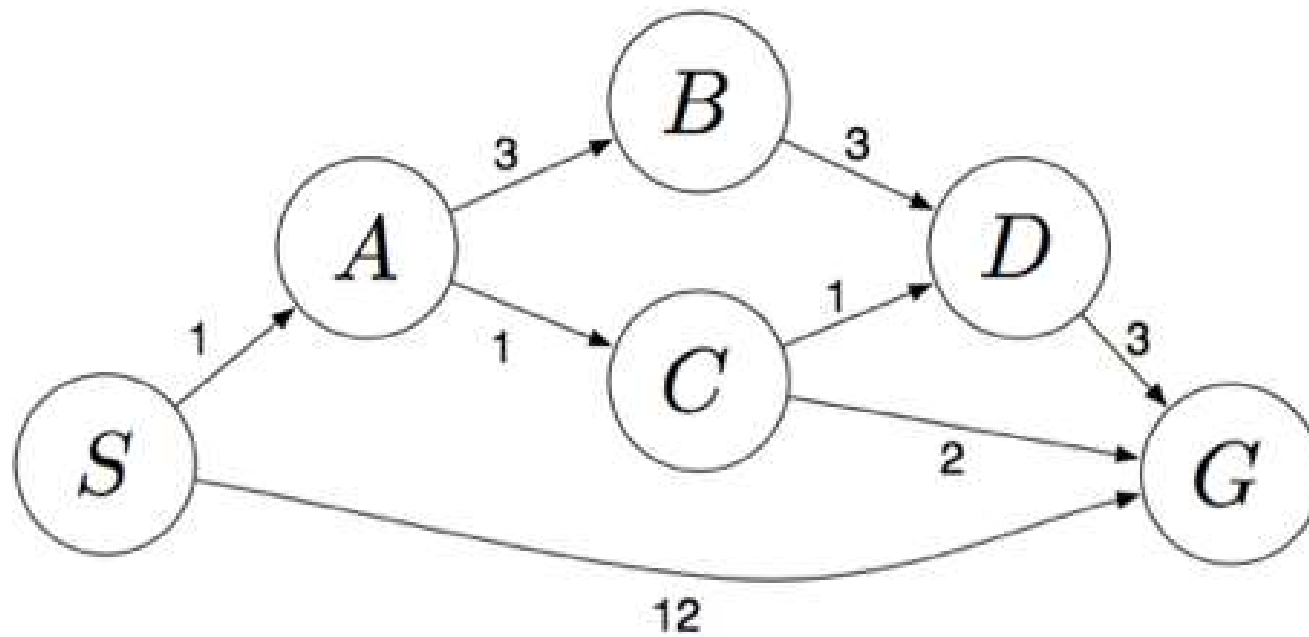
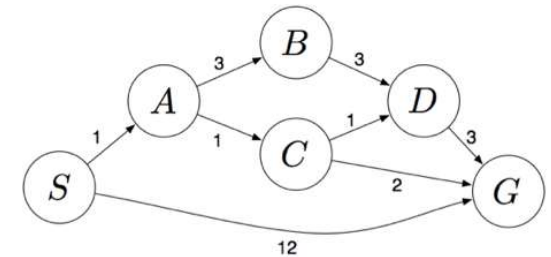


Question 5: BFS, DFS, UCS and A*



S denotes the start state, G denotes the goal state, step costs are written next to each arc. Assume that ties are broken alphabetically.

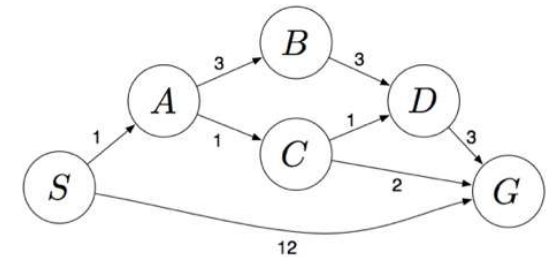
5(a): What path does BFS return?



- Frontier starts with {S}
- S is popped, A and G are inserted, so it contains {A,G}
- A is popped, B and C are inserted, so it contains {G,B,C}
- G is popped. It is the goal state.

Answer: S,G

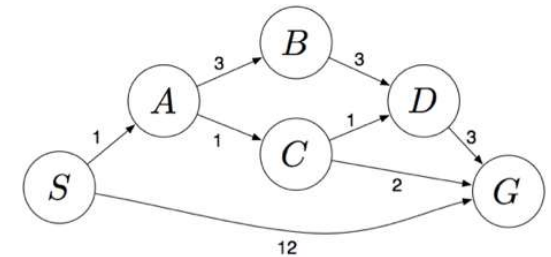
5(b): What path does DFS return?



- Frontier starts with {S}
- S is popped, A and G are inserted, so it contains {A,G}
- A is popped, B and C are inserted, so it contains {B,C,G}
- B is popped, D is inserted, so it contains {D,C,G}
- D is popped, G is inserted, so it contains {G,D,C,G}
- G is popped. It is the goal state.

Answer: S,A,B,D,G

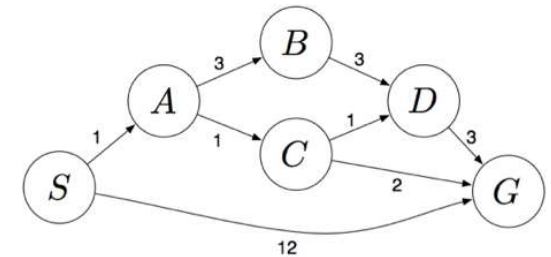
5(c): What path does UCS return?



- Frontier starts with {0:S}
- S is popped, A and G are inserted, so it contains {1:A,12:G}
- A is popped, B and C are inserted, so it contains {2:C,4:B,12:G}
- C is popped, D and G are inserted, so frontier contains {3:D,4:B,4:G,12:G}
- D is popped, G is inserted, so frontier contains {4:B,4:G,6:G,12:G}
- B is popped, and if there is no explored set, D is inserted, so frontier contains {4:G, 6:G, 7:D, 12:G}
- G is popped. It is the goal.

Answer: S,A,C,G – the optimal path

5(d): Heuristic h_1



Heuristic h_1 has the following values:

$h_1(S)=5$, $h_1(A)=3$, $h_1(B)=6$, $h_1(C)=2$, $h_1(D)=3$, $h_1(G)=0$

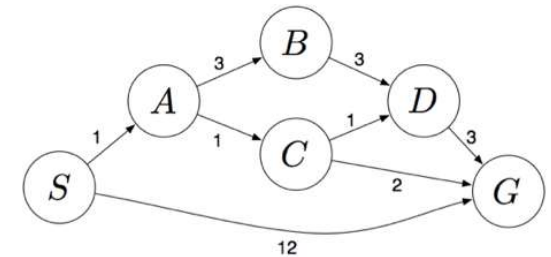
- Is it admissible?

No. $h_1(S) = 5$, but $d(S)=4$.

- Is it consistent?

No. An inadmissible heuristic is never consistent.

5(d): Heuristic h_2



Heuristic h_2 has the following values:

$h_2(S)=4$, $h_2(A)=2$, $h_2(B)=6$, $h_2(C)=1$, $h_2(D)=3$, $h_2(G)=0$

- Is it admissible?

Yes. $h_2(n) \leq d(n)$ for all nodes n .

- Is it consistent?

No. $d(S)-d(A)=1$, but $h_2(S)-h_2(A)=2$.