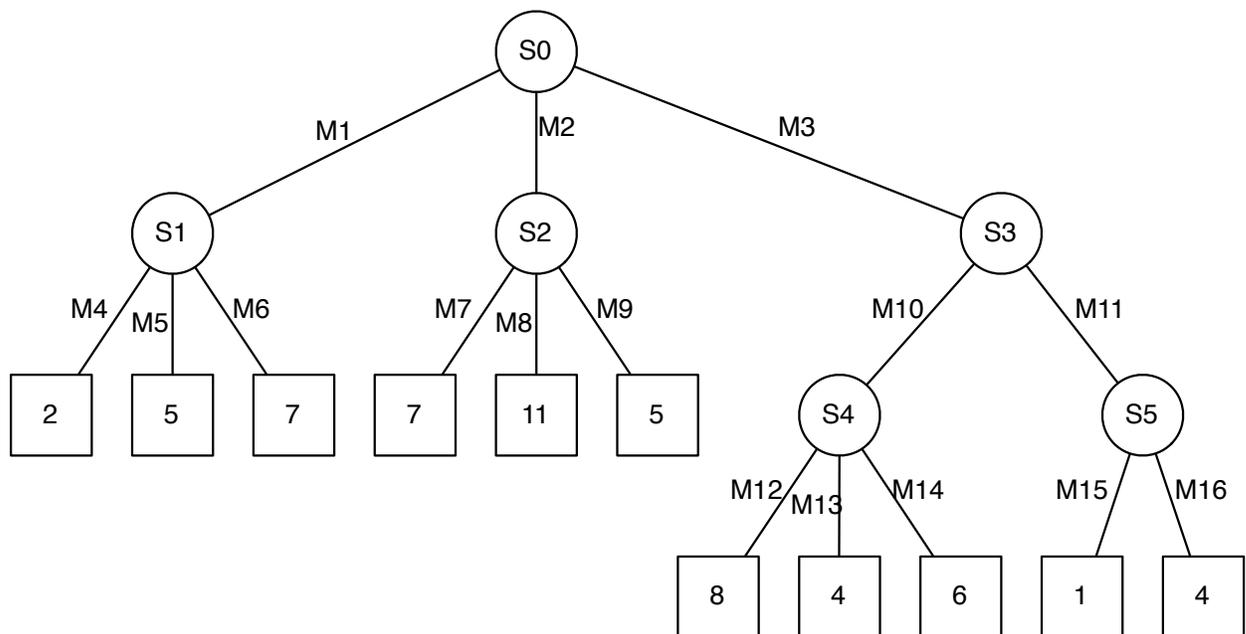


# CSC242: Introduction to Artificial Intelligence

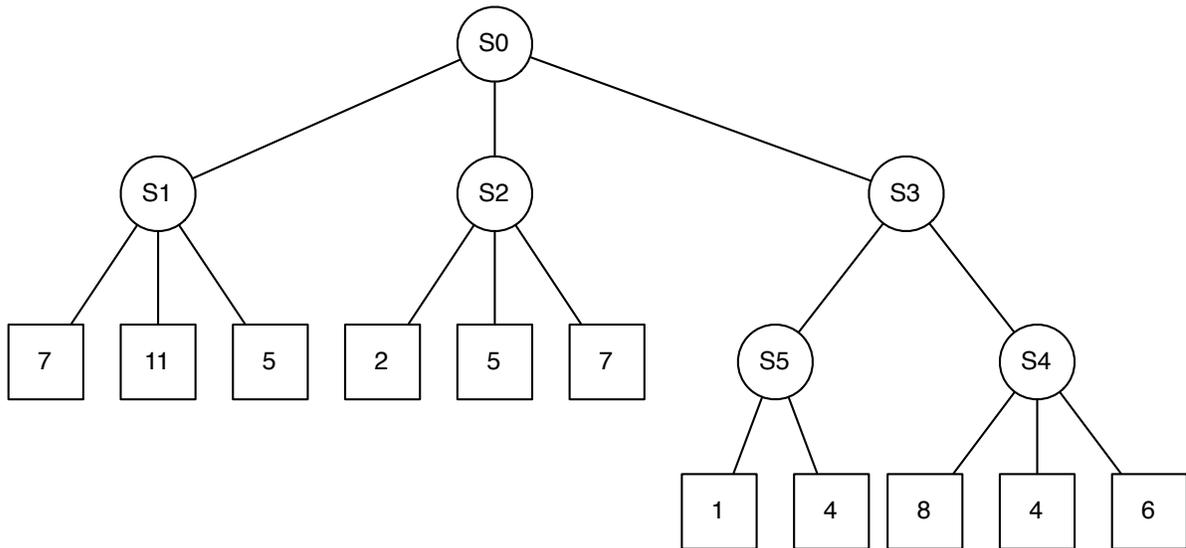
## Homework 2: AIMA Chapters 5-6

1. Define the following terms briefly:
  - (a) Zero-sum game
  - (b) Perfect information
  - (c) Terminal state
  - (d) Utility function
  - (e) Game tree
2. Where does the name “MINIMAX” come from?
3. Consider the following game tree:



Terminal states are squares (with their utility). Non-terminals are circles. Edges are labeled with the move that leads to the successor state.

- (a) Label the levels of the tree with MAX and MIN.
  - (b) Compute the minimax value of the non-terminal nodes.
  - (c) What is the optimal move for the first player? What is the second player's optimal response?
4. Games are interesting because they are too hard to solve optimally. That is, it is generally too hard to compute the optimal move.
- (a) What makes games hard in this sense?
  - (b) What is pruning?
  - (c) What replaces the terminal test when a search is cutoff before reaching a terminal state?
5. Can alpha-beta pruning ever lead to sub-optimal decisions?
6. Consider the following game tree:



Terminal states are squares (with their utility). Non-terminals are circles.

Display or describe the results of game tree search with alpha-beta pruning on this game tree. Show which nodes are pruned and the final utility bounds for all the internal nodes that are not pruned.

7. In order to maximize pruning, in what order would it be best for the successors to be generated at a MAX level? What about at a MIN level? Is it practical to do this?
8. Which of the following are true and which are false. Briefly explain your answers.
- (a) In a fully-observable, turn-taking, zero-sum game between two perfectly rational players, it does not help the first player to know what strategy the second player is using—that is, what move the second player will make, given the first player's move.

- (b) In a partially-observable, turn-taking, zero-sum game between two perfectly rational players, it does not help the first player to know what move the second player will make, given the first player's move.
  - (c) A perfectly rational backgammon agent never loses.
9. What are the three components of a constraint satisfaction problem?
10. What is a solution to a constraint satisfaction problem?
11. Alice, Betty, and Carol are in a book club. They're trying to figure which of five different books they should read next. The books are: *Dreams From My Father* by Barack Obama, *Lord of the Rings* by J.R.R. Tolkein, *Artificial Intelligence: A Modern Approach* by Stuart Russell and Peter Norvig, *Harry Potter and The Sorceror's Stone*, by J.K. Rowling, and *The Fabric of the Cosmos: Space, Time, and the Texture of Reality* by Brian Greene.

In this book club, they don't all have to read the same book. Alice only likes fiction, while Betty only likes non-fiction. Furthermore, Alice won't read whatever either Betty or Carol are reading, while Betty and Carol always read the same book.

- (a) Formulate this as a constraint satisfaction problem.
- (b) Propagate unary constraints and show the results.
- (c) Solve the CSP using a combination of search and constraint propagation. At each step (assignment or propagation), show the state of the problem. (Hint: You should only need two iterations if you've done it right.)