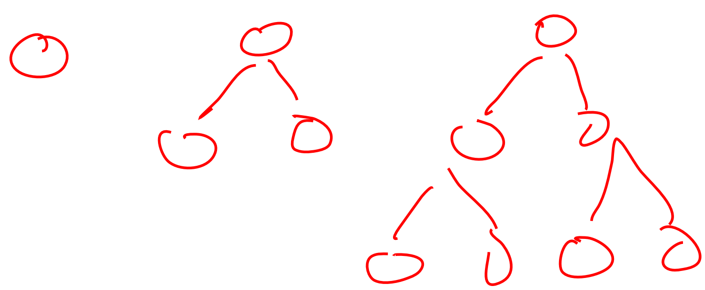
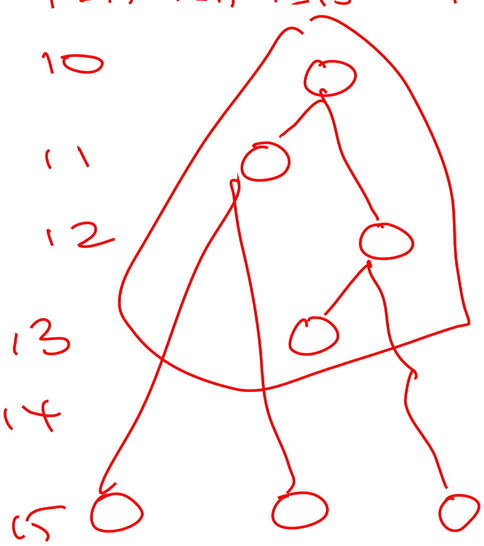
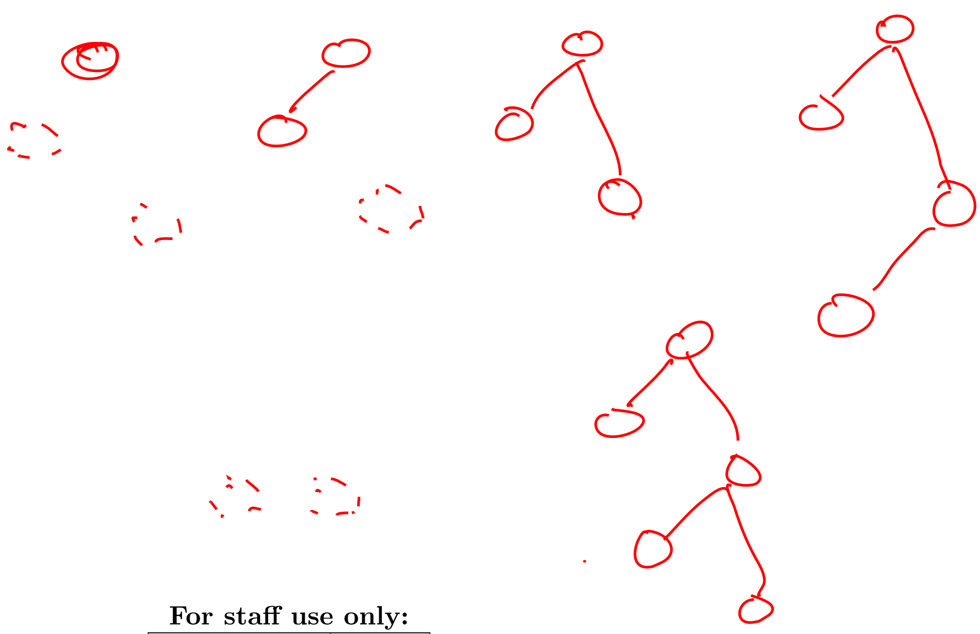
CSE 412A Spring 2022 | Introduction to Artificial Intelligence | **Exercise 4**

- You have approximately as many minutes as there are points.
- Mark your answers ON THE EXERCISE ITSELF. If you are not sure of your answer you may wish to provide a *brief* explanation. All short answer sections can be successfully answered in a few sentences AT MOST.
- For True/False questions, please *circle* your answer.

