

CSE 604

# Artificial Intelligence

## Chapter 1: Introduction

Adapted from slides available in Russell & Norvig's textbook webpage

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# Objectives

- To **define** what Artificial Intelligence (AI) is
- To give an overview of **topics** to be covered in this course
- To look at some **applications** of AI
- To get an idea about the **state of the art** in AI

# What is AI?

- AI is a relatively new field - started at the end of the 1940s
- The name “Artificial Intelligence” was coined by John McCarthy in 1956
- Two of the many definitions of Artificial Intelligence are:

“AI is an attempt to understand intelligent entities and to build them” (Russell and Norvig, 1995)

“AI is the design and study of computer programs that behave intelligently” (Dean, Allen, and Aloimonos, 1995)

What is an “intelligent entity” or what does it mean to “behave intelligently”?

“The aggregate or global capacity to act purposefully, to think rationally, and to deal effectively with its environment” (Wechsler, 1958)

My favorite definition of AI

“The study of how to make computers do things at which, at the moment, humans are better” (Rich and Knight, 1991)

# What is AI? (cont.)

AI can be seen as an ensemble of ideas & techniques for:

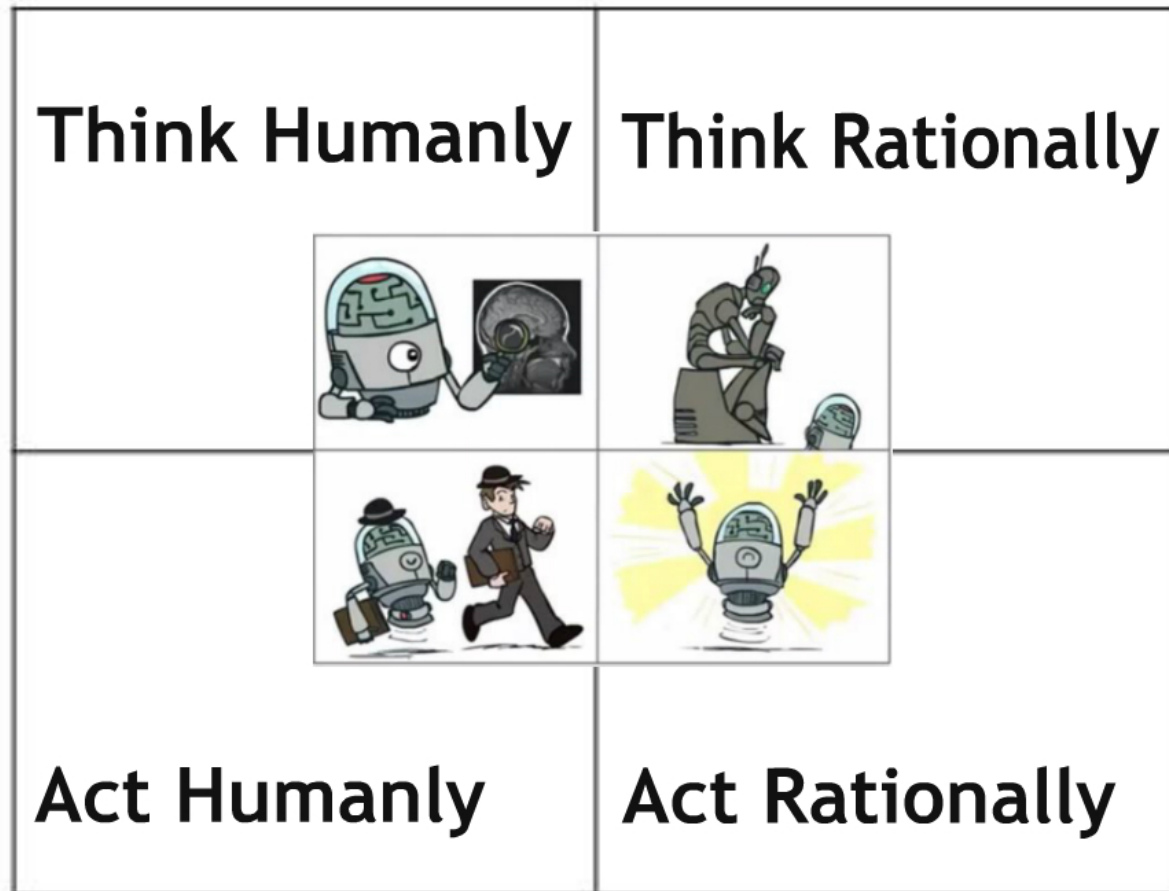
- representing knowledge
- using knowledge to solve problems

with two goals:

