



Introduction to Artificial Intelligence

Week 4



Learning by Searching



Backtracking



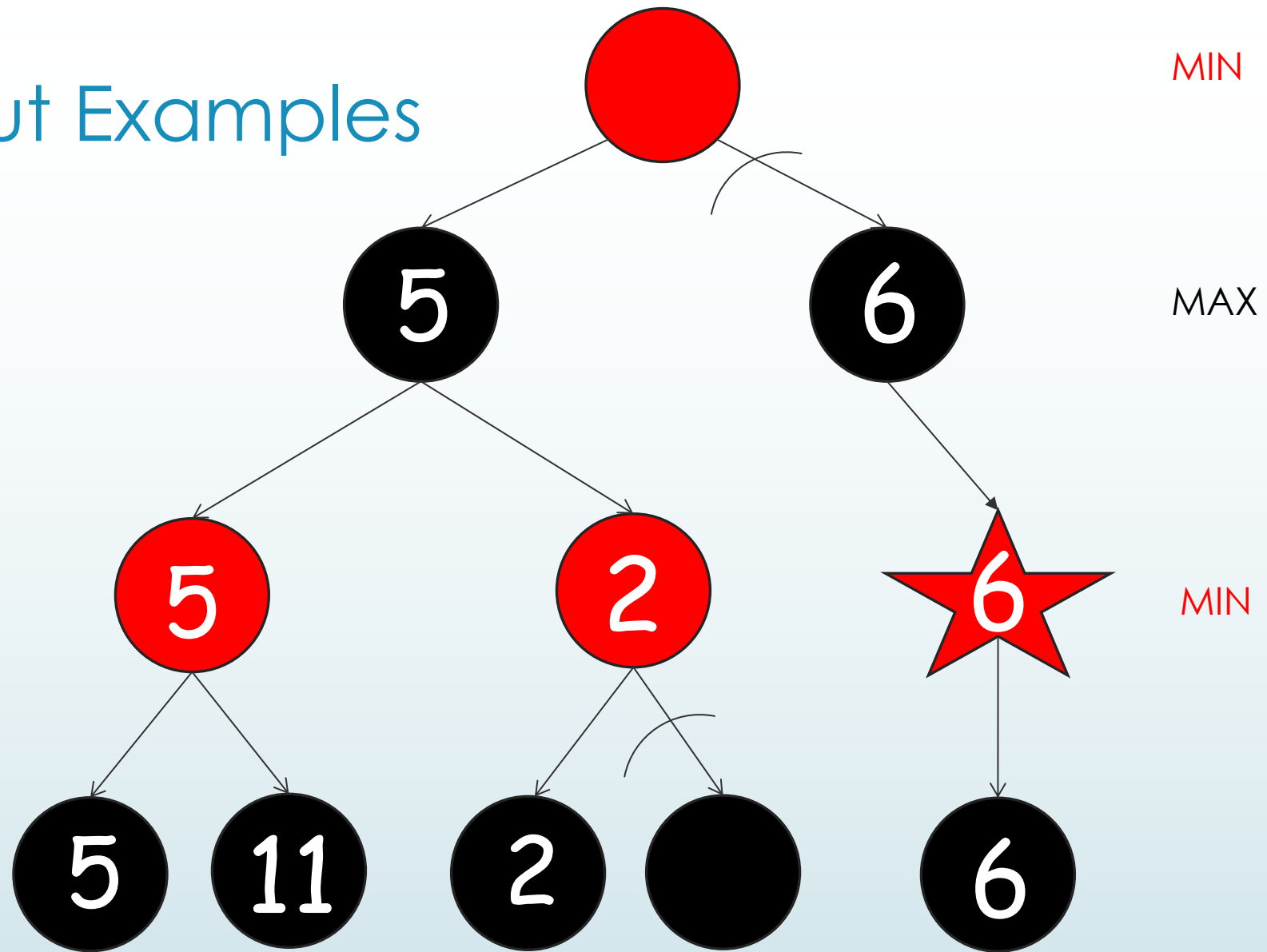
- Simulate the entire game
- Assume rational/perfect play from the opponent
- Theoretically there is a perfect game play method if we search the entire game
- Solved Games
 - Tic Tac Toe
 - Checkers
 - Two player heads-up limit poker – Recent discovery by researchers in University of Alberta
- Unsolved
 - Chess
 - Go