First name	
Last name	
WUSTL ID	







For staff use only:

Q1. Search	/17
Total	/17

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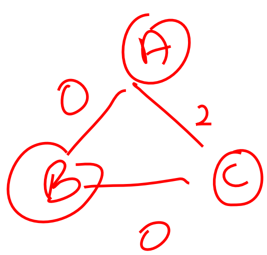
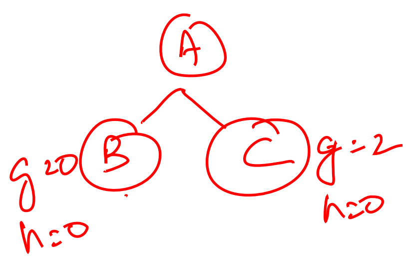
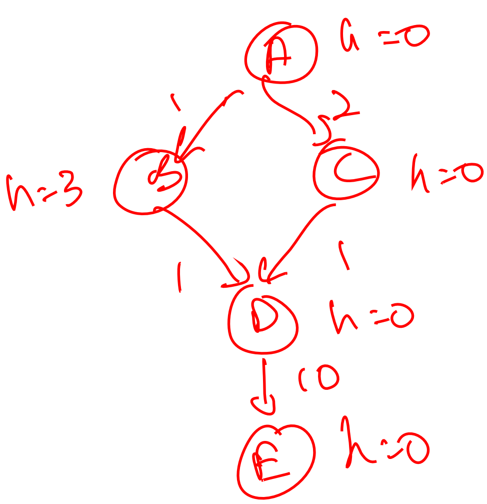
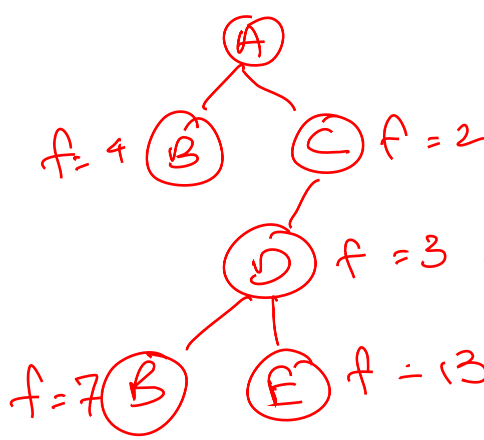
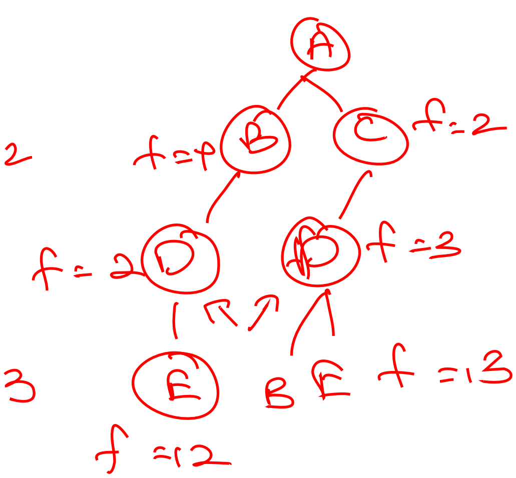


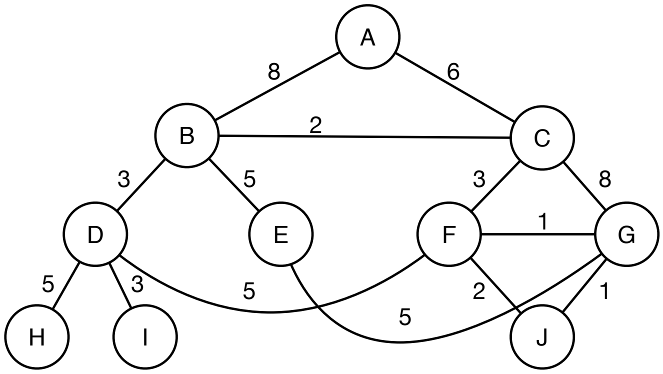








Q1. [17 pts] Search



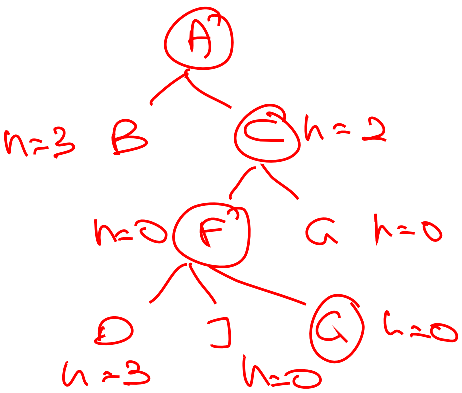
The questions on this page refer to the graph above, where the start state is A and the goal state is G. The number on an edge corresponds to the cost of traversing that edge. Additionally, assume that we have the following heuristic values:

State	A	B	C	D	E	F	G	H	I	J
Heuristic value	5	3	2	3	2	0	0	5	4	0

Assume that each algorithm re-generates states that are not yet expanded, does not re-expand states, breaks ties in lexicographical ordering, and terminates after expanding the goal state.
Note: These assumptions may differ with the operations of some of the algorithms in the textbook.

(a) [5 pts] What is the order of state expansions if you used used Greedy Best-First Search?
(If state A is expanded before state B, which is expanded before state C, then write "A, B, C".)