- Engineering Goal:
  - To solve real-world problems using AI
- Scientific Goal:
  - To explain various sorts of intelligence

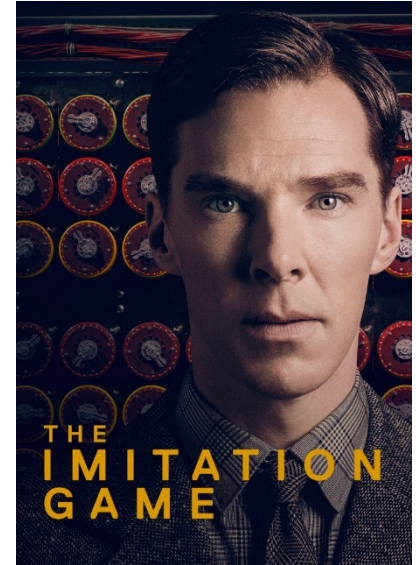
# What is AI? (cont.)

Views of AI fall into four categories:

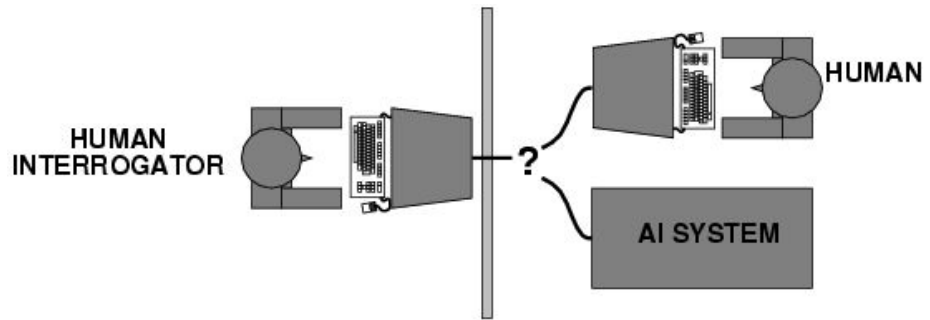


# Acting humanly: Turing Test

- Alan Turing (1950) "Computing machinery and intelligence":
- "Can machines think?" "Can machines behave intelligently?"
- Operational test for intelligent behavior: [the Imitation Game](#)



**The test:** A computer is interrogated by a human through a terminal and passes the test if the interrogator cannot tell if there is a computer or a human at the other end.



# Acting humanly: Turing Test (cont.)

- To pass the Turing test a machine will need to:
  1. represent knowledge
  2. reason automatically
  3. learn
  4. process natural language
- For the TOTAL Turing test (which includes also a video signal so that the interrogator can test the subject's perceptual abilities) the machine will also need to:
  5. “see” (computer vision)
  6. “move” (robotics)
- In 2014, a chatbot named “[Eugene Goostman](#)” claimed to have passed the Turing test, but was later dismissed by critics.

# Thinking humanly: cognitive modeling

- Requires scientific theories of internal activities of the brain
- Three ways to do this
  - **Introspection** – catching one's own thoughts
  - **Psychological experiments** - predicting and testing behavior of human subjects
  - **Direct identification** - from brain imaging and neurological data
- Cognitive Science brings together computer models from AI and techniques from psychology
- Problem:
  - We know very little about how human brain works!
  - Experimenting on humans is costly and imprecise



# Thinking rationally: "laws of thought"

- Aristotle: what are “the right” arguments/thought processes?
- **Syllogisms** provide patterns for argument: always yield correct conclusions when correct premises are given.
  - “Socrates is a man. All men are mortal.
  - Therefore, Socrates is mortal”
- Logicians in the 19<sup>th</sup> century developed a notation for statements about all kinds of objects in the real world.
- Problems:
  1. Not all intelligent behavior is mediated by logical deliberation
  2. Difference between solving problems “in principle”, and solving them in practice

# Acting rationally: rational agent

- Rational behavior: doing the right thing
- The right thing: that which is expected to maximize goal achievement, given the available information
- Doesn't necessarily involve thinking – e.g., blinking reflex – but thinking should be in the service of rational action

## Advantages:

- More general than the “laws of thought” approach
- More amenable to scientific development than approaches based on human behavior or human thought

