

Introduction to Artificial Intelligence

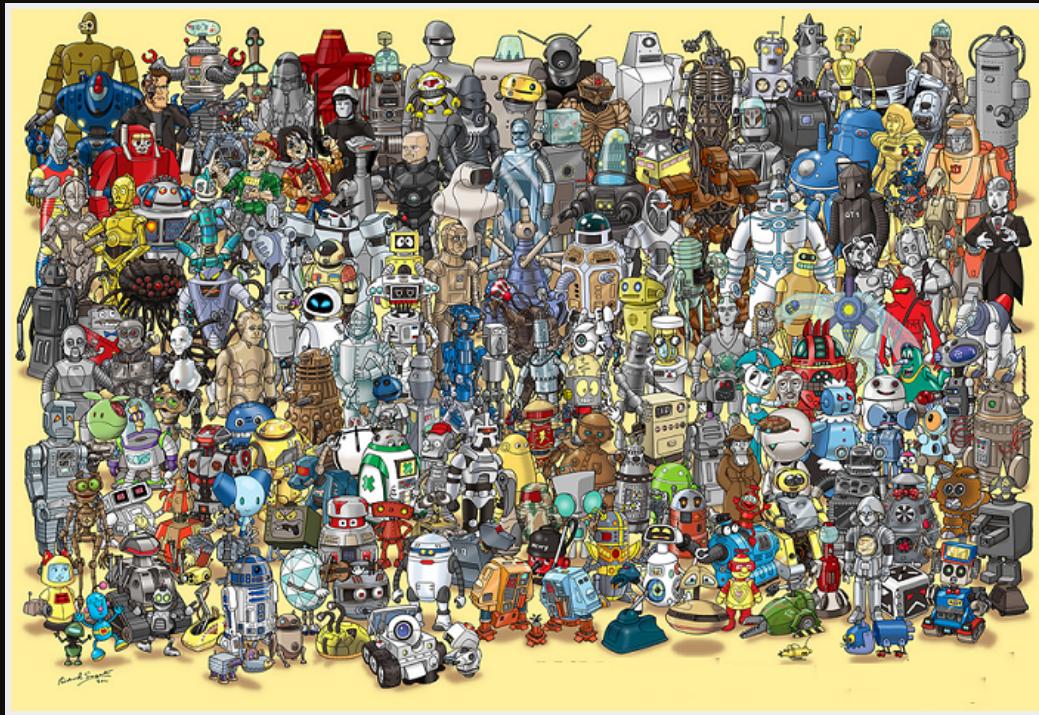
Lecture 1, CMSC 170

John Roy Daradal / Instructor

Today's Topics

- Artificial Intelligence
- Brief History of AI
- Applications

Sci-Fi AI

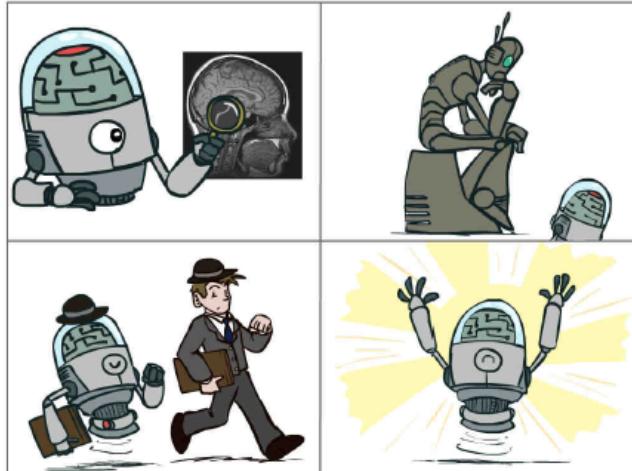


Artificial Intelligence

What is Artificial Intelligence?

The science of making machines that:

Think like people



Think rationally

Act like people

Act rationally

[CS188 Lecture 1 slides, UC Berkeley]

AI: Think Like People?

- **Natural intelligence**: people
- *Cognitive science, computational neuroscience*: fields that study how the brain functions

AI: Act Like People?

- Early definition from **Alan Turing** (1950)
- Is the **behavior** *human-like*?

Turing Test

Turing test

During the Turing test, the human questioner asks a series of questions to both respondents.

After the specified time, the questioner tries to decide which terminal is operated by the human respondent and which terminal is operated by the computer.

