Name: Feedback

SA367 · Mathematical Models for Decision Making Spring 2022 · Uhan

Quiz 5 – 3/3/2022

Problem	Weight	Score
1	1	
Total		/ 10

Instructions. You have 15 minutes to complete this quiz. You may not use any other materials (e.g., notes, homework, website).

Show all your work. To receive full credit, your solutions must be completely correct, sufficiently justified, and easy to follow.

Problem 1. One common task at Navy Munitions Command Detachment Sewell's Point is to transport munitions by truck to a pier for eventual loading onto a ship. Suppose you are in charge of determining which subset of the following munitions should be loaded on the next truck:

		Capability Value	Net Explosive Weight (tons)	Area (ft^2)
1	Standard Missile MK13	7	2	70
2	Standard Missile MK15	10	3	70
3	Standard Missile MK21	5	4	80
4	Tomahawk	8	1	60

For this problem, assume there is only one of each munition type. The truck is allowed to transport at most 8 tons of net explosive weight (NEW), and has an area capacity of 200 ft^2. Your goal is to maximize the total capability value of the munitions on the next truck.

We can formulate this problem as a dynamic program by giving its longest path representation. In particular, we define the states and stages as follows:

$$\text{Stage } t \leftrightarrow \begin{cases} \text{considering munition } t & \text{for } t = 1,2,3,4 \\ \text{end of the decision making process} & \text{for } t = 5 \end{cases}$$

$$\text{Node } t_{n_1,n_2} \leftrightarrow \text{having } n_1 \text{ remaining NEW capacity and } n_2 \text{ remaining area capacity at stage } t \quad \text{for } n_1 = 0,\dots,8;\ n_2 = 0,\dots,200$$

Define the following notation for $t = 1,2,3,4$:

v_t = capability value of munition t $\quad$ w_t = NEW of munition t $\quad$ a_t = area of munition t

Sketch the edges from node t_{n_1,n_2} in stage t to all the relevant nodes in stage $t+1$. Specify the edge lengths.

t_{n_1,n_2}

- Many of you were on the right track here.
- Note that there is only one of each munition type. So in this problem, the decisions boil down to either (1) taking munition t or (2) not taking munition t.
- For a similar problem, see Example 1 from Lesson 8.