CS 331 **Introduction to Artificial Intelligence** Fall 2024

OREGON STATE UNIVERSITY

School of Electrical Engineering and Computer Science

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Total points: 100 HW 1: **Agents and Uninformed Search** Due date: Oct 12, 2024

Instructions: This homework assignment consists of a written portion and a programming portion. Collaboration is not allowed on any part of this assignment. Solutions must be typed (hand written and scanned submissions will not be accepted) and saved as a .pdf file. You will submit a single .zip file that contains the code base and solutions as a .pdf file.

1. **(30 points)** You will be answering parts (a)-(c) for an agent that runs on your cell phone and performs physical activity recognition using the data from the accelerometer on your cell phone. The physical activity recognition task identifies the physical activity you are performing at the current point in time as being from one of five physical activities: sitting, standing, walking, running or other.

   (a) (10 points) Develop a PEAS description (Performance, Environment, Actuators, Sensors)

   Answer:
   Note: Student answers may vary.

   - Performance: accuracy of activity prediction (# of times predicted activity = actual activity) / # total number of activities
   - Environment: operates on your cell phone
   - Actuators: display to screen
   - Sensors: accelerometer on cell phone

   (b) (10 points) Describe its environment according to the following properties:

   - Fully vs Partially Observable
   - Deterministic vs Stochastic
   - Episodic vs Sequential
   - Static vs Dynamic
   - Discrete vs Continuous
   - Single agent vs Multi-agent

   Note that in some cases, both answers might be correct. Justify each answer to the task environment properties with a one sentence explanation.

   Answer:

- Partially observable: because the accelerometer cannot capture everything about you (eg. is the cell phone really on you?) and the environment
- Stochastic: because of partial observability
- Episodic: because the prediction stops after the activity and there is no information carried over between predictions
- Dynamic: the environment keeps changing while the agent "thinks"
- Continuous: the accelerometer readings are continuous
- Single agent: there is only one agent here

(c) What type of agent design (goal-directed, utility-directed, etc.) is best suited for this problem? Briefly justify your design choice.

Answer:
A model-based reflex agent is most suitable. This is because inferring the activity really requires a model to map from the accelerometry signal to an actual activity. Utility-directed agents are also suitable if the utility accounts for the trade-off in time taken for prediction and the accuracy of predicting the activity. Simple reflex doesn't work here because the current percept (eg. if it is a single reading of the accelerometer) doesn't give enough information. Goal-based is not suitable because there really isn't a "goal" state to reach.

2. **(10 points)** For each of the following, identify if the system is an automated system or an intelligent system. provide a one sentence justification of your answer.

   - At a grocery store, customers use a self-checkout kiosk to scan and pay for their items. The system provides instructions, processes payment, and dispenses a receipt. Is the self-checkout kiosk an automated system or an intelligent system? Briefly justify your answer. Answer:
     Automated. The kiosk is pre-programmed to follow a set of instructions that is independent of the customer, the items purchased and the environment.
   - A water sprinkler system for your home garden that runs for 30 minutes everyday at 4:00 pm. Is this water sprinkler an automated system or an intelligent system? Briefly justify your answer. Answer:
     Automated. The sprinkler is programmed to follow an irrigation pattern independent of the garden size, weather, and other environmental factors.
   - HVAC system that adjusts the room temperature based on occupancy levels in the room. Is this HVAC system an automated system or an intelligent system? Briefly justify your answer. Answer:
     Intelligent. Temperature control involves sensing the number of people in the room and adjusting accordingly.
   - A large e-commerce company uses machines to move items from shelves to packing stations. The machines pick up each item from the shelf, scan it using a barcode scanner that identifies the packing station, and then places the item at the packing station. Is this machine automated or intelligent? Briefly justify your answer. Answer:
     Automated. The machine are programmed to follow the bar code instructions for moving objects independent of the objects and moves them in the same way, irrespective of their contents (e.g. fragile items are not treated differently).
   - A vacuum cleaner that can identify high-traffic areas where dust accumulates most frequently and adjusts its cleaning patterns accordingly. Is this vacuum cleaner automated or intelligent? Briefly justify your answer. Answer:
     Intelligent. The vacuum cleaner can adjust its cleaning schedule automatically based on the dust accumulation frequency.

