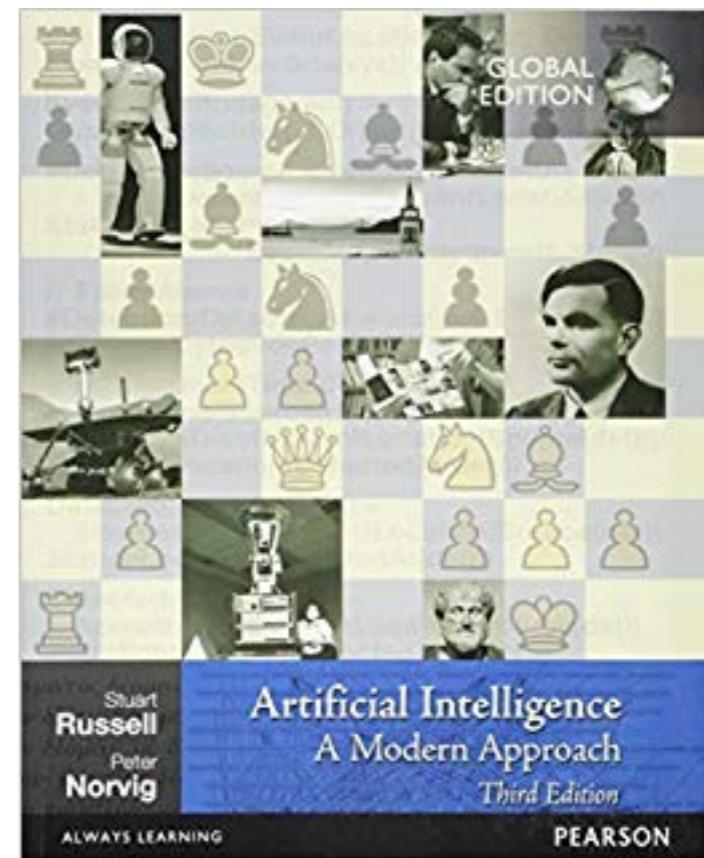
Albert Einstein

Course Requirements

- Submission Place: Blackboard
- Six/Seven (individual/group) Assignments
- Midterm Exam
- Final Exam
- Final Project (Presentation + Program + Report)
(Encourage students to join!)
- Reports: Google Doc or AAAI template (Latex)
<https://aaai.org/Conferences/AAAI-20/aaai20call/>

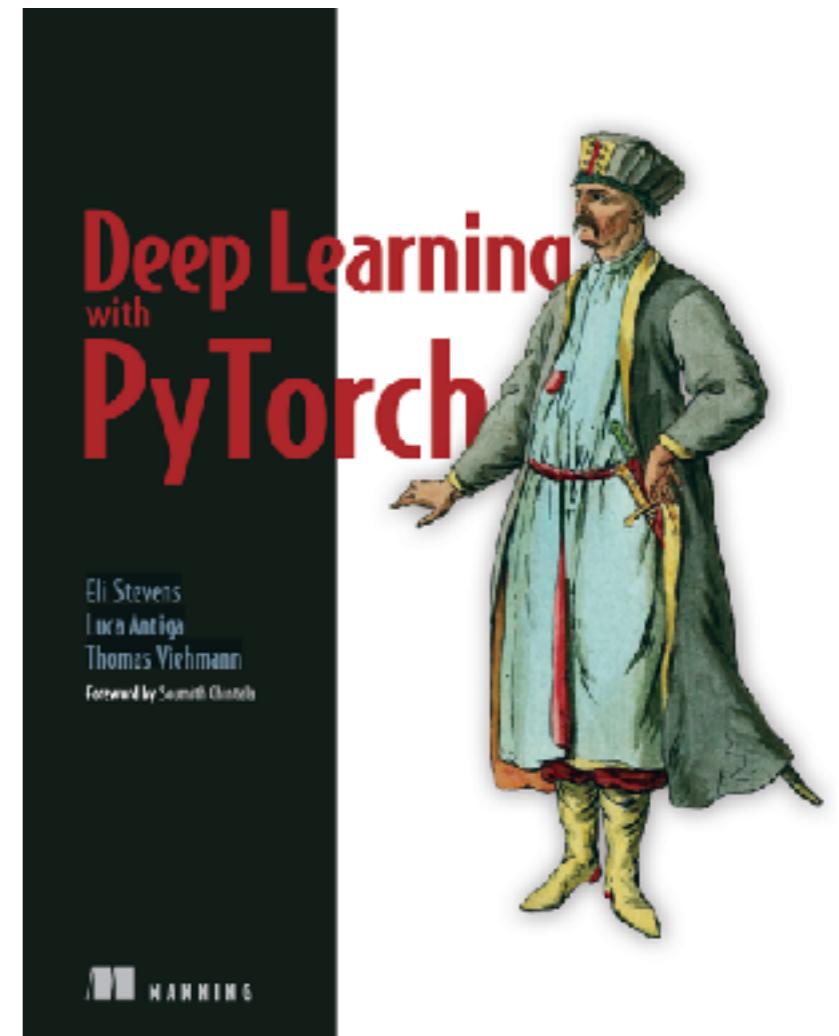
Textbook

- Most important materials will be covered in slides/lectures
- **Artificial Intelligence: A Modern Approach**, Third Edition, Pearson Publisher, 2010 by Stuart Russell and Peter Norvig
<http://aima.cs.berkeley.edu>



Textbook

- Most important materials will be covered in slides/lectures
- **Deep Learning with Pytorch**, First Edition, 2020 (Free Online)
by Eli Stevens, Luca Antiga & Thomas Viehmann
<https://pytorch.org/deep-learning-with-pytorch>



