

Dimensions of Complexity

- Flat or modular or hierarchical
- Non-planning or finite stage or indefinite stage or infinite stage
- Explicit states or features or individuals and relations
- Perfect rationality or bounded rationality
- Knowledge is given or knowledge is learned from experience
- Fully observable or partially observable
- Deterministic or stochastic dynamics
- Goals or complex preferences (utility)
- Single-agent or multiple agents
- Reason offline or reason while interacting with environment

Some Representations

- **Hier. Control** Hierarchical control (Chapter 2)
- **Search** – state-space search (Chapter 3)
- **Det. Planning** – deterministic planning (Chapter 6)
- **Decision Net** – decision networks (Chapter 12)
- **MDP** – Markov decision processes (Chapter 12)
- **Dynamic DN** – dynamic decision networks (Chapter 12)
- **POMDP** – partially observable Markov decision processes (Chapter 12)
- **Extensive game** – extensive form of game (Chapter 14)
- **Q-Learning** – (Chapter 13)
- **Deep RL** – deep reinforcement learning (Chapters 13/14)
- **Stochastic PI** – stochastic policy iteration (Chapter 14)

	Hier. Control	Search	Det. Planning	Decision Net	MDP	Dynamic DN	POMDP	Extensive game	Q-Learning	Deep RL	Stochastic PI
Modularity											
flat	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
modular	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
hierarchical	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Planning Horizon											
non-planning	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
finite	✗	✓	✓	✓	✗	✗	✗	✓	✗	✗	✓
indefinite	✗	✓	✓	✗	✓	✓	✓	✓	✓	✓	✗
infinite	✗	✗	✗	✗	✓	✓	✓	✗	✓	✓	✗
Representation											
states	✓	✓	✗	✗	✓	✗	✓	✓	✓	✗	✓
features	✓	✗	✓	✓	✗	✓	✗	✗	✗	✓	✗
relational	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗

	Hier. Control	Search	Det. Planning	Decision Net	MDP	Dynamic DN	POMDP	Extensive game	Q-Learning	Deep RL	Stochastic PI
Computational Limits											
perfect	✓	✓	✓	✓	✗	✗	✗	✓	✗	✗	✗
bounded	✗	✗	✗	✗	✓	✓	✓	✗	✓	✓	✓
Learning											
given	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
learned	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓
Sensing Uncertainty											
fully obs.	✓	✓	✓	✗	✓	✓	✗	✗	✓	✓	✓
partial obs.	✗	✗	✗	✓	✗	✗	✓	✓	✗	✗	✗
Effect Uncertainty											
deterministic	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗
stochastic	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓

	Hier. Control	Search	Det. Planning	Decision Net	MDP	Dynamic DN	POMDP	Extensive game	Q-Learning	Deep RL	Stochastic PI
Preference											
goals	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗
utility	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓
Number of Agents											
single	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✗
adversary	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓
multiple	✓	✗	✗	✗	✗	✗	✗	✓	✗	✗	✓
Interactivity											
offline	✗	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
online	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓

State-space Search

- **flat** or modular or hierarchical
- **explicit states** or features or individuals and relations
- static or finite stage or **indefinite stage** or infinite stage
- **fully observable** or partially observable
- **deterministic** or stochastic dynamics
- **goals** or complex preferences
- **single agent** or multiple agents
- **knowledge is given** or knowledge is learned
- **reason offline** or reason while interacting with environment
- **perfect rationality** or bounded rationality

Classical Planning

- flat or modular or hierarchical
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Decision Networks

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Markov Decision Processes (MDPs)

- flat or modular or hierarchical
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Decision-theoretic Planning

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Reinforcement Learning

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Relational Reinforcement Learning

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Classical Game Theory

- flat or modular or hierarchical
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- fully observable or partially observable
- deterministic or stochastic dynamics
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- reason offline or reason while interacting with environment
- perfect rationality or bounded rationality

- flat or modular or **hierarchical**
- explicit states or features or **individuals and relations**
- static or finite stage or **indefinite stage or infinite stage**
- fully observable or **partially observable**
- deterministic or **stochastic** dynamics
- goals or **complex preferences**
- single agent or **multiple agents**
- knowledge is given or **knowledge is learned**
- reason offline or **reason while interacting with environment**
- perfect rationality or **bounded rationality**

Comparison of Some Representations

	CP	MDPs	IDs	RL	POMDPs	GT
hierarchical	✓					
properties	✓		✓	✓		
relational	✓					
indefinite stage	✓	✓		✓	✓	
stochastic dynamics		✓	✓	✓	✓	✓
partially observable			✓		✓	✓
values		✓	✓	✓	✓	✓
dynamics not given				✓		
multiple agents						✓
bounded rationality						