Projet Int. Art. and Optimization

An introduction

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Last improvement in Artificial Intelligence

- *Nov. 2007*, Carnegie-Mellon win the Darpa Urban Challenge ($2M\$$)
- *Oct. 2015*, First release of Tesla Autopilot

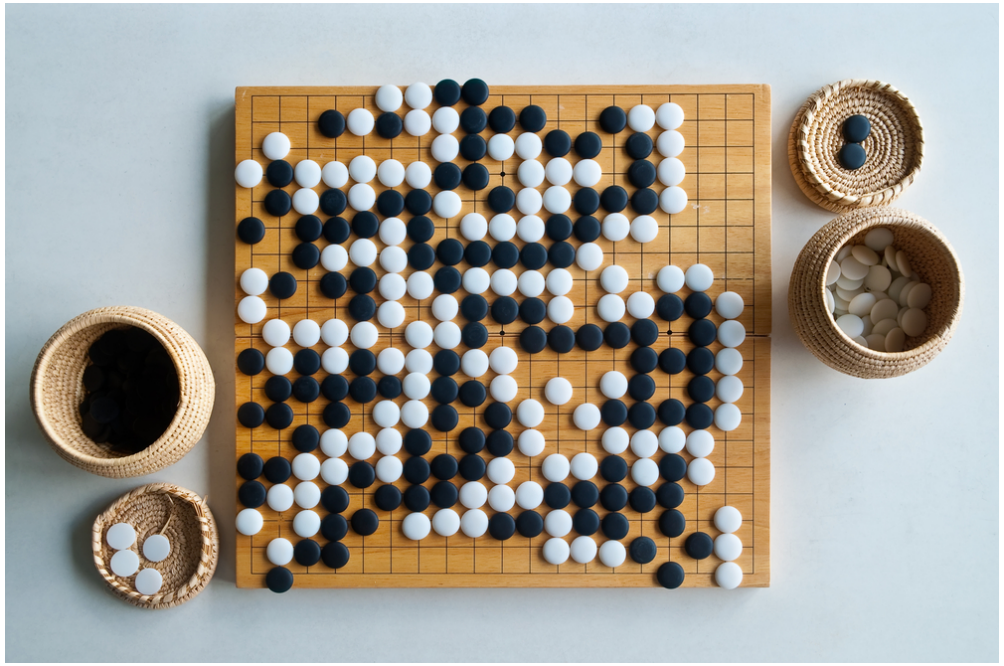
- *Oct. 2015*, Victory of d'**AlphaGo** over professional player

Our topic: Autonomous Decision Making

- Model the capability of actions
- Learn action interest
- Optimize policies of actions
- Handle large problem with optimization techniques

The notion of complexity (Go)

GO: 10^{170} positions, 10^{600} games (chess: 10^{120} games)



The notion of complexity (Go)

A classical 3 GHz computer: 3×10^9 op. per second
$\rightarrow$ 2.6×10^{14} op. a day $\rightarrow$ 10^{17} op. a year

Enumerating all games: $O(n)$ with $n = 10^{600}$: around 10^{583} years.
$\rightarrow$ requires decomposed model and statistics...

Sun Life: around 10^{30} years

Decision Making Problem

How to compute ~~optimal~~ appropriate responses to control dynamic systems ?

Knowing that:

- Evolutions are generally uncertain
- We potentially do not have the model
- Model could require very large exploration

Introduction to Decision Under Uncertainty

Is an introduction to models and algorithms to perform decision-making at a time step *t*, by considering potential effects.

- 2 course sessions : 3 hours 30 with theory and practices
- 2 tutorial sessions : 2×4 hours
  - Apply and optimize Q-Learning
  - Simple games as a playground
- Integration to a larger project : The remaining times

1. **Introduction**

- The notion of Agent
- Class of problems
- Practice

Notion of Agent - Simple definition

An agent:

An entity capable of perception and action evolving in an environment.

Question:

How to choose appropriate action to perform considering the perception at a each time step ?

