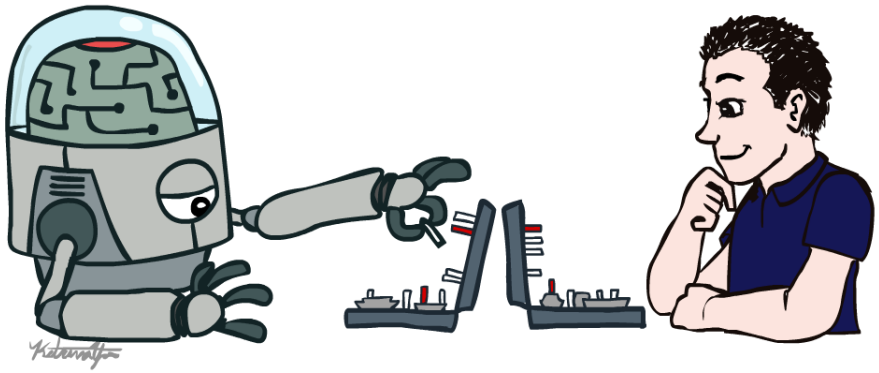
CSE 3521:
Introduction to Artificial Intelligence



[These slides are partially adapted from the UC Berkeley. CS188 Intro to AI at UC Berkeley]

THE OHIO STATE UNIVERSITY

The Turing Test

- Ingredients:
  - Human Judge, unknown Entity
  - 2 computer terminals in different room

- Recipe:
  - Have human Judge sit at one computer
  - Judge converses with Entity via chat window for 5 minutes
  - Judge decides if Entity is human or computer

Which is Which?

Left hand side

- Judge: Hi what's your name?
- Entity: I don't know
- Judge: My name's Jane. I live in London. Where do you live?
- Entity: I live in London as well
- Judge: Do you like living in London?
- Entity: Yes I like it because there are a lot of things to do and it is the capital city of England
- Judge: What's my name?
- Entity: sorry?
- Judge: What's my name?
- Entity: Jane
- Judge: And what's your name?
- Entity: I don't know

Right hand side

- Judge: What color is the carpet in your room
- Entity: I like pink; what do you like?
- Judge: I like pink. My name is John. What's your name?
- Entity: Red. Hello John. Its nice to meet such a fine person as yourself.
- Judge: Red is my favorite color. What's yours?
- Entity: My favorite color is red.
- Judge: You use American spelling. Are you in the USA?
- Entity: But you are not even American. Just remember atheism is only a belief system. And it too can be forced on people who don't agree.
- Judge: How do you like your eggs – ever easy or sunny side up?
- Entity: How I wonder if I like my eggs-over easy or sunny side up? This is so explainable. That list makes me feel unsure John.

Example taken from "Turing's Imitation Game," by Warwick and Shah (2016)

How to do well in the Turing Test?

- Chatting “like a human” involves:
  - Generating coherent language
  - Responding appropriately to unexpected inputs
  - …

What is not shown?

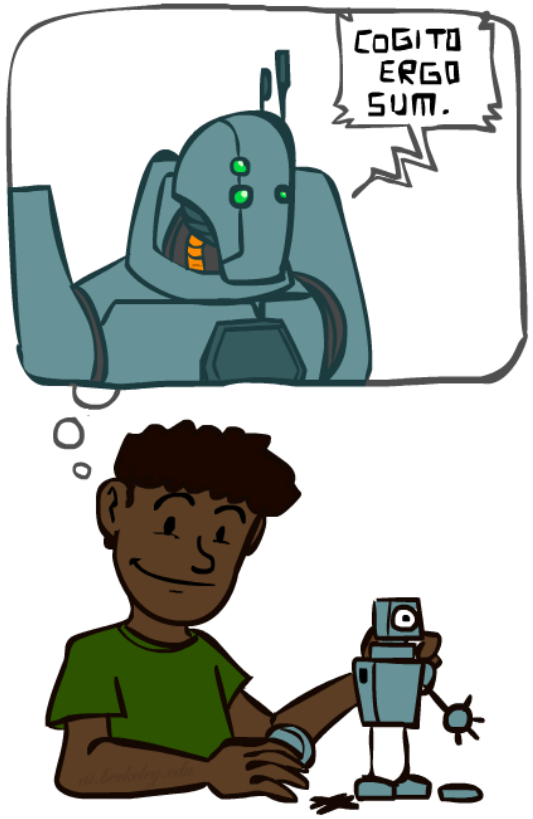
- The Turing Test does not show
  - Understanding or thinking
  - Ability to learn
  - Interaction with an unconstrained world
  - Processing sensory input
  - Having knowledge
  - Much of anything useful, really