Reference Materials

- THE ASSOCIATION FOR THE ADVANCEMENT OF ARTIFICIAL INTELLIGENCE
<http://www.aaai.org>
- AAAI Conference: <https://aaai.org/Conferences/AAAI-20/>
- AI Magazine: <https://www.aaai.org/ojs/index.php/aimagazine/issue/archive>
- **Compendium of Vision**
 - <http://homepages.inf.ed.ac.uk/rbf/CVonline/>
- **IEEE Explore**
 - <https://ieeexplore.ieee.org/Xplore/home.jsp>
- **Journals**
 - <https://ieeexplore.ieee.org/Xplore/home.jsp>

Programming Languages

- Python (Mainly)
- Matlab

Grading

The grading in this course will be distributed as follow

- Participation: 5%
- Homework: 50%
- Midterm: 20%
- Final: 25%
- Bonus: 2%

Approach

- Grading based on absolute scale
- Getting an A v.s mastering the materials
- Take advantage of extra credits
- Build your resume with meaningful project experience

Late Days

- 5 late days in total (except for Midterm & Final exams)
- 3 days per assignment/project maximum use
- Use them wisely (save them for the last ones)

Learning Objectives

- Describe AI concepts, models, algorithms
- Model real-world problems using AI models
- Implement AI algorithms introduced in class
- Deliver written and oral presentation (bonus)

Pre-requisites

CSCE 3193 or CSCE 3193H or DASC 2103

Please see the instructors if you are unsure whether your background is suitable for the course.

Major Topics In This Course (15w)

(Subject to change)

1. Introduction to AI (1 Week)
2. AI Programming Reviews (Python & Google Colab) (1 Week)
3. Search & Heuristics (2 Weeks)
4. Satisfiability (1 Week)
5. Deterministic/symbolic reasoning (1 Weeks)
6. Knowledge representation (2 Weeks)
7. Probabilistic reasoning (1 Weeks)
8. Sequential Decision Making (1 Weeks)
9. Neural Networks (1 Weeks)
10. Deep Learning Basics (2 Weeks)
11. A.I Applications (1 Week)

Disability Accommodations

If you have a disability and have an accommodations letter from the Disability Resources office, we encourage you to discuss your accommodations and needs with us as early in the semester as possible.

We will work with you to ensure that accommodations are provided as appropriate.

If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, we encourage you to contact them at

Academic Integrity

- Strict honor code with severe punishment for violators. UA's academic integrity policy can be found here: <https://honesty.uark.edu/policy/>
- You may discuss assignments with other students as you work through them, but writeups must be done alone.
- No downloading / copying of code or other answers is allowed.
- If you use a string of at least 5 words from some source, you must cite the source

Student Well-Being

- Start early! Avoid last-minute panic.
- UA services and resources are available, and treatment does work
<https://registrar.ua.edu/student-services/>
- Take care of yourself

What is “AI”?



Some classic definitions

Building computers that...

Think like humans

- cognitive science / neuroscience
- e.g., General Problem Solver (Newell and Simon, 1961)

Think rationally

- logic and automated reasoning
- but not all problems can be solved just by reasoning