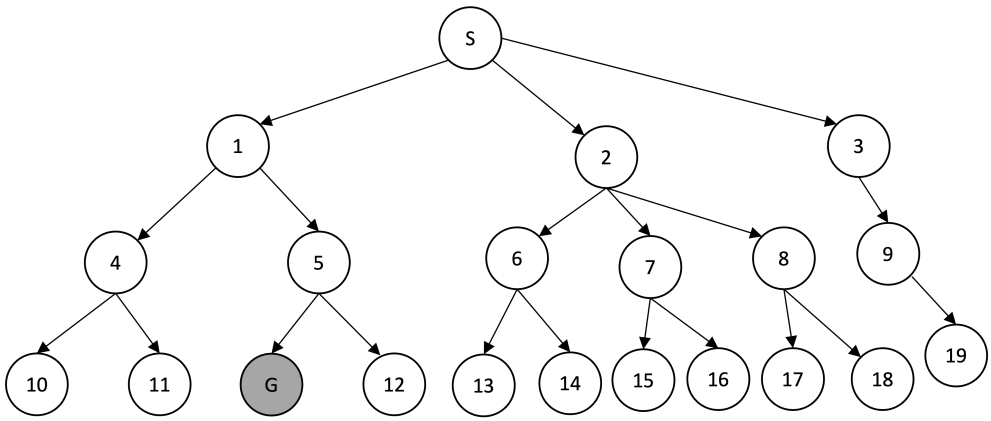

Figure 1:

3. **(30 points)** For the graph in Figure 1, implement **Breadth First Search** and complete the table below with the order in which the nodes will be expanded. Include a screenshot of your code output in this document, in addition to filling in the table below.

   Answer:

Expanded Nodes List	Frontier List
	{S}
{S}	{1,2,3}
{S,1}	{2,3,4,5}
{S,1,2}	{3,4,5,6,7,8}
{S,1,2,3}	{4,5,6,7,8,9}
{S,1,2,3,4}	{5,6,7,8,9,10,11}
{S,1,2,3,4,5}	{6,7,8,9,10,11,G, 12}
{S,1,2,3,4,5,6}	{7,8,9,10,11,G, 12,13, 14}
{S,1,2,3,4,5,6,7}	{8,9,10,11,G, 12,13, 14, 15, 16}
{S,1,2,3,4,5,6,7,8}	{9,10,11,G, 12,13, 14, 15, 16, 17, 18}
{S,1,2,3,4,5,6,7,8,9}	{10,11,G, 12,13, 14, 15, 16, 17, 18, 19}
{S,1,2,3,4,5,6,7,8,9, 10}	{11,G, 12,13, 14, 15, 16, 17, 18, 19}
{S,1,2,3,4,5,6,7,8,9, 10, 11}	{G, 12,13, 14, 15, 16, 17, 18, 19}
{S,1,2,3,4,5,6,7,8,9, 10, 11,G}	{12,13, 14, 15, 16, 17, 18, 19}

4. **(30 points)** For the graph in Figure 1, implement **Depth First Search** and complete the table below with the order in which the nodes will be expanded. Include a screenshot of your code output in this document, in addition to filling in the table below.

   Answer:
   Order may vary if the implementation processed nodes right to left.

Expanded Nodes List	Frontier List
	{S}
{S}	{1,2,3}
{S,1}	{4,5,2,3}
{S,1,4}	{10,11, 5,2,3}
{S,1,4,10}	{11, 5,2,3}
{S,1,4,10, 11}	{5,2,3}
{S,1,4,10, 11,5}	{G,12,2,3}
{S,1,4,10, 11,5,G}	{12,2,3}