

CS 480/580

Introduction to Artificial Intelligence

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Reading for Next Class:
Chapter 1, Textbook
Syllabus

About Me

- Ph.D. from University of Rhode Island
- My research
 - Machine Learning and Data Mining
 - Multi-view Learning
 - Transfer Learning
 - Imbalanced Learning
 - Few-shot Class Incremental Learning
- How about you?
 - Name/Year/Major
 - Expectation from this course

Administrivia

- Class Web Page
 - Canvas
- Instructional E-mail Address
 - lusili@cs.odu.edu
- Instructor: Lusi Li
 - Office phone: 757-683-7822
 - Office location: 3214 E&CS
 - Office hours:
 - Thursday: 4:30PM-5:30PM
 - Or by appointment
- TA: Yash Prakash
 - Email address: yprak001@odu.edu

Administrivia

- Grading Policy
 - Four Assignments: 40%
 - Homework 1: 23:59 pm on 02/01 (on Canvas)
 - Homework 2: 23:59 pm on 02/27 (on Canvas)
 - Homework 3: 23:59 pm on 04/04 (on Canvas)
 - Homework 4: 23:59 pm on 04/18 (on Canvas)
 - Late Assignment Policy (without a valid reason)
 - 0~24 hrs: -5%
 - 24~48 hrs: -10%
 - >48 hrs: grade = 0
 - Midterm Exam: 30%
 - 8:00 am on 02/09 – 23:59 pm on 03/01 (3 hours on Canvas)
 - Final Exam: 30%
 - 8:00 am on 04/25 – 23:59 pm on 04/26 (3 hours on Canvas)

Honor Code

- All assignments, unless explicitly specified, are to be completed on your own
- Use of ChatGPT
- ODU Honor Council
 - <http://orgs.odu.edu/hc/>
- Evidence of cheating, plagiarism, or unauthorized collaboration will result in a 0 grade for quiz/assignment/exam
 - May have further consequences

How to get help?

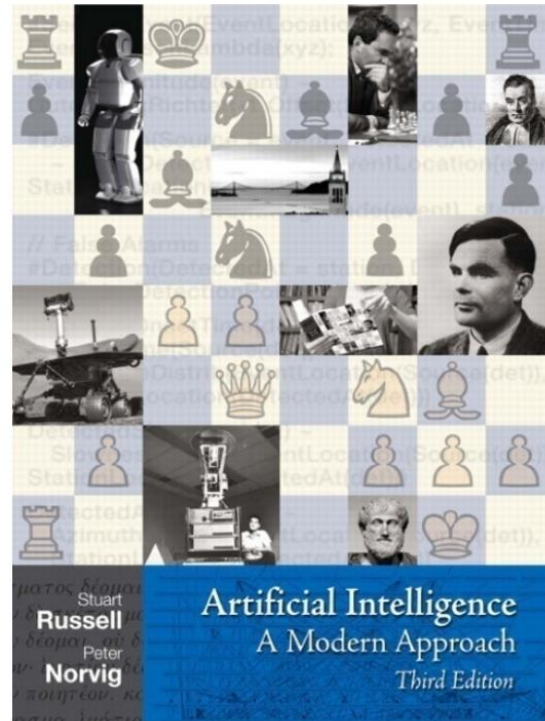
- Ask questions in class (or after class)
- Attend office hours
- Email me
 - Make sure that you put “CS480” or “CS580” in your subject line
 - Send it from your .odu.edu account
 - It wouldn't come to my spam folder
 - State clearly what you need in your email

How To Get an A in This Course

- Attend classes
- Review class notes and books
 - Review class notes
 - Review book chapters
- Be aware of resources
 - Check with the course website about
 - Recorded lectures
 - Resources online
 - Check with classmates about material from missed lectures
- Start working on your assignment early
 - How to start virtuous (as opposed to vicious) cycle
 - How not to cheat

Textbook

- **Artificial Intelligence: A Modern Approach,**
3rd/4th Edition, by Stuart Russell and Peter Norvig



Introduction to AI

- What is AI?
- What can AI do?
- What is this course?