Act like humans

- Turing test
- ELIZA, Julia, chatbots, Loebner prize

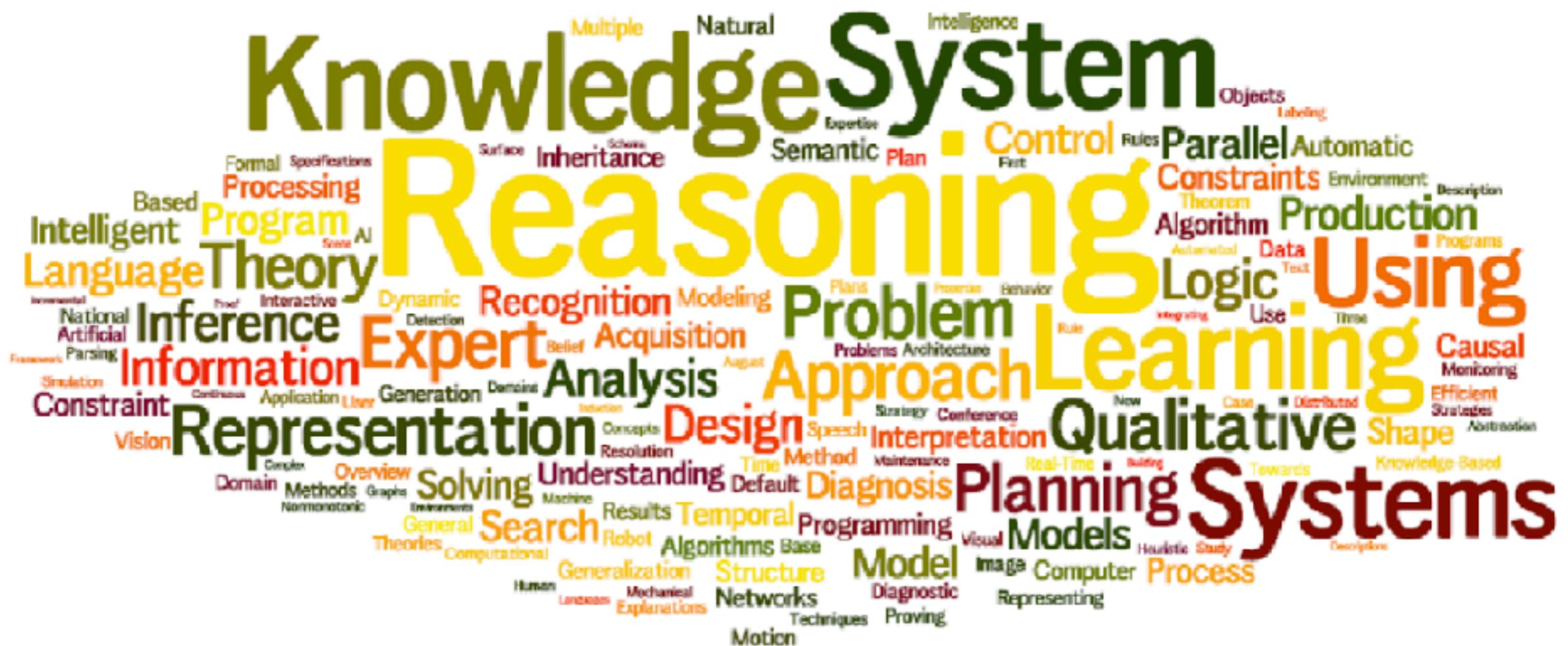
Act rationally

- basis for intelligent agent 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 ...

The pragmatist's view



1980s

The pragmatist's view



1990s

The pragmatist's view



2000s

The pragmatist's view



2010s

A broader definition

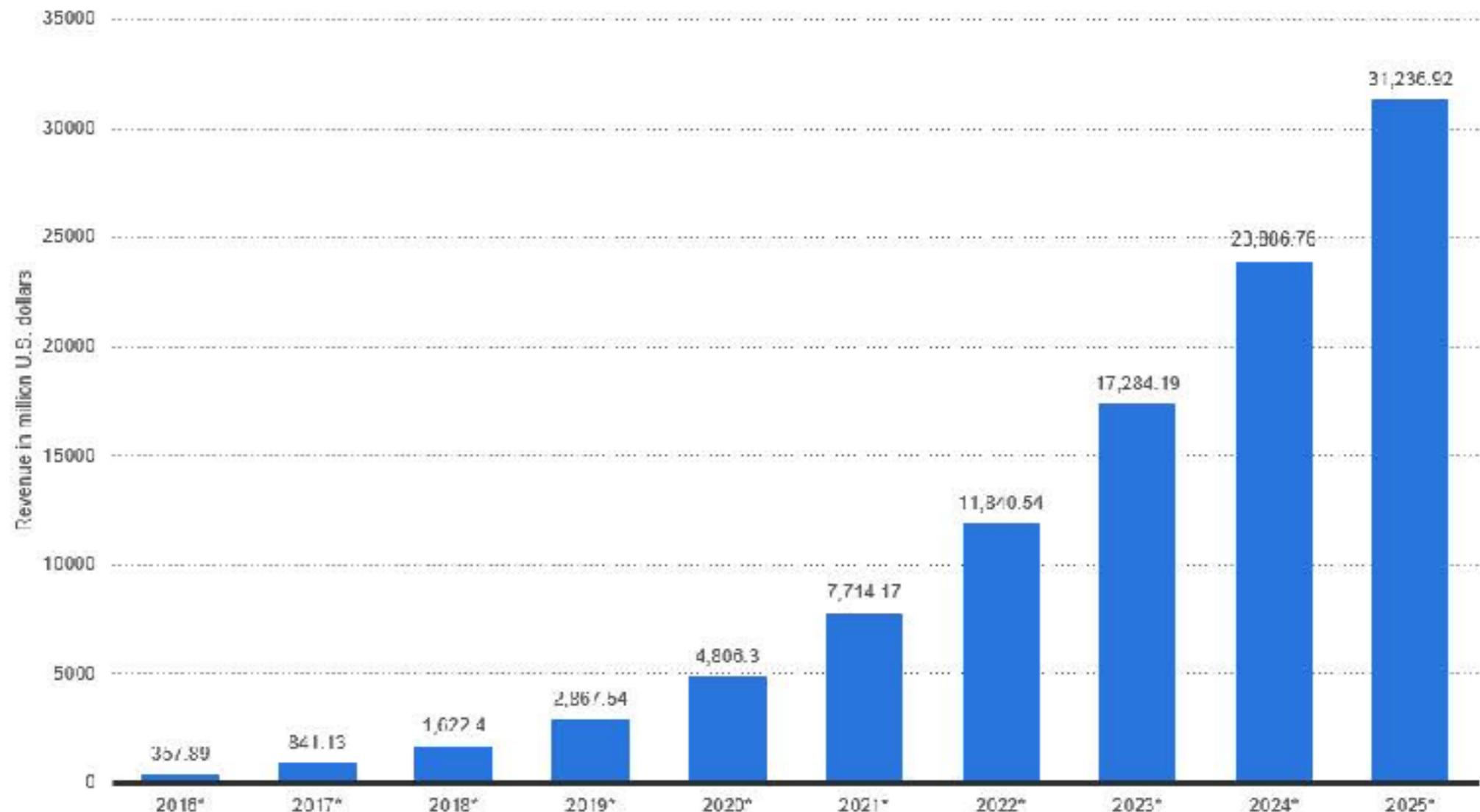
We won't worry too much about definitions of AI, but the following will suffice:

Artificial Intelligence is the development and study of computing systems that address a problem typically associated with some form of intelligence

Why A.I now?

