Artifical Intelligence Tutorial 1

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1 Question 1

For each of the following activities, give a PEAS description of the task environment (that is, describe a possible performance measure, the environment, the actuators, and the sensors). Classify the task environments into fully observable vs partially observable, determin- istic vs stochastic, episodic vs sequential, static vs dynamic, discrete vs continuous.

- Football player
- Robot exploring mars
- Shopping for used Computer Science books on the internet

1.1 Football player

So PEAS stands for performance measure, environment, actuators and sensors.

- Performance - How many goals they get, win or lose a game
- Environment - Football pitch
- Actuators - Legs, head, their body
- Sensors - Eyes, touch, feet, hands
- Partially observable - cannot see the back of their head
- Stochastic - cannot be determined easily
- Sequential - THe ball is kicked on a series of events
- Dynamic - the environment changes
- Continuous - It's never quite sure what's happening

1.2 Robot exploring mars

- Performance - How many rocks it finds, its performance in performing experiments,surface area mapped
- Environment - Mars
- Actuators - Wheels, robot hands and arms
- Sensors - temp sensor, ground sensor, moisture sensor
- Partially observable - It can't see all of mars
- Stochastic - Because Mars isn't fully mapped yet or there might be an asteroid
- Sequential - requires past knowledge to make sure it doesn't go over its path again
- Dynamic - it can change
- Continuous - Data is continually comining in

1.3 Shopping for used computer science books on the internet (wrong)

- Performance - Good quality books for low prices
- Environment - The internet
- Actuators - Mouse and keyboard
- Sensors - Website interfaces
- Fully observable - YOu can see everything at a glance
- Deterministic - Everything is fixed and determined already
- Sequential - Back and forward buttons
- Static - the environment doesn't change
- Discrete

2 Question 2

Define in your own words:

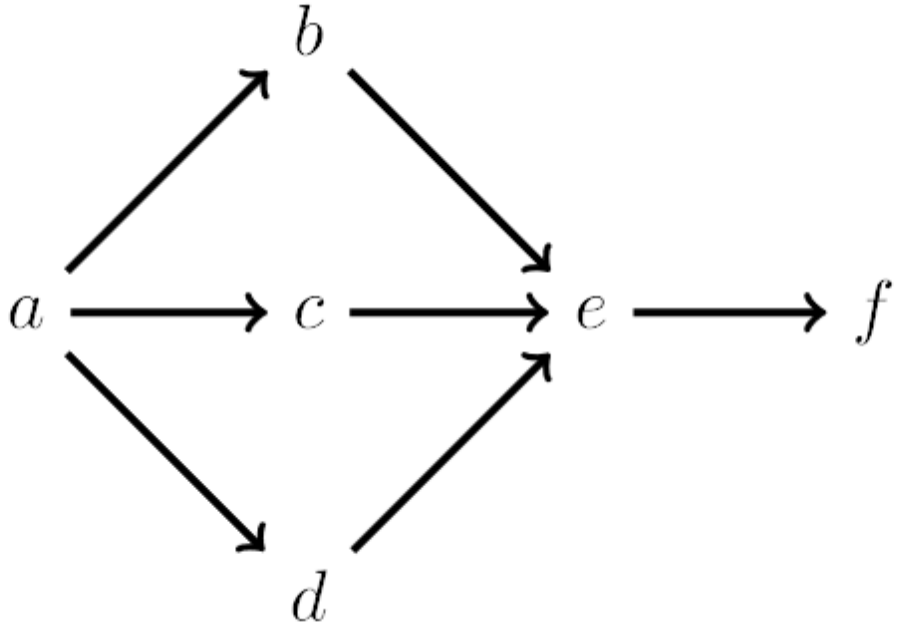
- Simple Reflex Agents
- Model-based reflex agents
- Goal-based agents
- Utility based agents
- Learning agents

Answer

- Simple Reflex Agents - Responds to an input, much like a reflex. If input x, it will respond y. It doesn't hold history. Only succeeds if environment is fully observable.
- Model-based reflex agents - Current state is stored inside the agent, unlike the simple reflex agent which has no history.
- Goal-based agents - has "goal" information. Describes situations that are desirable. Allows agent to choose among multiple possibillities, selecting the one which reaches a goal state.
- Utility based agents - Has "utility". Goal based agents can only tell what is a goal or what not is a goal. Utility based agents can understand the inbetween, what is sort of a goal but not yet the goal state.
- Learning agents - can operate in unknown environments. Allows agent to improve it self with "learning" feature.

