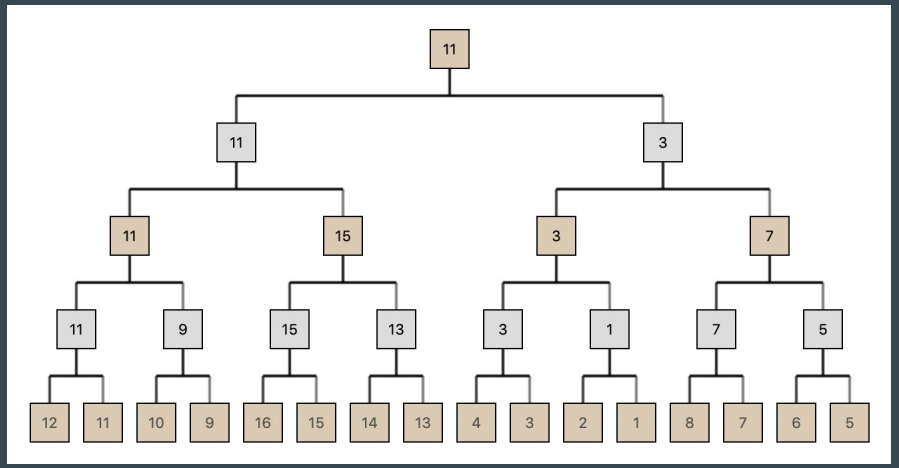
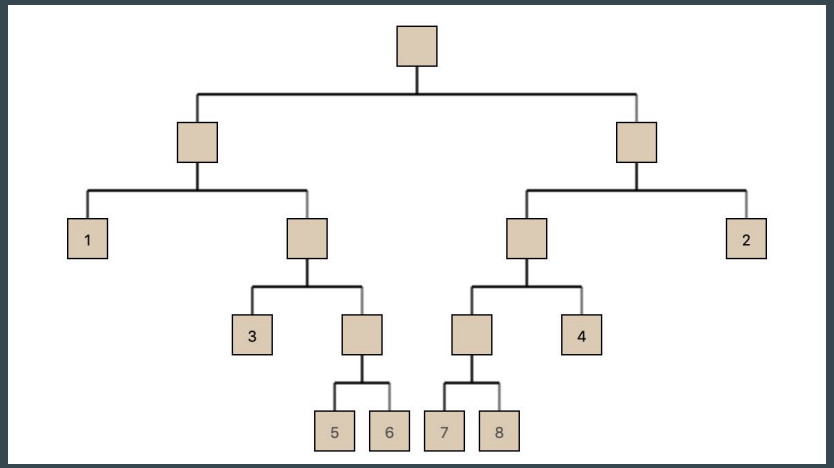
Heuristic Search

CS227B: General Game Playing - Week 3

Introduction





- Two Primary Tasks:
  - **Limit the size of the game tree.**
  - **Estimate the values of non-terminal states.**

Limiting the Search Space

- **Types of Players:**
  - **Depth-Limited:** explore nodes to a certain depth in the game tree.
  - **Node-Limited:** explore a certain number of nodes in the game tree.
  - **Time-Limited:** search the game tree for a specified amount of time.
- Players return actual reward on terminal states and zero for all other states once the limit is reached (provide a conservative lower bound on utility).
- However, the value of zero for non-terminal states is relatively arbitrary.

Leveraging Heuristics

- Instead of placing a value of 0 on all non-terminal states, we can apply an heuristic evaluation function to non-terminal states.
- Types of Heuristics:
  - **Mobility -** measures the number of things a player can do (multiple varieties).
  - **Focus -** inverse of mobility.
  - **Reward -** favor intermediate states with higher rewards.
  - **Keep-Alive -** Extension of the reward heuristic. When rewards are the same and not 100, favor non-terminal states to terminal states.
- Heuristics are not guaranteed to work, but they tend to work more often than not.

Moving Forward

- **Additional Ideas:**
  - **Iterative deepening:** iteratively perform increasing depth limited searches.
  - **Weighted combination of heuristics**
    - $f(s) = w1 \times f1(s) + \cdots + wn \times fn(s)$
  - **Variable depth heuristic:** search levels of the tree to variable degrees.
  - **Custom heuristic functions**
- **Next Time:**
  - Probabilistic methods for dealing with incomplete search.

Questions?