Homework 2: Linear Optimization

A simple approach for you to finish the homework assignment is to use Markdown in Colab. That is, you enter text descriptions (文字說明) in conjunction with Python codes. After you solve ALL problems, print the text and codes into a single pdf file. Please submit a pdf that shows your name, ID, answers & Python code onto wm5. **The file name must be HW2_xxx, where xxx is your student ID**.

Q1. B&Q makes wo models of tables for its clients. Both models use the same tabletops, but model A has 4 short (18-inch) legs and model B has 4 longer (30-inch) legs. It takes 0.1 labor hour to cut and shape a short leg, 0.15 labor hour to do the same for a long leg, and 0.5 labor hour to produce a table top. An additional 0.3 labor hour is needed to attach the set of legs for either model after all parts are available.

The profit estimate is $30 for model A and $45 for model B. Plenty of top materials is on-hand but B&Q wants to decide how to use the available 500 feet of leg stock (1 feet = 12 inches) of leg stock and 80 labor hours to maximize its profit, assuming that everything made can be sold eventually.

Please formulate a linear programming (LP) model using five decision variables – x_1 for the number of assembled model A, x_2 for the number of assembled model B, x_3 for the number of short legs produced, x_4 for the number of long legs produced, and x_5 for the number of tabletops produced. Explain your balance constraints. Solve it using Gurobi and Python.

Q2. Please solve the integer programming (IP) problem using Gurobi and Python. Make sure brief explanations for your solutions are included.

1 Coach Night is trying to choose the starting lineup for the basketball team. The team consists of seven players who have been rated (on a scale of 1 = poor to 3 = excellent) according to their ball-handling, shooting, rebounding, and defensive abilities. The positions that each player is allowed to play and the player's abilities are listed in Table 9.

The five-player starting lineup must satisfy the following restrictions:

1 At least 4 members must be able to play guard, at least 2 members must be able to play forward, and at least 1 member must be able to play center.

2 The average ball-handling, shooting, and rebounding level of the starting lineup must be at least 2.

3 If player 3 starts, then player 6 cannot start.

4 If player 1 starts, then players 4 and 5 must both start.

5 Either player 2 or player 3 must start.

Given these constraints, Coach Night wants to maximize the total defensive ability of the starting team. Formulate an IP that will help him choose his starting team.

TABLE 9

Player	Position	Ball-Handling	Shooting	Rebounding	Defense
1	G	3	3	1	3
2	C	2	1	3	2
3	G-F	2	3	2	2
4	F-C	1	3	3	1
5	G-F	3	3	3	3
6	F-C	3	1	2	3
7	G-F	3	2	2	1