IE400 Principles of Engineering Management

- Write a report explaining your choice of decision variables, constraints, parameters and the objective function in details. Include your comments about the problems. Your report should not contain any codes.

- Zip your report with your codes and name it "IE400_Project_GroupXX".

- You will be demonstrating your codes in-class in the last week of lectures.

- You may find the contact information of your group members in Moodle.

Question 1

A tech startup, **Tan-Tech**, is planning a promotional tour to launch their latest product across multiple cities. The goal is to maximize exposure and attract both potential investors and customers, but their budget and time are limited. Each city has a different level of market potential, represented as benefit points. However, visiting every city is not feasible due to budget and time constraints.

Travel Costs Between Cities:

	A	B	C	D	E	F	G	H	I	J
A	0	300	450	150	225	330	495	600	315	405
B	300	0	180	330	315	375	510	195	420	240
C	450	180	0	210	495	135	240	435	180	345
D	150	330	210	0	360	195	300	405	270	285
E	225	315	495	360	0	240	465	180	285	225
F	330	375	135	195	240	0	270	300	345	390
G	495	510	240	300	465	270	0	135	255	210
H	600	195	435	405	180	300	135	0	285	315
I	315	420	180	270	285	345	255	285	0	150
J	405	240	345	285	225	390	210	315	150	0

City	Benefit Points
A	350
B	420
C	270
D	300
E	380
F	410
G	320
H	450
I	330
J	400

To ensure the tour is impactful, Tan-Tech's objectives and constraints are as follows:

- The total travel cost for the tour cannot exceed $1,500.

- Due to logistical and team limitations, Tan-Tech can visit a maximum of 7 cities in total.

- The tour must start and end in city A.

Using Gurobi or a similar optimization software, formulate and solve the problem to generate an optimal route.

Question 2

Ece and Arda are working together to prepare a balanced meal plan for a one-day hiking trip. They have limited space in their bags, and each can carry upto a specific amount of weight. Additionally, Ece and Arda have different preferences for calorie intake. They can share the items in their backpacks once they reach their destination. They aim to select food items from a list so that they have enough food to reach their total calorie goal while considering the capacity requirements and minimizing the combined cost of all selected items.

- Ece's backpack can carry up to 10 kg of food, while Arda's can carry up to 8 kg.

- Ece wants to consume at least 2,000 calories per day, and Arda requires at least 1,500 calories per day.

Item	Weight (kg)	Calories	Cost ($)
Granola Bars	2	300	5
Trail Mix	1	800	10
Dried Fruit	2	200	4
Canned Beans	6	800	7
Rice	4	1100	8
Energy Drink	6	150	3
Pasta	5	1200	9
Jerky	2	500	6

As the day of the hike approaches, Ece and Arda gather all the food items they've chosen and start to pack their backpacks. However, as they look at their options, they suddenly realize something important: they only have one item from each type of food.

Formulate this as a binary integer programming problem where the decision variable x_i represents whether each item i is included in the meal plan (1) or not (0). Implement a branch-and-bound algorithm in your code to solve this problem. Compare the algorithm you implemented with Gurobi.