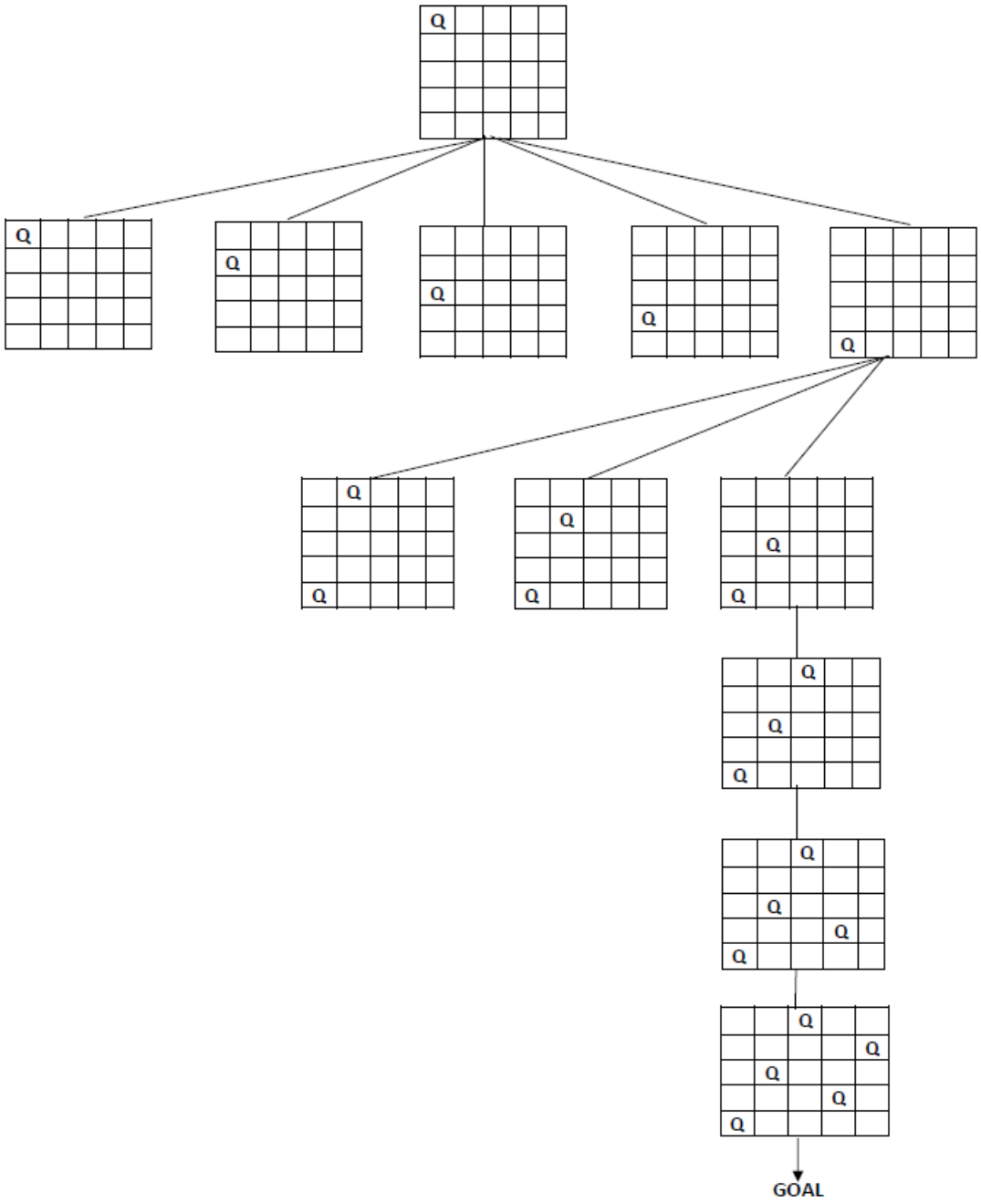
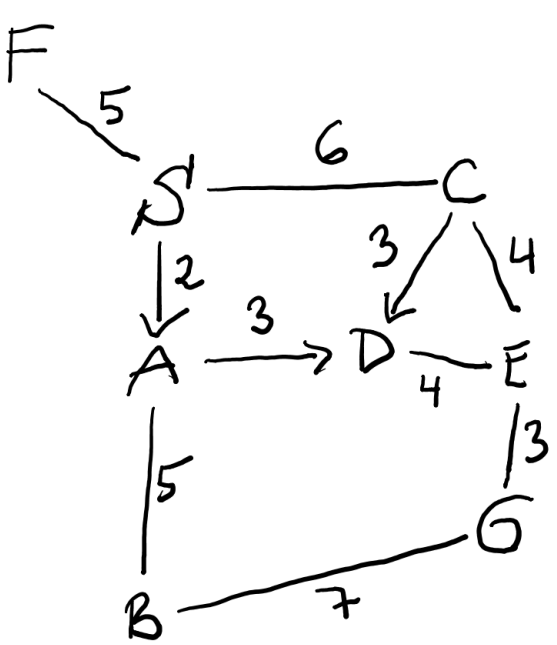
Assignment 1 solution