Notion of Agent - Not reserved to Artificial Intelligence

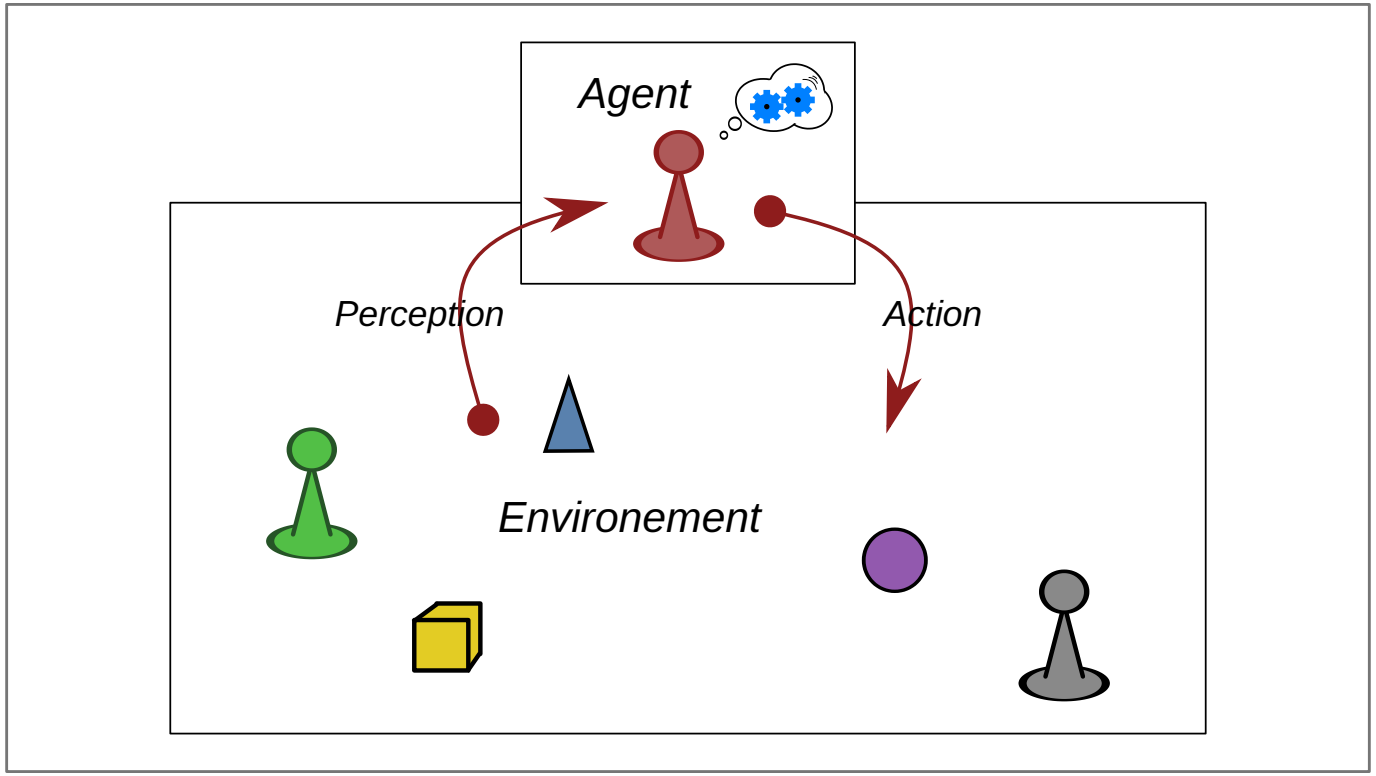
"I act therefore I am"

- my actions have an effect on the world
- **and** I have the choice to act or not

cf. "BullShit Jobs" - David Graeber (2019)
(p.132-133 fr. in version)

or the joy to be cause - Karl Groos (1901)