Enterprise artificial intelligence market revenue worldwide 2016-2025

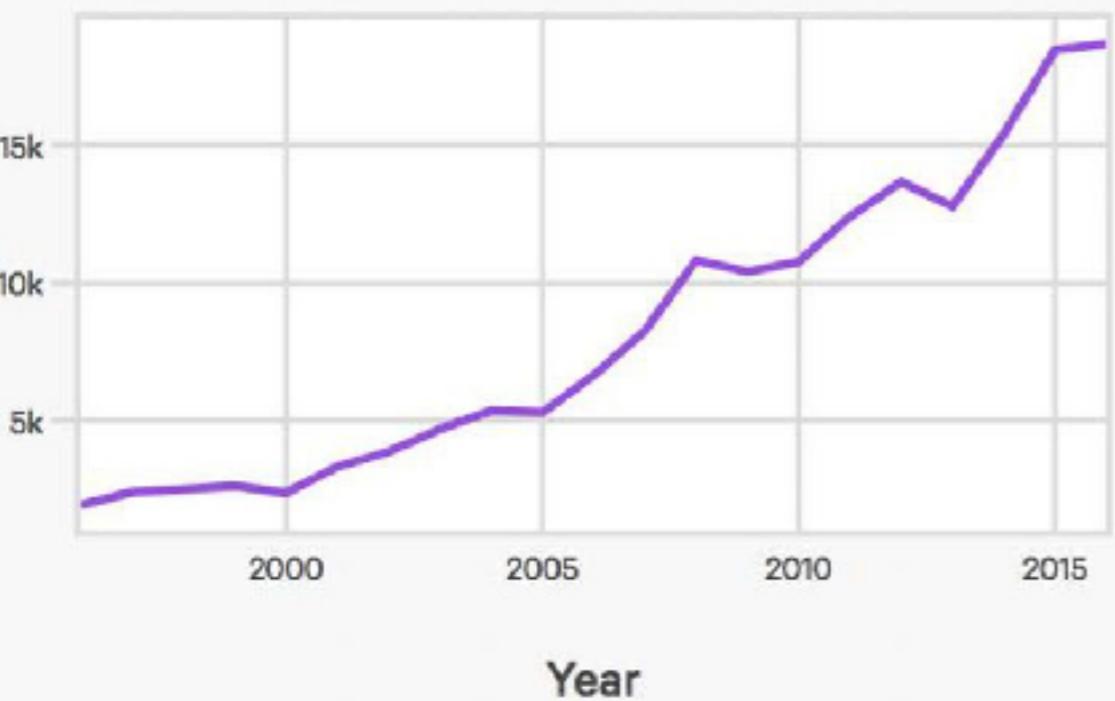
Revenues from the artificial intelligence for enterprise applications market worldwide, from 2016 to 2025 (in million U.S. dollars)