3 Question 3

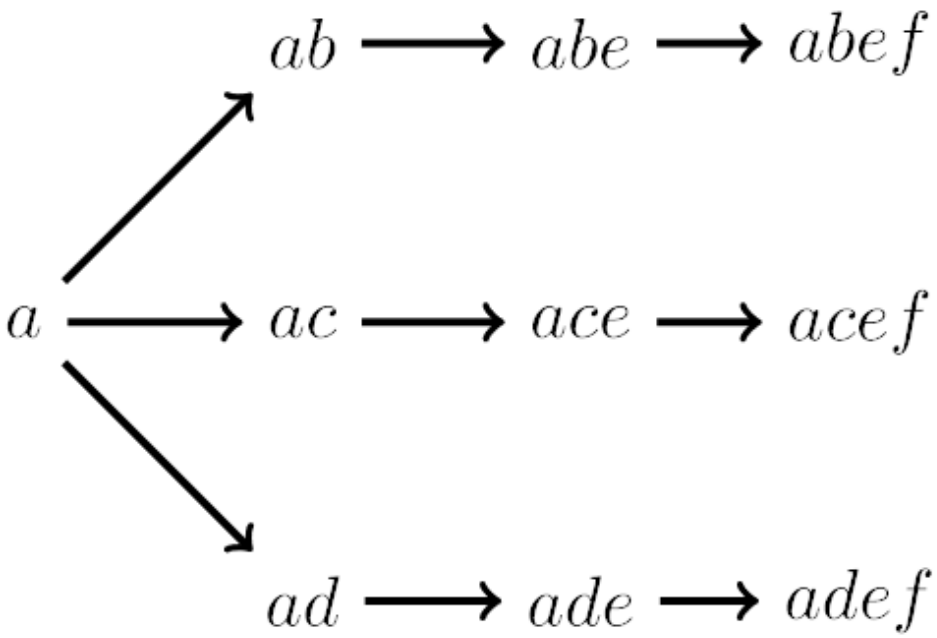
Consider the following search graph with states {a, b, c, d, e, f} and start state $S_(start) = a$.



- List the successors of a
- List the successors of b
- List all paths starting with a
- Draw the search tree (recall that the search tree consists of all items starting with a)

Answers

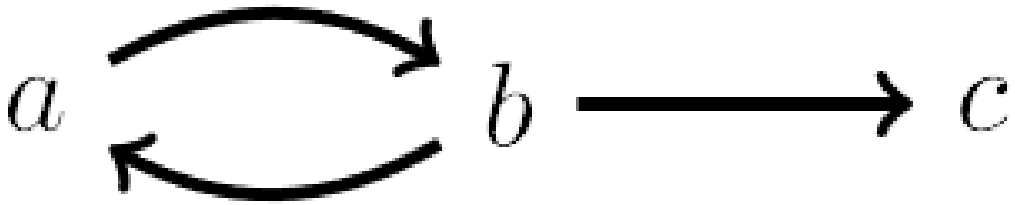
- List the successors of a - b, c, d
- List the successors of b - e
- List all paths starting with a {a, a->b, a->c, a->d, a->b->e, a->c->e, a->d->e, a->b->e->f, a->c->e->f, a->d->e->f}
- Draw the search tree (recall that the search tree consists of all items starting with a)



Notice how each item has the entire path up to that point, or just every single item in the set containing all paths in the search graph.