Act Rationally; Rational Decisions

- We'll use the term **rational** in a very specific, technical way:
  - Rational: maximally achieving pre-defined **goals**
  - Rationality only concerns what decisions are made (not the thought process behind them)
  - Goals are expressed in terms of the **utility** of outcomes
  - Being rational means **maximizing your expected utility**
  - Rational behavior = doing the right thing, does not necessarily involve thinking

A (** Short **) History of AI

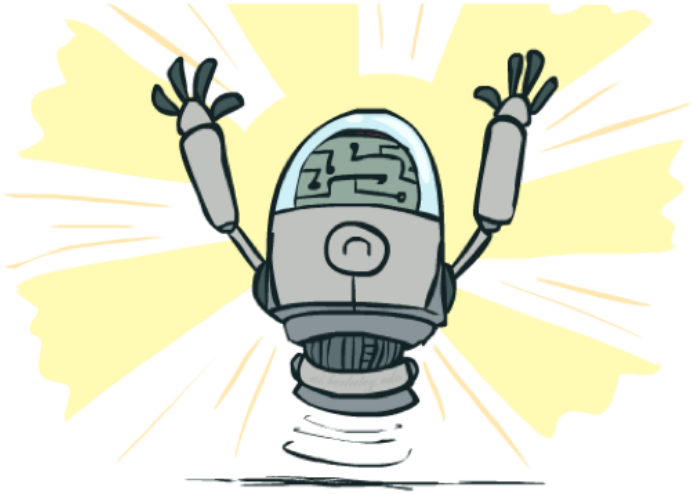
- 1940-1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's “Computing Machinery and Intelligence”
- 1950—70: Excitement: Look, Ma, no hands!
  - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
  - 1956: Dartmouth meeting: the term **“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—: Statistical approaches
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - Agents and learning systems… “AI Spring”?
- 2000—: Where are we now? (Machine learning, neural networks, deep learning, …)



What AI Can Do

Quiz: Which of the following can be done at present?

- Play a decent game of table tennis?
- Play a decent game of Jeopardy/Go/Atari/Star raft?
- Drive safely along a curving mountain road (w/o other traffic agents
- Drive safely along High Street?
- Buy a week's worth of groceries on the web?
- Buy a week's worth of groceries at Worthington Farmers Market?
- Discover and prove a new mathematical theorem?
- Converse successfully with another person for an hour?
- Perform a surgical operation?
- Put away the dishes and fold the laundry?
- Translate spoken Chinese into spoken English in real time?
- Write an intentionally funny story?



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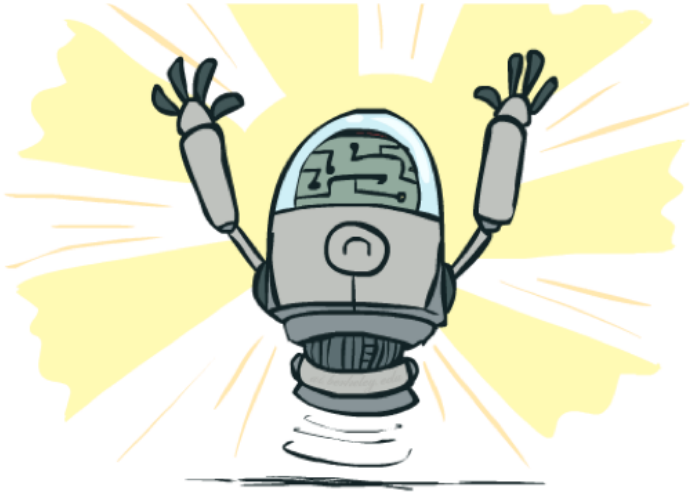


