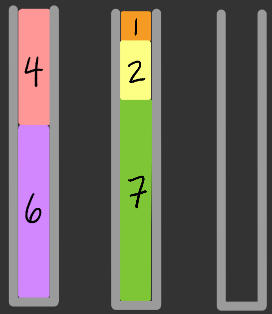
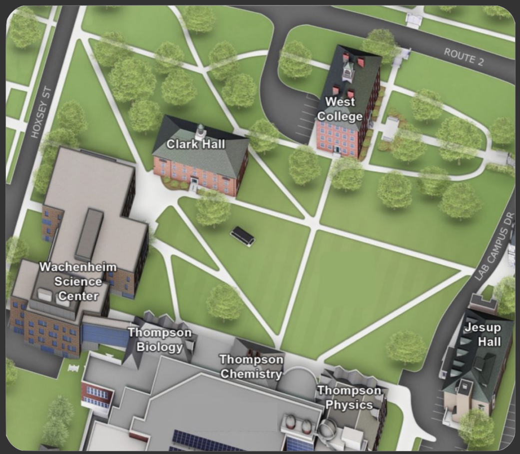
multiplayer games

CSCI 373

train
brain
brawn
prawn



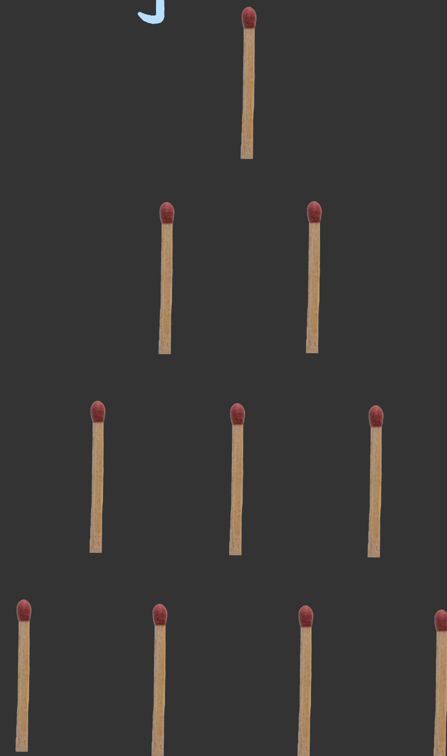


all of the tasks we've discussed so far have involved a **single agent** but what if others want to stop us from **succeeding?**