4 Question 4

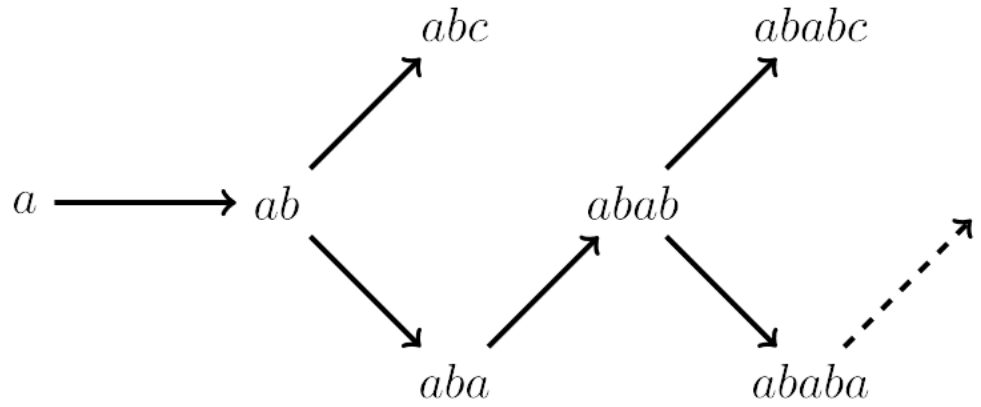
Consider the following search graph with states $\{a, b, c\}$ and start state $S_(start) = a$



- List all items of length 4 starting with a.
- Draw the search tree up to depth 4

Answers

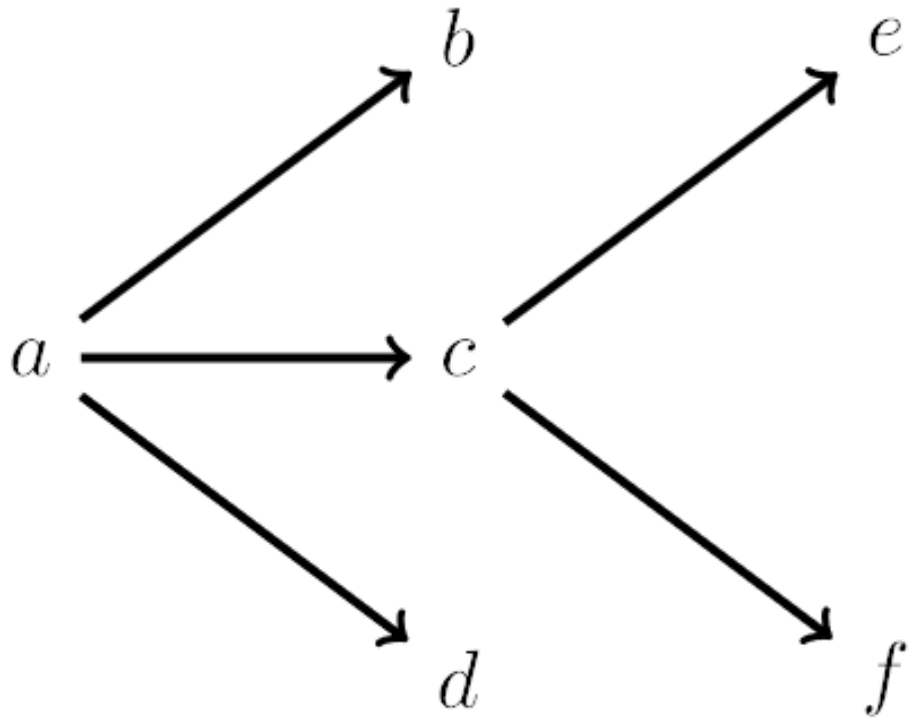
- List all items of length 4 starting with a - The path length of just "a" is 0, therefore the first path that starts with length 4 is a>b>a>b>c is length 4 since we start counting from 0 and so on.
- Draw the search tree up to depth 4



Because you can either terminate after ab by choosing c or continuing to go over the loop of abab.