■ QUESTION TO RESPONDENTS ■ ANSWERS TO QUESTIONER

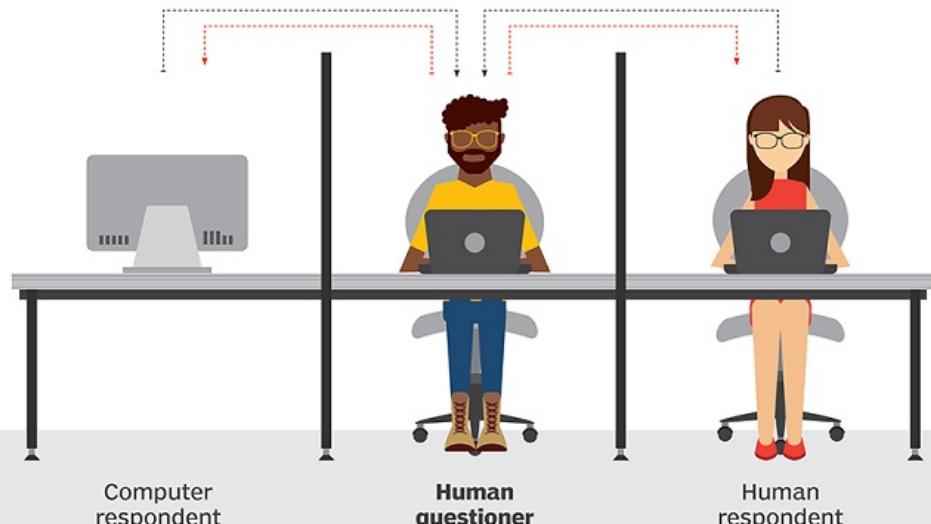


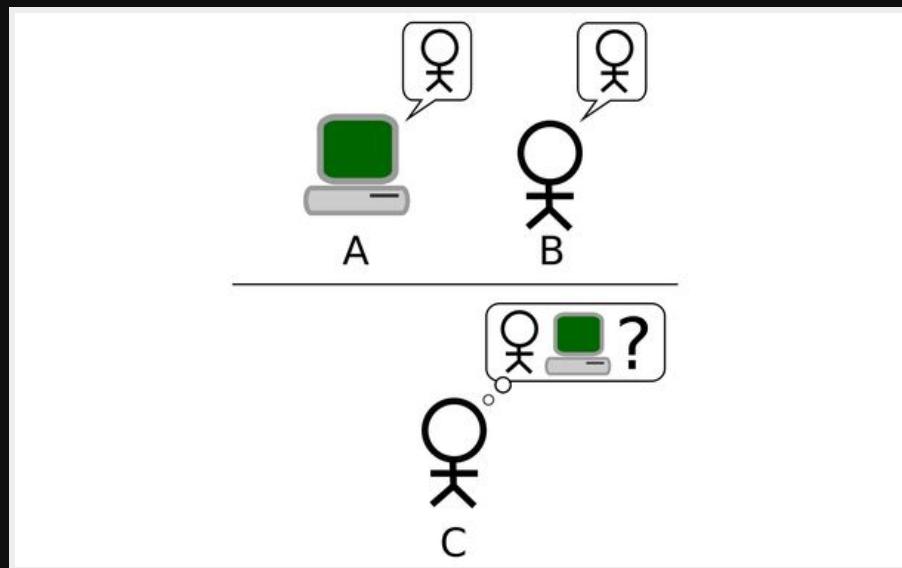
ILLUSTRATION: GSTUDIO GROUP/ADOBESTOCK

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[http://cdn.ttgtmedia.com/rms/onlinelimages/crm-turing_test.jpg]

Turing Test

Aka the **Imitation Game**



[<https://images2.onionstatic.com/clickhole/2726/8/original/600.jpg>]

Problems

- Spelling correctly all the time
- Computing $\sqrt{5}$
- "What's your favorite color?"
- Have to *build in errors* to *mimic human limitations*

AI: Think Rationally?

- How do we know machine is **thinking** rationally?
- How to teach machines step-by-step **logical deduction**?
- Not easy to take *informal knowledge* and have *formal representation*

AI: Act Rationally?

- The **accepted definition** of AI
- Only *requirement*: **achieve goal optimally**

Rational Decisions

- **Maximally** achieves pre-defined goals
- Focus on **decisions** made, not the *thought process* behind them
- **Goals:** expressed in terms of **utility** (value, benefit) of outcomes

Artificial Intelligence

"Maximize your expected utility."

The Brain



[<http://www.drsyrasderksen.com/uploads/2/1/3/7/21378714/1378733765.jpg>]

The Brain

- Very good at making **rational decisions**,
but not perfect
- **Working prototype** for AI
- *Not modular* like software
- Hard to *reverse engineer*

The Brain

"Brains are to intelligence as wings are to flight"

Learn from the Brain

- Keys to *decision-making*:
simulation & memory
- Analogous to **planning & machine learning**

History of AI

"In order to do something original, you have to understand the work of those who came before you."

History of AI

1940-50s: Early days

- 1943: McCulloch and Pitts: Boolean circuit model of brain (**artificial neurons**)
- 1950: Turing's paper *Computing Machinery and Intelligence* (**Turing test**)

History of AI

1950-70s: Excitement

- 1950s: Early AI programs: checkers, etc
- 1956: **Dartmouth meeting**: McCarthy et al adopted the term *Artificial Intelligence*
- 1965: ELIZA chatterbot

History of AI

1970-90: Knowledge-based approaches

- 1970s: **knowledge-based systems**: store info / facts about the world
- 1980-88: Expert systems industry **booms**
- 1988-93: Expert systems industry **busts**;
AI Winter

History of AI

1990-2010: Statistical Approaches

- Resurgence of **probability**, focus on **uncertainty**: accept that *nothing is perfect*
- General increase in technical depth
- Agents and learning systems (ML)
- Robotics
- **AI Spring**