statista

Annually Published AI Papers

Papers



Source: Scopus.com

AIINDEX.ORG RI

RESEARCH

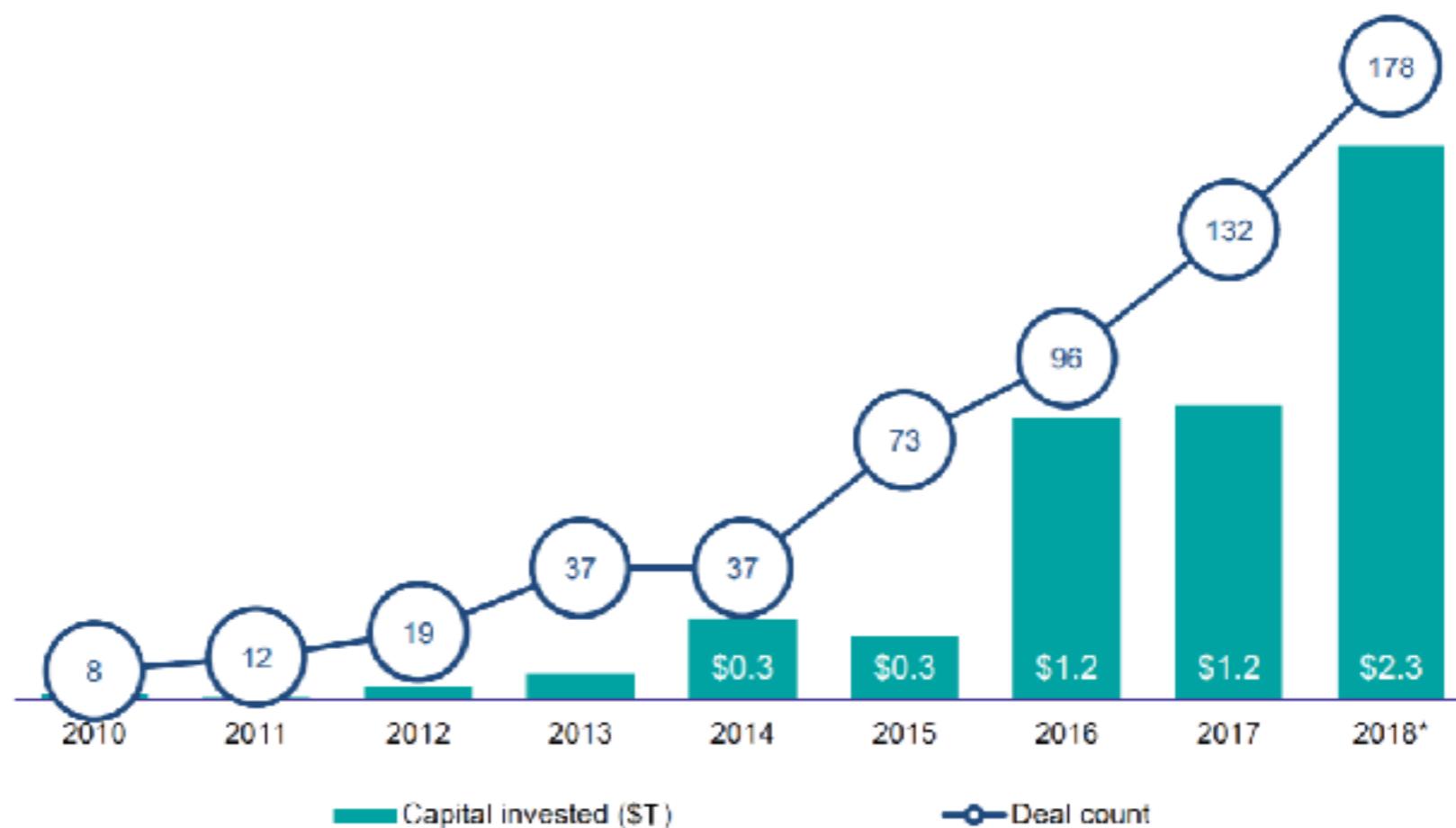


STARTUPS

Exploring AI Investing

Global venture financing of artificial intelligence companies, 2018

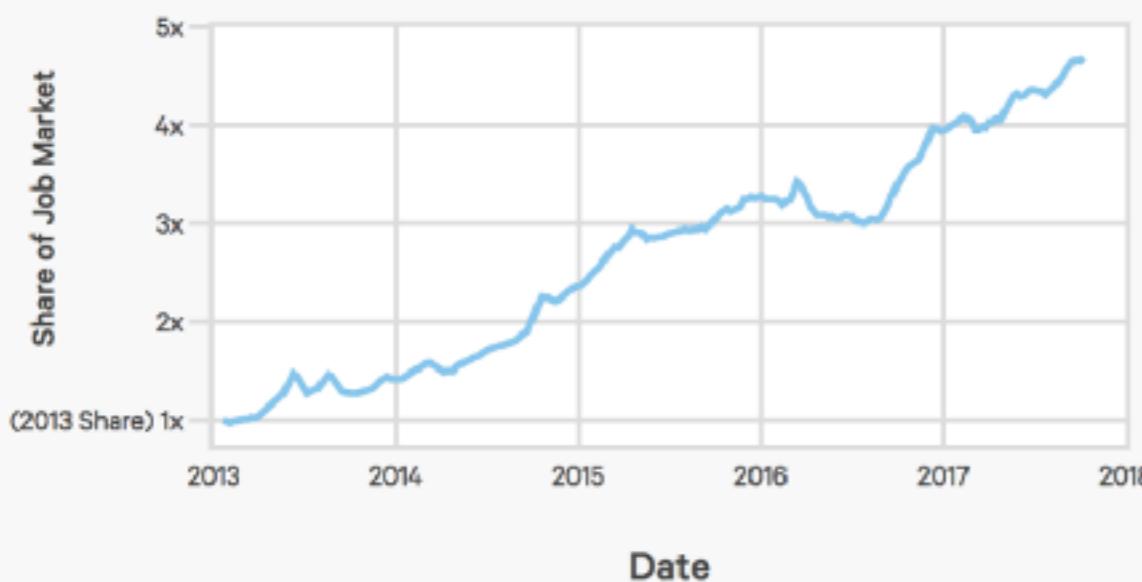
2010–2018*



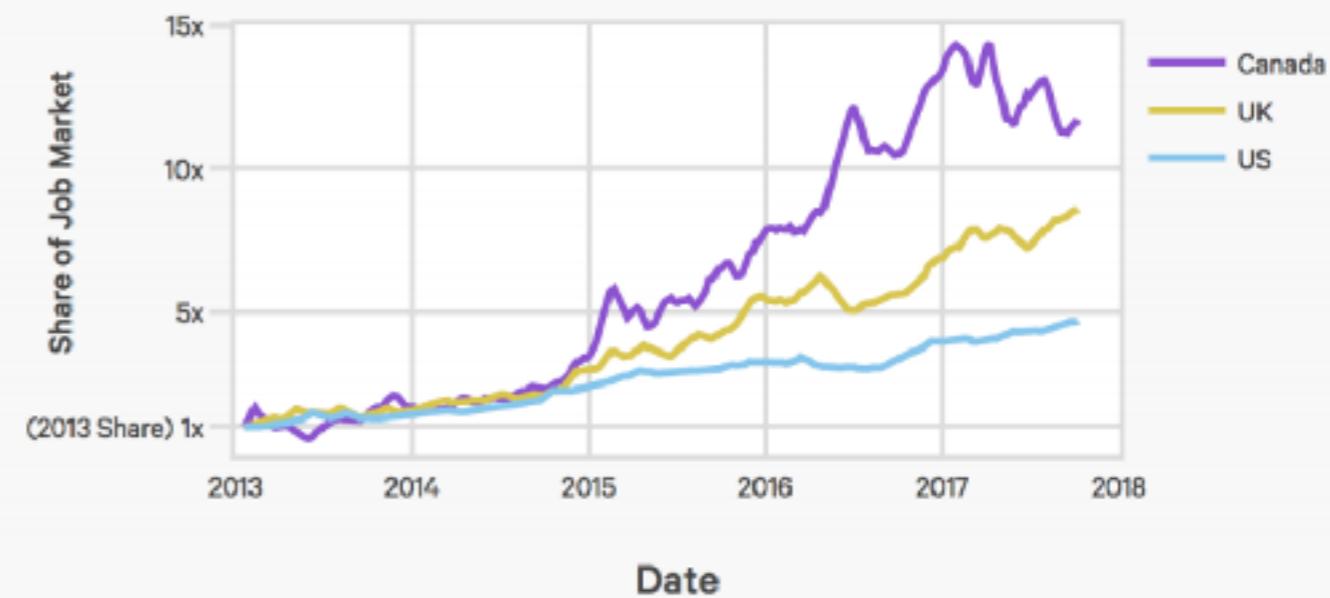
Source: Venture Pulse, Q4'18, Global Analysis of Venture Funding, KPMG Enterprise. *As of 12/31/18. Data provided by PitchBook, January 15, 2019

