Lecture Overview

What is Artificial Intelligence?
Agents acting in an environment

Learning objectives: at the end of the class, you should be able to
- describe what an intelligent agent is
- identify the goals of Artificial Intelligence
- classify the inputs and the outputs of various agents
What is Artificial Intelligence?

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- An agent is something that acts in an environment.
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  - its actions are appropriate for its goals and circumstances
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  - it is flexible to changing environments and goals
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  - it is flexible to changing environments and goals
  - it learns from experience
Artificial Intelligence is the synthesis and analysis of computational agents that act intelligently.

An agent is something that acts in an environment.

An agent acts intelligently if:

- its actions are appropriate for its goals and circumstances
- it is flexible to changing environments and goals
- it learns from experience
- it makes appropriate choices given perceptual and computational limitations
Examples of Agents

- **Organisations** Microsoft, Al Qaeda, Government of Canada, UBC, CS Dept,...
Examples of Agents

- **Organisations** Microsoft, Al Qaeda, Government of Canada, UBC, CS Dept, ...
- **People** teacher, physician, stock trader, engineer, researcher, travel agent, farmer, waiter...
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- **People** teacher, physician, stock trader, engineer, researcher, travel agent, farmer, waiter...
- **Computers/devices** thermostat, user interface, airplane controller, network controller, game, advising system, tutoring system, diagnostic assistant, robot, Google car, Mars rover...
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- **book(?)**, sentence(?)**, word(?)**, letter(?)
Examples of Agents

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- **Animals** dog, mouse, bird, insect, worm, bacterium, bacteria ...
- book(?), sentence(?), word(?), letter(?)
  Can a book or article do things?
Examples of Agents

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Goals of Artificial Intelligence

- **Scientific goal**: to understand the principles that make intelligent behavior possible in natural or artificial systems.
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  - analyze natural and artificial agents
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▶ analyze natural and artificial agents
▶ formulate and test hypotheses about what it takes to construct intelligent agents
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- **Scientific goal**: to understand the principles that make intelligent behavior possible in natural or artificial systems.
  - analyze natural and artificial agents
  - formulate and test hypotheses about what it takes to construct intelligent agents
  - design, build, and experiment with computational systems that perform tasks that require intelligence
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- **Engineering goal:** design useful, intelligent artifacts.
Goals of Artificial Intelligence

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  - analyze natural and artificial agents
  - formulate and test hypotheses about what it takes to construct intelligent agents
  - design, build, and experiment with computational systems that perform tasks that require intelligence

- **Engineering goal:** design useful, intelligent artifacts.

- Analogy between studying flying machines and thinking machines.
Agents acting in an environment

Abilities
Goals/Preferences
Prior Knowledge
Stimuli
Past Experiences

Agent

Environment

Actions
Inputs to an agent

- Abilities — the set of possible actions it can perform
- Goals/Preferences — what it wants, its desires, its values,...
- Prior Knowledge — what it comes into being knowing, what it doesn’t get from experience,...
- History of stimuli
  - (current) stimuli — what it receives from environment now (observations, percepts)
  - past experiences — what it has received in the past
Example agent: autonomous car

- abilities:
Example agent: autonomous car

- abilities: steer, accelerate, brake
Example agent: autonomous car

- **abilities**: steer, accelerate, brake
- **goals**:

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Example agent: autonomous car

- **abilities:** steer, accelerate, brake
- **goals:** safety, get to destination, timeliness, ...
Example agent: autonomous car

- abilities: steer, accelerate, brake
- goals: safety, get to destination, timeliness, ...
- prior knowledge:
Example agent: autonomous car

- **abilities:** steer, accelerate, brake
- **goals:** safety, get to destination, timeliness, ...
- **prior knowledge:** what signs mean, what to stop for
Example agent: autonomous car

- **abilities:** steer, accelerate, brake
- **goals:** safety, get to destination, timeliness, ... 
- **prior knowledge:** what signs mean, what to stop for 
- **stimuli:** 

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Example agent: autonomous car

- **abilities**: steer, accelerate, brake
- **goals**: safety, get to destination, timeliness, ...
- **prior knowledge**: what signs mean, what to stop for
- **stimuli**: vision, laser, GPS, ...
Example agent: autonomous car

- **abilities**: steer, accelerate, brake
- **goals**: safety, get to destination, timeliness,...
- **prior knowledge**: what signs mean, what to stop for
- **stimuli**: vision, laser, GPS...
- **past experiences**:
Example agent: autonomous car

- abilities: steer, accelerate, brake
- goals: safety, get to destination, timeliness, ...
- prior knowledge: what signs mean, what to stop for
- stimuli: vision, laser, GPS...
- past experiences: streetmaps, how breaking, steering affects direction..
Example agent: robot

- abilities:

- goals:

- prior knowledge:

- stimuli:

- past experiences:
Example agent: robot

- abilities: movement, grippers, speech, facial expressions, ...
Example agent: robot

- **abilities:** movement, grippers, speech, facial expressions, ...

