Week 7 Practice Problems

July 28, 2023

Practice Problems based on Week 7 content

General Course Logistics

- Work on your project! This week you should finish your implementation and start working on your solution analysis. Think about whether your solution "makes sense." Do you need to make any changes to your model? Add new assumptions? Remove assumptions? Change your input data? Continue working on the report. Remember, writing as you go will save you a lot of time at the end of the semester!

Integer Programming Basics

Logical Modeling practice

Let's suppose the CS524 class has decided collectivley to adopt some puppies. There are 6 different breeds ofdogs we can adopt. Each breed has a minimum and maximum number of puppies if we adopt any of that breed (we have to adopt entire litters so no puppies are left alone!). These restrictions, along with the expected happiness we get from each breed, are in the following table:

Breed	Min adopted	Max adopted	Happiness
Golden retriever	5	7	8
Shiba Inu	2	10	10
Great Dane	3	5	4
Pomeranian	6	13	5
Water Spaniel (WI state dog!)	3	15	9
Husky	7	10	6

We have decided that because of the personality of the Shiba Inu, the total number of Shiba Inu puppies adopted should be no more than the combined number of Golden Retriever, Water Spaniel, and Husky puppies. In addition, if any Pomeranians are adopted, we require that at least the minimum number of Great Dane puppies are adopted. We will adopt 40 total dogs and obviously we want to maximize our total happiness. Which breeds of puppies should we adopt, and how many of each?

Set Covering

Thanos is here! Once again, Earth is relying on the Avengers for protection. For convenience, the United Nations has divided up the world into 8 different zones: North America (NA), South America (SA), Eurasia (EU), North Africa (NF), South Africa (SF), East Asia (EA), South/West

Asia (WA), and Oceania (OC). The number of hours required to get from each zone to each other zone by Quinjet is given in the following table:

Zone	NA	SA	EU	NF	SF	EA	WA	OC
NA	0	5	7	8	10	15	11	16
SA	5	0	11	10	9	15	12	13
EU	7	11	0	4	7	9	5	19
NF	8	10	4	0	3	8	3	18
SF	10	9	7	3	0	10	4	16
EA	15	15	9	8	10	0	3	7
WA	11	12	5	3	4	3	0	15
OC	16	13	19	18	16	7	15	0

A rough estimate of the population in each district (in millions) as follows: NA: 580, SA: 420, EU: 900, NF: 250, SF: 200, EA: 1700, WA: 400, OC: 40. The UN have declared there are going to be n Avenger locations. The problem is, the UN isn't sure how many of the Avengers will be available during the defense against Thanos. Their goal is to maximize the number of people that live within 3 hours of an Avenger. We have been asked to assist the UN by determining where to place the Avengers for different values of n. Solve the problem for $n = 1, 2, 3, 4$.

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