COMS 4701 Artificial Intelligence

Homework 1 - Conceptual

PEAS, Environments, Search, Heuristics

Due date: September 22, 2023

Please review the **lectures and the required materials** before answering these questions.
You are required to type your answers. You can use LaTeX (we provided a template), Word, any text editors, or type into the PDF provided. Handwritten homework will not be graded.
Justify all your answers, unless stated otherwise.

1. **(12 points) Short questions**
   Answer the following questions. No need to justify. Check all that apply.

   (a) The main differences between McCulloch Pitts (MP) and Perceptron models are:
   [ ] Inputs to the MP are boolean (0/1), whereas inputs to the Perceptron can be any real value.
   [ ] MP has a threshold that can be adjusted, whereas Perceptron has a fixed threshold.
   [ ] Inputs are equally weighted in MP, whereas Perceptron can weigh inputs differently.

   (b) According to the video, "Introduction to Artificial Intelligence," AI success is due to a large extent to:
   [ ] Small datasets
   [ ] More computational power
   [ ] Deep learning architectures
   [ ] Using logic to model uncertainty
   [ ] Machine learning
   [ ] Multidisciplinary collaborations
   [ ] Clean energy

   (c) The lecture video states that AI models can be unfair. Which of the following is true?
   [ ] Human discriminative decisions can find their ways in the data used to train AI models.
   [ ] Because they are machine-generated, AI models do not have the ability to be unfair, unlike humans.
   [ ] Demographic disparities lead to the under-representation of some segments of our society (e.g., race, gender, etc.) in the data.

2. **(20 points) PEAS and environments**

   Since its release in 2022 by OpenAI, ChatGPT has taken our world by storm! ChatGPT is a large language model–based chatbot. It is capable of holding human-like conversation, a dream of AI researchers for a long long time... ChatGPT can compose responses to queries and solve problems through textual conversations.

   In this question, we will assume ChatGPT is not connected to the internet. We would like formalize its PEAS and descrtibe its environment. Given the open-ended nature of this question, please provide a rationale for your answers to receive full credit.

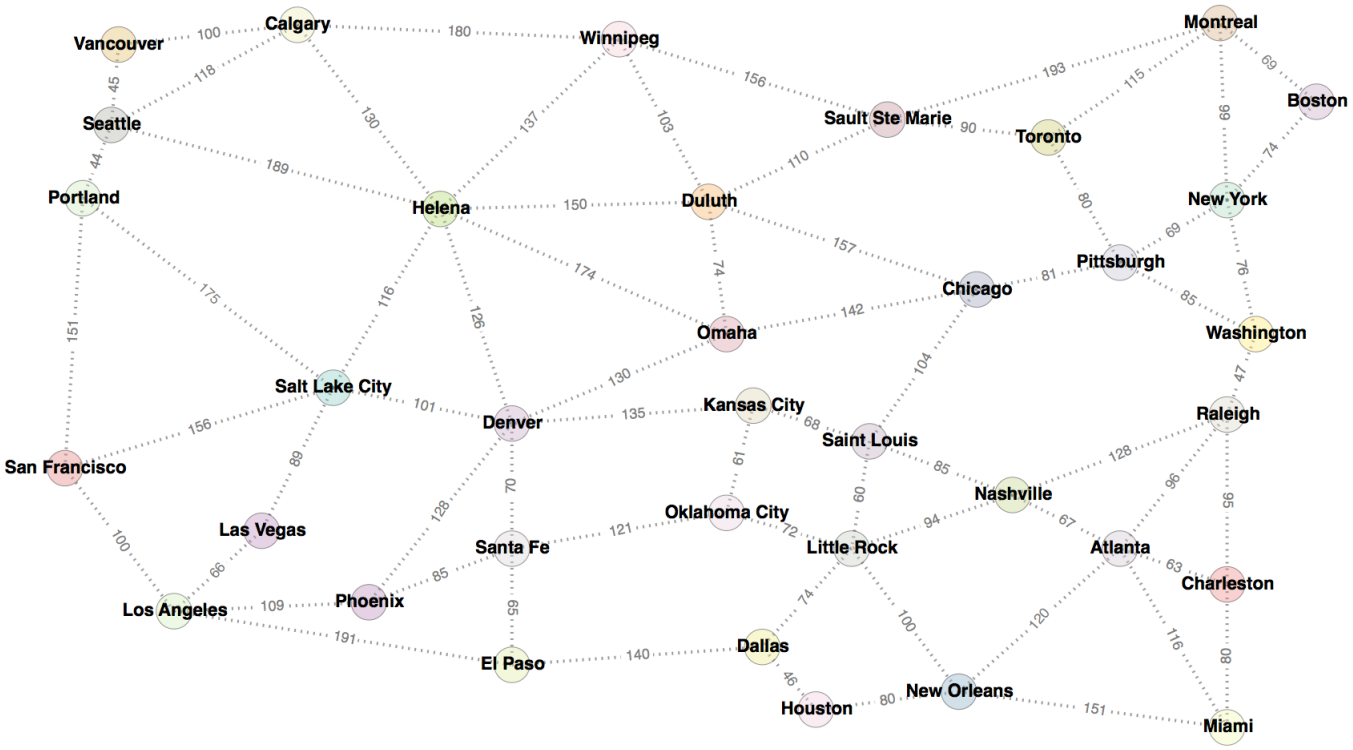
   (a) Do a PEAS analysis of ChatGPT.