- **goals:**
Example agent: robot

- **abilities:** movement, grippers, speech, facial expressions, ...
- **goals:** deliver food, rescue people, score goals, explore, ...
Example agent: robot

- abilities: movement, grippers, speech, facial expressions, ...
- goals: deliver food, rescue people, score goals, explore, ...
- prior knowledge:
Example agent: robot

- **abilities:** movement, grippers, speech, facial expressions, . . .
- **goals:** deliver food, rescue people, score goals, explore, . . .
- **prior knowledge:** what is important feature, categories of objects, what a sensor tell us, . . .
Example agent: robot

- **abilities**: movement, grippers, speech, facial expressions,\ldots
- **goals**: deliver food, rescue people, score goals, explore,\ldots
- **prior knowledge**: what is important feature, categories of objects, what a sensor tell us,\ldots
- **stimuli**: 
Example agent: robot

- **abilities**: movement, grippers, speech, facial expressions, ...
- **goals**: deliver food, rescue people, score goals, explore, ...
- **prior knowledge**: what is important feature, categories of objects, what a sensor tell us, ...
- **stimuli**: vision, sonar, sound, speech recognition, gesture recognition, ...
Example agent: robot

- **abilities**: movement, grippers, speech, facial expressions,...
- **goals**: deliver food, rescue people, score goals, explore,...
- **prior knowledge**: what is important feature, categories of objects, what a sensor tell us,...
- **stimuli**: vision, sonar, sound, speech recognition, gesture recognition,...
- **past experiences**:...
Example agent: robot

- abilities: movement, grippers, speech, facial expressions, ...
- goals: deliver food, rescue people, score goals, explore, ...
- prior knowledge: what is important feature, categories of objects, what a sensor tell us, ...
- stimuli: vision, sonar, sound, speech recognition, gesture recognition, ...
- past experiences: effect of steering, slipperiness, how people move, ...
Example agent: teacher

- abilities:
Example agent: teacher

- **abilities**: present new concept, drill, give test, explain concept, ...
Example agent: teacher

- **abilities:** present new concept, drill, give test, explain concept, ...
- **goals:**
Example agent: teacher

- **abilities:** present new concept, drill, give test, explain concept, ...
- **goals:** particular knowledge, skills, inquisitiveness, social skills, ...
Example agent: teacher

- **abilities**: present new concept, drill, give test, explain concept, ...
- **goals**: particular knowledge, skills, inquisitiveness, social skills, ...
- **prior knowledge**: 
Example agent: teacher

- **abilities:** present new concept, drill, give test, explain concept, . . .
- **goals:** particular knowledge, skills, inquisitiveness, social skills, . . .
- **prior knowledge:** subject material, teaching strategies, . . .
Example agent: teacher

- **abilities:** present new concept, drill, give test, explain concept, ...
- **goals:** particular knowledge, skills, inquisitiveness, social skills, ...
- **prior knowledge:** subject material, teaching strategies, ...
- **stimuli:**
Example agent: teacher

- **abilities**: present new concept, drill, give test, explain concept, ...

- **goals**: particular knowledge, skills, inquisitiveness, social skills, ...

- **prior knowledge**: subject material, teaching strategies, ...

- **stimuli**: test results, facial expressions, errors, focus, ...
Example agent: teacher

- **abilities**: present new concept, drill, give test, explain concept, ...
- **goals**: particular knowledge, skills, inquisitiveness, social skills, ...
- **prior knowledge**: subject material, teaching strategies, ...
- **stimuli**: test results, facial expressions, errors, focus, ...
- **past experiences**:
abilities: present new concept, drill, give test, explain concept, . . .

goals: particular knowledge, skills, inquisitiveness, social skills, . . .

prior knowledge: subject material, teaching strategies, . . .

stimuli: test results, facial expressions, errors, focus, . . .

past experiences: prior test results, effects of teaching strategies, . . .
Example agent: thermostat for heater

- abilities:
Example agent: thermostat for heater

- **abilities**: turn heater on or off
Example agent: thermostat for heater

- **abilities:** turn heater on or off
- **goals:**

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Example agent: thermostat for heater

- **abilities:** turn heater on or off
- **goals:** conformable temperature, save fuel, save money
Example agent: thermostat for heater

- abilities: turn heater on or off
- goals: conformable temperature, save fuel, save money
- prior knowledge:
Example agent: thermostat for heater

- **abilities:** turn heater on or off
- **goals:** conformable temperature, save fuel, save money
- **prior knowledge:** 24 hour cycle, weekends
Example agent: thermostat for heater

- **abilities:** turn heater on or off
- **goals:** conformable temperature, save fuel, save money
- **prior knowledge:** 24 hour cycle, weekends
- **stimuli:**
Example agent: thermostat for heater

- **abilities**: turn heater on or off
- **goals**: conformable temperature, save fuel, save money
- **prior knowledge**: 24 hour cycle, weekends
- **stimuli**: temperature, set temperature, who is home, outside temperature
Example agent: thermostat for heater

- **abilities**: turn heater on or off
- **goals**: conformable temperature, save fuel, save money
- **prior knowledge**: 24 hour cycle, weekends
- **stimuli**: temperature, set temperature, who is home, outside temperature
- **past experiences**: 
Example agent: thermostat for heater

- **abilities**: turn heater on or off
- **goals**: conformable temperature, save fuel, save money
- **prior knowledge**: 24 hour cycle, weekends
- **stimuli**: temperature, set temperature, who is home, outside temperature
- **past experiences**: when people come and go, who likes what temperature
Example agent: medical doctor

- abilities:
- goals:
- prior knowledge:
- stimuli:
- past experiences:
Example agent: Apple Inc.

- abilities:
- goals:
- prior knowledge:
- stimuli:
- past experiences:
Other Agents

- user interface
- bee
- smart home
- ...

- abilities:
- goals:
- prior knowledge:
- stimuli:
- past experiences:
Example agent:

- abilities:
- goals:
- prior knowledge:
- stimuli:
- past experiences:
Agents acting in an environment

- Abilities
- Goals/Preferences
- Prior Knowledge
- Stimuli
- Past Experiences

Agent

Environment

Actions