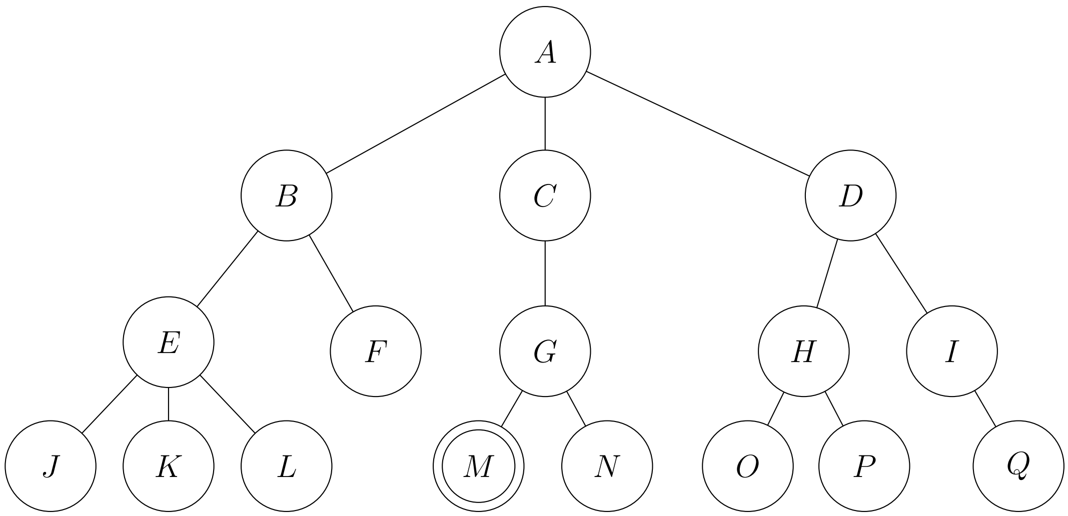
Intro to AI (331)
Homework 02
Borrelli
Due: Wednesday, June 9th, 2021 by 11:59pm

- Be sure to put your NAME and Section number on the first page.
- You must submit your solution to MyCourses in **PDF** format **only**.
- Late work is not accepted.
- Only the last thing submitted to the dropbox will be accepted.

1. **(12 Points)** For each of the following, give a PEAS description of the task and given solver of the tasks. There may be several reasonable answers, but the key is that all four parts of your answer go together.
   (a) Robots playing soccer
   (b) Netflix/Amazon on-line recommendation system
   (c) Expert system for medical diagnosis

2. **(12 Points)** Show the execution of the following search techniques on the tree shown below. A is the root node and M is the goal state. For BFS and DFS, keep track of the open and closed arrays at each step of the search. If a node has more than one child, add them to the open list in the left-to-right order as they are shown in the tree (not alphabetical order). For IDS, give a list of the states that are examined for each limit (starting with limit 0), in the order that the states are examined.
   (a) Breadth-First Search
   (b) Depth-First Search
   (c) Iterative Deepening



3. **(10 Points)** There is a famous problem similar to the Missionaries and Cannibals from the notes: A farmer has to get a fox, a chicken, and a sack of corn across a river. The farmer has a rowboat that can only carry one thing at a time (in addition to the farmer). If the fox and the chicken are left together, the fox will eat the chicken. If the chicken and the corn are left together, the chicken will eat the corn. How does the farmer get everyone across the river?

   (a) Give a complete problem formation for this problem. Choose a formulation that is precise enough to be implemented. Formulate a scheme for the problem similar to the one from the notes, including an initial state, goal state and solution sequence.

   (b) Show the entire search tree for the farmer problem. Remove illegal states, and duplicate states.

4. **(16 Points)** For each of the following assertions, say whether it is true or false and support your answer with examples or counterexamples where appropriate.

   (a) An agent that senses only partial information about the state cannot be perfectly rational.

   (b) There exist task environments in which no pure reflex agent can behave rationally.

(c) There exists a task environment in which every agent is rational.

(d) The input to an agent program is the same as the input to the agent function.

(e) Every agent function is implementable by some program/machine combination.

(f) It is possible for a given agent to be perfectly rational in two distinct task environments.

(g) Every agent is rational in an unobservable environment.

(h) A perfectly rational poker-playing agent never loses.

5. **(10 Points)** Write pseudocode agent programs for the following agents:

    (a) goal-based agent

    (b) utility-based agent

6. **(16 Points)** Give a complete problem formation for each of the following. Choose a formulation that is precise enough to be implemented (this includes: initial state, goal test, actions, path cost, and potentially a solution if the problem is specific enough to be solved).

    (a) Using only four colors, you have to color a map in such a way that no two adjacent regions have the same color.

    (b) A 3-foot-tall monkey is in a room where some bananas are suspend from the 8-foot ceiling. The monkey would like to get the bananas. The room contains two stackable, movable, climbable 3-foot-high crates.

    (c) You have two jugs, measuring 5 gallons and 3 gallons, and a water faucet. You can fill the jugs up or empty them out (completely) from one to another or onto the ground. You need to end up with exactly 4 gallons in the larger jug.

    (d) You are able to pick from coins in three denominations: 3 cent, 7 cent, and 12 cent. What is the largest amount that you *cannot* represent with these coins.

    Hint: since there is no largest number in general, it would not make sense to speak of "the largest number you CAN represent," this implies then that there is a number beyond which ALL numbers can be represented.