Notion of Agent - Simple definition



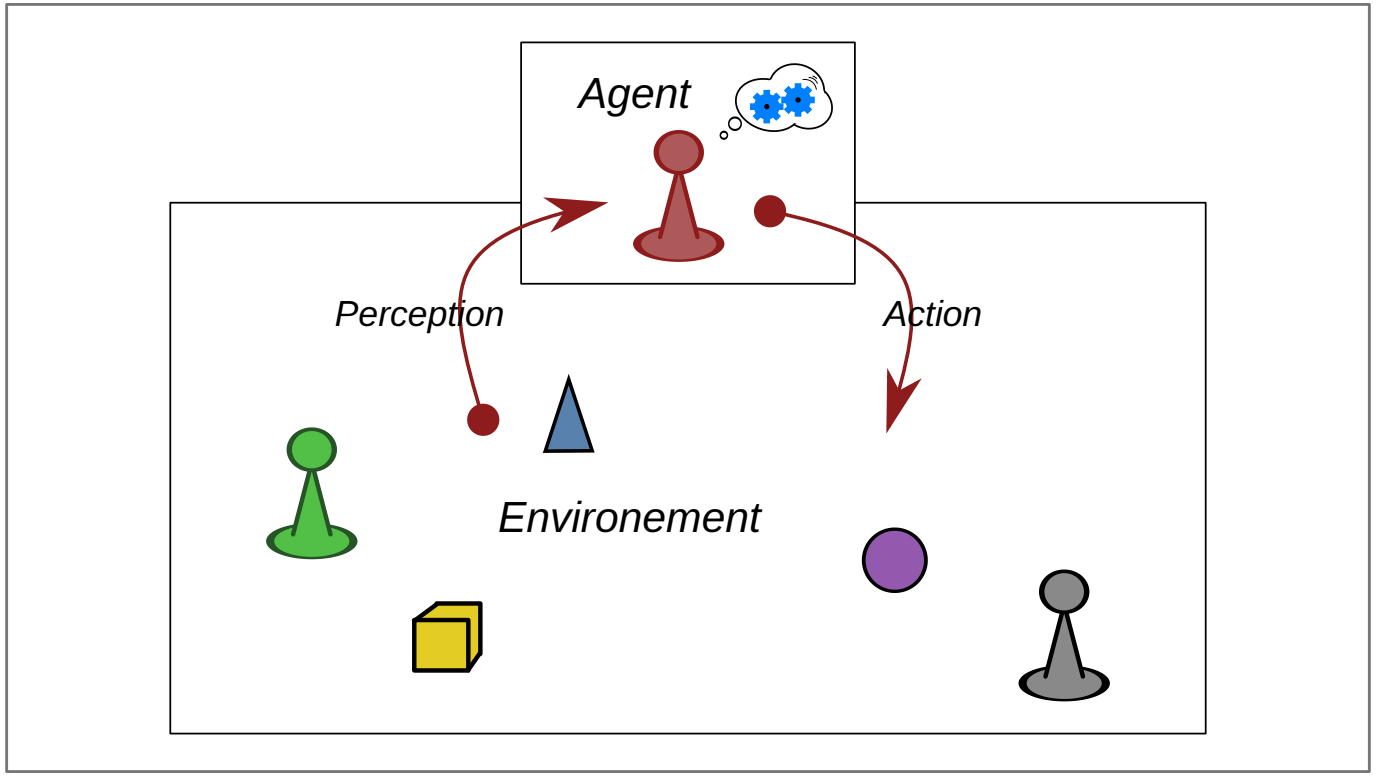
rarely determinist, mostly uncertain (even stochastic)

Notion of Agent - Complementary Notions

Agent:

- Defining by a perception-state, goals and a policy to achieve its goals (*BDI* model: Belief - Desire - Intention)
- with different positions in social structure (*AGR* model: Agent - Group - Role)
- Capable of communication
- Capable of adaptation (learning)
- Driven by emotions
- ...

