What is Al?

The science of making machines that:

Think like people

Act like people



Think rationally

Act rationally

Fundamental question for this lecture (and really this whole AI field!):

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

Much (though not all!) of AI is concerned with **agents** operating in **environments.**

Agent – an entity that *perceives* and *acts*

Environment – the problem setting



Fleshing it out

Performance – measuring desired outcomes

Environment – what populates the task's world?

Actuators – what can the agent act with?

Sensors – how can the agent perceive the world?



PEAS in a taxi

Automated taxi driver

Performance – Safe, fast, legal, comfortable trip, maximize profits
Environment – Roads, other traffic, pedestrians, customers
Actuators – Steering, accelerator, brake, signals, horn, display

Sensors - Cameras, sonar, speedometer, GPS, odometer, accelerometer, engine sensors, microphone/keyboard

What makes an Agent?

Agent – an entity that <u>perceives</u> its environment through <u>sensors</u>, and acts on it with <u>actuators</u>.



What makes one rational?

Actually pretty simple:

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

Our sample agents

Pacman

Percepts – squares around Pacman

<u>Actions</u> – move U/D/L/R

<u>Environment</u> – map with walls, dots, and ghosts



Spam detector

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



Reflex Agents

- Reflex agents:
 - Choose action based on current percept (and maybe memory)
 - May have memory or a model of the world's current state
 - Do not consider the future consequences of their actions
 - Consider how the world IS



Reflex Agents

- Reflex agents:
 - Choose action based on current percept (and maybe memory)
 - May have memory or a model of the world's current state
 - Do not consider the future consequences of their actions
 - Consider how the world IS
- Can a reflex agent be rational?



Planning Agents

- Planning agents:
 - Ask "what if"
 - Decisions based on (hypothesized) consequences of actions
 - Must have a model of how the world evolves in response to actions
 - Must formulate a goal (test)
 - Consider how the world WOULD BE



Goal-based Agents

Chooses action (sequence) to get from current state to some goal

Pacman

Percepts – squares around Pacman

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Spam detector

<u>Percepts</u> – sender, subject line, body of current email <u>Actions</u> – mark Spam/Not Spam <u>Environment</u> – your email inbox <u>Goal</u>:

???

Utility-based Agents

Chooses action (sequence) to get from current state to some <u>goal</u> with <u>maximum utility along the way</u>

Pacman

Percepts – squares around Pacman

Actions – move U/D/L/R

<u>Environment</u> – map with walls, dots, and ghosts

<u>Goal:</u>



... in as short a path as possible!

Spam detector

<u>Percepts</u> – sender, subject line, body of current email Actions – mark Spam/Not Spam

Environment – your email inbox

<u>Goal</u>:



Summary



Much (though not all!) of AI is concerned with **agents** operating in **environments**.

Agent – an entity that *perceives* and *acts*

Environment – the problem setting



6 common properties to distinguish tasks (not exhaustive)

- Fully observable vs Partially observable
- Single agent vs Multiagent
- Deterministic vs Stochastic
- Episodic vs Sequential
- Static vs Dynamic
- Discrete vs Continuous

Fully observable vs partially observable

Fully observable – agent is able to sense everything in the environment

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Partially observable – noisy, inaccurate, or incomplete sensors

Single agent vs Multiagent

Single agent – self-explanatory

Multiagent – task involves more than one agent, each with its own performance measure

May be **competitive** (measures are opposed) or **cooperative** (measures align)

Deterministic vs Stochastic

Deterministic – next state of the world is fully determined by

current state + agent action

Stochastic – it's not deterministic

Episodic – Each step/decision is independent of the previous ones

Sequential – Each step/decision affects later ones

Static vs Dynamic

Static – world doesn't change while agent is choosing an action

Dynamic – decision time matters!

Discrete vs Continuous

Discrete – possible states/actions are distinct; world changes discretely

Continuous – states/actions take on continuous values

Static -> can focus on getting really high accuracy/utility
Dynamic -> trade some utility for higher efficiency (speed!)

Episodic -> reflex agent with a great model **Sequential** -> need a goal-oriented agent

Stochastic -> need robustness to uncertainty/failure (robots!)
Deterministic -> can focus on efficiency and exactness (Internet crawler)

Next up

Defining search problems – how to choose the right action sequence?

Uninformed search approaches – simple reflex agents for searching