"spy vs. spy"
mad magazine

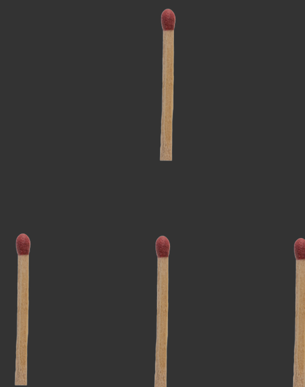
the game of nim

on your turn, you must remove one or more matchsticks from a single row

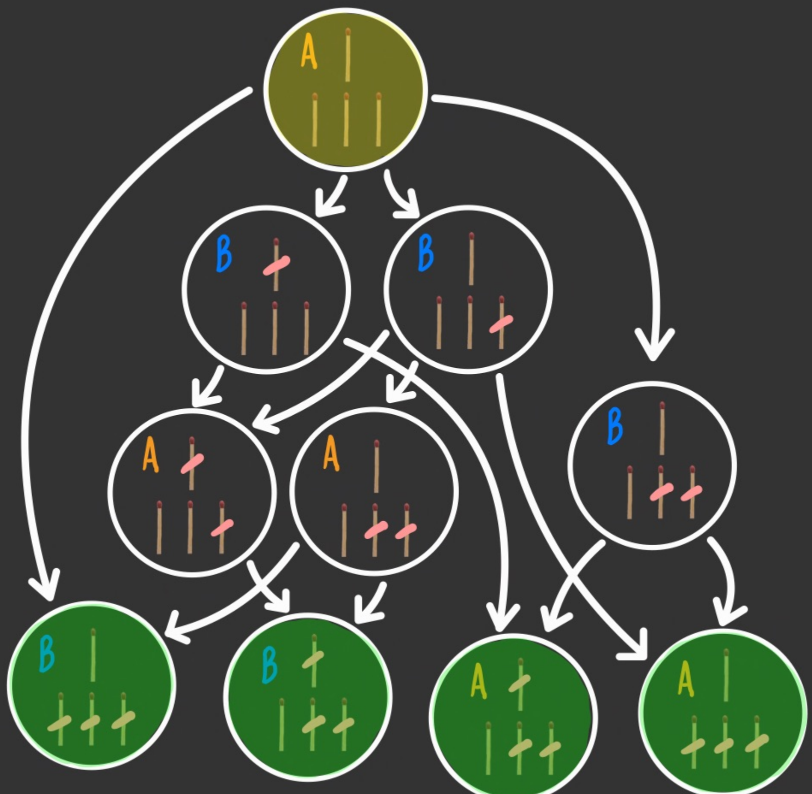


you lose if you remove the last **matchstick**

the game of nim



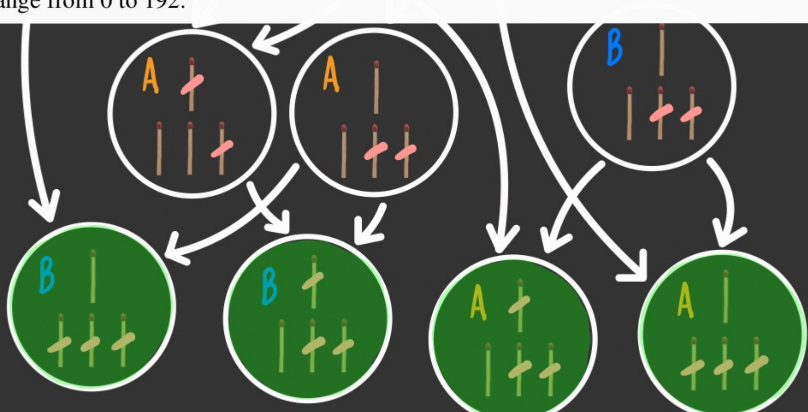
assume this initial nim board



a game with players P is a tuple $(\mathcal{M}, U)$ where:

- $\mathcal{M} = (Q, \Sigma, \Delta, q_0, F)$ is a state machine where each state $q \in Q$ has the form $(p, q') \in P \times Q'$ for an auxiliary set Q' of states
- utility function $U : F \times P \to \mathbb{R}$ which gives the value of each final state for each player

- S_0: The **initial state**, which specifies how the game is set up at the start.
- TO-MOVE(s): The player whose turn it is to move in state s.
- ACTIONS(s): The set of legal moves in state s.
- RESULT(s, a): The **transition model**, which defines the state resulting from taking action a in state s.
- IS-TERMINAL(s): A **terminal test**, which is true when the game is over and false otherwise. States where the game has ended are called **terminal states**.
- UTILITY(s, p): A **utility function** (also called an objective function or payoff function), which defines the final numeric value to player p when the game ends in terminal state s. In chess, the outcome is a win, loss, or draw, with values 1, 0, or $1/2$.[2] Some games have a wider range of possible outcomes—for example, the payoffs in backgammon range from 0 to 192.



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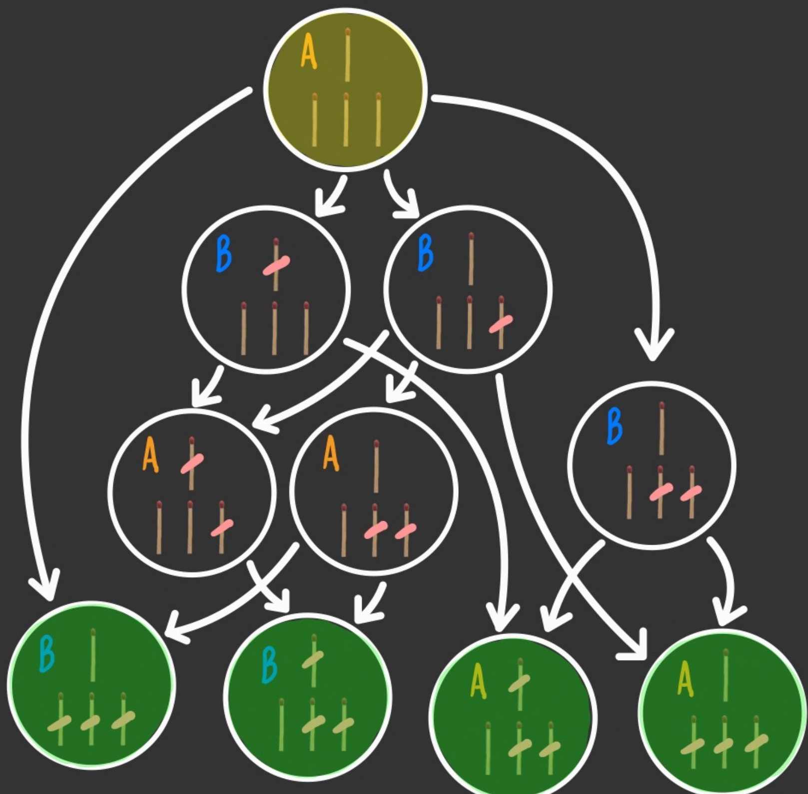
$P = \{A, B\}$