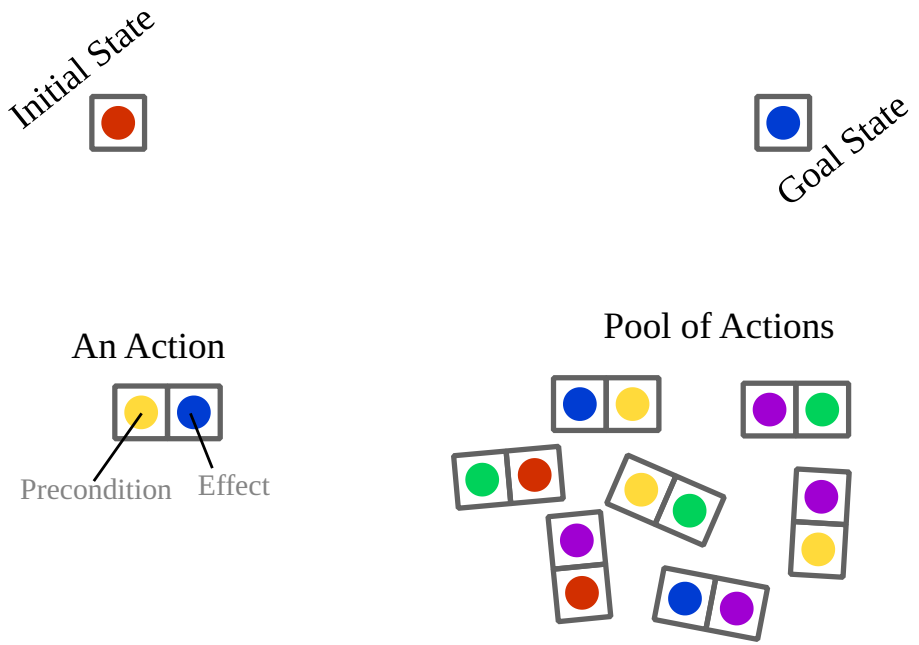
Notion of Agent - rational Agent



- Capable of **perception** and **action** & driven toward its **goals** (**Desire** in **BDI** model)
- *I.E.* Somehow, a value function allows optimizing the course of actions.

Class of problems - Deterministic Planning

Determining *a succession of actions* to drive a system from an initial state to a target state.

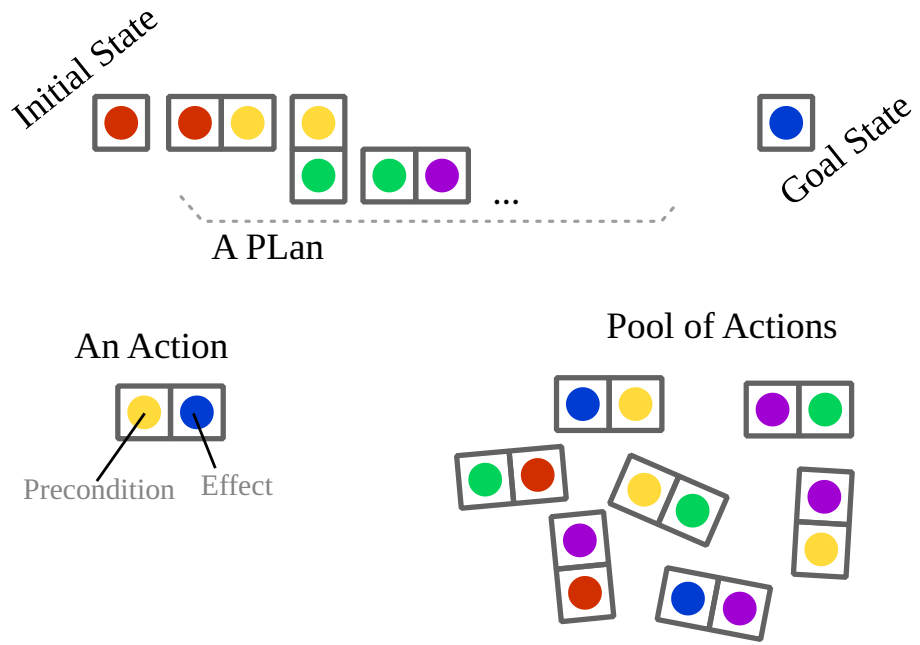


Deterministic case:

- the effects, by doing an action, from a specific state is certain.

Class of problems - Deterministic Planning

Determining *a succession of actions* to drive a system from an initial state to a target state.

