Exercise Sheet: A*, Knapsack problem

Data Structures and Algorithms (X_400614)

1) Perform the A* graph search algorithm on the graph below. The distance between two vertices is given as the weight of the graph. The heuristic $h(n)$ is the value given at the vertex (in red), representing the straight-line distance from that vertex to the goal: vertex G.
    a) Given that you use a *queue*, simulate the queue changes as A* unfolds.
    b) What is the shortest path from vertex S to vertex G?
    c) What is the distance of the shortest path calculated in 1b?

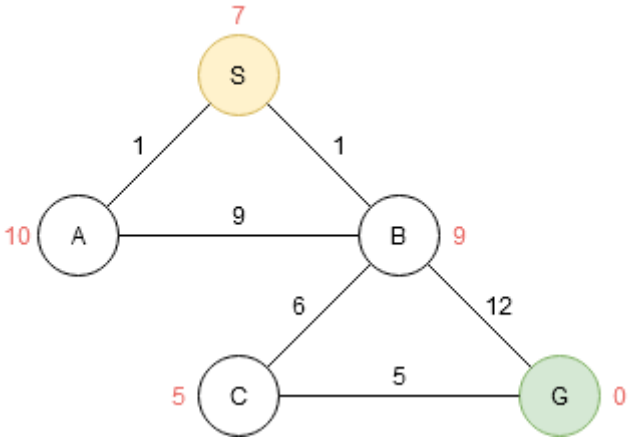

Figure 1. The graph on which to perform A*.

2) Answer true or false for the following statements. Assume that the algorithms use a consistent heuristic $h(n)$.
    a) A* graph search is guaranteed to return an optimal solution.
    b) A* graph search is guaranteed to expand no more nodes than depth-first graph search.
    c) A* graph search is guaranteed to expand no more nodes than Dijkstra's graph search algorithm.

3) Solve the 0/1 knapsack problem via dynamic programming. The weights for the items are $\{3, 4, 5, 6\}$ and the profits for the items are $\{2, 3, 4, 1\}$ and the maximum weight the knapsack can hold is 8.
    a) Show the matrix you obtain after applying the algorithm.
    b) Taking which items will maximise your profits?

4) You are given a knapsack that can carry a maximum weight of 60. There are 4 items with weights $\{20, 30, 40, 70\}$ and values $\{70, 80, 90, 200\}$. What is the maximum value of the items you can carry using the knapsack?
    a) 160
    b) 200
    c) 170
    d) 90