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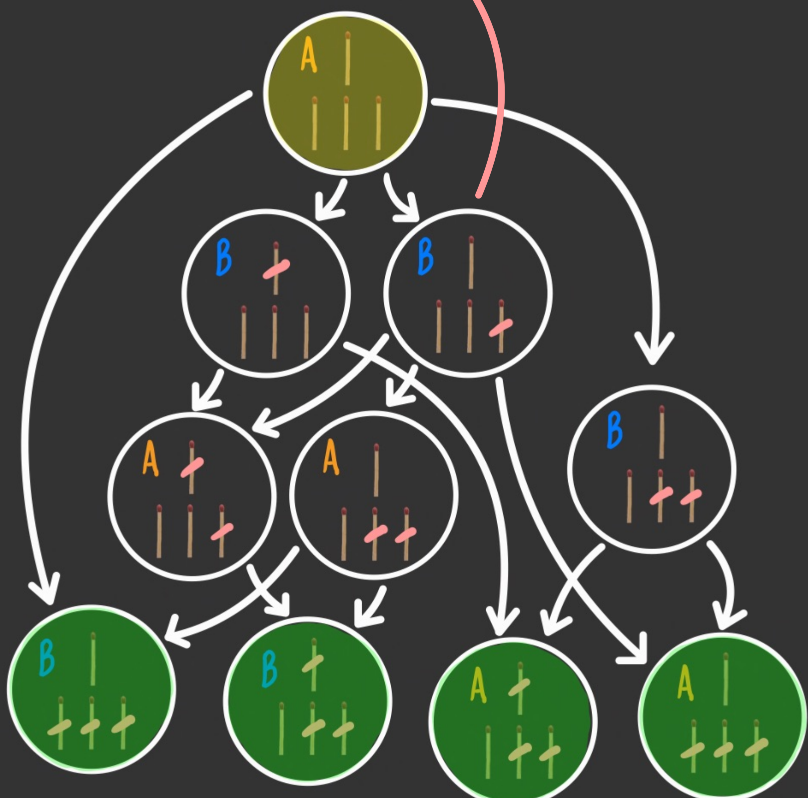
Shorthand for $(B, \text{[matchsticks]})$



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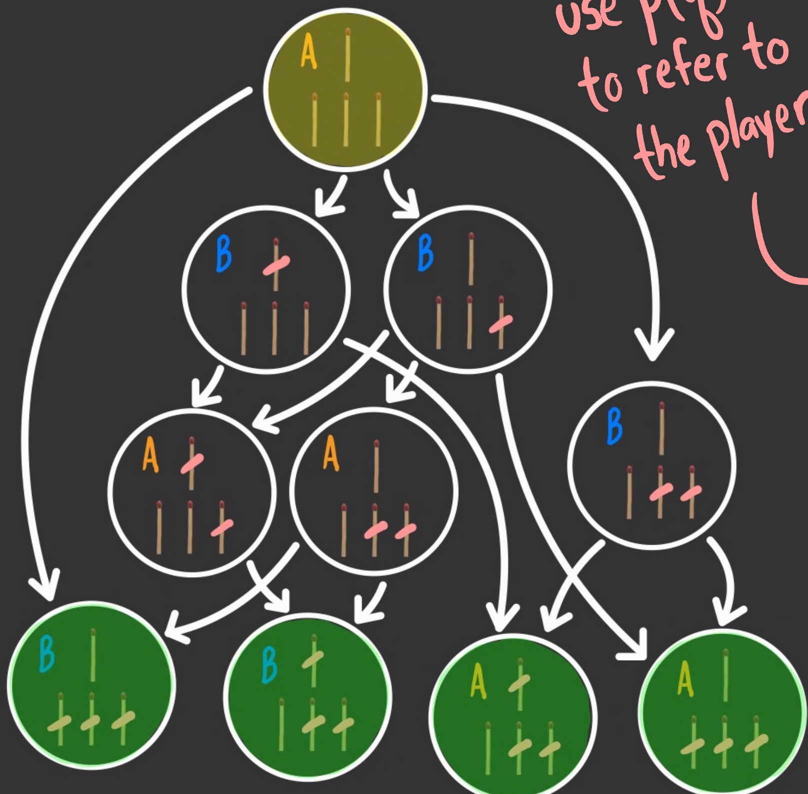
e.g. $p\left(\bigcirc\right) = B$