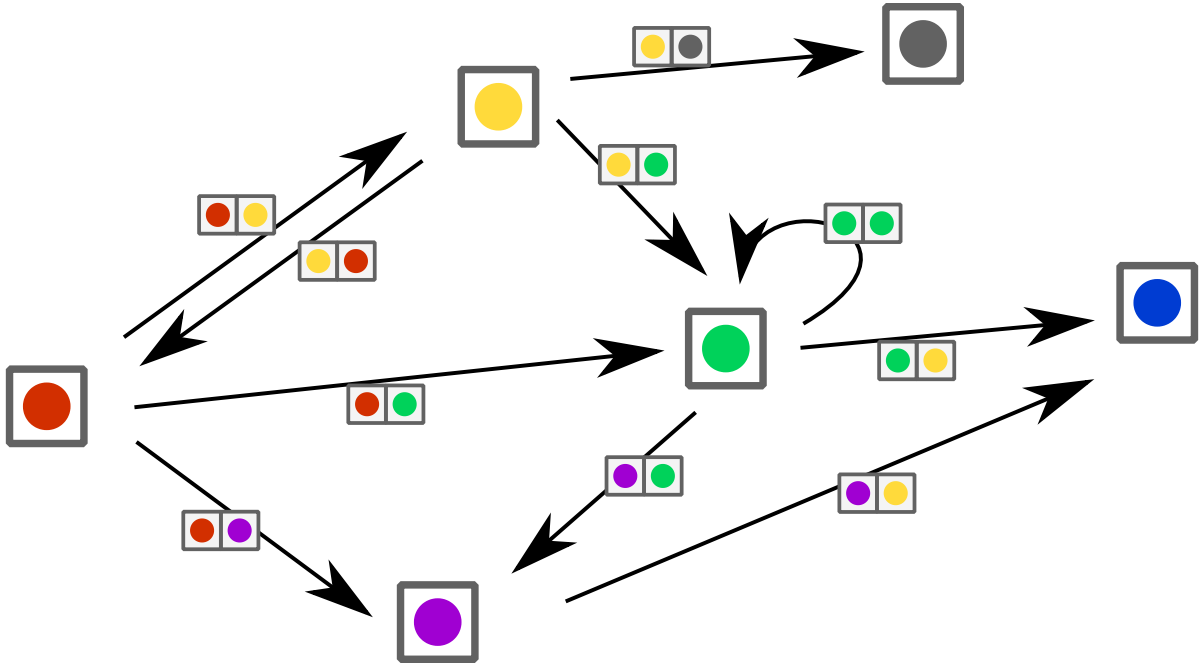


Deterministic case:

- the effects, by doing an action, from a specific state is certain.