Introduction to AI

- What is AI?
- What can AI do?
- What is this course?

What is AI?

- **AI is the science of creating**

	Like humans	Not necessarily like humans
Think	Systems that think like humans	Systems that think rationally
Act	Systems that act like humans	Systems that act rationally

**Intelligence: human vs. rational
thought vs. behavior**

What is AI?

- Acting Like a Human
 - *Functions that require intelligence when performed by people* (Kurzweil, 1990)
 - *Making computers do things people currently do better* (Rich and Knight, 1991)
- Thinking Like a Human
 - *Machines with minds* (Haugeland, 1985)
 - Automation of “decision making, problem solving, learning...” (Bellman, 1978)
- Thinking Rationally
 - Computational models of mental faculties (Charniak and McDermott, 1985)
 - Computations that make it possible to *perceive, reason, and act* (Winston, 1992)
- Acting Rationally
 - Explaining, emulating intelligent behavior via computation (Schalkoff, 1990)
 - Branch of CS concerned with automation of intelligent behavior (Luger and Stubblefield, 1993)



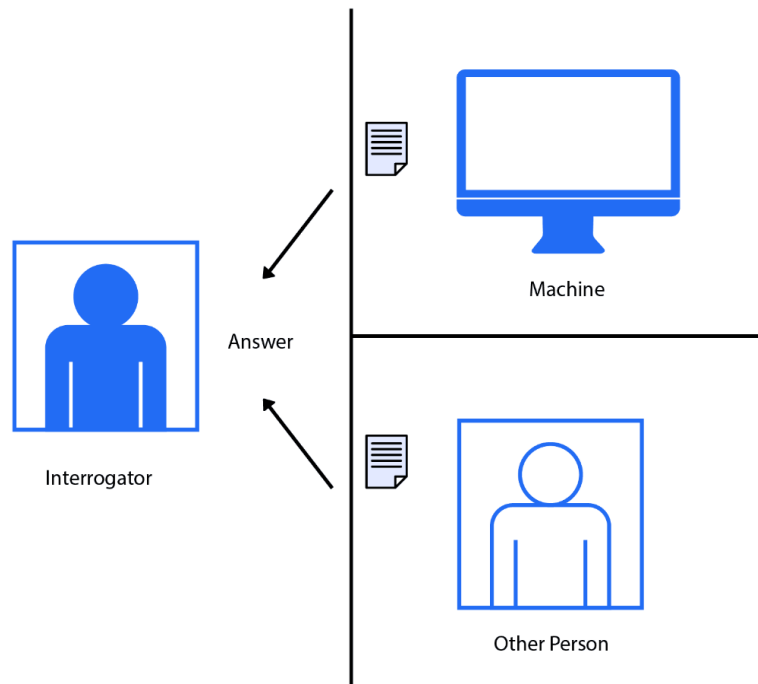
Acting Like a Human:

- Goal of Artificial Intelligence
 - Make machines “intelligent”
- Can machines think?
 - Vitally important
 - But “thinking” is hard to define
 - No simple answer of “Yes” or “No”
 - A fuzzy answer