use $p(q)$ to refer to the player

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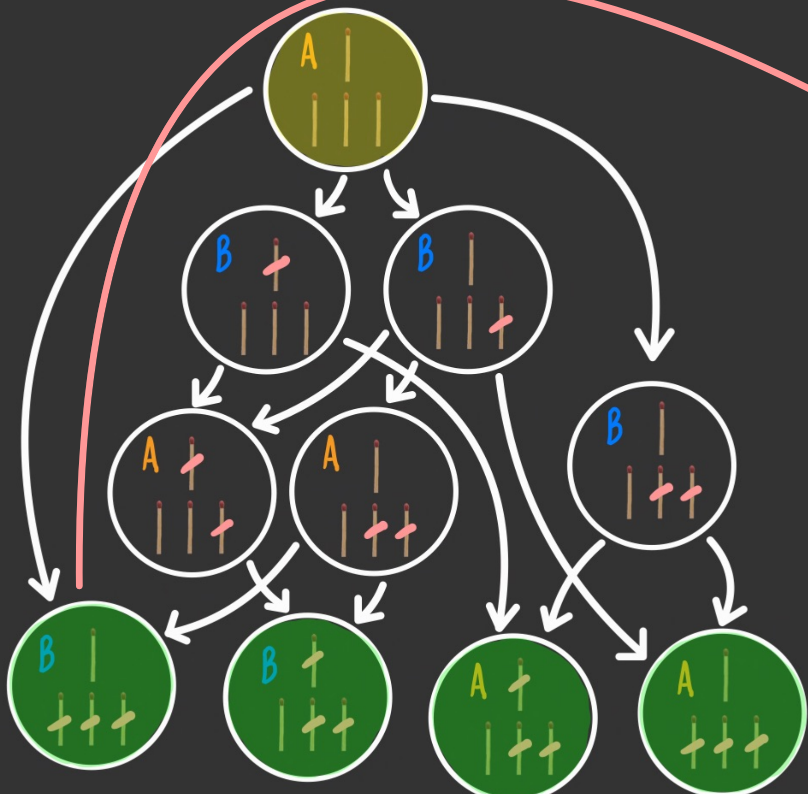
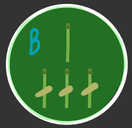
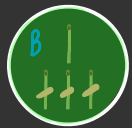


