
CMPUT 261, Fall 2026
Assignment #1

1. (Uninformed search; 22 points)

- (a) [12 points] Construct a search graph with **at least 5 and no more than 10 nodes** for which all of the following are true:

- i. Least-cost search returns an optimal solution.
- ii. Depth-first search returns a non-optimal solution.
- iii. Breadth-first search returns the same non-optimal solution as depth-first search.

Assume each algorithm stops as soon as it returns a solution. Note that this means your search graph must have multiple solution paths of differing costs. (You are allowed to have multiple goal nodes.) Be sure to include and formally describe each component of the search graph. If necessary for concreteness, specify the order in which successor paths are added to the frontier by each algorithm.

- (b) [5 points] List the paths that are **removed** from the frontier by a breadth-first search of the problem you specified in part (1a), **in the order in which they are removed**. The algorithm should stop as soon as it returns a solution.

- (c) [3 points] List the paths **added** to the frontier by a least-cost search of the problem you specified in part (1a), **in the order in which they are added**.

- (d) [2 points] Alter the problem you specified in part (1a) such that depth-first search is **not complete**. You are **not** allowed to add or remove any nodes.

2. (**Heuristic search**; 105 points)

A group of researchers are being chased by zombies through a dark forest late at night. They come to a rope bridge over a ravine. If they can all get over the bridge before the zombies arrive, they will survive.

At most two people can cross at a time. A person or pair of people can only cross when they have a flashlight with them. The group has only a single flashlight among them, so one person must bring the flashlight back across the bridge to the starting side before anyone else can cross. Each pair moves at the pace of its slowest member; i.e., the Undergrad and the Professor will take 20 minutes to cross if they go together.

Each person moves at a different pace:

- The Undergrad can cross the bridge in 2 minutes
- The Grad Student can cross the bridge in 4 minutes
- The Postdoc can cross the bridge in 10 minutes
- The Professor can cross the bridge in 20 minutes

How can the whole group get to the other side of the bridge in the shortest possible time?

- (a) [**20 points**] Represent this problem as a search graph. Be sure to include and formally describe each component of the search graph.
- (b) [**5 points**] What is the forward branching factor for your representation from part (2a)? Justify your answer.
- (c) [**10 points**] Construct an admissible heuristic for this problem that is non-constant (i.e., returns different values for at least two states).

- (d) **[5 points]** Argue that the heuristic from part (2c) is admissible.
- (e) **[5 points]** Is the heuristic from part (2c) consistent? Justify your answer.
- (f) **[60 points]** Implement your representation from part (2a) and heuristic from part (2c) in Python 3 by editing the `Zombie_problem` class in the provided `zombie.py`. You can run the solution with the command `python3 zombie.py`. Your code should complete in far less than 2 minutes.