AI Job Markets

Share of US Jobs Requiring AI Skills (Indeed.com)



Share of Jobs Requiring AI Skills (Indeed.com)

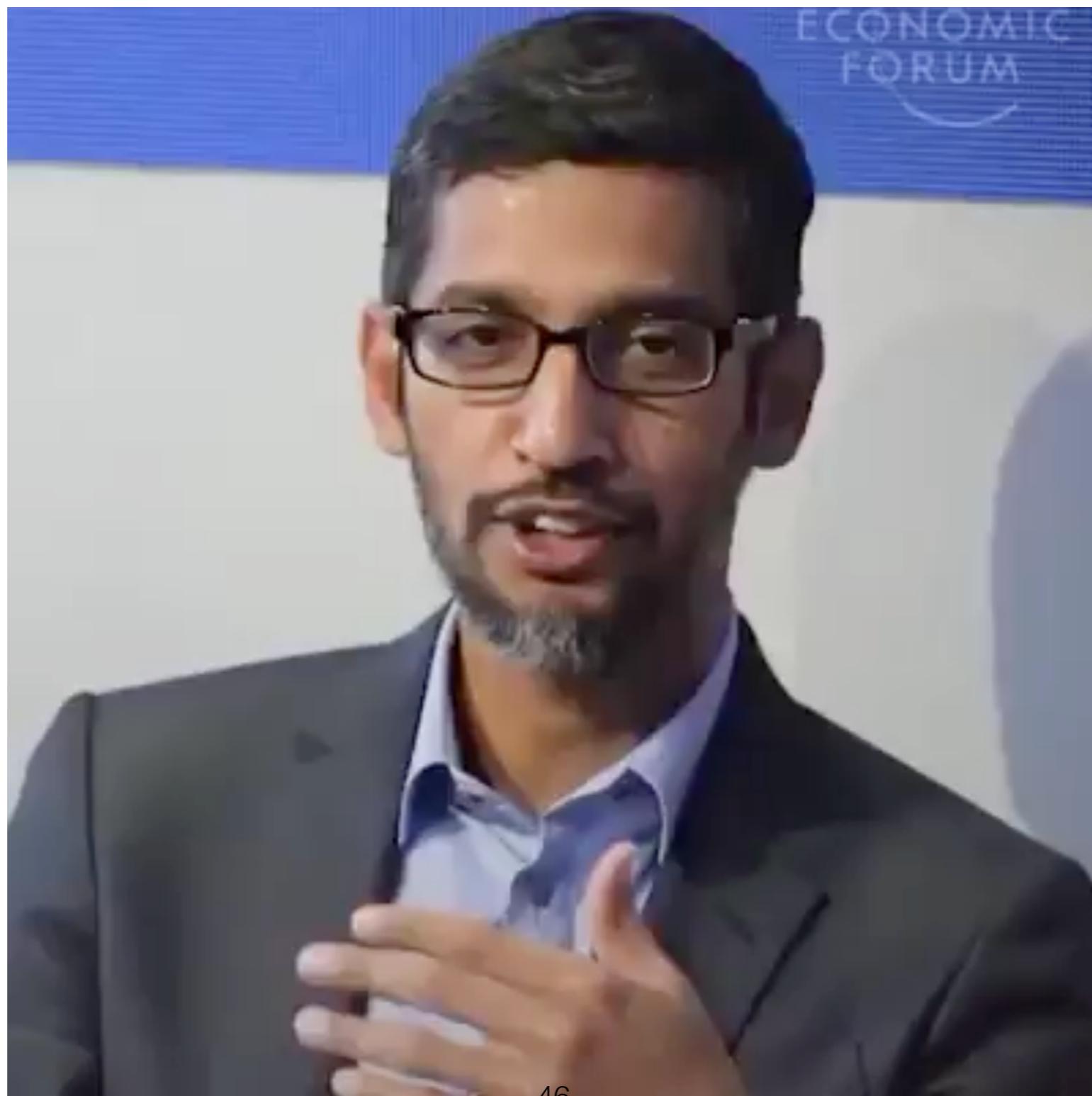


Sources: Indeed.com

AIINDEX.ORG Source: Indeed.com

AIINDEX.ORG RI

Could #AI be the most important thing that humankind has worked on?
What's your thoughts?



#Microsoft Program Aimed to empower people and organizations to solve environmental challenges using #AI