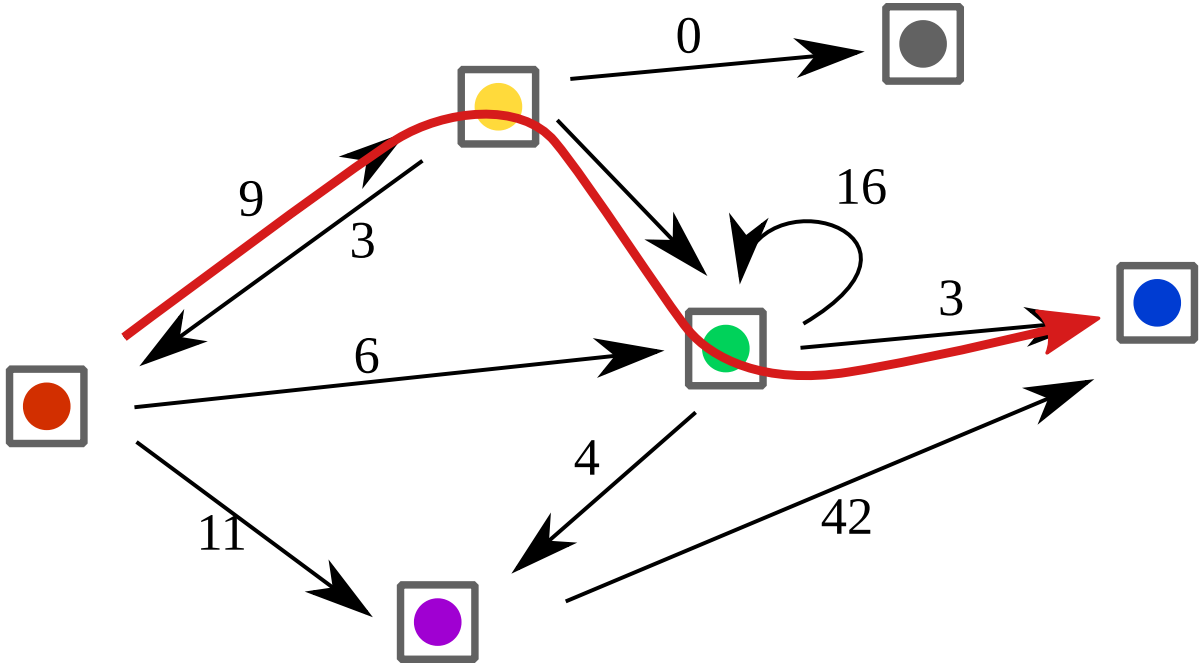
Class of problems - Determine a Plan

Finding a *path* in a *graph* modeling all possible evolutions



Class of problems - Plan Optimization

Finding an *optimized* path in a *weighted* Graph

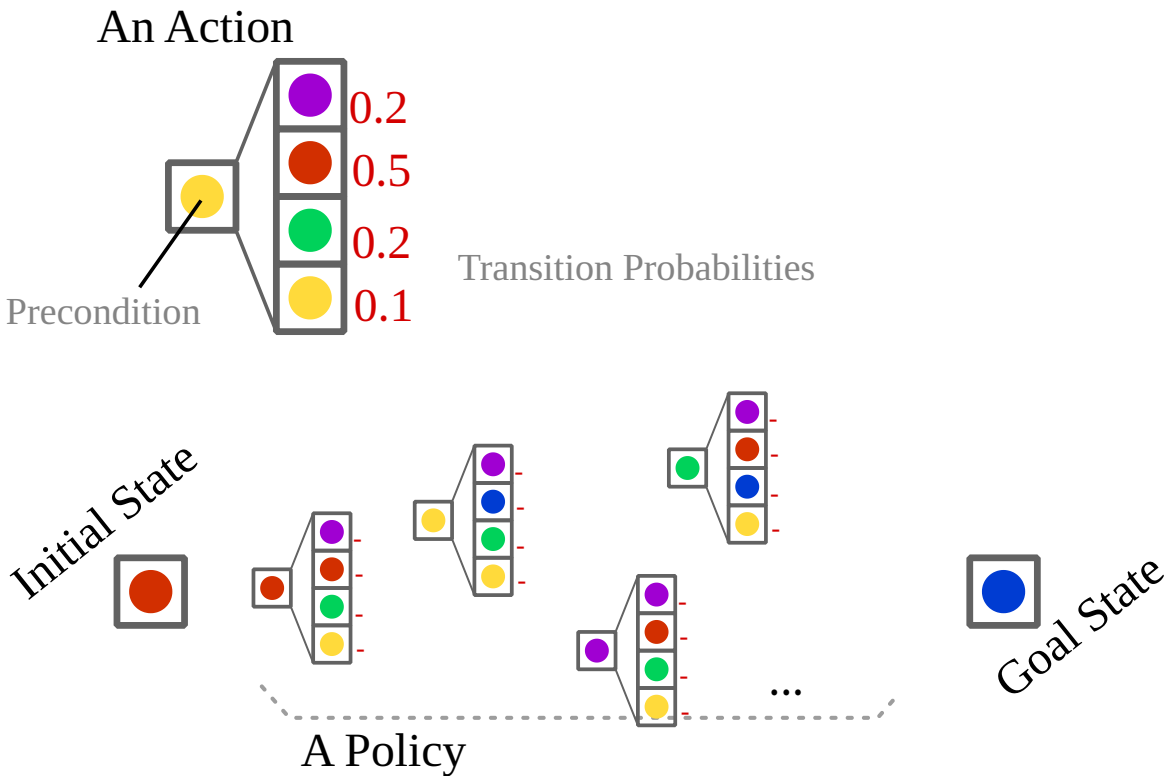


- Tipically: *Finding the shortest path from A to B*

Class of problems - Stokastic Planning

Build a *policy*:

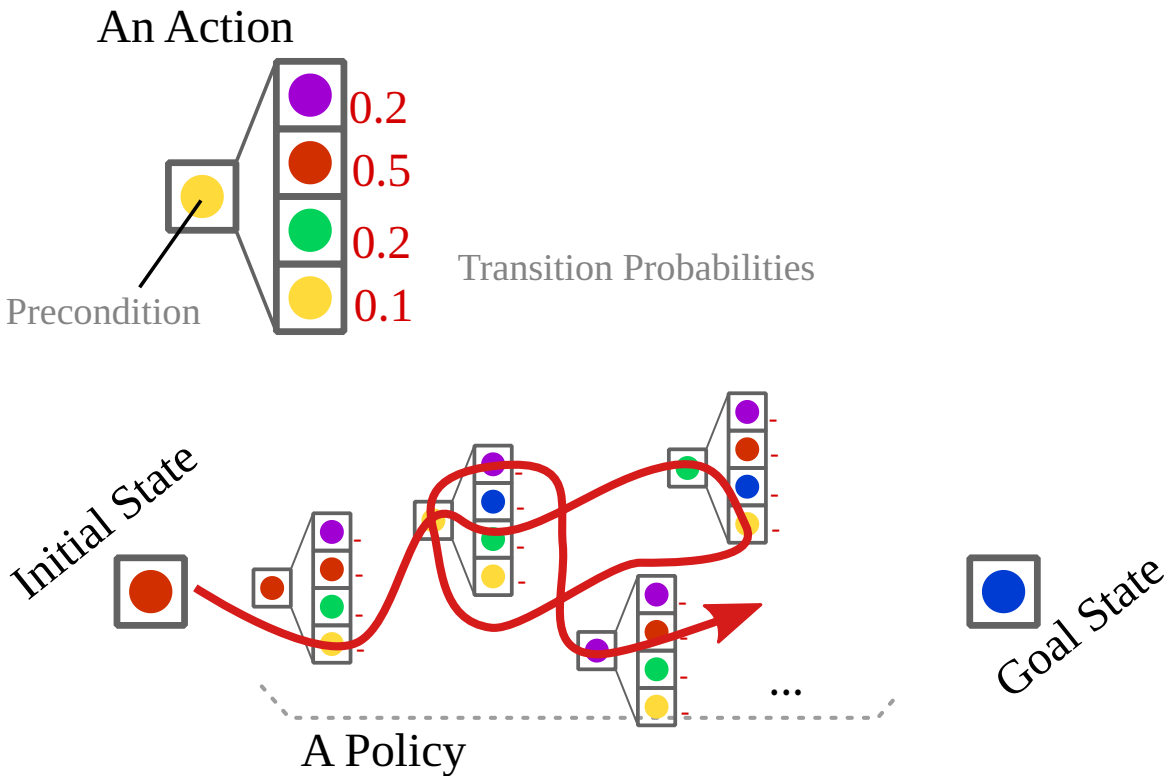
- Associate an *action* to perform *to each* reachable *state*