This course will focus on building rational agents

# The Foundations of AI

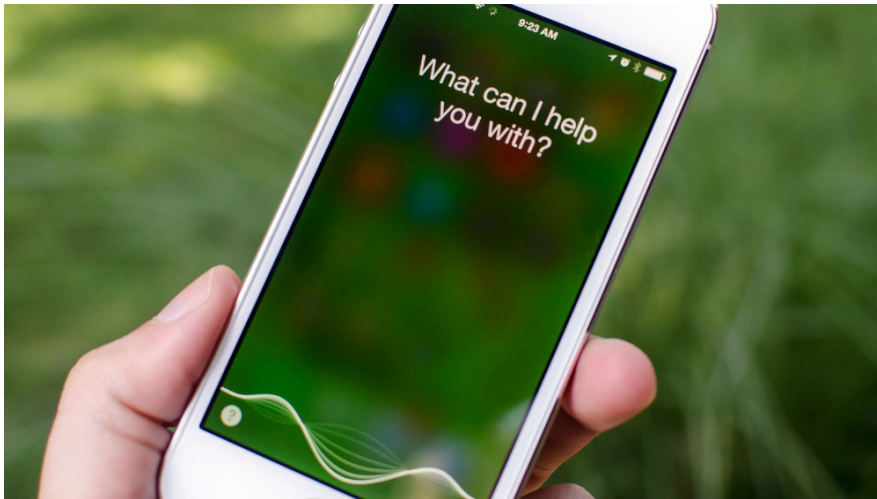
- **Philosophy**      Methods of reasoning, mind as a physical system, foundations of knowledge and learning
- **Mathematics**      Formal representation and proof, algorithms, computation, (un)decidability, (in)tractability, probability
- **Economics**      Formal theory of rational decisions
- **Neuroscience**      Physical substrate for mental activity
- **Psychology**      Experimental techniques on human and animal behavior
- **Computer engineering**      Building fast and efficient computers
- **Linguistics**      Knowledge representation, human interaction

# Overview of Topics in this Course

- **Introduction, Intelligent Agents**
- **Problem-solving techniques:**
  - Blind Search, Heuristic Search, Optimal search, Adversarial Search (Game Playing), Constraint Satisfaction
- **Knowledge representation and Logical reasoning**
- **Machine Learning**
- **Applications of AI**
  - Computer vision, Natural language processing, Robotics

# AI in everyday life

## Personal assistants



[Bgr.com/tag/siri](https://Bgr.com/tag/siri)

## Recommendation Systems

**NETFLIX**

**amazon**

**You Tube**

# AI in everyday life (cont.)

Email categorization,  
Spam filtering



<https://sendpulse.com/support/spam-filter>

Fraud prevention,  
Credit decisions



<https://www.cafecredit.com/free-credit-score>

# AI in everyday life (cont.)

- Face and Object recognition
  - Facebook, Pinterest



<https://www.classaction.org/blog/facebook-sued-over-face-recognition-feature>

# AI Success stories

- Game Playing
  - DeepBlue beats Gary Kasparov (1997)



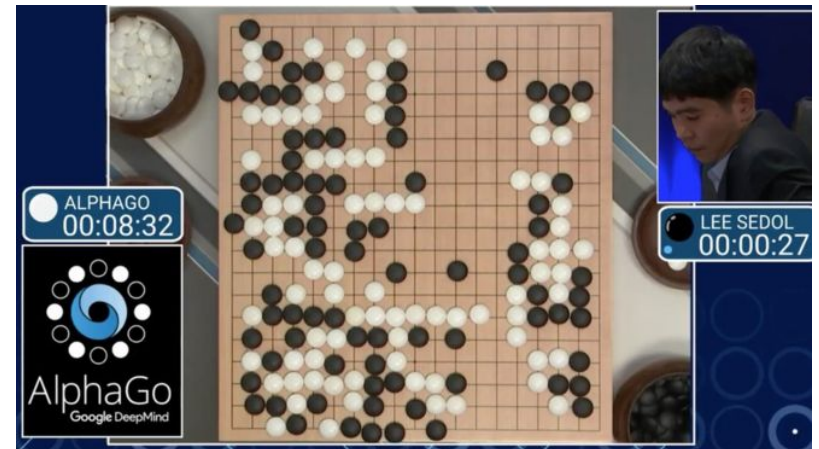


# AI Success stories (cont.)

- Game Playing
  - IBM Watson wins Jeopardy! (2011)
  - AlphaGo beats world champion Go player (2016)