The Fundamental question for this course topics
(and really this whole AI field !):

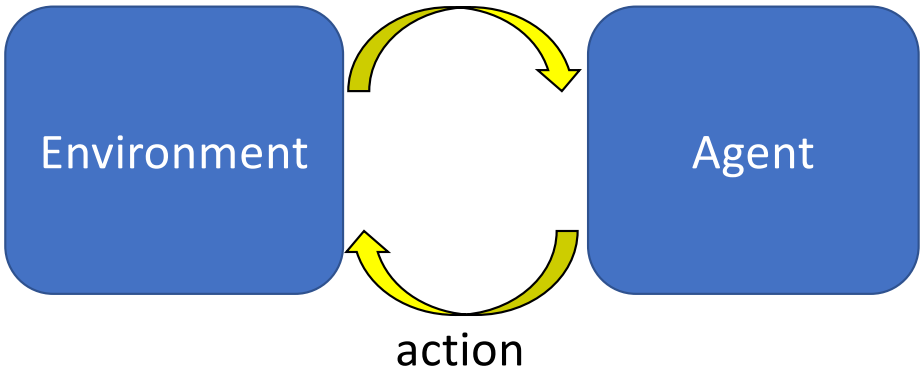
How do you turn a real-world problem into an AI solution?

AI – Agents and Environments

- Much (though not all!) of AI is concerned with **agents** operating in **environments.**
- **Environment –** the problem setting
- **Agent –** an entity that *perceives* its environment through *sensors* and *acts* upon that environment through *effectors (actuators)*

AI – Agents and Environments

Cross walks



Humans

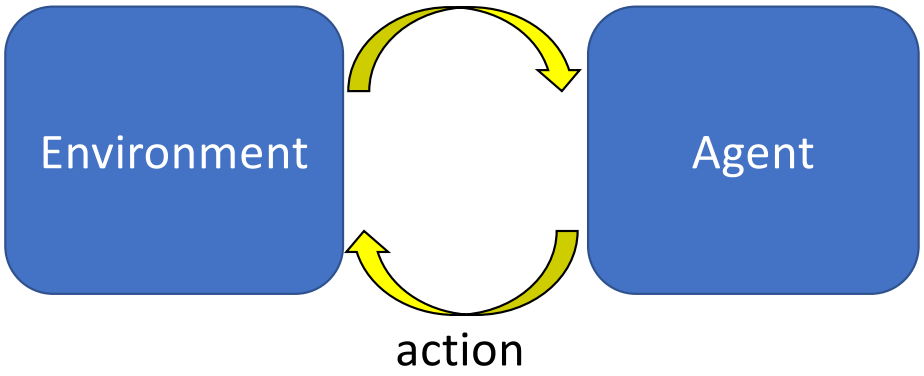
Sensors: eyes, ears, etc.
Effectors: hands, legs, mouth, etc.

Sensors: cameras, 3D sensors, etc.
Effectors: various motors, robot arms, etc.

Robots

AI – Agents and Environments

Cross walks



- **Percept:** Agent's perceptual inputs at any given instant
- **Percept sequence:** Complete history of everything agent has perceived
- Agent's choice of **action** (e.g., walk forward for a step, push the bottom) can depend on entire percept sequence

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Robots

Fleshing it out

- **P**erformance – measuring the agent's success
- **E**nvironment – what populates the problem's world?
- **A**ctuators – what can the agent act with?
- **S**ensors – how can the agent perceive the world?