Backtracking with Alpha Beta Cuts

- Heuristic search based on backtracking
- Used in situations where there is a value to the solution at each point to allow for an evaluation
- Applied for Game Trees
- Alpha Cut
 - Maximum lower bound (Max Plays - Black)
- Beta Cut
 - Minimum upper bound (Min Play - Red)

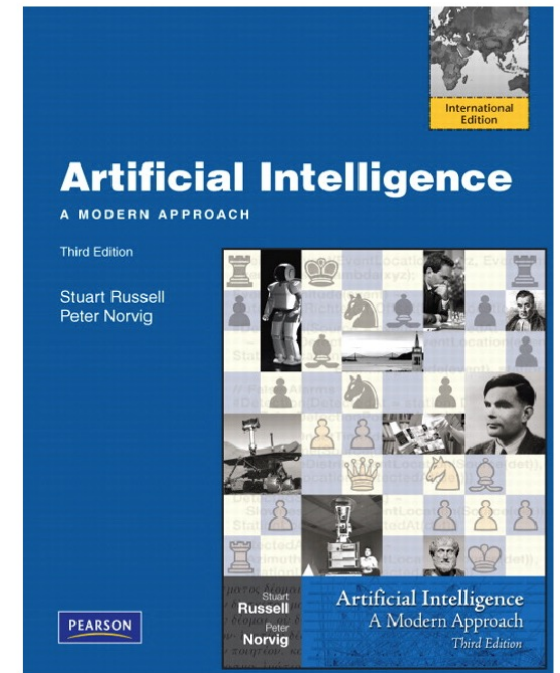
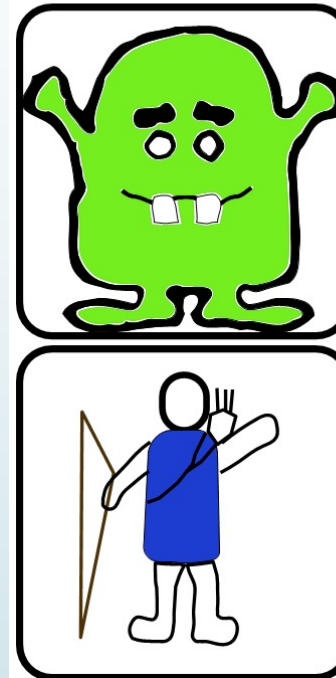
Cut Examples