<https://www.technobuffalo.com/2013/05/21/ibm-watson-smartphone-ap/>



<http://www.bbc.com/news/technology-35785875>

# AI Success stories (cont.)

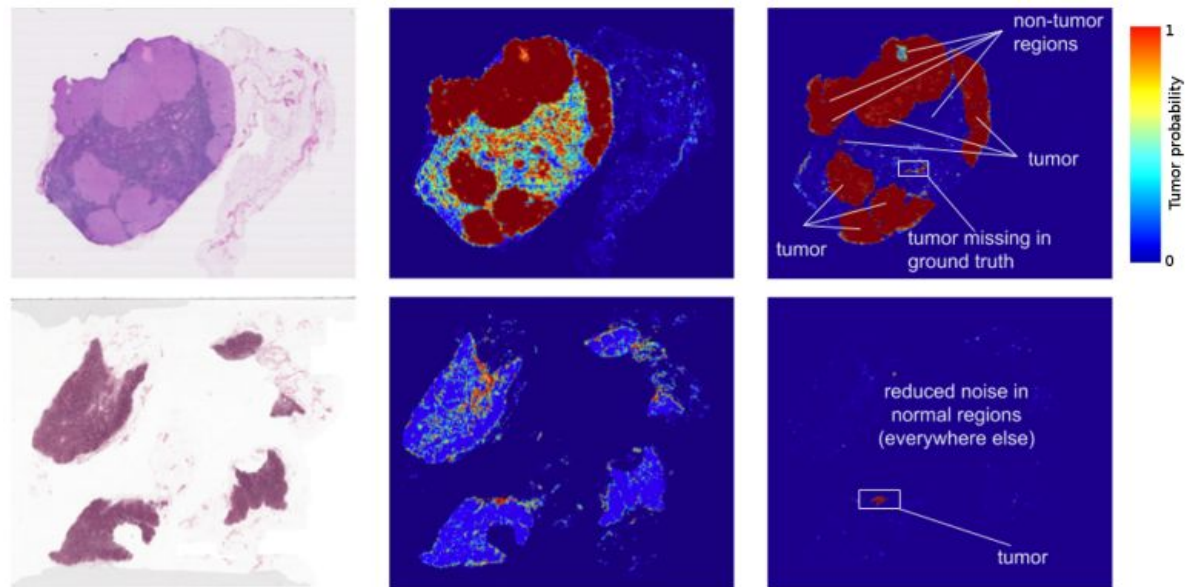
- Autonomous vehicles
  - Google self-driving car, Tesla autopilot



<https://www.tesla.com/videos/autopilot-self-driving-hardware-neighborhood-long>

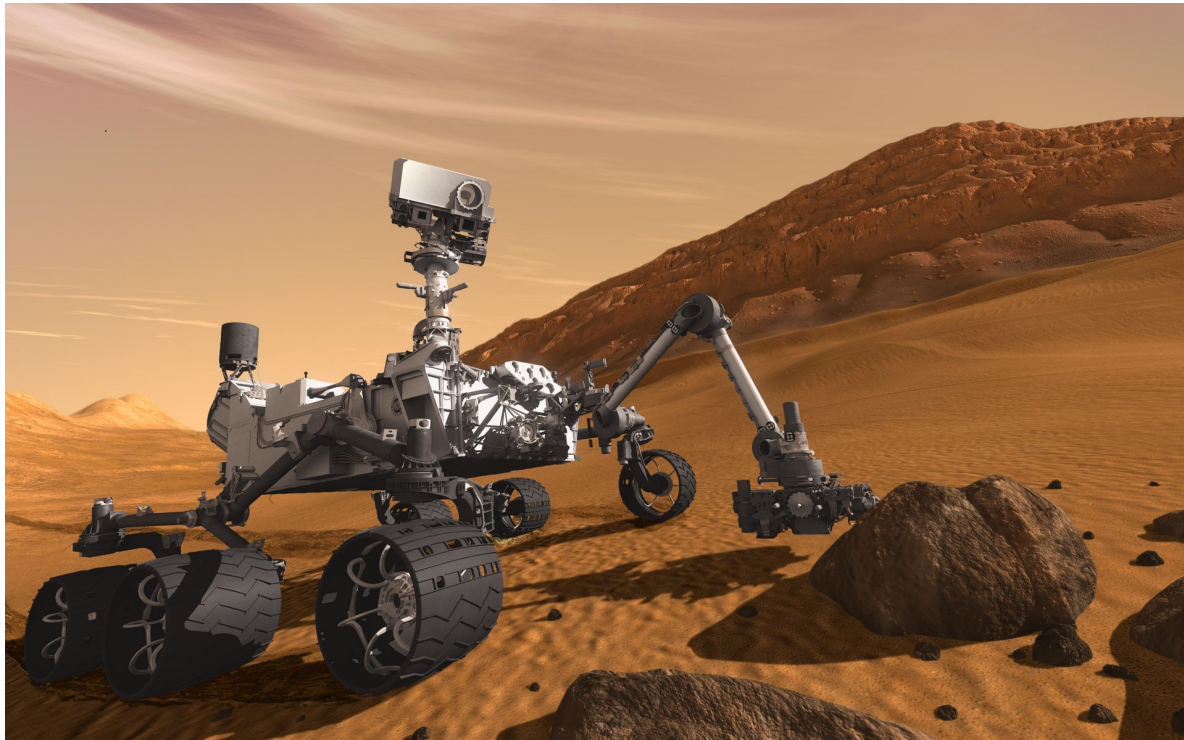
# AI Success stories (cont.)