History of AI

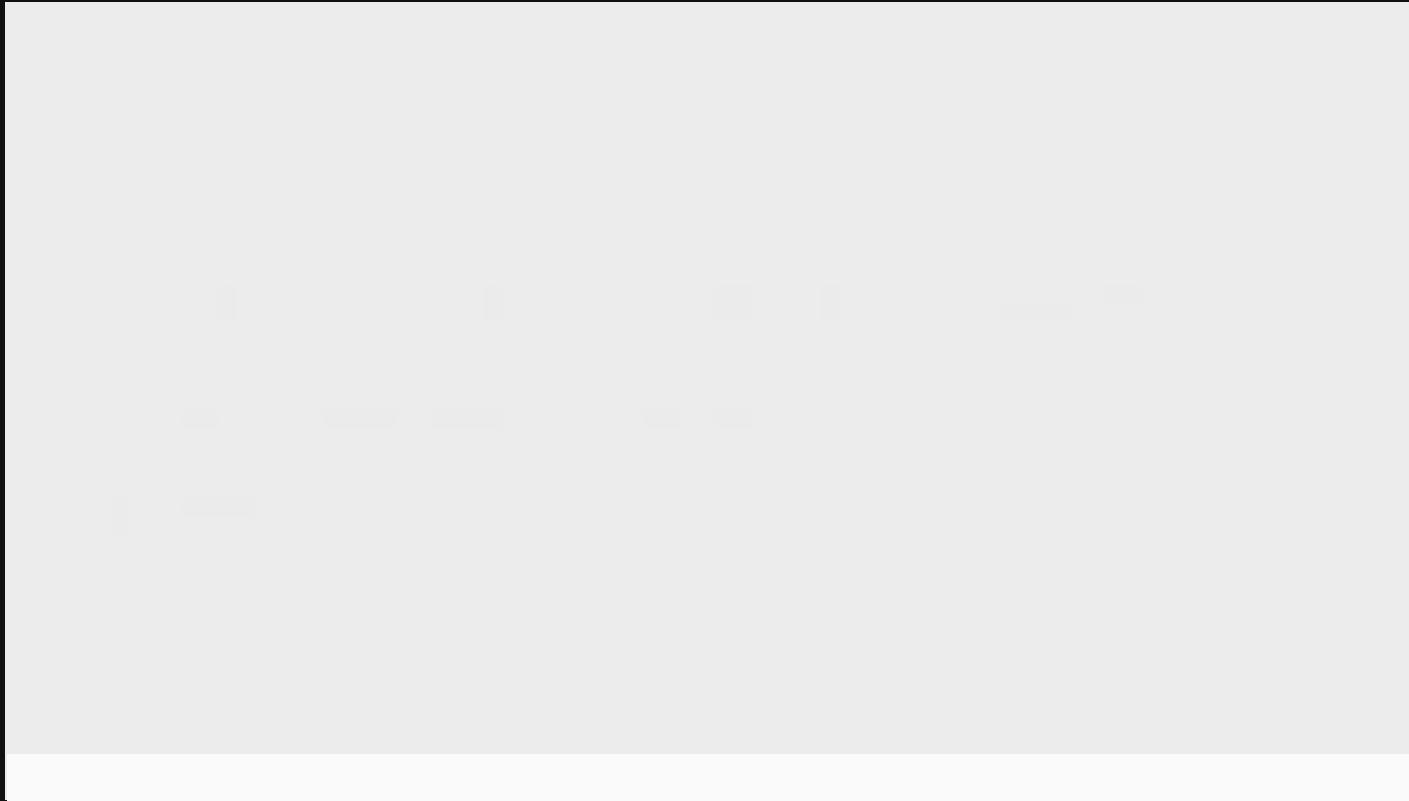
2010-present: Deep Learning

- Big Data
- Machine Learning at large scale
- Computer Vision, NLP
- AI Apps

What can AI do now?

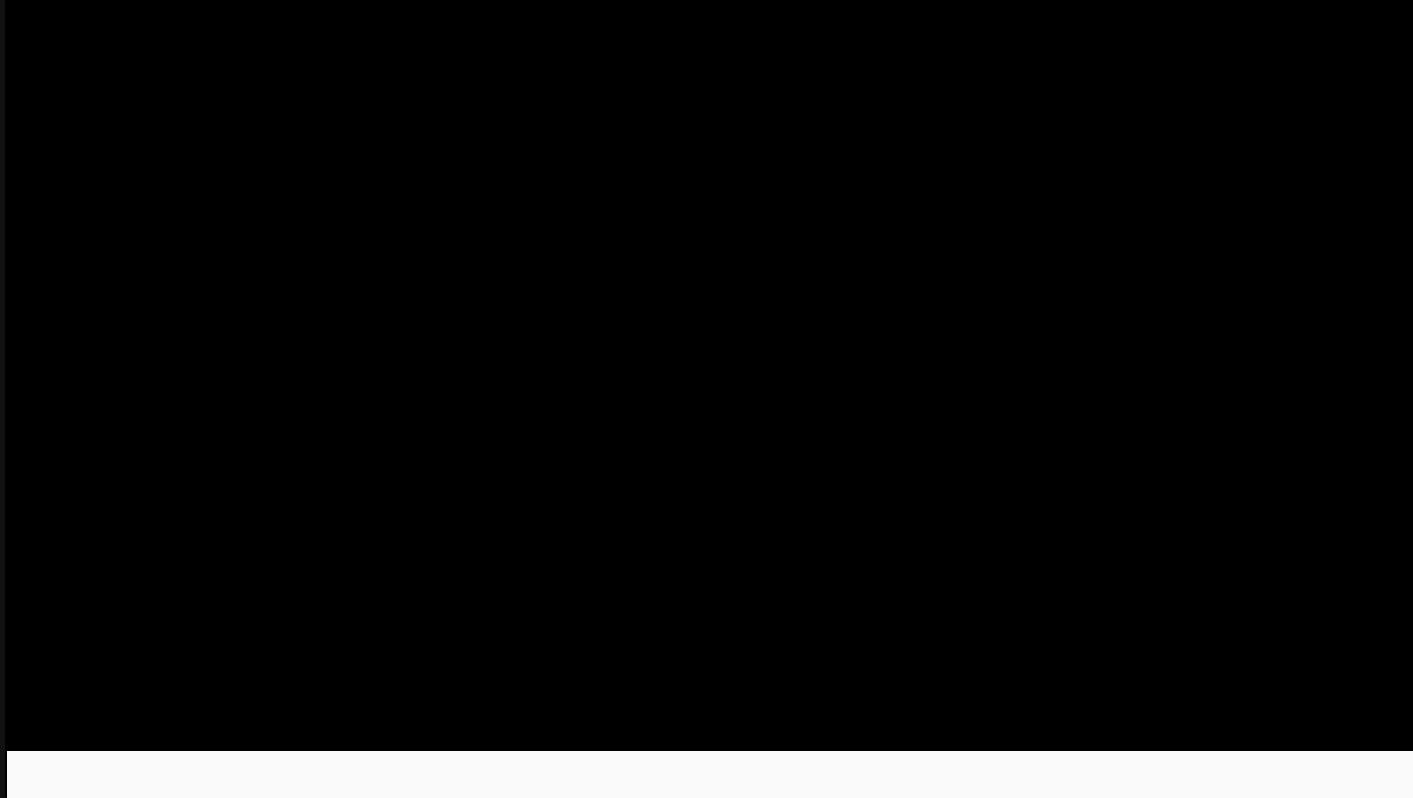
- Play a decent game of Table Tennis? (**Yes**)
- Play a decent game of Jeopardy? (**Yes**)
- Drive safely along a curving mountain road? (**Yes**)
- Drive safely along a busy city street? (**Yes**)

Play Table Tennis



[https://www.youtube.com/watch?v=t_qN3dgYGqE]

