Environments and Agents

Agents

Agents are:

Anything that perceives the **environment** through <u>sensors</u> and whose <u>actions</u> affect the environment

- Humans
- Robots
- ML models
- …

An "agent function" lies between the perceived environment and the proposed action.

The implementation of the "agent function" is core to agent design.

Agent program

A simplistic way of designing agents is through table lookup

Perception	Action
p1	a1
p2	a2
p3	a3

Search space grows rapidly within complex environment!

Agent action example

A	B
C	M

Agent action example

A	B
C	M

Perception	Action
(C=A, M=A)	Catch
(C=A, M=B)	Move right
(C=B, M=A)	Move left
(C=B, M=B)	Catch

Agent action example

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What if the search space grows large or infinite?

Agent programs

- Actions
  - How agents change the environment
- Sensors
  - What the agents know about the environment
- Prior knowledge
- Objective function
  - Description of the goal
- Measurement function
  - Is the goal reached?

Scenarios

- Binary rewards
    - +1 point when approaching the goal, -1 point otherwise
    - Maybe further +1 point when the goal is actually reached

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  - More difficult to optimize

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  - More difficult to optimize
- Unaware of the environment?
  - Explore (gain more knowledge about environment) vs. Exploit (attempt to reach the goal)

Environments

Observability

Fully Observable	Partially Observable

• Can sense everything in the environment without error	• Can only see some info
	
	• Two causes:
	
	    • Incomplete data
	
	    • Noise (error in perception data)

Determinism

Deterministic	Stochastic
• World changes exactly as desired	• Randomness
	• Uncertain effectors/sensors
	•Noise in sensors
	• P.O. world is (sensor) stochastic
	•Incomplete/incorrect information leads to randomness

Static

Static	Dynamic
• World doesn't change when agent is deliberating	• World changes faster than you can think

Discreteness

Discrete	Continuous
• World broken up into a finite number of discrete chunks	• Infinite number of chunks
	• Infinite gradiations of values

- Time

- Actions

- Percepts

Episodic

Episodic	Sequential
• History doesn't matter	• History matters • Decisions affect future environment

Agents

Single agent	Multi agent

• You are the only agent in the world	• Other agents in the world that are autonomous from you
	
	    • Cooperative
	
	    • Competitive

	Hanoi	Solitare	Chess	Pool	Poker	Driving
Observability?						
Determinism?						
Episodic?						
Static?						
Discrete?						
Agents?						

	Hanoi	Solitare	Chess	Pool	Poker	Driving
Observability?	F.O.					
Determinism?	Det					
Episodic?	Seq					
Static?	Static					
Discrete?	Discrete					
Agents?	Single					

	Hanoi	Solitare	Chess	Pool	Poker	Driving
Observability?	F.O.	P.O.				
Determinism?	Det	Sto*				
Episodic?	Seq	Seq				
Static?	Static	Static				
Discrete?	Discrete	Discrete				
Agents?	Single	Single				

	Hanoi	Solitare	Chess	Pool	Poker	Driving
Observability?	F.O.	P.O.	F.O.			
Determinism?	Det	Sto*	Det			
Episodic?	Seq	Seq	Seq			
Static?	Static	Static	Static			
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Agents?	Single	Single	Multi			

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Episodic?	Seq	Seq	Seq	Seq		
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