A.I Now and *Then*

Self-driving Cars

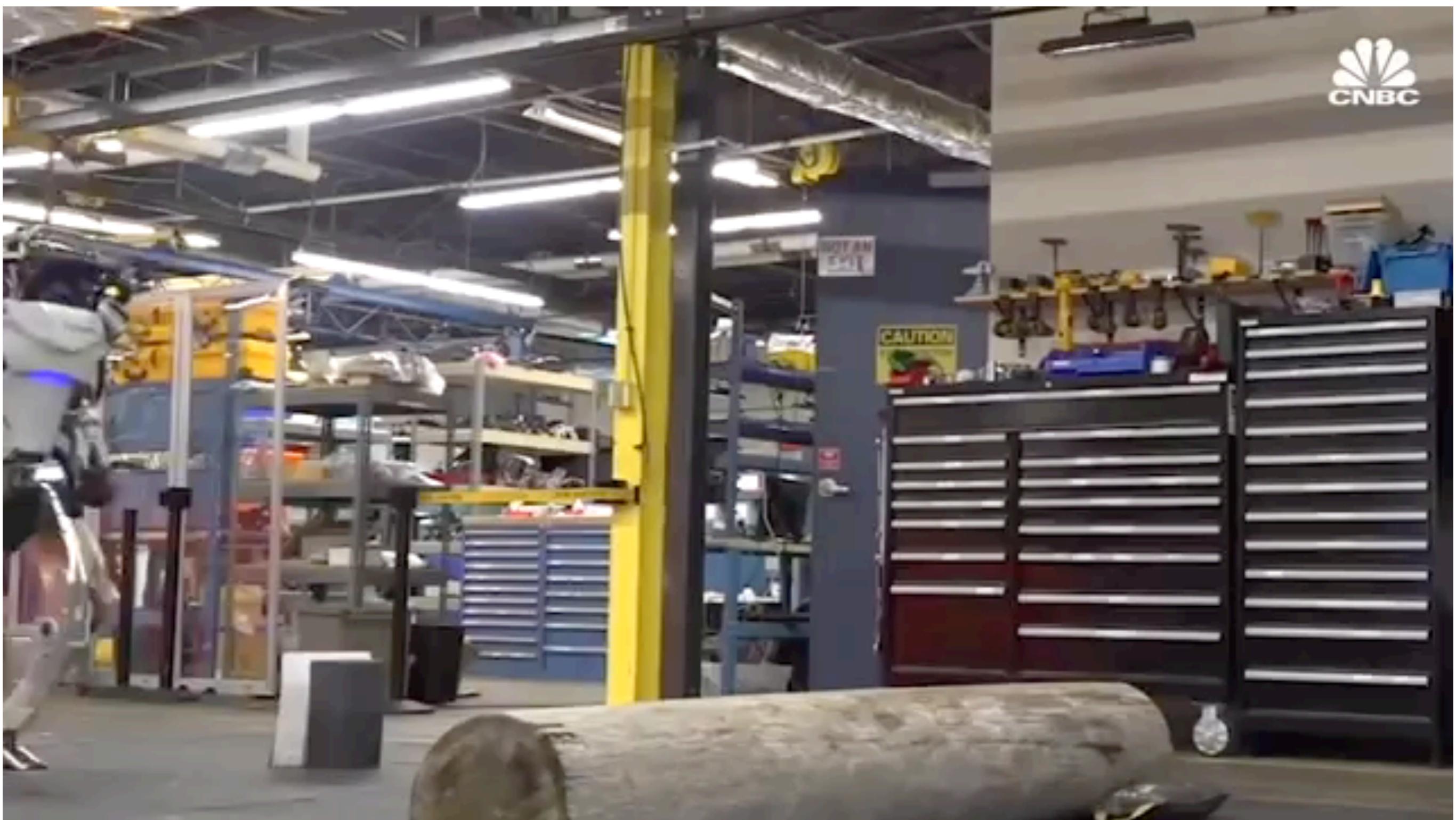
THE PERSON IN THE DRIVER'S SEAT
IS ONLY THERE FOR LEGAL REASONS

HE IS NOT DOING ANYTHING.
THE CAR IS DRIVING ITSELF.

Now a Disable Person mind Can control the Artificial Hand. This is the power of #AI



Robot Vision



History of AI and AI today

Pre-history (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 network

1950 – Turing test

1955-56 – Newell and Simon: Logic Theorist

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

Other attendees were [Ray Solomonoff](#), [Oliver Selfridge](#), [Trenchard More](#), [Arthur Samuel](#), [Herbert A. Simon](#), and [Allen Newell](#)



Early successes (1950s–1960s)



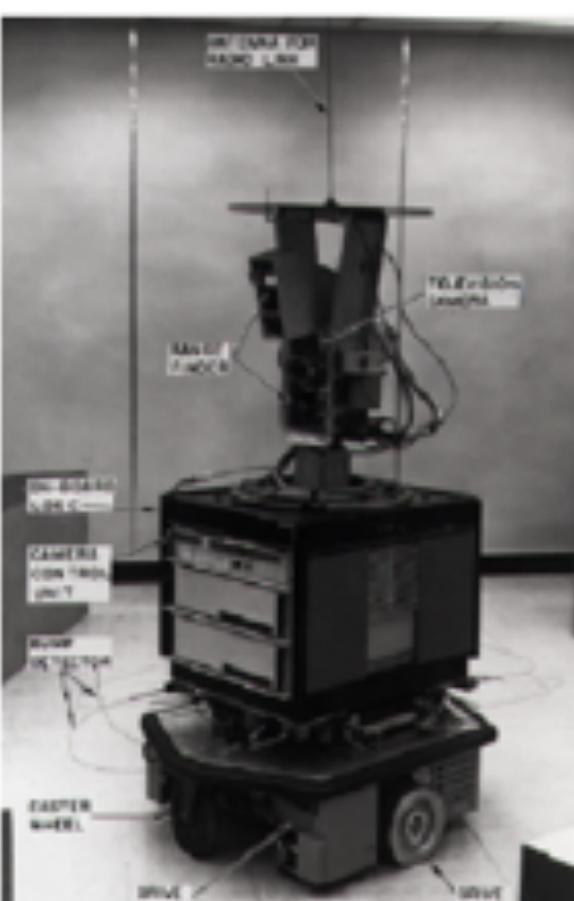
1952 – Arthur Samuel develops checkers program, learns via self-play

1958 – McCarthy LISP, advice taker, time sharing

1958 – Rosenblatt's Perceptron algorithm learns to recognize letters

1968-72 – Shakey the robot -> A* algorithm

1971-74 – Blocksworld planning and reasoning domain



First “AI Winter” (Later 1970s)



Many early promises of AI fall short

1969 – Minsky and Pappert’s “Perceptrons” book shows that single-layer neural network cannot represent XOR function

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

1970s – DARPA cuts funding for several AI projects

Expert systems & business (1970s–1980s)



Move towards encoding domain expert knowledge as logical rules

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

1981 – Japan's “fifth generation” computer project, intelligent computers running Prolog

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

Focus on applications (1990s-2010s)

Meanwhile, AI (sometimes under the guise of a subfield), achieved some notable milestones



1997 – Deep Blue beats Gary Kasparov

2001-2010 – \$60 billion involved in combinatorial sourcing auctions



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

2011 – IBM's Watson defeats human opponents on Jeopardy

Reemergence of “AI” (2010s–??)