Self-Driving Car

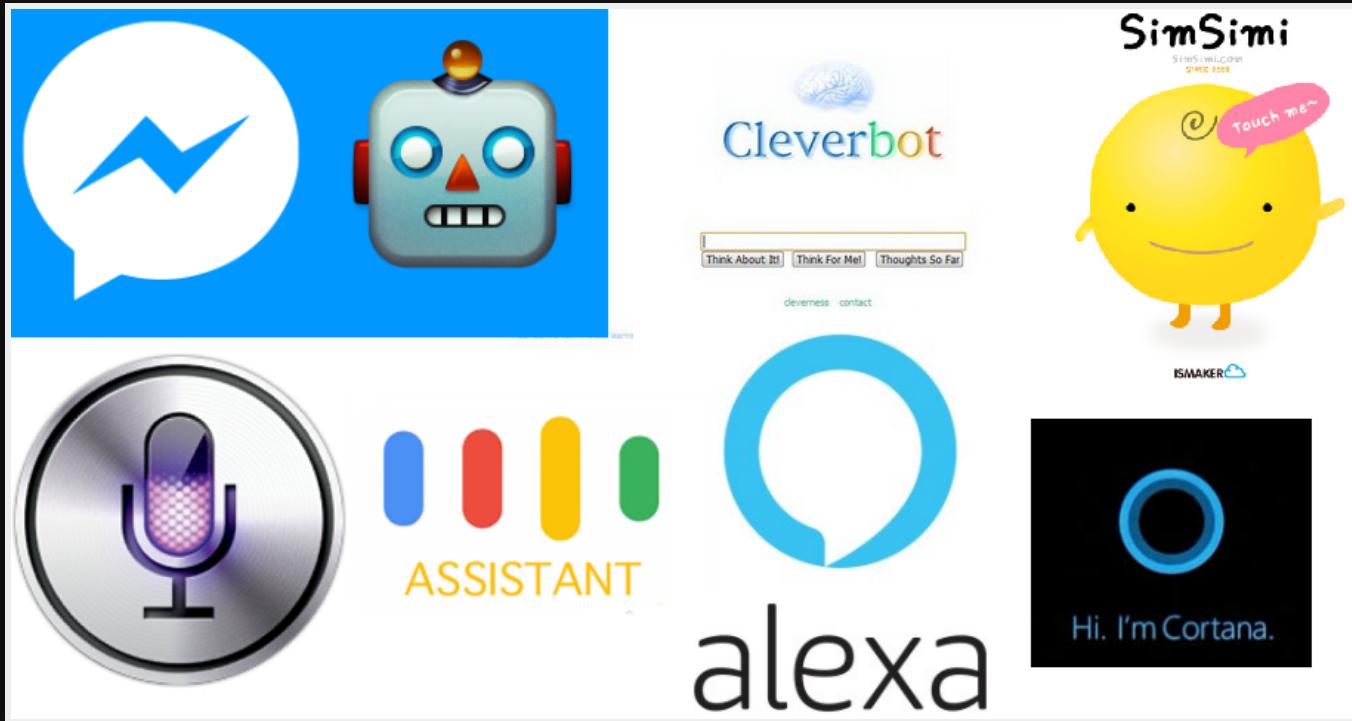


[<https://www.youtube.com/watch?v=fmVWLr0X1Sk>]

What can AI do now?

- Buy groceries online (**Yes**)
- Buy groceries from the mall (**No**)
- Discover and prove a new mathematical theorem (?)
- Converse successfully with another person for an hour (?)

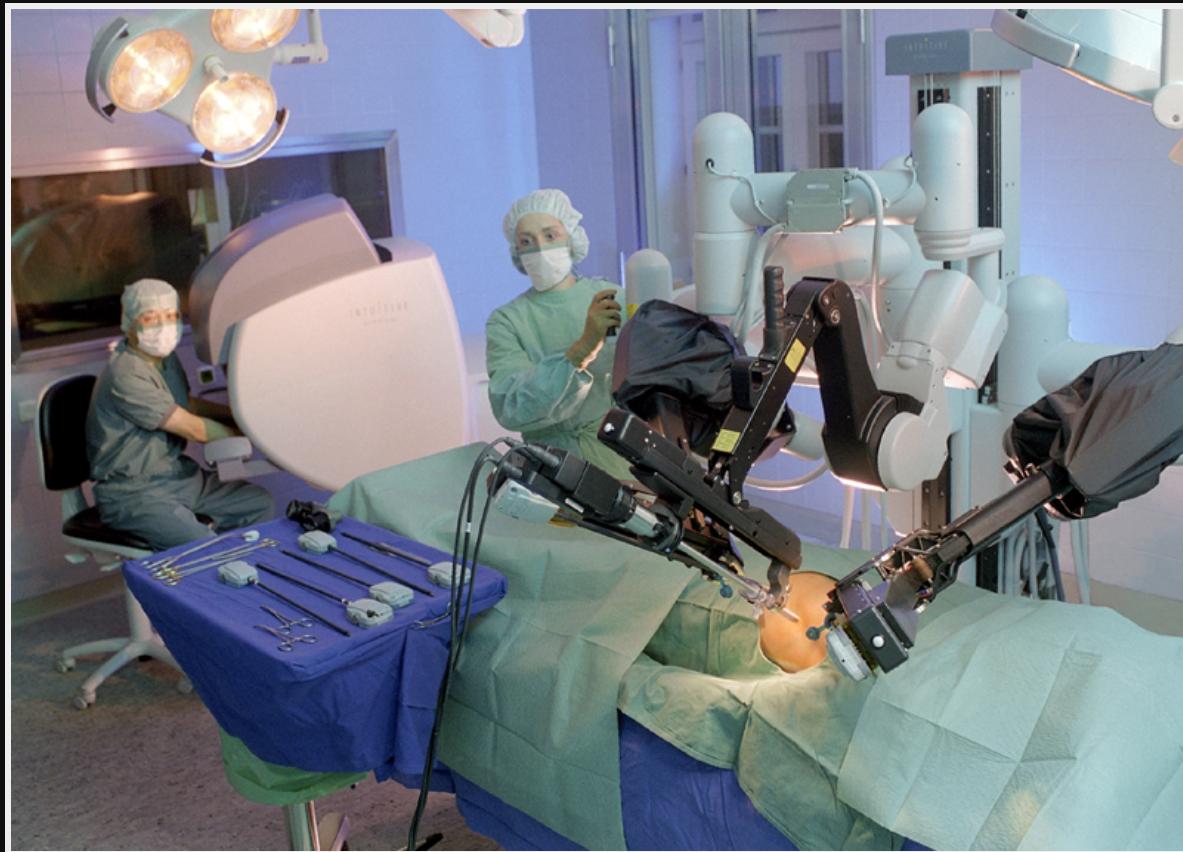
Chatbots & IPAs



What can AI do now?

