8 Algorithms 1 (jkf21)

(*a*) A haulage company uses electric trucks to move goods from one warehouse to another. There are recharging points at the warehouses A and B, and at $n-1$ intermediate points. The recharging points, $A = r_0, r_1, \ldots, r_n = B$, are at increasing distances $d_0 = 0, d_1, d_2, \ldots, d_n$ from A. Trucks can travel for distance c on a full charge, and the distance between adjacent recharging points is less than c. To maximise time on the road, the haulage company asks you to find a way of getting from A to B that minimises the number of occasions when the trucks have to stop to recharge. Trucks always recharge at A before setting off. They wish to know which recharging points to use, not only the minimum number of recharges required. You decide to solve the problem using dynamic programming.

(*i*) State and explain a formula that expresses an optimal solution in terms of the optimal solutions to subproblems. [5 marks]

(*ii*) Devise an algorithm based on dynamic programming to solve the problem and state whether it is top-down or bottom-up. [6 marks]

(*iii*) Derive the big-Theta space and time complexities of your approach. [4 marks]

(*b*) A friend believes that this optimisation problem can be solved with a greedy algorithm. Are they correct? If so, explain a greedy algorithm. If not, explain why no greedy solution can exist. [5 marks]