“AI” seems to be a buzzword again

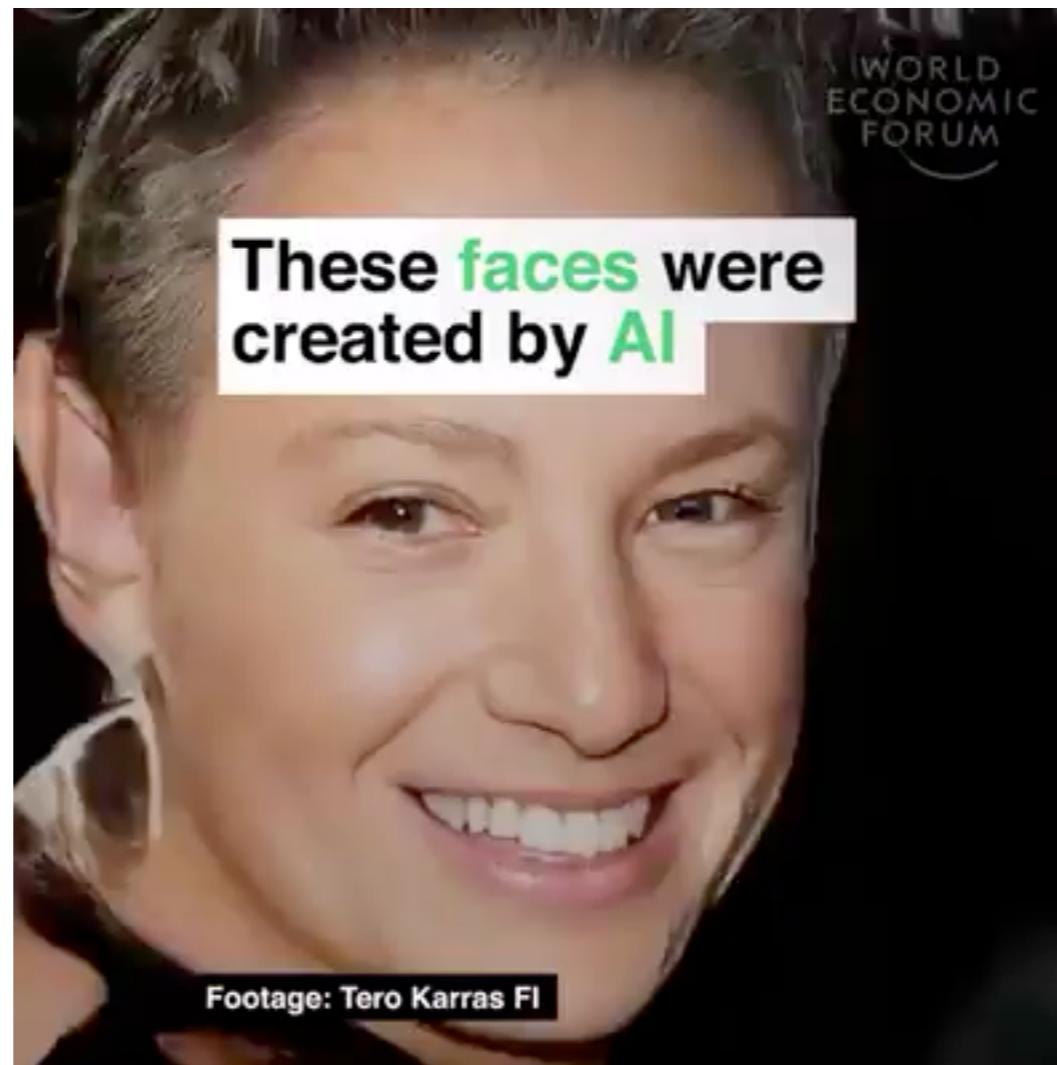
Google, Facebook, Twitter, etc, all have large AI labs, labeled as such

2012 – Deep neural network wins image classification contest

2013 – DeepMind shows computer learning to play Atari games

2015-2017 – superhuman speech understanding

This #AI is able to learn different faces from any picture it sees and generate new ones.



Kiki Understands Your feelings and tries to cheer you up. She Can be affectionate, Social and even moody. The power of #AI



Thoughts about Goals of AI

- AI has many different goals
 - This is nothing to avoid
 - E.g., OR has same “problem” and is not shy about it
 - Shouldn’t define AI as that which still cannot be done
 - Human-level intelligence just a milestone along the way
-
- Q: Will there be a super-human species?
 - A: No, AIs will be tools for various purposes

Some potential new AI applications with huge positive impact on the world

- Better electricity markets
- Combinatorial CO₂ allowance / pollution credit markets
- Automated market making
- Campaign market for advertising
- Security games
 - Physical, information, malware protection, ...
 - Sequential

- AI is a fast-moving exciting area
- We can directly make the world a better place

Homework:

- Reading: Eli Stevens et al., Chapters 1 & 2
- Reading: Russell & Norvig, Chapters 1 & 2