

# POMDPs

- We've been living a lie:

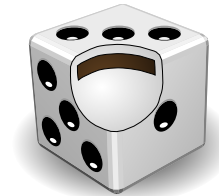
```
s = observe(env)
```

# Types of Uncertainty

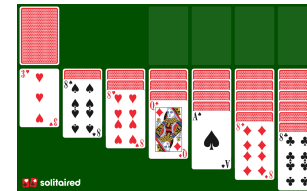
**Alleatory**



**Epistemic (Static)**



**Epistemic (Dynamic)**

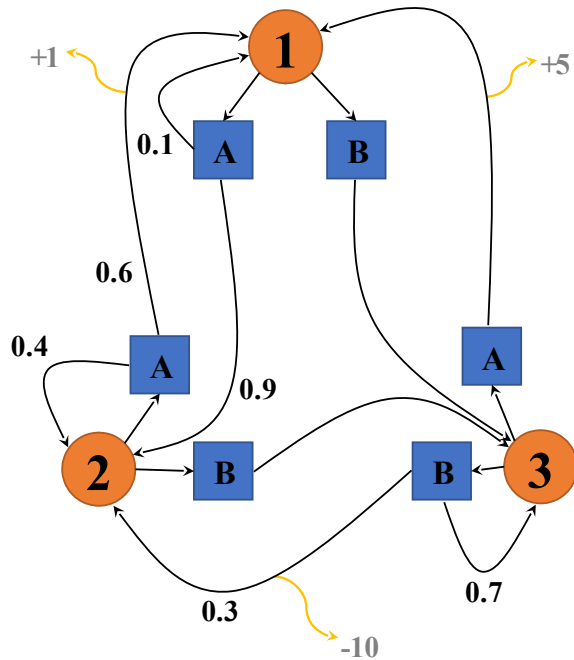


**Interaction**



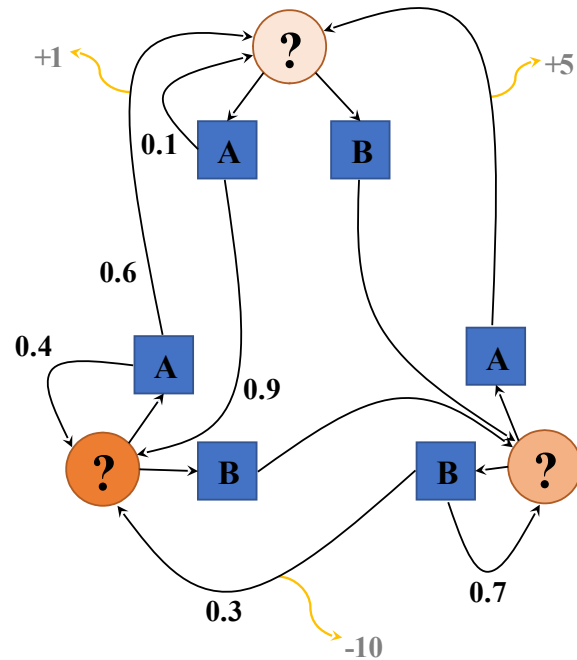
# Markov Decision Process (MDP)

- $\mathcal{S}$  - State space
- $T : \mathcal{S} \times \mathcal{A} \times \mathcal{S} \rightarrow \mathbb{R}$  - Transition probability distribution
- $\mathcal{A}$  - Action space
- $R : \mathcal{S} \times \mathcal{A} \rightarrow \mathbb{R}$  - Reward



**Alleatory**

# Partially Observable Markov Decision Process (POMDP)



- $\mathcal{S}$  - State space
- $T : \mathcal{S} \times \mathcal{A} \times \mathcal{S} \rightarrow \mathbb{R}$  - Transition probability distribution
- $\mathcal{A}$  - Action space
- $R : \mathcal{S} \times \mathcal{A} \rightarrow \mathbb{R}$  - Reward
- $\mathcal{O}$  - Observation space
- $Z : \mathcal{S} \times \mathcal{A} \times \mathcal{S} \times \mathcal{O} \rightarrow \mathbb{R}$  - Observation probability distribution

Alleatory

Epistemic (Static)

Epistemic (Dynamic)

# Tiger POMDP Definition

# Hidden Markov Models and Beliefs

# Bayesian Belief Updates

# Filtering Loop



# Tiger Example



# Recap