$U($  $, A) = 1$

$U($  $, B) = -1$

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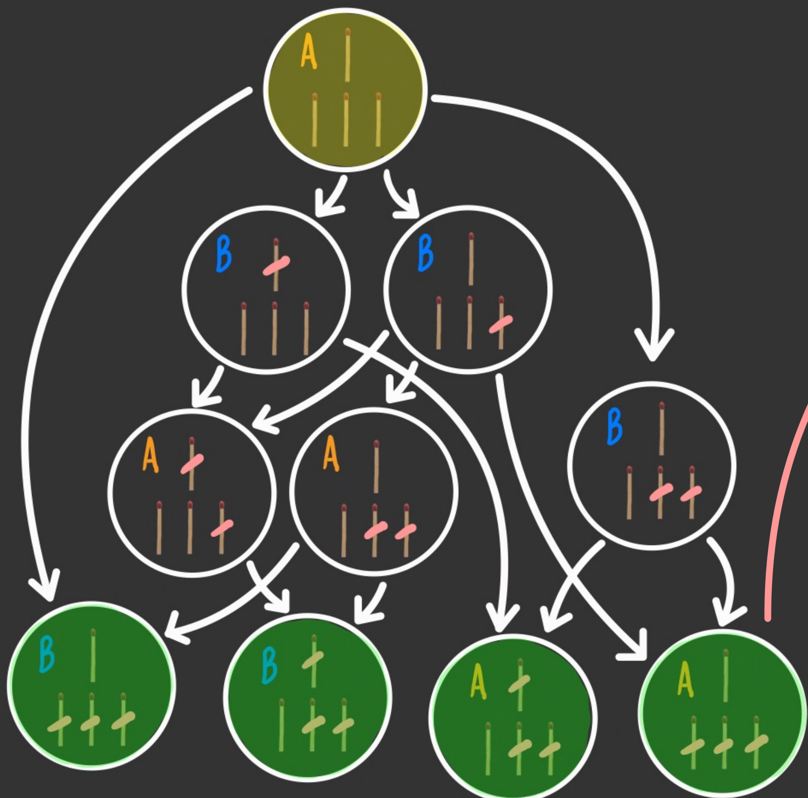

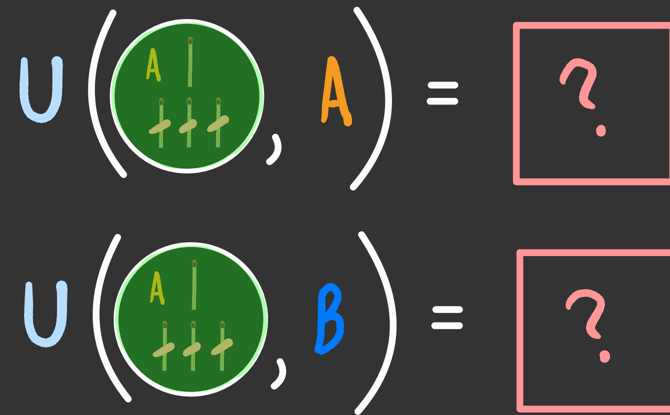

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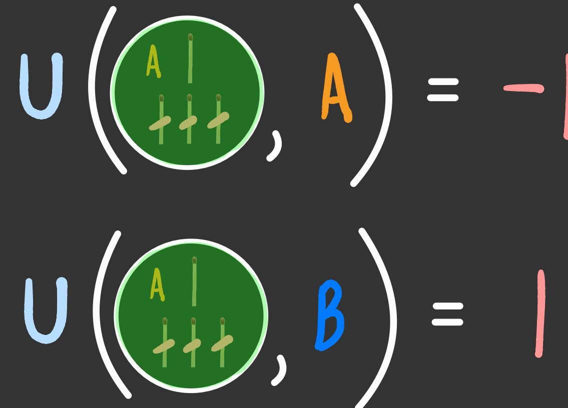

