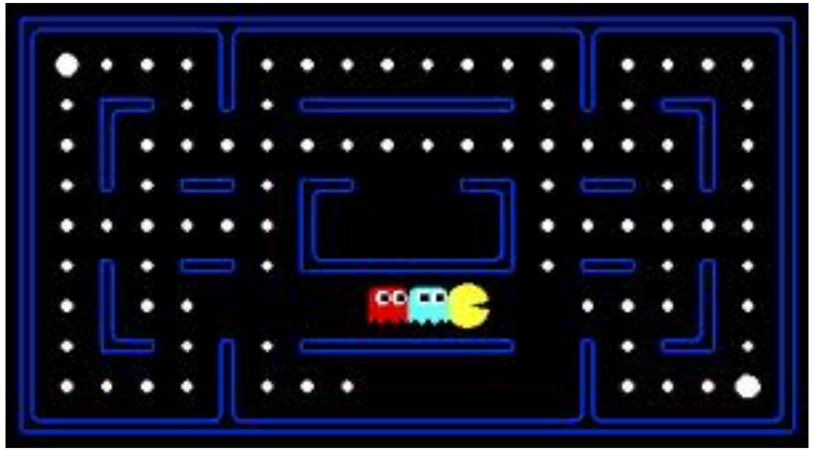
Games: overview



Course plan

Search problems

Markov decision processes

$\boxed{\text{Adversarial games}}$

Constraint satisfaction problems

Bayesian networks

Reflex **States** **Variables** **Logic**

"Low-level intelligence" "High-level intelligence"

Machine learning

A simple game

Example: game 1

You choose one of the three bins.

I choose a number from that bin.

Your goal is to maximize the chosen number.