- Perform surgical operation (?)
- Put away dishes and fold laundry (**Yes**)
- Translate spoken Chinese to spoken English in real time (**Yes**)
- Write intentionally funny stories (**No**)

Robotic Surgery



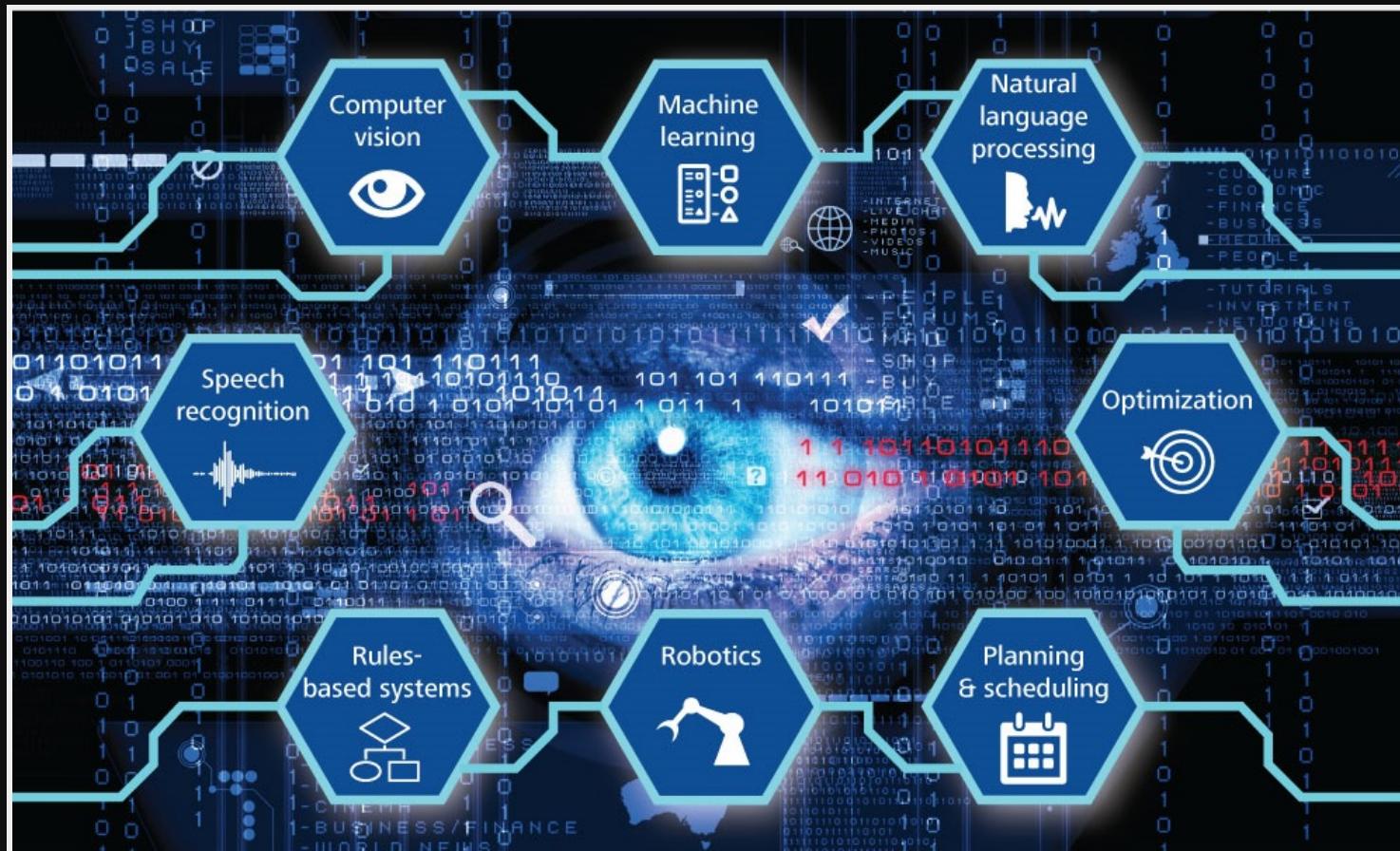
[<https://arabiangazette.com/wp-content/uploads/2012/03/da-vinci-robotic-surgery.jpg>]

Robot Maid



[<https://www.youtube.com/watch?v=G5Vd9k3-3LM>]

AI Applications



[http://siliconvalleynest.com/wp-content/uploads/2016/05/DUP_1030-Figure-1_Cognitive-technologies.jpg]

AI Applications

- Language
- Vision / Perception
- Robotics
- Logic
- Game Playing
- Decision Making

AI: Language

Speech Technologies

- Automatic speech recognition (ASR)
- Text-to-speech synthesis (TTS)
- Dialog systems
- *Examples:* Siri, Youtube Closed Captioning, Waze, Facebook Chatbots

AI: Language

Language Processing Technologies

- Question Answering (*IBM's Watson*)
- Machine Translation (*Google Translate*)
- Web Search (*Google*)
- Text classification (*spam filter*)

AI: Vision

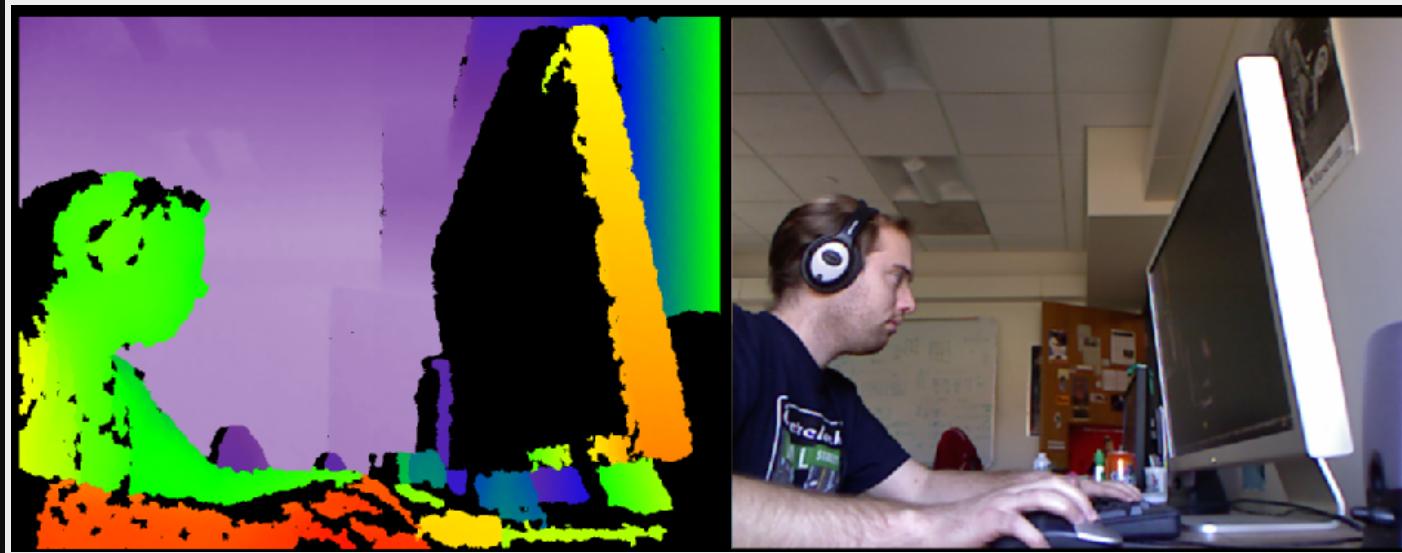
- Object and face detection
- Object and face recognition
- Image segmentation
- Image classification