Peas in Automated-Taxi

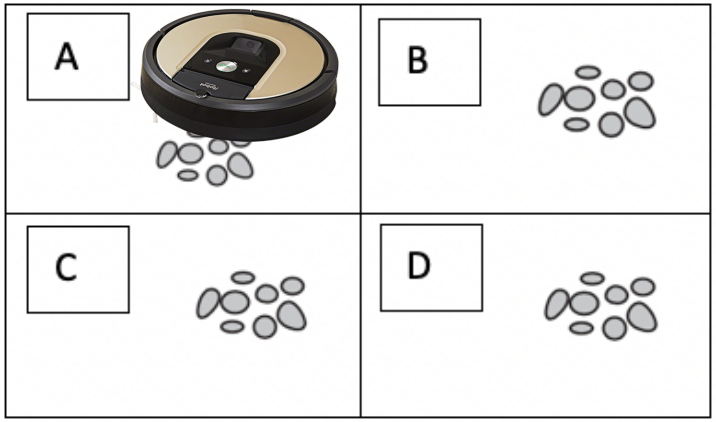
- **P**erformance – Safe, fast, legal, comfortable trip, maximize profits
- **E**nvironment – Roads, other traffic agents (e.g., pedestrians), customers
- **A**ctuators – Steering, accelerator, brake, signals, horn, display
- **S**ensors – Cameras, sonar, LiDAR, radar, speedometer, GPS, odometer, accelerometer, engine sensors, microphone/keyboard

Peas: Other Examples

Agent Type	**Perf. Measure**	**Environment**	**Actuators**	**Sensors**
Medical diagnosis system	Healthy patient, minimize costs/lawsuits	Patient, hospital, staff	Display questions, tests, diagnoses, treatments, referrals	Keyboard entry of symptoms, findings, patient's answers
Satellite image analysis system	Correct image classification	Downlink from orbiting satellite	Display classification of scene	Color pixel arrays (cameras)
Part-picking robot	Percentage of parts in correct bins	Conveyor belt with parts, bins	Jointed arm and hand	Camera, joint angle sensors
Refinery controller	Maximize purity, yield, safety	Refinery, operators	Valves, pumps, heaters, displays	Temperature, pressure, chemical sensors
Interactive English tutor	Maximize student's score on test	Set of students, testing agency	Display exercises, suggestions, corrections	Keyboard entry

In Class Exercise

- Give a ‘PEAS’ description of the task environment for the following vacuum-cleaner world with four locations.



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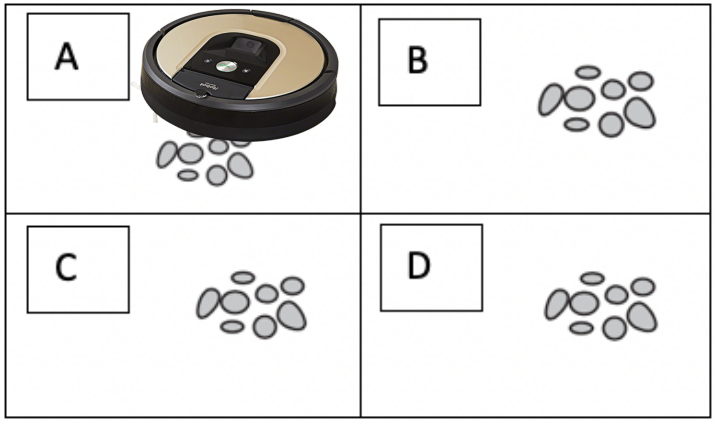
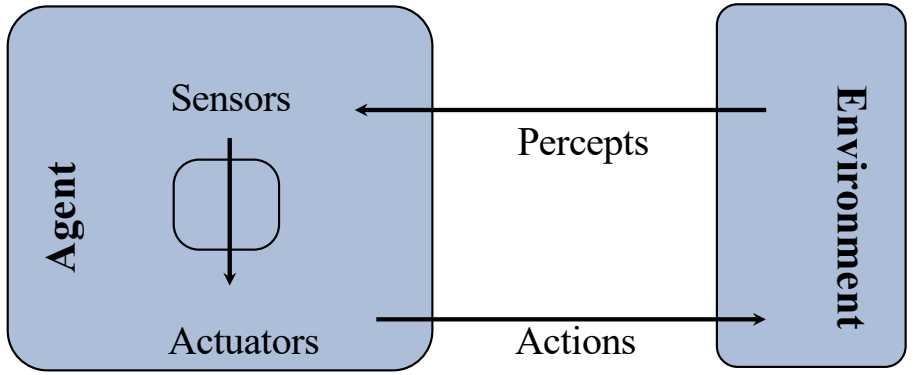


- **P**erformance – cleanness, efficiency, distance traveled
- **E**nvironment – room with 4 squares
- **A**ctuators – wheels, brushes, vacuum extractor
- **S**ensors – dirt detection

What makes an AI agent

- **Agent** – an entity that perceives its environment through sensors, and acts on it with effectors (actuators).

