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CSCI 331 Section 1

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Homework 2

1) *For each of the following, give a PEAS description of the task and a given solver of the tasks. There may be several reasonable answers, but the key is that all four parts of your answer go together.* PEAS: Performance measure, Environment, Actuator, and Sensors

a) *Robots playing soccer*

P - The number of scored goals for each team

E - The soccer field they're playing on

A - Motors to kick the ball and run

S - Ways to listen/see the ball coming toward the player

b) *Netflix/Amazon online recommendation system*

P - The user's engagement to the website

E - Netflix's or Amazon's website

A - The collection of recommendations

S - What the user clicks on or searches

c) *Expert system for medical diagnosis*

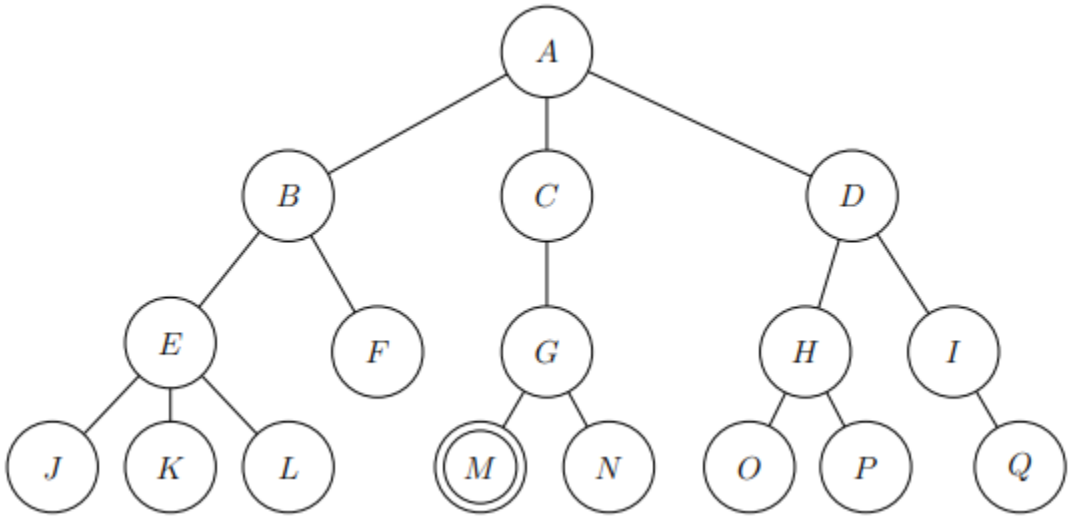
P - Any correct medical diagnosis

E - The hospital or and any form of a medical room

A - The patient's information (on paper or digital)

S - Any machine/device that can assist the doctor/examiner in a diagnosis

2) *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*

[A, B, C, D, E, F, G, M]

b) *Depth-First Search*

[A, B, E, J, K, L, F, C, G, M]

c) *Iterative Deepening*

1: [A]

2: [A, B, C, D]

3: [A, B, E, F, C, G, D, H, I]

4: [A, B, E, J, K, L, F, C, G, M]

3) *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.

