

Washington State University  
School of Electrical Engineering and Computer Science  
Fall 2018

CptS 440/540 Artificial Intelligence

**Homework 1 Solution**

Due: August 30, 2018 (11:59pm)

**General Instructions:** Put your answers to the following problems into a PDF document and submit as an attachment under Content → Homework 1 for the course CptS 440 Pullman (all sections of CptS 440 and 540 are merged under the CptS 440 Pullman section) on the Blackboard Learn system by the above deadline. Note that you may submit multiple times, but we will only grade the most recent entry submitted before the above deadline.

1. Suppose you want to implement an intelligent agent to translate Klingon to English. Assume the agent has several examples of Klingon with English translations (like the menu from Homework 0) and uses a learning method like that demonstrated in the Udacity lectures.
  - a. What is the performance measure for this agent?
  - b. Answer true or false as to whether this agent:
    - i. Acts humanly?
    - ii. Thinks humanly?
    - iii. Acts rationally?
    - iv. Thinks rationally?
  - c. For this Klingon-to-English translation environment, identify the following:
    - i. Sensors (Percepts)
    - ii. Actuators (Actions)
  - d. For this Klingon-to-English translation environment, choose the correct option for each of the following properties.
    - i. Fully observable or partially observable?
    - ii. Single agent or multi-agent?
    - iii. Deterministic or stochastic?
    - iv. Episodic or sequential?
    - v. Static or dynamic?
    - vi. Discrete or continuous?
    - vii. Known or unknown?
  - e. Since this is a Learning Agent (it learns from the samples of Klingon to English), briefly describe the following components of the learning agent:
    - i. Critic
    - ii. Learning element
    - iii. Performance element

**Solution:**

- a. Percentage of correct translations (or some statistic based on the correctness of the translations).
- b. Type of AI
  - i. Acts humanly? True
  - ii. Thinks humanly? False
  - iii. Acts rationally? True
  - iv. Thinks rationally? True
- c. Sensors/Actuators
  - i. Sensors (Percepts): Input English string
  - ii. Actuators (Actions): Output Klingon string
- d. Properties
  - i. Fully observable or partially observable? Fully observable
  - ii. Single agent or multi-agent? Single agent
  - iii. Deterministic or stochastic? Deterministic
  - iv. Episodic or sequential? Episodic
  - v. Static or dynamic? Static
  - vi. Discrete or continuous? Discrete
  - vii. Known or unknown? Known
- e. Learning elements
  - i. Critic: Determines if translation performance is increasing or decreasing.
  - ii. Learning element: Modifies the probability distribution over one-word translations.
  - iii. Performance element: Table-based agent that uses probability distribution to lookup most likely Klingon word for each English word.