Classical Test of (Human) Intelligence

- **Turing Test**

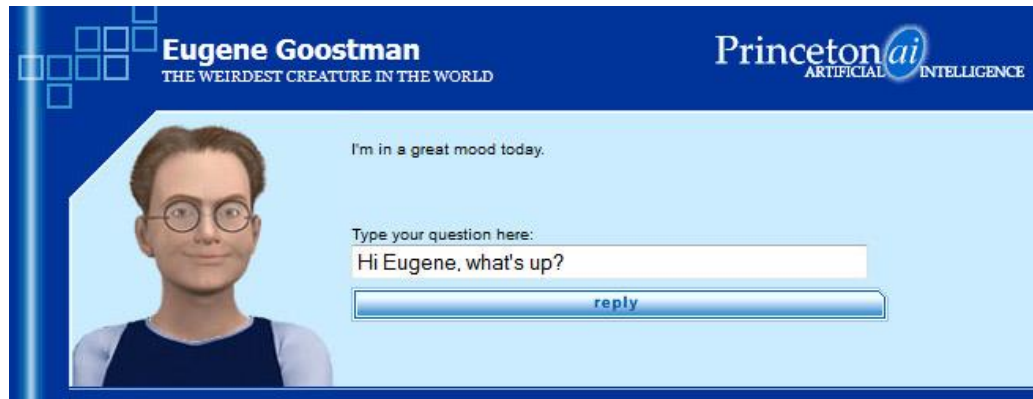
- A computer passes the **Turing test** (aka the Imitation Game) if a human interrogator, after posing some written questions, cannot tell whether the written responses come from a person or from a computer.



*Can machines think?
(Alan Turing, 1950)*

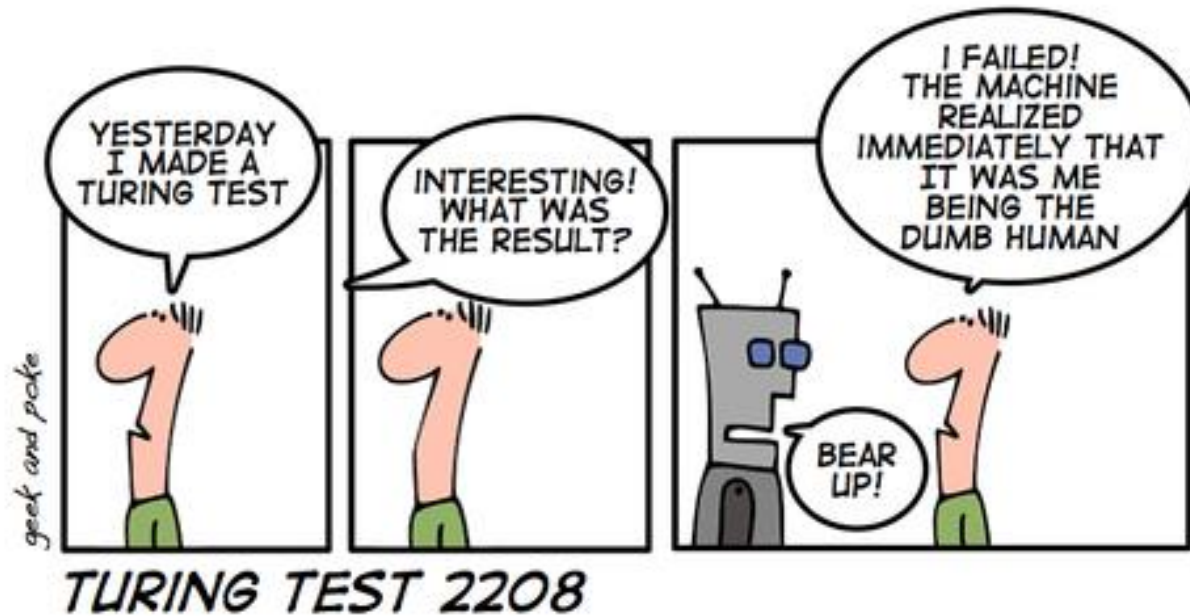
Eugene Goostman

- Turing predicted that by year 2000, computers would be intelligent enough to trick humans into thinking they were real 30% of the time.
- Eugene Goostman



- A Chatterbot
- Portrayed as a 13-year old Ukrainian boy
- On June 7, 2014, in University of Reading Competition, Eugene convinced 33% contest judges that it is a real boy
- "Turing test has been passed for the first time"