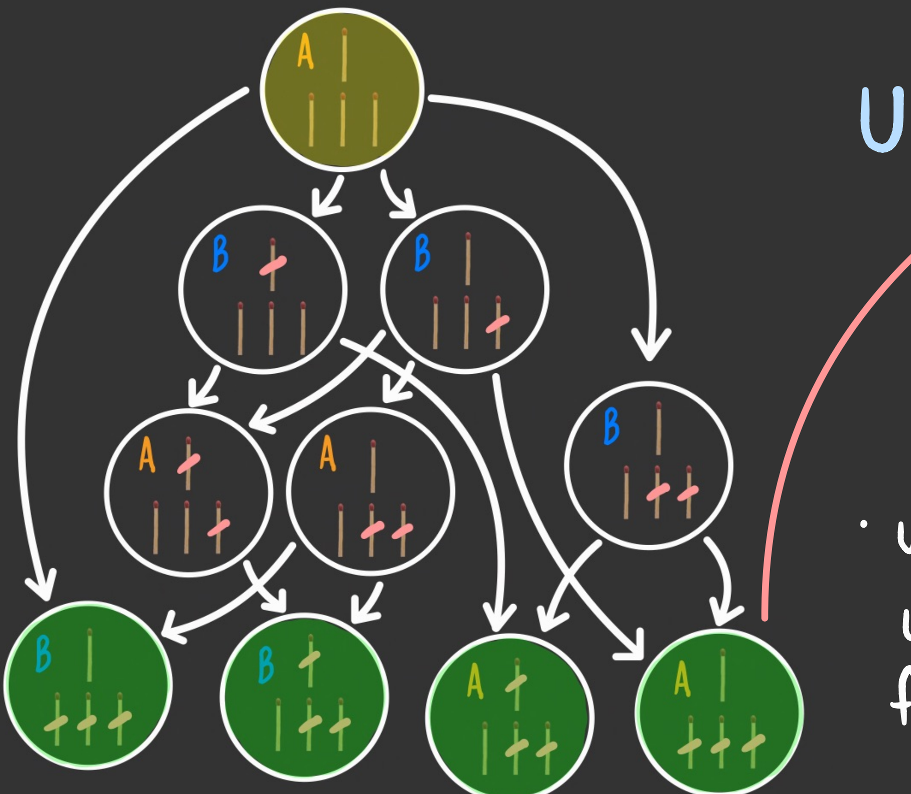

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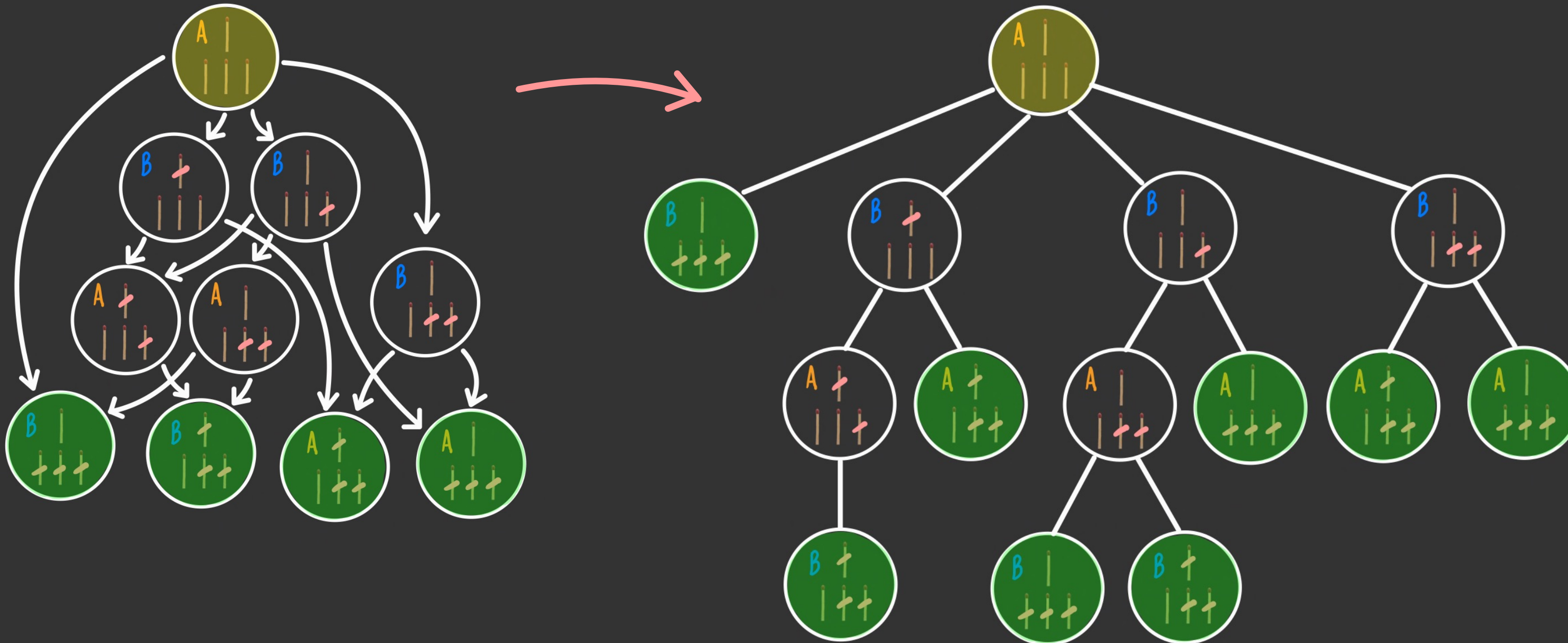

analogous to single-agent search, a game can be unraveled into a search tree