Kinect



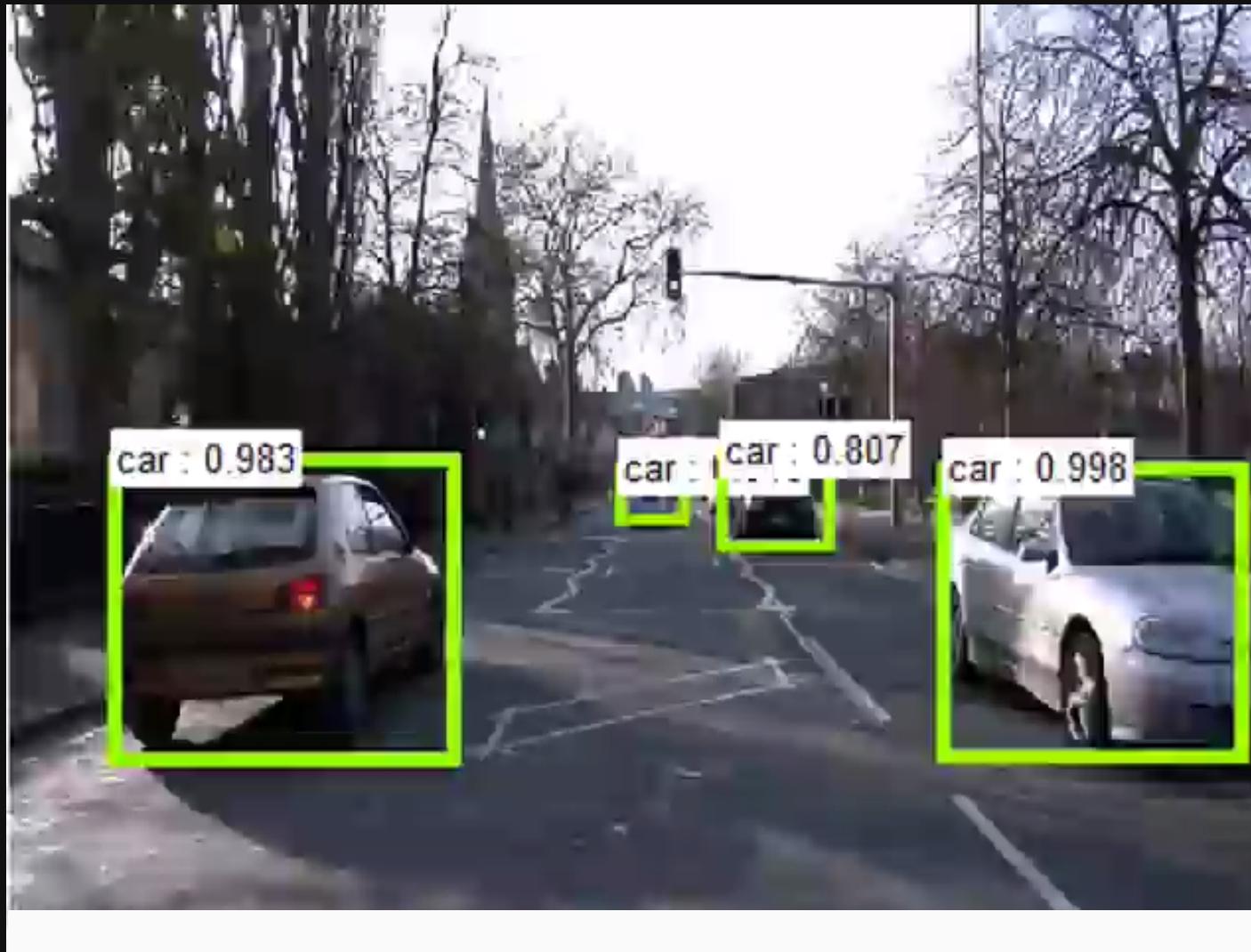
[<https://www.generationrobots.com/img/cms/Kinect-sensor.png>]

Kinect



[<https://graphics.stanford.edu/~mdfisher/Images/KinectSensors.png>]

Object Detection & Recognition



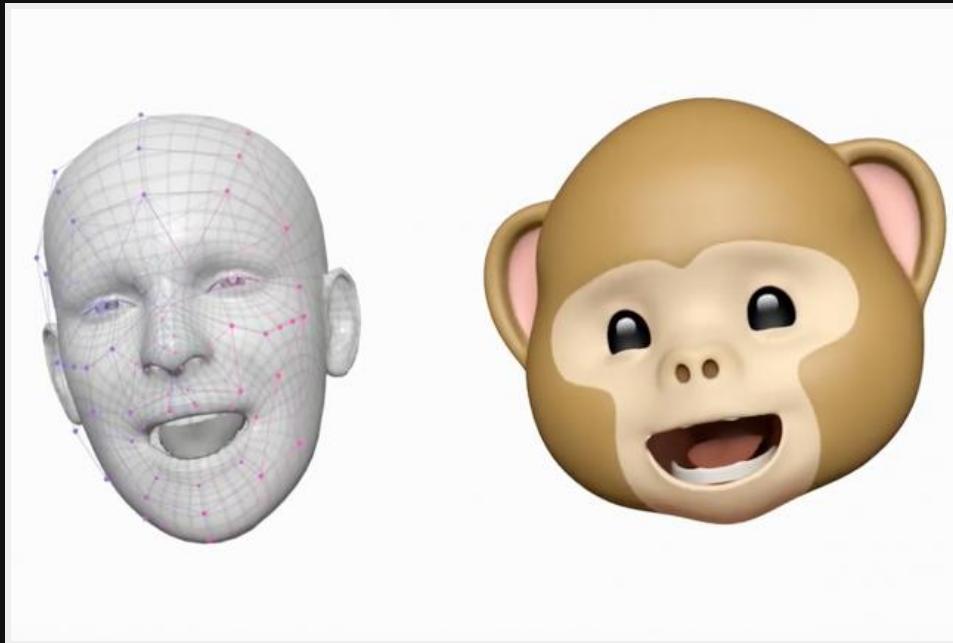
[<https://www.youtube.com/watch?v=WZmSMkK9VuA>]