A	**B**	**C**
-50 50	1 3	-5 15

Roadmap

Modeling

Modeling Games

Algorithms

Game Evaluation

Expectimax

Minimax

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Evaluation Functions

Alpha-Beta Pruning

Learning

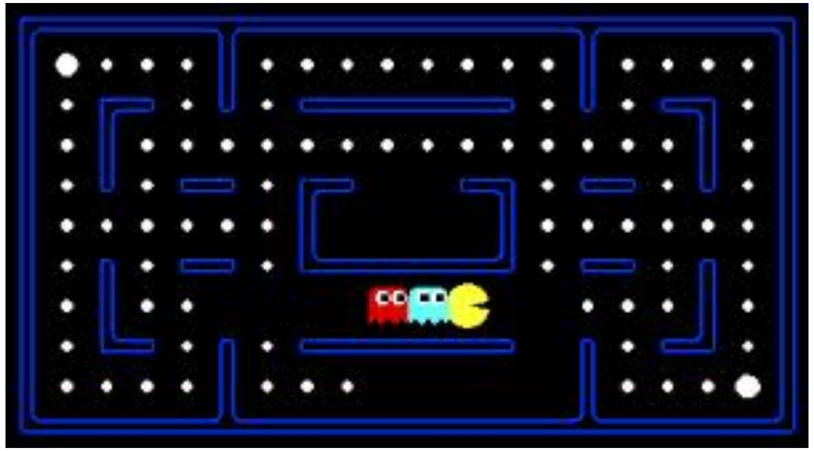
Temporal Difference Learning

Other Topics

Simultaneous Games

Non-Zero-Sum Games

Games: modeling

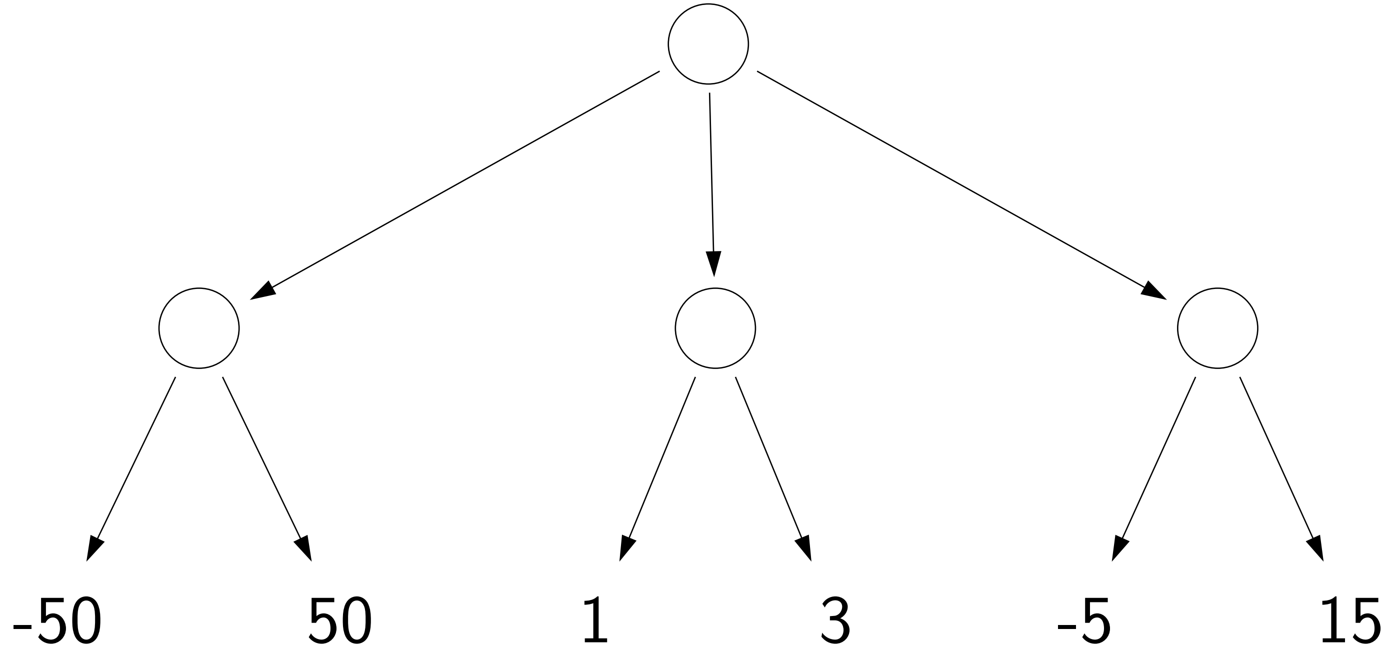


Game tree

Key idea: game tree

Each node is a decision point for a player.

Each root-to-leaf path is a possible outcome of the game.



Two-player zero-sum games

Players $= \{\text{agent}, \text{opp}\}$

Definition: two-player zero-sum game

s_{start}: starting state

$\text{Actions}(s)$: possible actions from state s

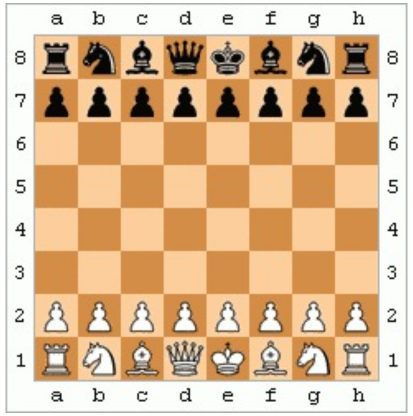
$\text{Succ}(s, a)$: resulting state if choose action a in state s

$\text{IsEnd}(s)$: whether s is an end state (game over)

$\text{Utility}(s)$: agent's utility for end state s

$\text{Player}(s) \in \text{Players}$: player who controls state s

Example: chess



Players $= \{\text{white}, \text{black}\}$

State s: (position of all pieces, whose turn it is)

Actions(s): legal chess moves that Player(s) can make

IsEnd(s): whether s is checkmate or draw

Utility(s): $+\infty$ if white wins, 0 if draw, $-\infty$ if black wins

Characteristics of games

- All the utility is at the end state

- Different players in control at different states

The halving game

Problem: halving game

Start with a number N.

Players take turns either decrementing N or replacing it with $\lfloor \frac{N}{2} \rfloor$.

The player that is left with 0 wins.

[semi-live solution: `HalvingGame`]

Policies

Deterministic policies: $\pi_p(s) \in \text{Actions}(s)$

action that player p takes in state s

Stochastic policies $\pi_p(s, a) \in [0, 1]$:

probability of player p taking action a in state s

[semi-live solution: `humanPolicy`]