   (b) Discuss ChatGPT environment, using the properties of: (1) observability, (2) number of agents, (3) deterministic/stochastic, (4) discrete/continuous, and (5) static/dynamic.

3. **(24) Uninformed search**

The following is the same map used in lecture.

A path-finding agent is given a starting point and a destination point.



Let the start be: **Houston** and destination be: **Los Angeles**.

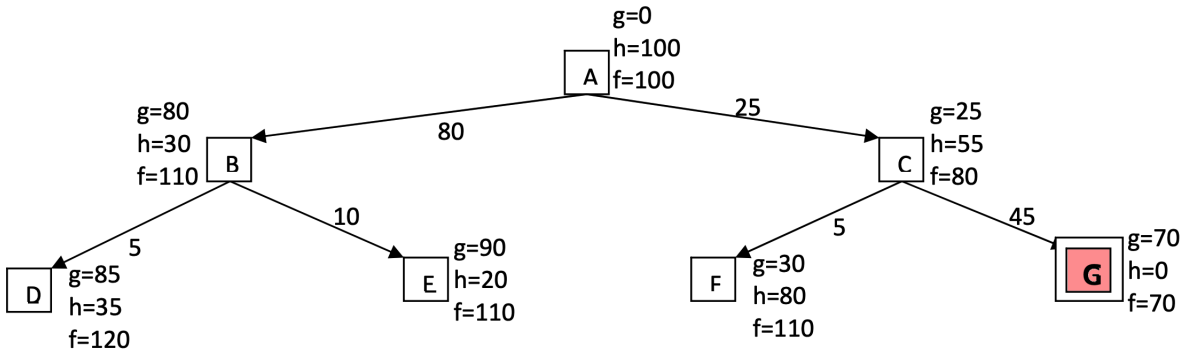
For each of the following search strategies, please provide: (a) the list of the cities, separated by commas, in the exact order they are visited. (2) The resulting path from the start to the goal.

Assume that the nodes are always visited in a lexicographic order.

1. Breadth-first search (BFS)
2. Depth-first search (DFS)
3. Uniform-cost search (UCS)

4. **(20 points) Search Algorithms**

Use the following tree to indicate **the order that nodes are expanded**, for different types of search to reach the goal. Assume that A is the start node and G (double box) is the only goal node. Here, path costs are shown to the right of each path, g = cost of path so far, h = estimate of remaining cost to goal, f = estimate of total path cost. No need to justify, just list the nodes.



(a) Uniform cost search (UCS)

(b) Iterative deepening depth-first search.

(c) Greedy best-first search.

(d) A* search.

(e) Is heuristic h admissible? Justify your answer.

5. **(24 points) Heuristics**

Let h_1 and h_2 be two admissible heuristics. Which of the following heuristics are admissible? Justify your answer.

1. $h(n) = min\{h_1 n), h_2(n)\}$
2. $h(n) = max\{h_1(n), h_2(n)\}$
3. $h(n) = wh_1(n) + (1 - w)h_2(n)$ with $0 \leq w \leq 1$