1. Solve the 5-queens problem (place 5 queens on a 5x5 board so that none is attacked) using DFS-tree search. The initial state is an empty board. Available actions at each state is to put a queen at the left-most empty column (use only legal actions). (This is a similar setup to the 4-queens problem we solved in class). Show the search tree.

Answer:



For questions 2, 3, 4, 5, and 6, please use the following figure. We want to travel from S to G, where some of the roads allow only one-way traffic. The distances between two locations are given on the figure. The estimates, h, from a location to G are given on the side.



h	
A:	5
B:	2
C:	7
D:	5
E:	2
F:	10
G:	0
S:	8

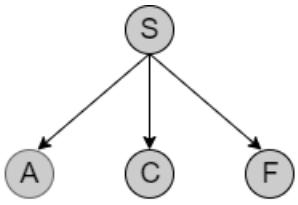
2. Hand-trace breadth-first tree search. What is the solution path found and what is its cost? Show your work.

Answer: The breadth-first tree search is as the following:

① step 1

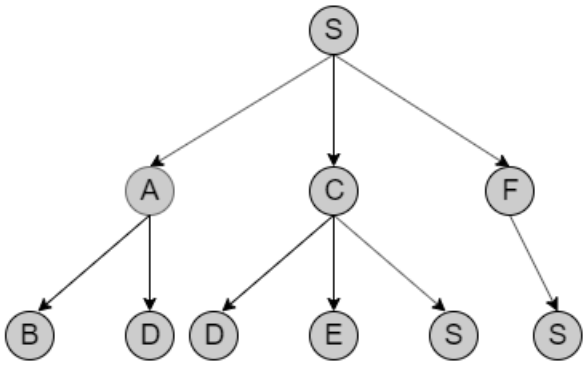
Frontier: S

② step 2



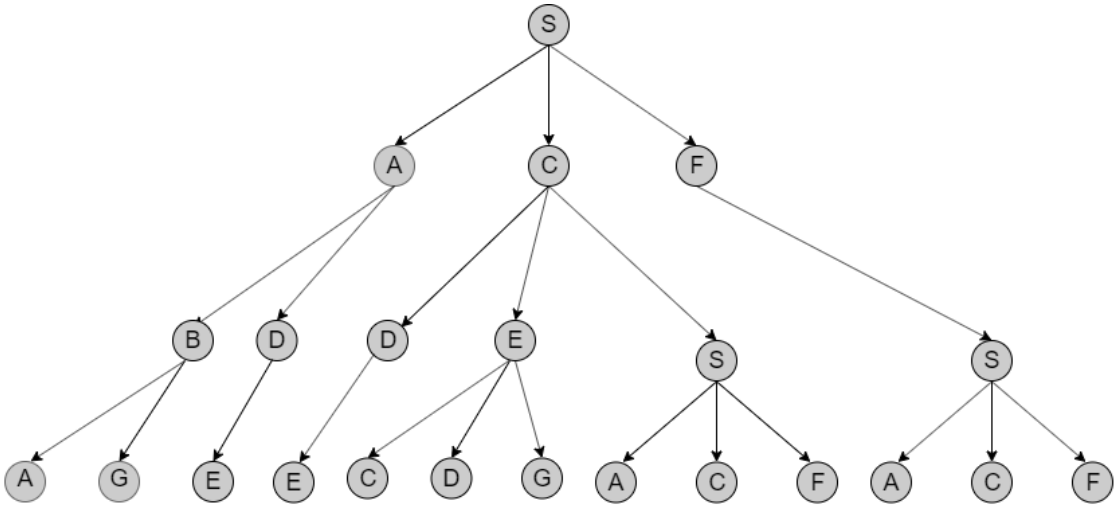
Frontier: /S, A, C, F

③ step 3



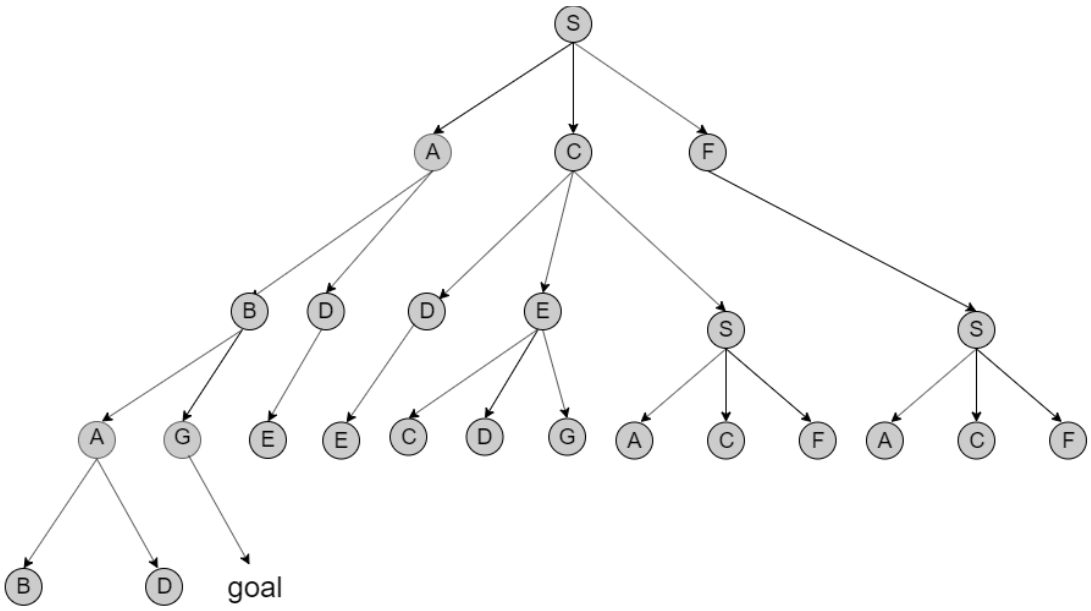
Frontier: /S, /A, /C, /F, B, D, D, E, S, S

④ step 4



Frontier: /S, /A, /C, /F, /B, /D, /D, /E, /S, /S, A, G, E, E, C, D, G, A, C, F, A, C, F

⑤ step 5



Frontier: /S, /A, /C, /F, /B, /D, /D, /E, /S, /S, /A, /G, /E, /E, /C, /D, /G, /A, /C, /F, /A, /C, /F, B, D

The solution path is S->A->B->G, and the cost is 14.

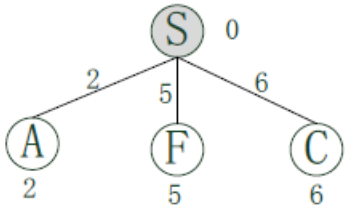
3. Hand trace uniform-cost graph search. What is the solution path found and what is its cost? Show your work.

Answer: The uniform cost graph search is as the following:

① The initial state

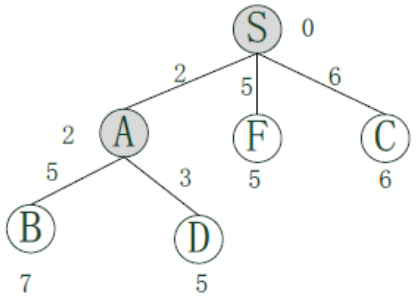
Explored set:

② After expanding S



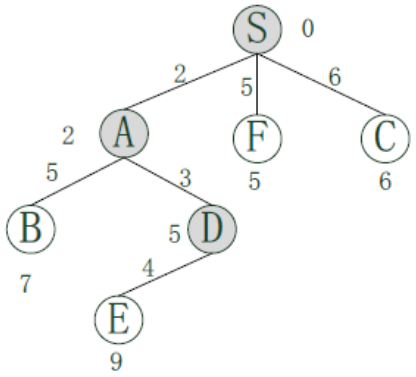
Explored set: S

③ After expanding A



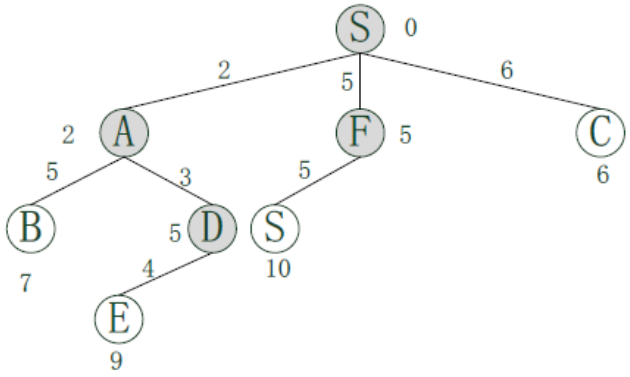
Explored set: S
A

③ After expanding D



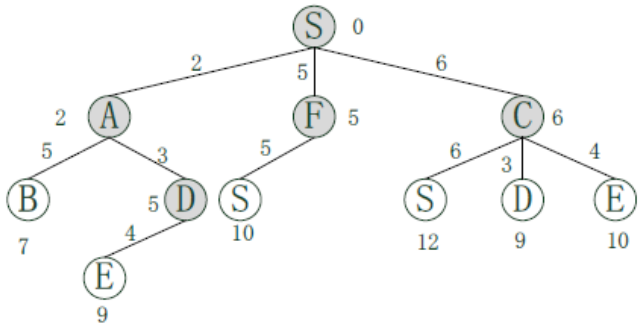
Explored set: S
A
D

④ After expanding F



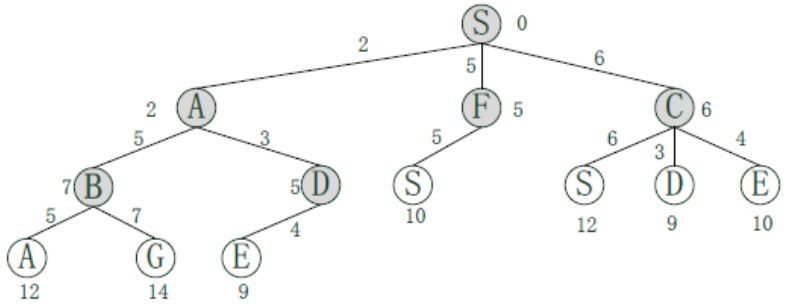
Explored set: S
A
D
F

⑤ After expanding C



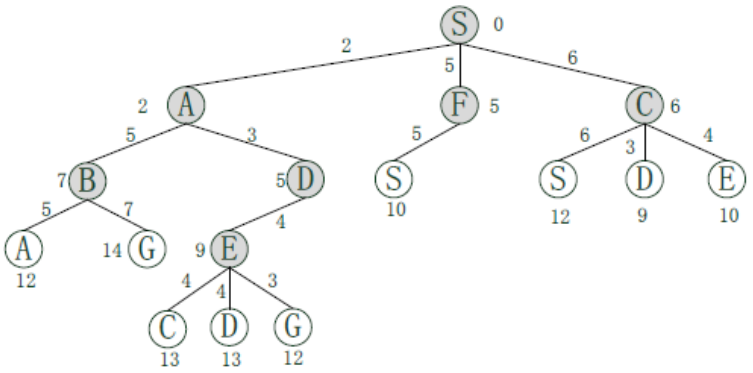
Explored set: S, A, D, F, C

⑥ After expanding B



Explored set: S, A, D, F, C, B

⑦ After expanding E



Explored set: S, A, D, F, C, B, E

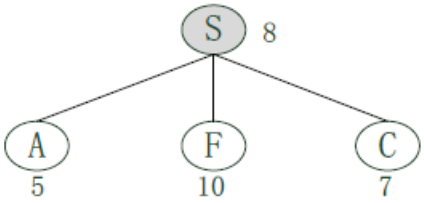
The solution path is S->A->D->E->G, and the cost is 12.

4. Hand trace greedy best-first tree search, where best is defined as the node that has the smallest h(n). What is the solution path found and what is its cost? Show your work.

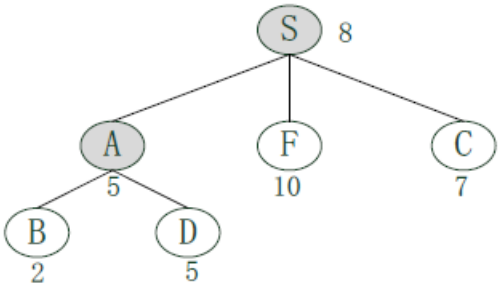
Answer: The greedy best-first tree search is as the following:

① The initial state

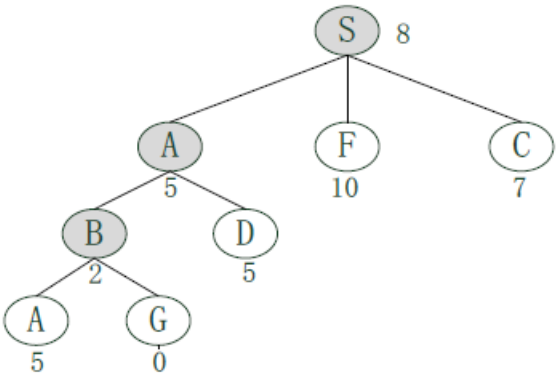
② After expanding S



③ After expanding A



④ After expanding B

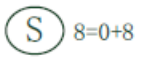


As we can see, the solution path is S->A-> B->G, and the cost is 14.