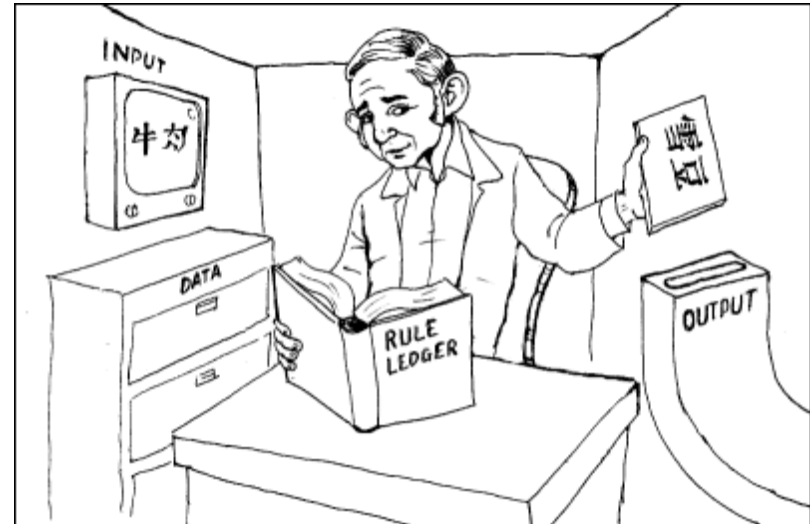
Turing Test in 2208



Searle's Chinese Room Argument

- **Searle's Chinese Room Experiment**

- Locked in a room
- Input: Chinese Characters
- Processing: Rule book in English
- Output: Chinese Characters



- Assuming that the output would make sense to a Chinese speaker, does it mean that the person inside the room understands Chinese?
 - Yes → “Strong AI”
 - No → “Weak AI”

**Searle's argument:
the room has no intelligence in it!**

Acting and Thinking Like a Human:

Acting humanly requires:

- Natural Language Processing
- Knowledge Representation
- Automated Reasoning
- Machine Learning
- Computer Vision
- Robotics

Thinking humanly

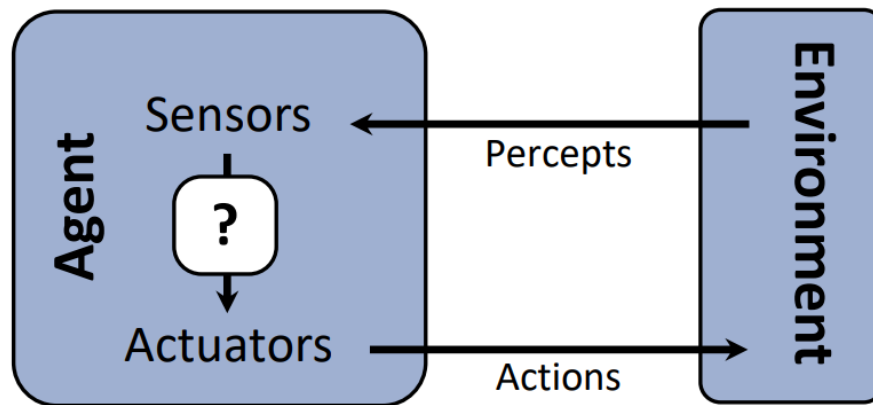
- Cognitive science (introspection, psychological experiments, and brain imaging)

Thinking Rationally

- Thinking Rationally
- The “laws of thought” Approach
 - Logic
 - Purely logical thought and reasoning
 - Correct inferences
 - Example
 - Every gardener likes the sun.
 - Tom is a gardener.
 - \Rightarrow Tom likes the sun.

Acting Rationally

- **Acting Rationally: The Rational Agent Approach**
 - 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



What is AI?

- AI is the science of creating

	Like humans	Not necessarily like humans
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Our
focus

Intelligence: human vs. rational
thought vs. behavior

Foundations of AI

- Philosophy Foundations (400 B.C. – present)
 - Rationalism: reasoning to understand the world
 - Dualism: a part of human mind is outside of nature and exempt from physical laws
 - Materialism: brain's operation according to the laws of physics constitute mind
- Mathematical Foundations (800 A.C. – present)
 - Algorithms
 - Boolean logic
 - Computability
 - Probability
- Economics
 - Decision Theory
 - Game Theory
- Neuroscience
 - How do brains process information?



