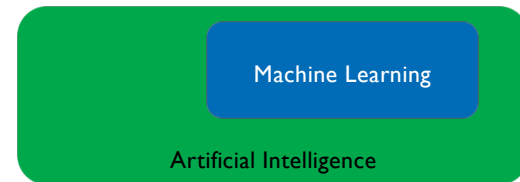


What is Artificial Intelligence?

▶ Historical definition (Dartmouth Workshop on AI, 1956):

“The study of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it.”

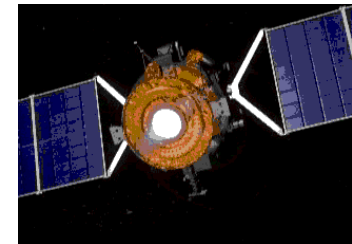


Modern AI: An Engineering Enterprise

- ▶ Building (partially) autonomous machines for a variety of tasks
 - ▶ Construction, transportation, search-and-rescue, exploration...
- ▶ Automating intelligence and formalizing knowledge
 - ▶ Internet search, expert systems, data mining, ...
- ▶ Using computational models to understand complex behavior
 - ▶ Automated planning, large-scale crowd simulation, traffic analysis, ...
- ▶ Using computers to discover new information
 - ▶ Medical image analysis, intrusion detection, stock market trading, ...
- ▶ Allowing computers to work better with people
 - ▶ Reactive tutoring, automated assistants, “sensitive” GPS systems, ...

Some Success: Space Exploration

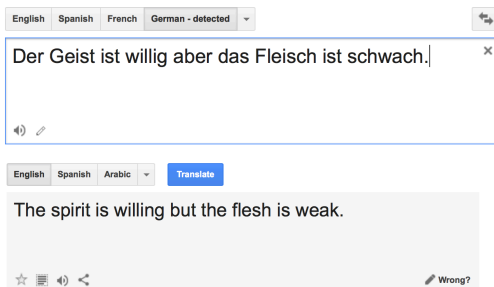
- ▶ 1999: NASA allowed the Deep Space I vehicle to be piloted for two days by Remote Agent AI program
- ▶ Completely controlled craft operations, over 60 Million miles from Earth



<http://ti.arc.nasa.gov/tech/asr/planning-and-scheduling/remote-agent/>

More Success: Natural Language Processing

- ▶ Modern tools have made lots of progress; free commercial software can now translate many highly ambiguous and complex phrases easily



<http://translate.google.com>

▶ Wednesday, 4 Sep. 2019

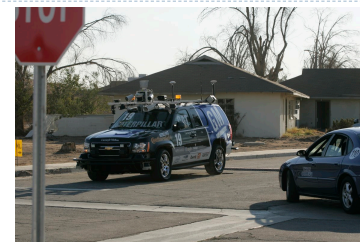
Machine Learning (COMP 135)

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Even More Success: Robotic Vehicles

- ▶ In the mid-2000's the CMU ALVINN system drove on its own from Washington, DC to San Diego, CA

- ▶ Managed all but 52 of the over-2800 miles
- ▶ Averaged 63 Miles per hour in day, night, bad weather



- ▶ In 2007, CMU's Boss system won the DARPA Urban Challenge

- ▶ 60 Miles of urban driving
- ▶ Merging with human traffic
- ▶ Obeying all traffic laws and posted signs

- ▶ This work is now part of Google self-driving car system

▶ Wednesday, 4 Sep. 2019

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How Do We Define Intelligence?

- ▶ It is not clear how "intelligence" should be understood (let alone how to get a machine to behave that way)
- ▶ How a **human being** might act?



- ▶ Or is it some sort of **ideal rationality**?

▶ Wednesday, 4 Sep. 2019

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Turing Test: Intelligence = **Acting Humanly**

- ▶ Alan Turing (1950) "Computing Machinery and Intelligence"

- ▶ Proposed an **imitation game**
- ▶ Predicted that by 2000, machines could fool average person for 5 minutes, 30% of the time

- ▶ One problem: not everyone agrees on the standard proposed by the test, and whether it is meaningful

- ▶ In any case, we still haven't got there yet...

- ▶ Loebner prize for convincing bots would award up to \$100,000 (and a gold medal) for a truly convincing interactive agent
- ▶ No such agent has ever really been approached

▶ Wednesday, 4 Sep. 2019

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What Should an Intelligent System Do?

- ▶ Following Turing, we take an **operational** approach:

Intelligence is defined by some means of measuring performance in a set task.

- ▶ An intelligent system is one that **optimizes** some measure
- ▶ How much it changes things so that it gets closer towards the goals that have been set for it
 - ▶ The word-count of error-free text translated
 - ▶ Customer satisfaction for automated dialogue systems
 - ▶ Hours of accident free, real-time driving
 - ▶ Amount of data collected by an autonomous space-vehicle
 - ▶ ...

Defining a Learning Problem



- ▶ Suppose we have three basic components:

1. Set of **tasks**, T
2. A **performance measure**, P
3. Data describing some **experience**, E

A computer program **learns** if its performance at tasks in T , as measured by P , improves based on E .

From: Tom M. Mitchell, *Machine Learning* (1997)

Next Week

- ▶ Information Theory & Decision Trees
- ▶ Readings:
 - ▶ Blog post on Information Theory (linked from class schedule)
 - ▶ Chapter 1 of the Daumé text (linked from class schedule)
- ▶ Office Hours: 237 Halligan
 - ▶ Tuesday, 11:00 AM – 1:00 PM