Let F = The farmer

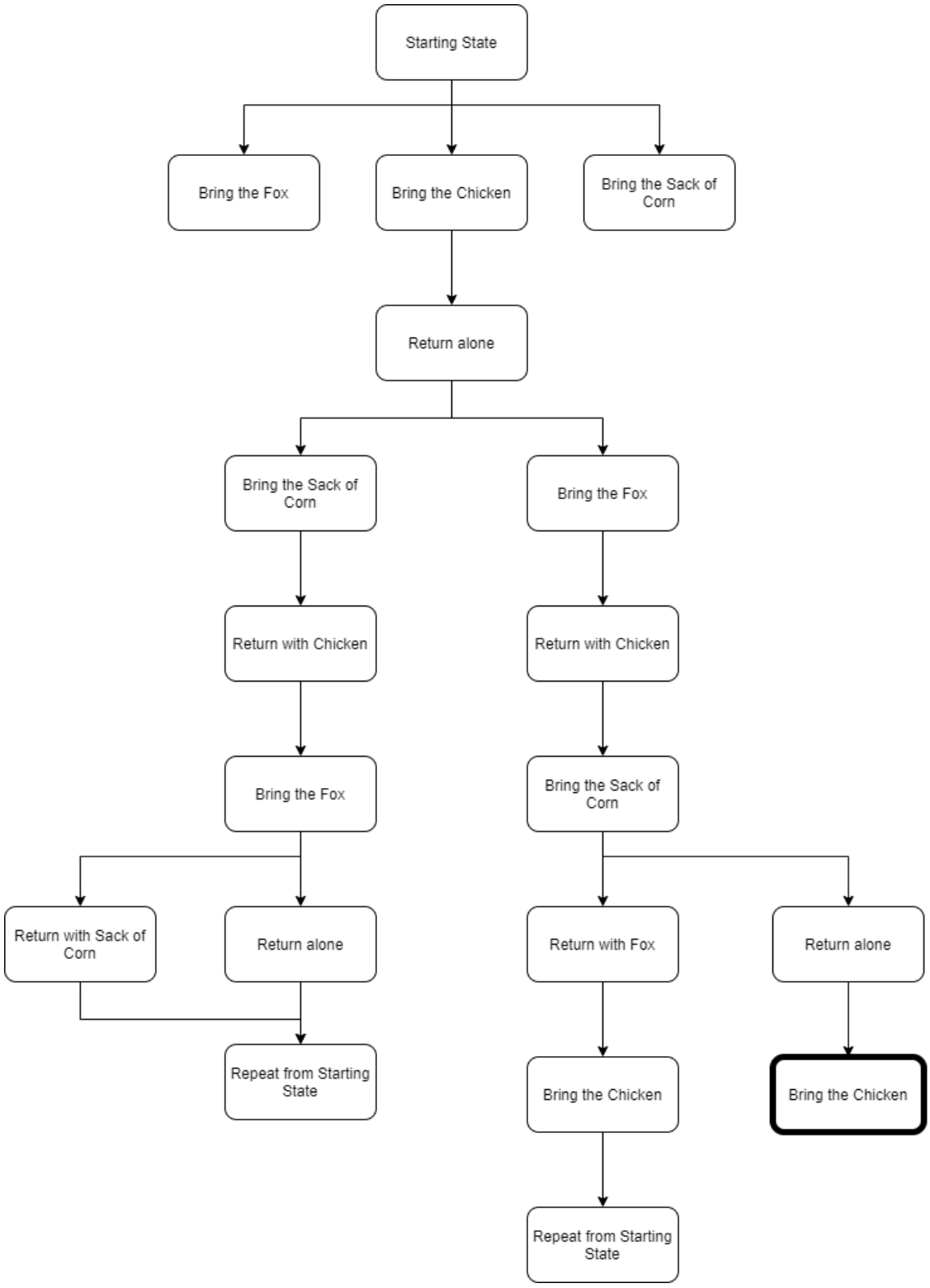
Let Fx = The fox

Let C = The chicken

Let S = The sack of corn

Start	**End**	**Action**
F, Fx, C, S		Original State
Fx, S	F, C	The farmer brings the chicken to the other side
F, Fx, S	C	The farmer returns alone
Fx	F, C, S	The farmer brings the sack of corn
F, Fx, C	S	The farmer returns with the chicken
C	F, Fx, S	The farmer brings the fox
F, C	Fx, S	The farmer returns alone
	F, Fx, C, S	The farmer brings the chicken

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



4) *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.*

False. This is because self-driving cars, for example, are able to act rationally from only information from their sensors.

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

True. This is because reflex agents are based on the world's state and rules.

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

True. This is because there can be an environment in which every action produces the exact same outcome, which would mean that every action is rational.

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

False. This is because the agent program records past actions to make new actions while the agent function can take the environment around it.

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

False. This is because there could be situations in which infinite memory is required and no heuristic can be applied.

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

True. This is because even if the task environments can be distinct, the goals for each activity could be the same.

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

False. This is because it would be impossible to maximize performance without any information about the environment.

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

False. This is because there are situations in which regardless of what actions the agent takes, there will be situations where a loss will be guaranteed.

5) *Write pseudocode agent programs for the following agents:*

a) *goal-based agent*

```
Public Action goal_based_action(Agent agent, Environment Env)
        State state = agent.get(Env)
        for action in agent.allActions
                Result result = agent.do_action(state, action)
                if result == agent.goal
                        return action
```

b) *utility-based agent*

```
Public State utility_based_action(Agent agent, Environment Env)
        State state = agent.get(Env)
        Utility[] allResults
        for action in agent.AllActions
                Result result = agent.do_action(state, action)
                add result.utility to allResults
        find the result with the max utility in allResults
```

6) *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.*

Initial State: Pick a random color from the four given colors

Goal Test: Check to see that no two adjacent regions have the same color.

Actions: Place a color on the region.

Path cost: The amount of time it would take to perform the tree search.

Solution: Create a search tree with every possible action from any given point, then search through the tree for the solution.

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

Initial State: A 3-foot tall monkey is in a room with 8-foot ceilings where bananas are placed. The monkey has two stackable, movable, and climbable 3-foot crates.

Goal Test: Check to see if the monkey has the bananas.

Actions: Move the monkey, climb on the crates, move the crates, stack the crates, and take the bananas.

Path Cost: The monkey's height can be used as a path cost.

Solution: The monkey must stack the crates then climb them to get the bananas.

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.*

Initial State: There are two empty jugs that measure three and five gallons with a water faucet.

Goal Test: Check to see if you have exactly four gallons of water.

Actions: Pour water, empty water into the faucet, empty water into a jug.

Path Cost: The number of actions required to reach the end state.

Solution:

Small Jug	**Large Jug**	**Action**
0	0	Original State
0	5	Fill large jug
3	2	Pour from large jug to small jug
0	2	Empty small jug
2	0	Pour from large jug to small jug
2	5	Fill large jug
3	4	Pour from large jug to small 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?*

Initial State: There are no coins on the table.

Goal Test: Check to see if the current amount is the goal amount.

Actions: Choose a coin.

Path Cost: The number of steps taken whenever a coin is chosen

Solution: Create a search tree that would simulate every possible combination of coins and search for the largest integer in the tree.