Foundations of AI (cont.)

- Psychology
 - How do humans and animals think and act?
 - Cognitive science
- Computer Engineering
 - How to build an efficient computer?
- Control Theory
 - How can artifacts operate under their own control?
 - Robotics
- Linguistics
 - How does language relate to thought?

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— present: Excitement: Look, Ma, no hands!
 - Big Data, big compute, neural networks
 - Some re-unification of subfields
 - AI is being used in industry.

Why Study AI?

- **New Computational Capabilities**
 - Advances in uncertain reasoning, knowledge representations
 - Learning to act: robot planning, control optimization, decision support
 - Database mining: converting (technical) records into knowledge
 - Self-customizing programs: learning news filters, adaptive monitors
 - Applications that are hard to program: automated driving, speech recognition
- **Better Understanding of Human Cognition**
 - Cognitive science: theories of knowledge acquisition (e.g., through practice)
 - Performance elements: reasoning (inference) and *recommender* systems
- **Time is Right**
 - Recent progress in algorithms and theory
 - Rapidly growing volume of online data from various sources
 - Available computational power
 - Large-scale parallel/distributed computing
 - Growth and interest of AI-based industries (e.g., data mining/KDD, planning)

Introduction to AI

- What is AI?
- What can AI do?
- What is this course?

What can AI do today?

- Translate spoken Chinese to spoken English, live?
- Answer multiple choice questions, as good as an 8th grader?
- Solve university math problems?
- Prove mathematical theorems?
- Converse with a person for an hour?
- Play decently at Chess? Go? Poker? Soccer?
- Drive a car safely on a parking lot? in New York? in Germany?
- Identify skin cancer better than a dermatologist?
- Write computer code?
- Tell a funny story?
- Paint like Vangogh? Compose music?
- Show common sense?

What can AI do today?

- Web Search

The screenshot shows a Google search for "artificial intelligence". The search bar at the top contains the text "artificial intelligence" with a search icon to its right. Below the search bar are tabs for "News", "Images", "Perspectives", "Videos", "Definition", "Examples", "Types", "Course", and "Jobs". To the right of these tabs are links for "All filters" and "Tools".

The search results show "About 1,390,000,000 results (0.45 seconds)". The first result is a snippet from SAS Institute: "Artificial intelligence (AI) makes it possible for machines to learn from experience, adjust to new inputs and perform human-like tasks. Most AI examples that you hear about today – from chess-playing computers to self-driving cars – rely heavily on deep learning and natural language processing." To the right of this snippet is a small image showing a brain with circuitry and a robotic hand, with the letters "AI" in the bottom right corner.

Below the first result is a link to "Artificial Intelligence (AI): What it is and why it matters - SAS".

On the left side of the search results, there is a section titled "People also ask" with four questions, each with a dropdown arrow: "What do mean by artificial intelligence?", "Is there a free AI I can use?", "What are the 4 powerful examples of artificial intelligence?", and "How is AI used today?". Below these questions is a "Feedback" link.