iPhone Face Recognition



[https://media.wired.com/photos/59b9b4eb9365592813946818/master/pass/FaceID_15005315.jpg]

iPhone Animoji



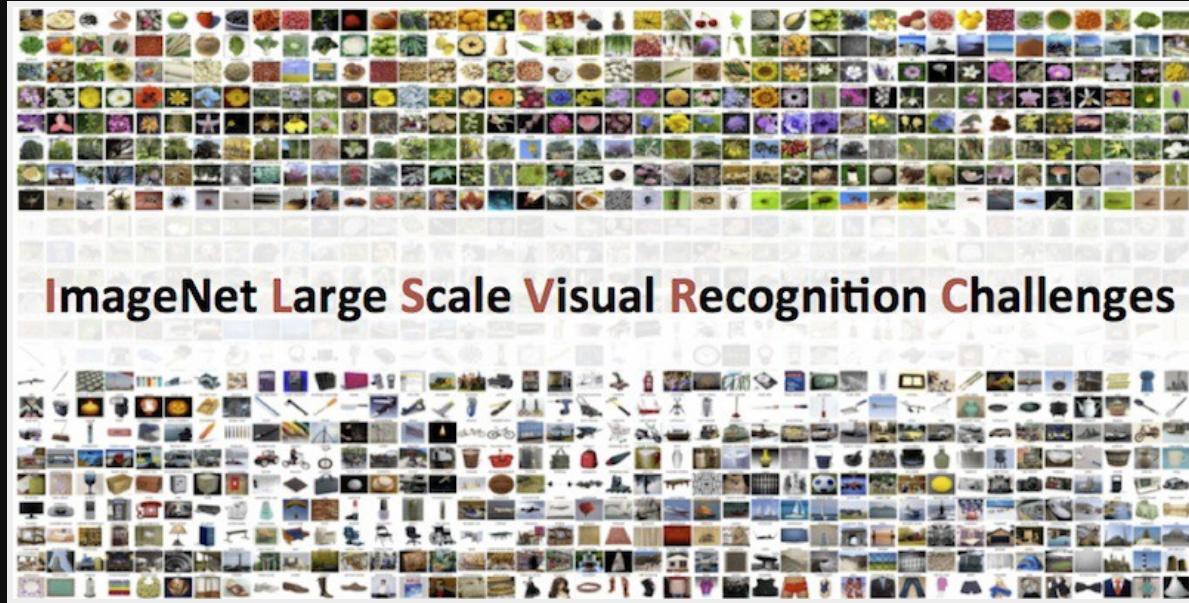
[<http://gaia.adage.com/images/bin/image/x-large/Apple---Meet-iPhone-X-17.jpg>]

Image Segmentation



[https://vision.in.tum.de/_media/spezial/bib/hazirbas2014msc.jpg]

ImageNet



[https://cdn-images-1.medium.com/max/1600/1*ci-wnR1A-F_RlCC_FJ6rfw.jpeg]

AI: Robotics

- **Robotics**: mechanical engineering + AI
- Reality much harder than *simulations*
- Used in vehicles, rescue, soccer playing, etc.

Waymo

Google Self-Driving Cars



RoboCup AIBO League



RoboCup AIBO League



Towel Folder



Cloth Grasp Point Detection
based on Multiple-View Geometric Cues
with Application to Robotic Towel Folding

Jeremy Maitin-Shepard
Marco Cusumano-Towner
Jinna Lei
Pieter Abbeel

Department of Electrical Engineering and Computer Science
University of California, Berkeley

International Conference on Robotics and Automation - 2010

ASIMO

First *two-legged* **humanoid** robot



Boston Dynamics



AI: Logic

- Theorem provers
- Question answering
- Deduction systems
- Constraint satisfaction
- Satisfiability solvers
- NASA fault diagnosis

Theorem Proving

- **Robbin's conjecture:** proved using a theorem prover
- *Brute force proving:* computer checks all 4.7 billion possibilities

AI: Game Playing

- *Chess*: DeepBlue
- *Go*: AlphaGo
- Computer Game bots (DotA, CS, NBA 2K)

Deep Blue

Garry Kasparov: Chess world champion



1996: Deep Blue vs Kasparov

- **Kasparov** beats Deep Blue, 4-2
- "I could feel... a new kind of intelligence across the table" (Kasparov, 1996)

1997: Deep Blue vs Kasparov

- **Deep Blue** beats Kasparov, 3.5-2.5
- "Deep Blue hasn't proven anything"
(Kasparov, 1997)

Deep Blue vs Kasparov



Deep Blue

- IBM supercomputer
- Processed **200M** board positions per second
- *Intelligent, creative* play
- Humans understood 99% of Deep Blue's moves

AlphaGo



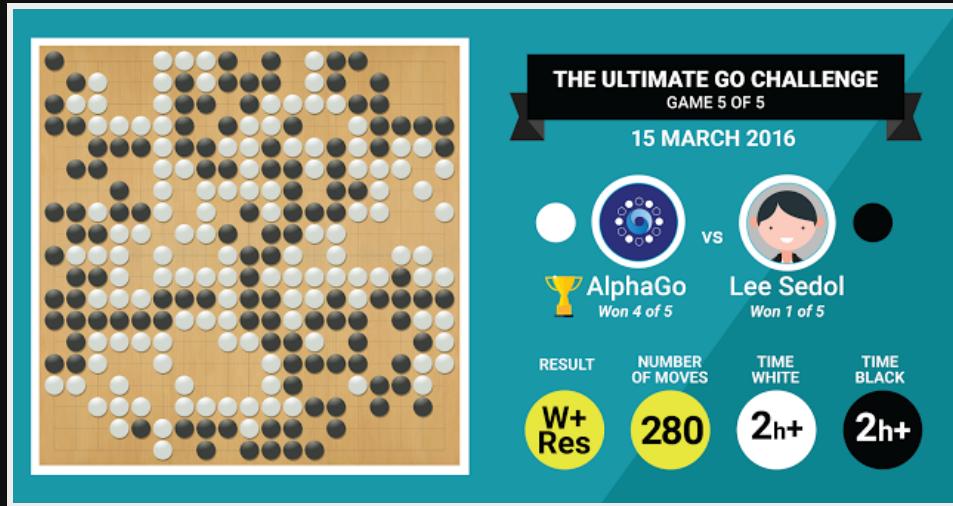
[<https://www.alphagomovie.com/images/share-700x366.jpg>]