The Wumpus World

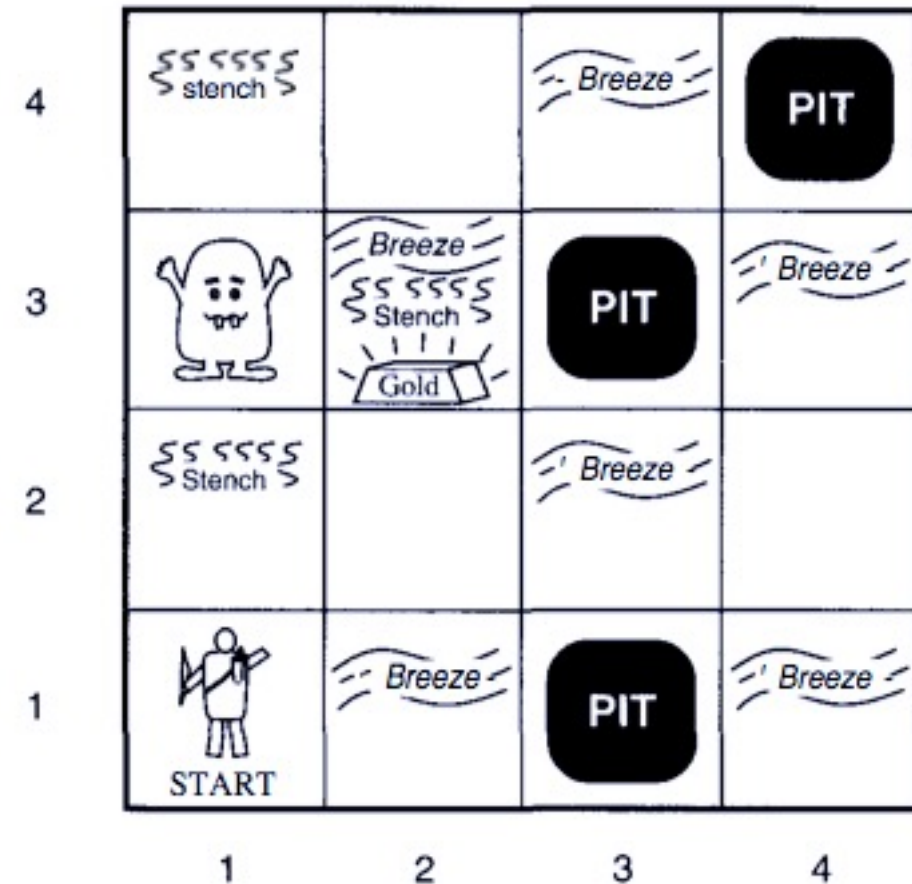
- Wumpus was an early computer game, based on an agent who explores a cave consisting of rooms connected by passageways. Lurking somewhere in the cave is the wumpus, a beast that eats anyone who enters its room. To make matters worse, some rooms contain bottomless pits that will trap anyone who wanders into these rooms (except for the wumpus, who is too big to fall in). The only mitigating feature of living in this environment is the occasional heap of gold.

Wumpus World



The Wumpus World Rules (1)

- Like the vacuum world, the wumpus world is a grid of squares surrounded by walls, where each square can contain agents and objects. The agent always starts in the lower left corner, a square that we will label [1,1]. The agent's task is to find the gold if it is possible, return to [1,1] and climb out of the cave.





The Wumpus World Rules (2)

- In the square containing the wumpus and in the directly (not diagonally) adjacent squares the agent will perceive a stench.
- In the squares directly adjacent to a pit, the agent will perceive a breeze.
- In the square where the gold is, the agent will perceive a glitter.
- When an agent walks into a wall, it will perceive a bump.
- When the wumpus is killed, it gives out a woeful scream that can be perceived anywhere in the cave.
- The percepts will be given to the agent in the form of a list of five symbols; for example, if there is a stench, a breeze, and a glitter but no bump and no scream, the agent will receive the percept [*Stench, Breeze, Glitter, None, None*]. The agent *cannot* perceive its own location.



The Wumpus World Rules (3)

- Just as in the vacuum world, there are actions to go forward, turn right by 90° , and turn left by 90° . In addition, the action *Grab* can be used to pick up an object that is in the same square as the agent. The action *Shoot* can be used to fire an arrow in a straight line in the direction the agent is facing. The arrow continues until it either hits and kills the wumpus or hits the wall. The agent only has one arrow, so only the first *Shoot* action has any effect. Finally, the action *Climb* is used to leave the cave; it is effective only when the agent is in the start square.
- The agent dies a miserable death if it enters a square containing a pit or a live wumpus. It is safe (but smelly) to enter a square with a dead wumpus.
- The agent's goal is to find the gold and bring it back to the start as quickly as possible, without getting killed. To be precise, 1000 points are awarded for climbing out of the cave while carrying the gold, but there is a 1-point penalty for each action taken, and a 10,000-point penalty for getting killed.

Let's play

- ➡ Divide into 2 teams and choose a captain.

7							
6							
5							
4							
3							
2							
1	start						
	1	2	3	4	5	6	7

Scheme

7		B				B	PIT
6	B	PIT	B		B		B
5		B		B	PIT	B	PIT
4			B	PIT	B	S	B
3			B	B	S B	W S	S
2		B	PIT	B	PIT	S B G	B
1	start		B	PIT	B	B	PIT
	1	2	3	4	5	6	7



References



- [Minimax and alpha-beta pruning](#)