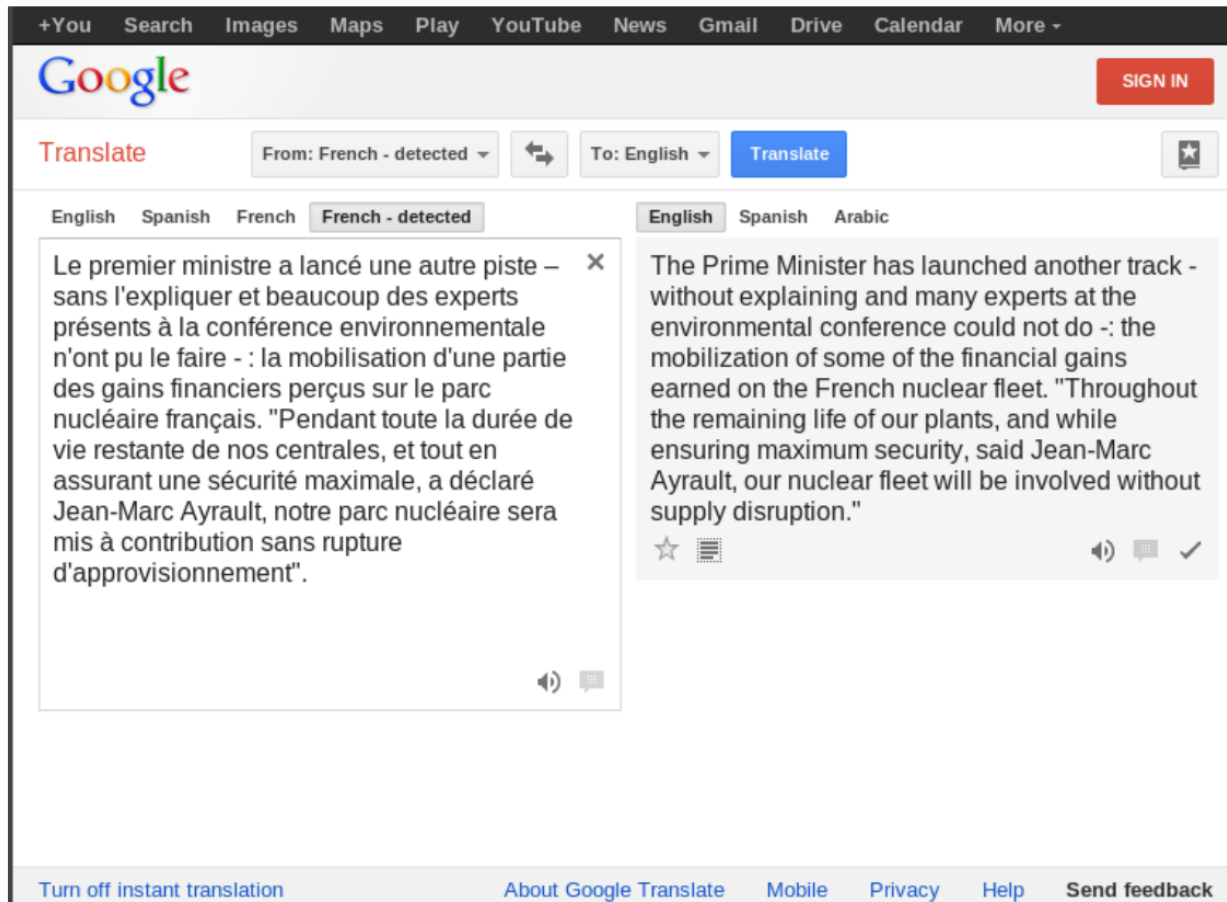
Below the "People also ask" section is a link to "Wikipedia" with the URL "https://en.wikipedia.org/wiki/Artificial_intelligence". Below this link is a snippet from Wikipedia: "Artificial intelligence (AI) is the intelligence of machines or software, as opposed to the intelligence of humans or animals. Applications of artificial... History · Outline · Timeline of artificial...".

On the right side of the search results, there is a section titled "Artificial intelligence" with a "Field of study" link. Below this link is a snippet from Wikipedia: "Artificial intelligence is the intelligence of machines or software, as opposed to the intelligence of humans or animals. It is a field of study in computer science that develops and studies intelligent machines. Such machines may be called AIs. Wikipedia". Below this snippet are four more questions, each with a dropdown arrow: "Examples: What are examples of artificial intelligence?", "Importance: Why is artificial intelligence important?", "Most used form: What is the most used form of artificial intelligence?", and "Most advanced country: Which country has the most advanced artificial intelligence?".