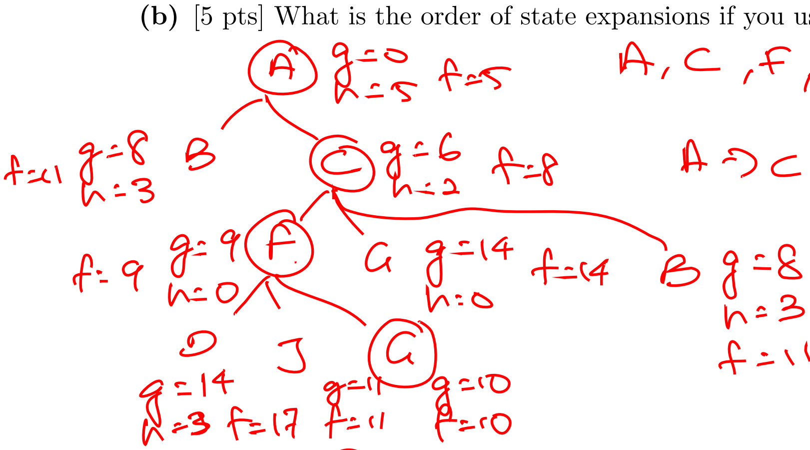
What path would the algorithm return?
(If the path is from state A to state B to state C, then write "$A \to B \to C$".)



A, C, F, G

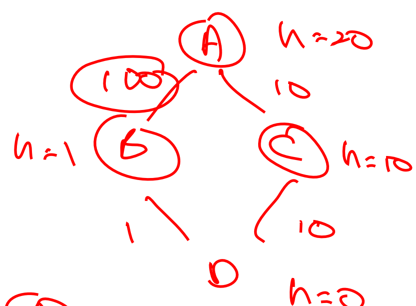
A → C → F → G

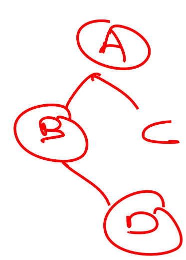
(b) [5 pts] What is the order of state expansions if you used A*? What path would the algorithm return?

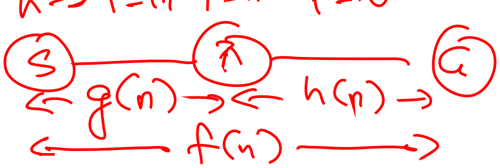


A, C, F, G

A → C → F → G







(c) Each question is worth 1 point. Leaving a question blank is worth 0 points. **Answering a question incorrectly is worth −1 point.** This gives you an expected value of 0 for random guessing.

(i) [1 pt] [*true* or *false*] With the same tie-breaking criteria, uniform-cost search will always expand more nodes than A* search.

(ii) [1 pt] [*true* or *false*] With the same tie-breaking criteria, greedy best-first search will always expand more nodes than A* search.

(iii) [1 pt] [*true* or *false*] The heuristic $h(n) = 0$ is admissible for every search problem with non-negative costs.

(iv) [1 pt] [*true* or *false*] The heuristic $h(n) = 0$ is consistent for every search problem with non-negative costs.

(v) [1 pt] [*true* or *false*] A* search with an admissible and consistent heuristic is correct and complete without re-generating and re-expanding nodes.

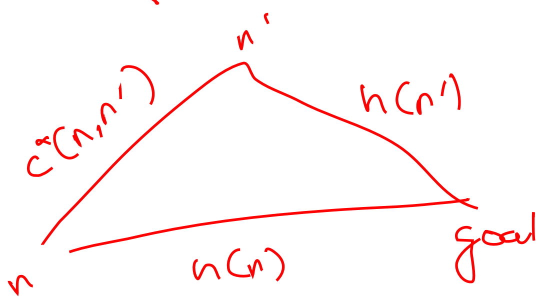
(vi) [1 pt] [*true* or *false*] A* search with an admissible but inconsistent heuristic is correct and complete without re-generating and re-expanding nodes.

(vii) [1 pt] [*true* or *false*] A* search with an admissible but inconsistent heuristic is correct and complete when it re-generates and re-expands nodes.

$$h(n) \le c^*(n, goal)$$

$$\begin{cases} 0 < c^*(n, goal) & \text{if } n \ne goal \\ 0 = c^*(goal, goal) \end{cases}$$

$$\hookrightarrow c^*(n, goal) \geq 0 = h(n)$$



$$\Longrightarrow \quad h(\cancel{n})^{0} \le \overbrace{c^*(n,n')}^{\geq 0} + h(\cancel{n'})^{0} \Leftarrow ?$$

$$\Longrightarrow \quad h(goal) = 0 \Leftarrow$$

$$h(n) = c^*(n, goal)$$