5 Question 5

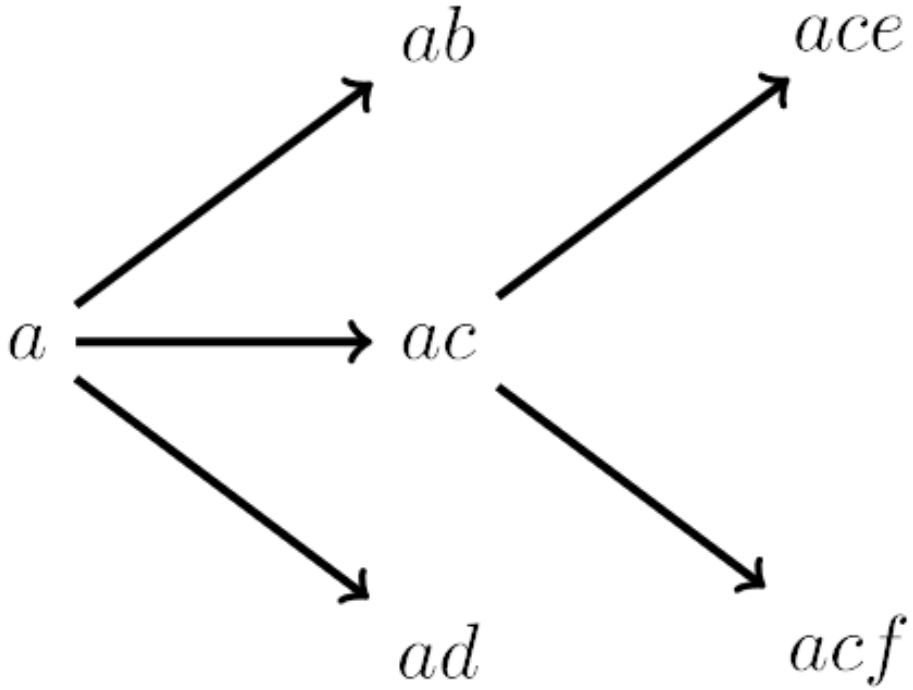
Consider the following search graph with states {a, b, c, d, e, f} and start state $S_(start) = a$



- List all paths in this graph starting with a
- Draw the search tree
- what is the relationship between the search graph and the search tree, in this case?

Answers

- List all the paths in this graph starting with a - a>b, a>c, a>d, a>c>e, a>c>f



- Draw the search tree
- what is the relationship between the search graph and the search tree, in this case? - The search graph and the search tree are the same except for the names.

6 Question 6

Consider a search graph in which every state has exactly 6 successors. Argue that there are exactly $1 + 6 + 6^2 + 6^3 + 6^4$ paths of length at most 4 starting with the start states start.

Answer We start with the start state which has exactly 1 path of length 0. We then calculate the next path, which has 6 possible nodes. Every one of these 6 nodes has 6 child nodes, making it 6^2 nodes. The branching factor is 6, so for every level we go down we increase by 6^n. To find all paths of length 4, we must go to the 4th level which is just saying that we have 6^4 paths of length 4.
In general, given a branching factor, b, and a depth level d, to find all paths of length d we simply calculate b^d.

7 Question 7

You are given two hourglasses, one of three minutes and one of four minutes. At the beginning both of them are empty (we call an hour-glass empty if all the sand is in its lower half). The task is to count up to five minutes so that at the end of the five minutes both hourglasses are empty again. There are four possible actions:

- w - wait for both hourglasses to be empty;
- t3 - turn the three-minute hourglass;
- t4 - turn the four-minute hourglass;
- tb - turn both hourglasses.

Actions t3, t4 and tb can be performed when one or both hourglasses are empty. Action w can be performed only when exactly one hourglass is empty and the other is not.

- Formulate the scenario as a searching problem

- set S of states
- start state $s_(start)$
- set $S_(goal)$ of goal states
- set A of actions
- cost function for each action

Answer Our goal is to count up to 5 with both hourglasses are considered empty. The simplest solution would be to not turn any hourglass and simply wait 5 minutes.

8 Extra

The rest of this answer can be found in the tutorial question answers.