- Percepts are constrained by Sensors + Environment
- Actions are constrained by Actuators + Environment



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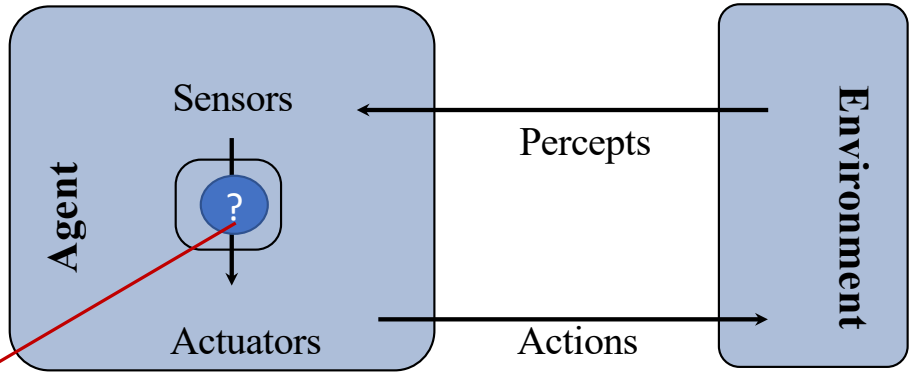
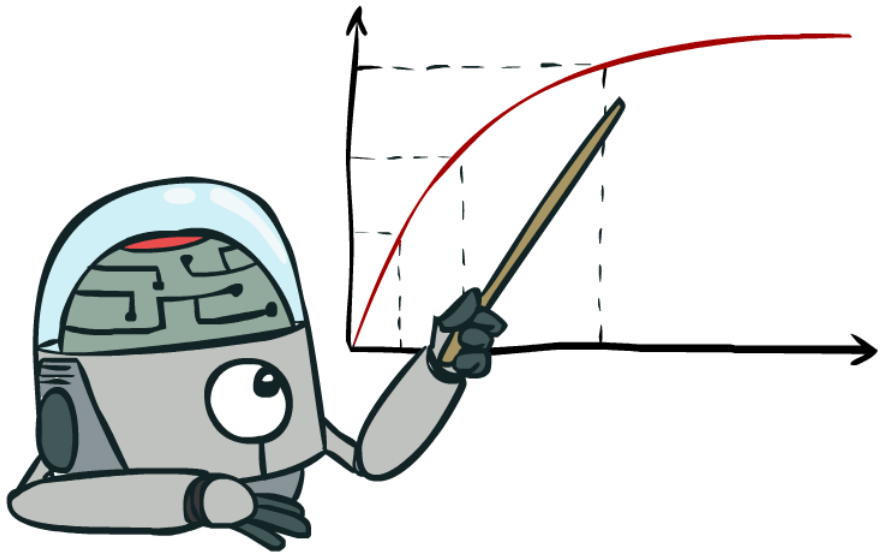


Agent Function (policy) – how does it choose the action?

What is a rational AI agent?

- A **rational agent** always acts to **maximize its expected performance measure**, given current **percept/state**

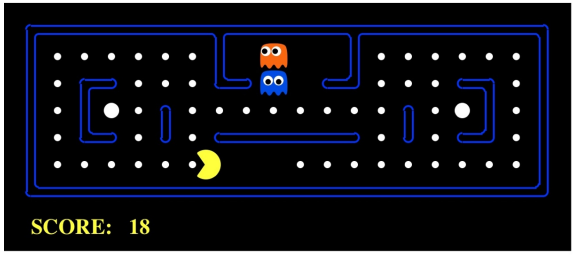
- Rationality ≠ omniscience
  - There is “uncertainty” in the environment.
  - That is why we emphasize “expected”.



Our Sample Agent

Pacman

- Percepts – squares around Pacman
- Actions – move U/D/L/R
- Environment – map with walls, dots, and ghosts



Spam Detector

- Percepts – sender, subject line, body of current email
- Actions – mark Spam/Not Spam
- Environment – your email inbox