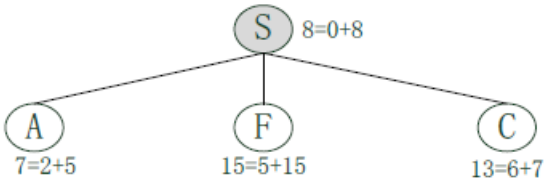
5. Hand trace A* tree search. What is the solution path found and what is its cost? Show your work.

Answer: The A* tree search is as the following:

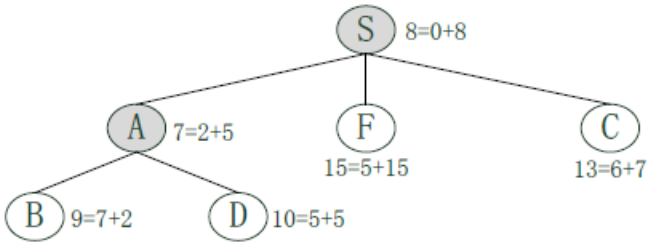
① The initial state



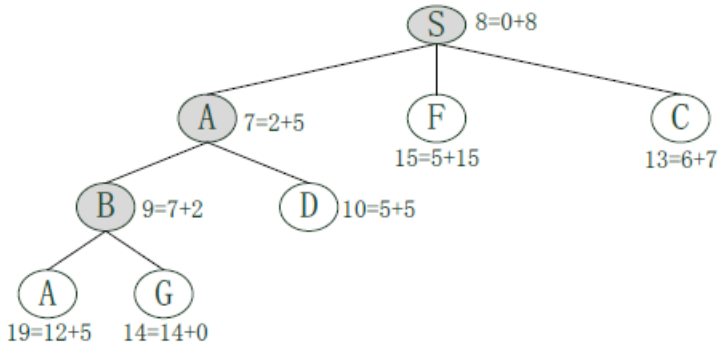
② After expanding S



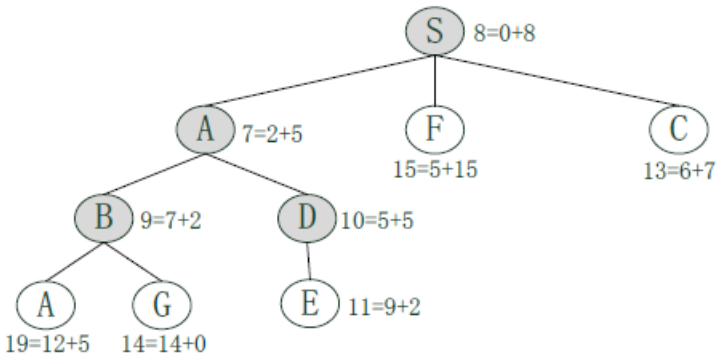
③ After expanding A



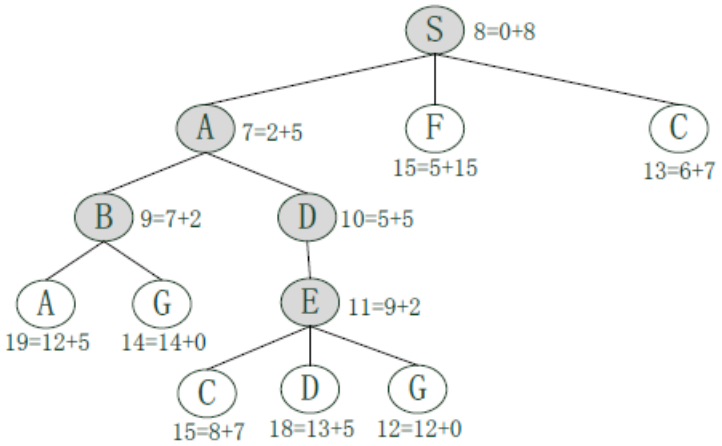
④ After expanding B



⑤ After expanding D



⑥ After expanding E



As we can see, the solution path is S->A->D->E->G, and its cost is 12.

6. Come up with an admissible heuristic function h* that dominates every possible admissible heuristic for this map; specify h*(n) for all n. Remember the definition of dominates: h1 dominates h2 if h1(n) ≥ h2(n) for all n.

Answer: Since the admissible heuristic function h* dominates all the possible heuristic functions, the h* should be the function that gives cost of shortest path to goal from each node.

Thus, h*= {A: 10, B: 7, C: 7, D: 7, E: 3, F: 17, G: 0, S: 12}.