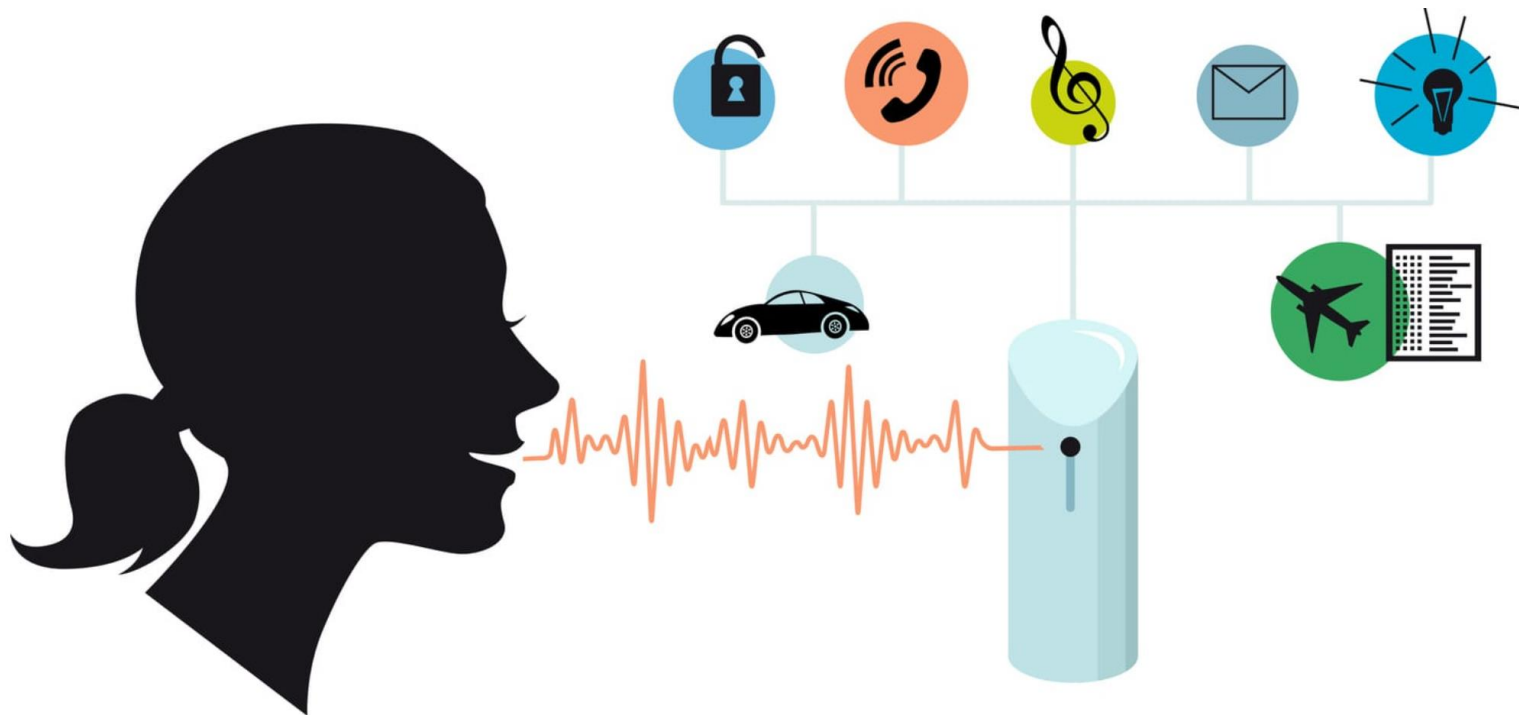
What can AI do today?

- Machine Translation (Text-to-Text)
 - Rule-based, statistical, neural, transformer-based...



What can AI do today?

- **Speech Recognition (Speech-to-Text)**
 - Hidden Markov Models, Deep Learning,...



Speech recognition applications

What can AI do today?

- AI-powered Speech and Text Translations
 - SeamlessM4T (Meta) supports:
 - Speech recognition for nearly 100 languages
 - Speech-to-text translation for nearly 100 input and output languages
 - Speech-to-speech translation, supporting nearly 100 input languages and 36 output languages
 - Text-to-text translation for nearly 100 languages
 - Text-to-speech translation, supporting nearly 100 input languages and 35 output languages

What can AI do today?