2. Consider the following initial and goal states for the 8-puzzle problem.

1	2	3
4		6
7	5	8

Initial State

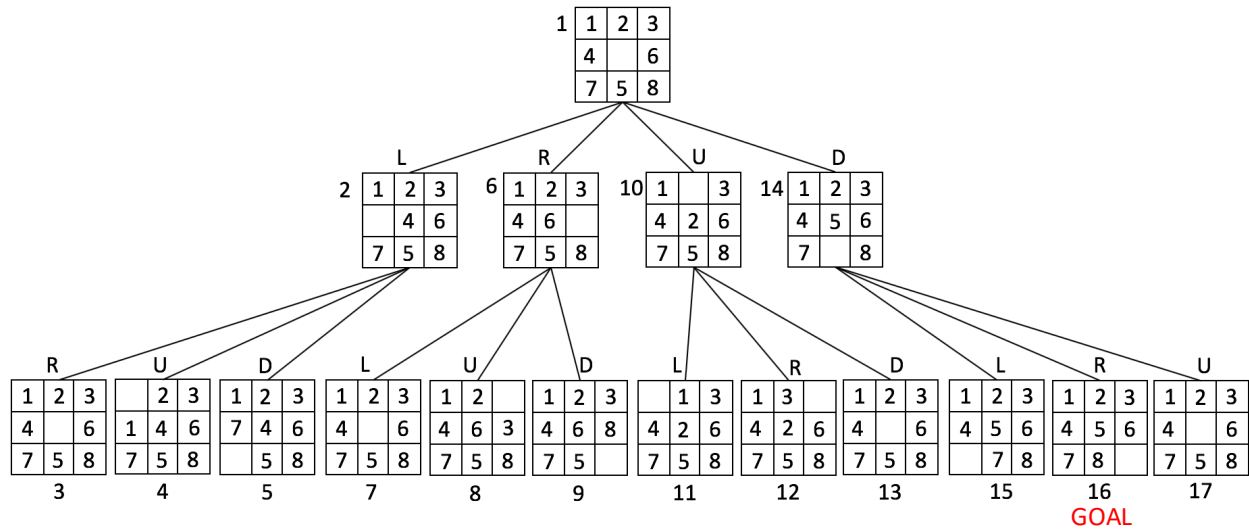
1	2	3
4	5	6
7	8	

Goal State

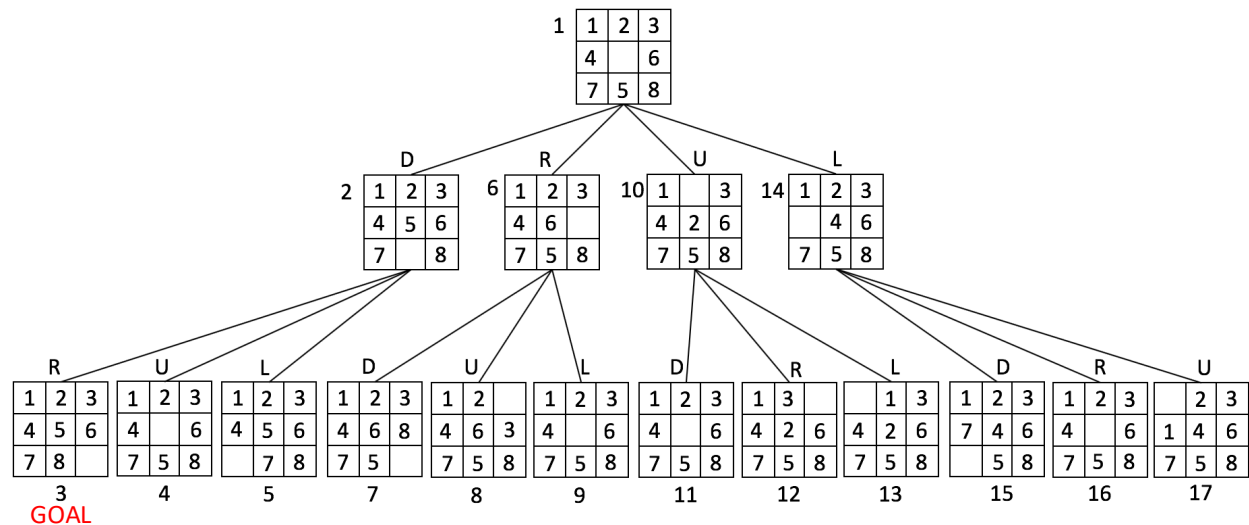
- a. Draw the entire search tree to a depth of 2. As you draw child nodes from left to right, consider actions (moving blank tile) in the order: left, right, up, down. Duplicate states should be shown, but illegal actions (attempting to move the blank tile off the 3x3 grid) should not be attempted.
- b. Draw the search tree again, as in part (a), but this time, consider the actions in the order: down, right, up, left.

**Solution:**

a. Order: L, R, U, D



b. Order: D, R, U, L



3. CPTS 540 Students Only:

- If you were to list the nodes in the search tree from problem 2a according to pre-order traversal of the tree, how many nodes would there be before the goal node?
- If you were to list the nodes in the search tree from problem 2b according to a pre-order traversal of the tree, how many nodes would there be before the goal node?

**Solution:** The trees in 2a and 2b are numbered according to a pre-order traversal. The goal node is indicated.

- 15 nodes.
- 2 nodes.