- Theorem Proving
  - Proved a mathematical conjecture (Robbins conjecture) unsolved for decades
- Medical diagnosis
  - AI systems outperformed human experts in blood infection diagnosis and lung cancer diagnosis



# AI Success stories (cont.)

- Robot explorers
  - Mars exploration rovers designed at the NASA Jet Propulsions Laboratory.
  - In 2016, NASA installed a new AI system called AEGIS in the Curiosity rover, enabling it to choose targets autonomously.



<https://www.jpl.nasa.gov/missions/mars-science-laboratory-curiosity-rover-msl/>



# AI Success stories (cont.)

- Image processing
  - Using deep neural networks, possible to identify and categorize objects in images



"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."



"girl in pink dress is jumping in air."



"black and white dog jumps over bar."



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

# AI Success stories (cont.)

- AI generated images
  - Using prompts, AI can synthesize never-before-seen images



# AI Success stories (cont.)

- Language synthesis



রবীন্দ্রনাথ ঠাকুরের মতো করে একটি গরু রচনা লিখ



গরু, তোমার মাঝে বেড়েছে গ্রাম্য সহজতা।  
তোমার আগুনে ধীর জ্বলে যায় প্রকৃতির প্রেম।  
তোমার চোখে অপরূপ শান্তির আবেগ।  
বিশ্বজনীন তোমার আঁচলে বসছে বিপ্লবের গীত।

হে গরু, তোমার চাষে সবুজ ক্ষেতে  
বৃষ্টির সুগন্ধ ছড়ায় প্রকৃতির দৃষ্টিতে।  
তোমার গোলাপী পশুপাখি আকর্ষণ করে,  
স্বপ্নের ভিতরে তোমার সুর ঘোষণা করে।

গর্বিত তোমার শিং, সত্যের প্রতীক,  
ধর্মের আলোকিত মসজিদের হতে প্রণম নামিয়েছে।  
তোমার গর্জনে উঠে পৃথিবীর আবেগ,  
বিশ্বজনীন তোমার সঙ্গে পথ চলে চলে।

গরু, তোমার মধুর গল্প গান,  
করুণাময় হৃদয়ে জীবনের বিপুল শ্রঙ্গ।  
তোমার প্রেমধ্বনি ছায়ায় আনন্দিত,  
সকলের হৃদয়ে ছড়ায় প্রেমের সুরাঙ্গ।



কাজী নজরুল ইসলামের মতো করে একটি গরু রচনা লিখ



গরু, তুমি ধূলোপাতালে খুঁজে পাওয়া মহান প্রাণী।  
তোমার শুভ্র দেহে মেঘমালার মত বিচ্ছিন্ন স্পর্শ।  
জ্বলন্ত নয়ন থেকে ছড়িয়ে আসা অগ্নিপালা,  
আকাশবানী রহস্যময় উচ্ছ্বসিত করে তোমার মুখ।

তোমার আড়ম্বরে বৃষ্টিকে ধরে রাখা হল সত্যের বিপ্লব,  
কাদম্বিনীর মতো তুমি হলে প্রকৃতির সবুজ পাখি।  
জনতার সোনালী আশা তুমি বাণী কর সুন্দর,  
আকৃতিশূন্য হৃদয়ে দুঃখের স্বর বাজাও গুরুত্বপূর্ণ।

গরু, তোমার আঘাত যার প্রেমপাত্র হয়ে উঠে,  
পশুপাখির মতো গায়ে বৃষ্টিকে সমর্পণ করে।  
আকাশের সীমানায় তোমার আবেগ ছাড়ায় ছুঁড়িয়ে,  
সৃষ্টিমাতার সান্ত্বনা রচনা করো তোমার গীত।

গরু, তোমার মধুর স্পর্শে প্রকৃতির উদগার,  
বাঁচতে যাচ্ছে নারীর শক্তি, যুদ্ধকে হারানো পাথর।  
তোমার চাষে প্রকৃতি কান্না করে আনন্দিত,  
স্বপ্নের ভিতরে বসে প্রেমের নীলাঞ্জলি।



# Final remarks



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