- AI-powered Speech and Text Translations

SeamlessM4T

Meta: SeamlessM4T (2023)

What can AI do today?

- Face Identification



Human-level performance, but privacy issues?

What can AI do today?

- AI Robots



Spot robot dog (Boston Dynamics)

What can AI do today?

- Autonomous Driving



Integration of various AI techniques

AI in Our Everyday Life

- Banks
 - Automatic check deposit and signature verification
 - Automated credit application approval
- Digital Cameras
 - Automatic focusing
 - Face and light detection
- Customer Services
 - Voice recognition and guiding
- Computer Security
 - Spam detector
- Computer Games
 - Intelligent character
- Education
 - Autograding system
- Driving
 - GPS Routing
 - Auto Parking

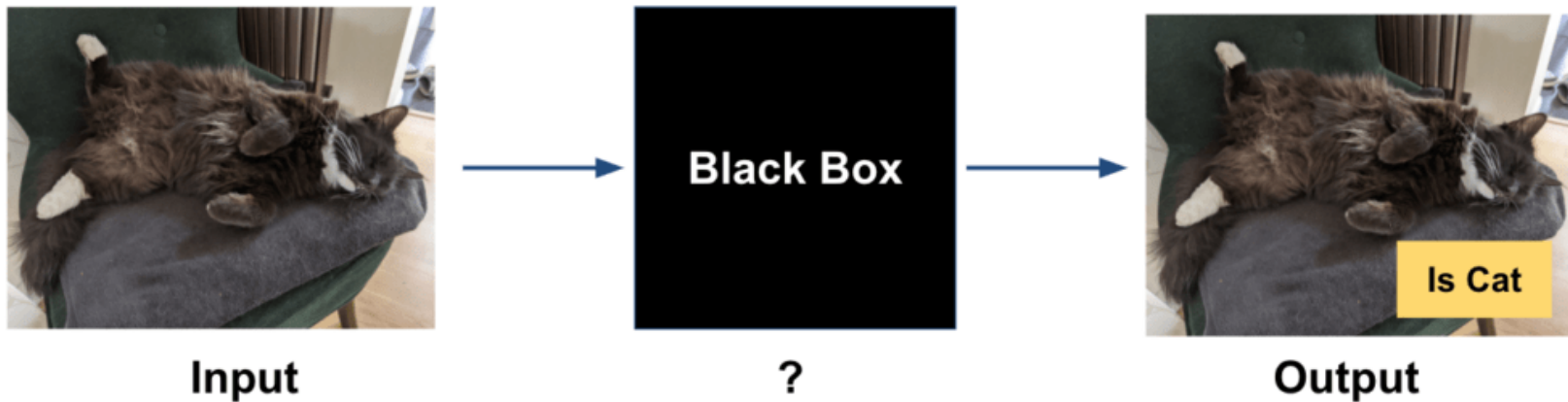
What CAN'T AI do today (so far)?

- Bug-free software



What CAN'T AI do today (so far)?

- Explain its decisions



I know I did it. I just don't know how I did it ☹️.

What CAN'T AI do today (so far)?

- Diagnose complex medical conditions



AI can help with diagnosis but cannot replace doctors.

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Course Outline

- **Artificial Intelligence (AI) Topics**
 - **Intelligent Agents (Chapter 2)**
 - **Problem Solving (Chapter 3, 4, 5, and 6)**
 - **Classical Search**
 - **Game Tree Search**
 - **Constraint Satisfaction Problem**
 - **Knowledge Representation (Chapter 7 and 8)**
 - **Logic and Inference**
 - **Learning (Chapter 18 and 21)**
 - **Supervised and Unsupervised Learning**

Summary

- Artificial Intelligence
 - What is Artificial Intelligence
 - Acting Humanly
 - Thinking Humanly
 - Thinking Rationally
 - Acting Rationally
 - Turing Test
 - Searle's Chinese Room Theory
- Foundations and history of AI
- Examples of AI Applications

What I want you to do

- Review Chapter 1
- Read Chapter 2
- Enjoy your new semester