AlphaGo

- **AlphaGo**: Google DeepMind
- **Lee Sedol**: 18-time Go world champion
- Seoul, South Korea, 2016
- Winner gets **\$1 million**

AlphaGo vs Lee Sedol

AlphaGo beats Lee Sedol, 4-1



[http://www.usgo.org/news/wp-content/uploads/2016/03/2016.03.15_deeplearning.png]

AlphaGo vs Lee Sedol



[<https://i.ytimg.com/vi/7jXQq3yp6Rs/hqdefault.jpg>]

AI: Decision Making

- Most AI applications = **automation**
- Some decision problems are hard to do by hand, need computer assistance

AI: Decision Making

- **Scheduling:** Airline routing, Final exam, Course timetable
- **Route Planning:** Google Maps, Waze
- Medical **diagnosis**
- Web **search** engines

AI: Decision Making

- **Spam** classifiers
- Automated **help** desks
- **Fraud** detection
- Product **recommendation**

Major AI Fields

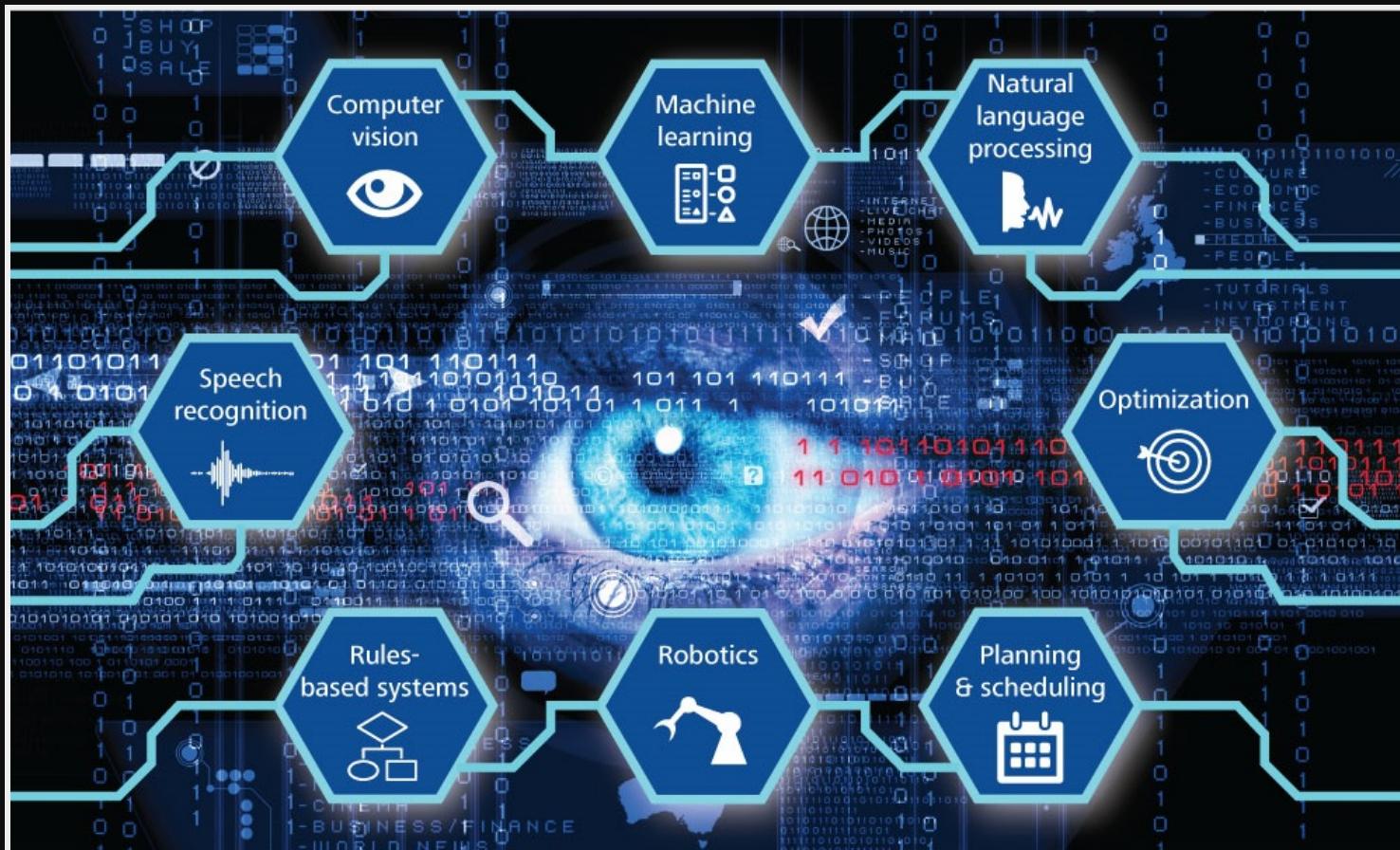
- Computer Vision (CV)
- Natural Language Processing (NLP)
- Robotics
- Machine Learning (ML)
- Knowledge Representation (KR)
- Automated Reasoning (Logic)

Turing Test

To pass **Turing test**, computer needs all six:

- CV for **perception**
- NLP for **communication**
- Robotics for **action**
- ML for **learning**
- KR for **storing & organizing info**
- AR for **logic**

AI Applications



[http://siliconvalleynest.com/wp-content/uploads/2016/05/DUP_1030-Figure-1_Cognitive-technologies.jpg]

Summary

- AI: machines that **act rationally**
- Simulation & Memory →
Planning & Learning
- Brief History of AI
- AI applications

Next Meeting

- Agents and Environments
- Problem-Solving as Search

Assignment

- AI in **Pop Culture** (movies, tv series, etc)
- **Videos** of Robots / other AI applications
- Post the links as a comment on Facebook Group, and add a **brief description**
- No **duplication** (first-come, first-served)
- Most reacts/likes = bonus points

References

- *Artificial Intelligence: A Modern Approach, 3rd Edition*, S. Russell and P. Norvig, 2010
- CS 188 Lec 1 slides, Dan Klein, UC Berkeley

Questions?