Due Date: 20 JAN 2022 at 11:59 Eastern Standard Time

PSet 2 – CS 4649/7649

CS 4649/7649 Robot Intelligence: Planning
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Instructions:

- You may work with one or more classmates on this assignment. However, all work must be your own, original work (i.e., no copy+pasting code). You must list all people you worked with and sources you used on the document you submit for your homework
- All final solutions to written problem must be enclosed by a box to make it easy and unambiguous for the graders what your final answer is. If your answer is illegible, you will not receive credit. If you answer is not boxed, you will not receive credit.

Problem 1:

Define the following terms:

- Soundness: An Algorithm is sound when its solution is returned, is it guaranteed to be correct

- Completeness: An Algorithm is complete when it is guaranteed to find a solution when there is one

  *source the lecture slides

Problem 2:

Prove the following holds true: $\sum_{k=0}^{n-1} r^k = \frac{1-r^n}{1-r}$

Start: $\sum_{k=0}^{n-1} r^k$

call the whole sum "S": S = 1 + r + r^2 + ... + r^(n−2)+ r^(n−1)

multiply S by r: S·r = r + r^2 + r^3 + ... + r^(n−1) + r^n

Subtract S – S*r: S − S·r = 1 – rn

Factor out S and a: S(1−r) = (1−rn)

End: Divide by (1−r): S = (1−r^n)/(1−r) -> $\frac{1-r^n}{1-r}$

Therefore: $\sum_{k=0}^{n-1} r^k = \frac{1-r^n}{1-r}$

*Source: https://www.mathsisfun.com/algebra/sequences-sums-geometric.html

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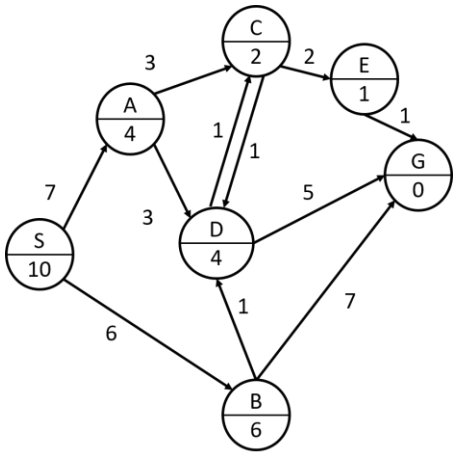
Problem 3 (CS 4649/7649)

Work out the A* execution trace for the graph below. You do not need to sort the queue when filling in the tables. Draw an arrow next to the partial path that you pop from the queue. Steps 0-1 have been completed for you below.



Step 0) g: cost get to v (paths only) h: last node value f: g+v

State	g	h	f
<S>	0	10	10

Step 1)

State	g	h	f
<A,S>	7	4	11
<B,S>	6	6	12

Step 2)

State	g	h	f
<D,A,S>	10	4	14
<C,A,S>	10	2	12
<B,S>	6	6	12

Step 3)

State	g	h	f
<D,A,S>	10	4	14
<C,A,S>	10	2	12
<D,B,S>	7	4	11
<G,B,S>	13	0	13

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Step 4)

State	g	h	f
<D,A,S>	10	4	14
<C,A,S>	10	2	12
<C,D,B,S>	8	2	10
<G,D,B,S>	12	0	12
<G,B,S>	13	0	13

Step 5)

State	g	h	f
<D,A,S>	10	4	14
<C,A,S>	10	2	12
<D,C,D,B,S>	4	9	13
<E,C,D,B,S>	1	10	11
<G,D,B,S>	12	0	12
<G,B,S>	13	0	13

Step 6)

State	g	h	f
<D,A,S>	10	4	14
<C,A,S>	10	2	12
<D,C,D,B,S>	4	9	13
<G,E,C,D,B,S>	11	0	11
<G,D,B,S>	12	0	12
<G,B,S>	13	0	13

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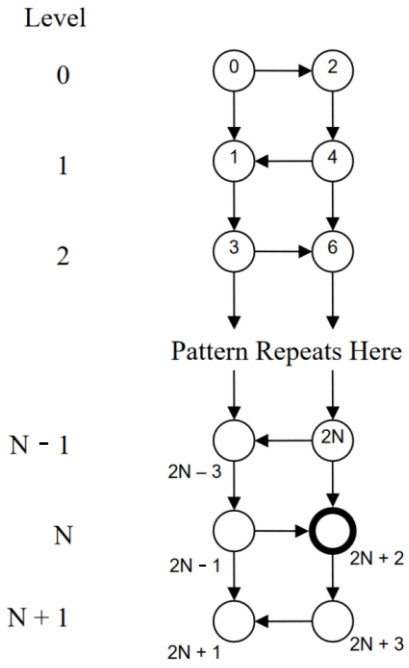
Problem 4:

Consider the following directed graph:



The start node is S = 0, and the goal node is G = 2N+2. During search, ties are broken by choosing the lower-index node. Assume N > 0. Assume a visited list is used unless otherwise noted.

Derive a precise analytical expression for the following prompts. Answers should be hand-written with pencil and paper, showing your work, with the final answer enclosed in a box.

A) The number of paths that DFS examines.
B) The largest number of paths for DFS that will ever be on the queue at any given time.

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C) The number of paths that BFS examines.
D) The largest number of paths for BFS that will ever be on the queue at any given time.

E) The number of paths that BFS examines. Assume a visited list is **not** used.
F) The largest number of paths for BFS that will ever be on the queue at any given time. Assume a visited list is **not** used.