Class of problems - Stokastic Planning

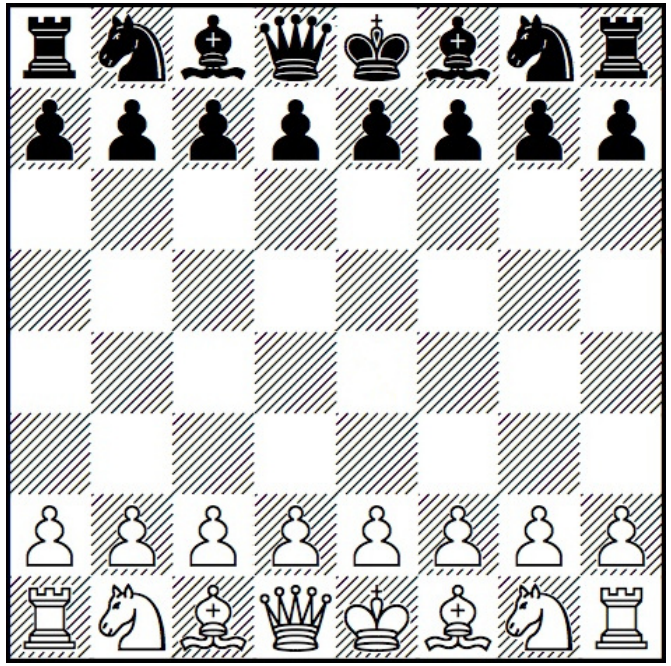
Execute a *policy*:

- Then, the effective succession of actions remains stochastic



Class of problems - Game Theory

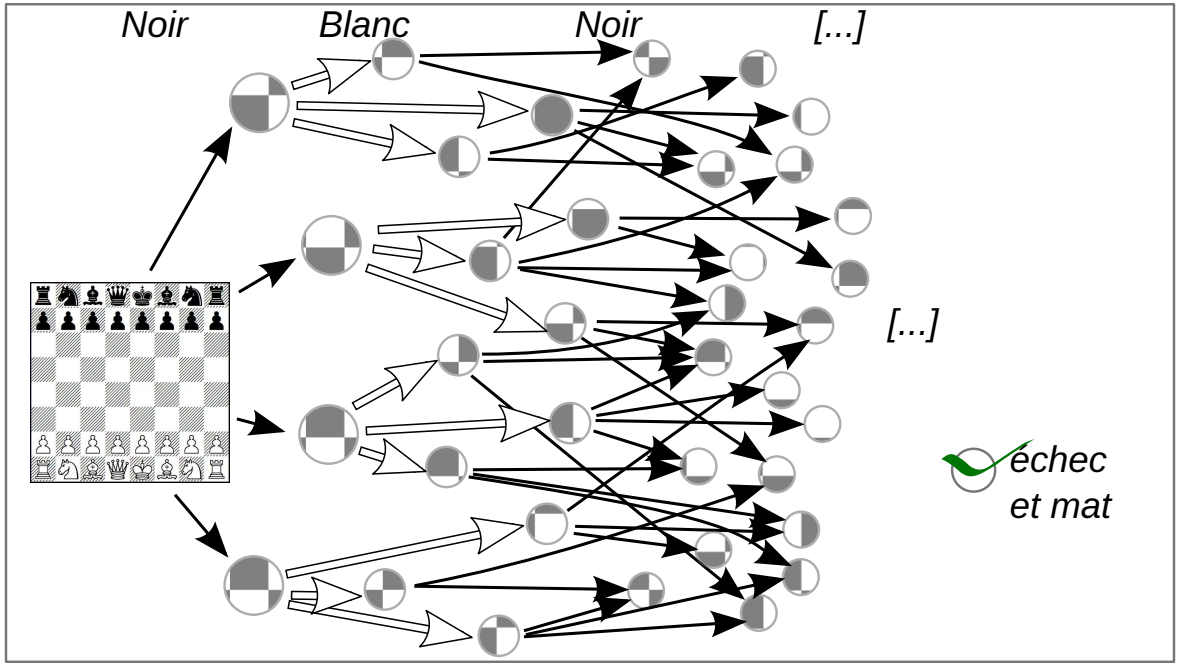
Few entities (players) control a system (with different goals)



- Which actions for each entity ?
- Which consequences ?

Class of problems - Game theory

Few entities control the same system (with different goals)



- *Uncertainty*: At least on the actions of the other players.

Game: 421

- Get the best combination
- by rolling 3 dices

Goal :

- Optimize the 2 re-roll possibility
- by choosing dices to roll again.

Tools :

- HackaGame: imt-mobisyst.bitbucket.io
- Salon virtuel: discord.gg/anGJR5RH

Game: 421

Code:

- On replit.com (for instance)

Expected:

- Get the code philosophy
- Developpe a scripted AI.