Question:

3. (30 points) A project manager is considering which of 7 projects she would like to select for her company's portfolio. The table below gives expected profit and capital cost of each project.

Project	Expected Profit (in million USD)	Capital Cost (in million USD)
1	\$12	\$8
2	\$21	\$10
3	\$23	\$13
4	\$14	\$9
5	\$5	\$4
6	\$9	\$7
7	\$3	\$3

The project manager has a \$30 million budget in total capital cost to invest in the selected projects for the portfolio. In addition, the portfolio has to abide by the the following additional project constraints.

- If project 1 is selected, then projects 4 and 5 must be selected.
- If project 2 is selected, then project 7 must be selected.
- If project 3 is selected, then projects 1 and 5 cannot be selected.
- If project 6 is selected, then project 7 cannot be selected.

Formulate, but do **not** solve, the project manager's portfolio integer program.

Answer:

#3

$x_j = \begin{cases} 1 & \text{projects selected for her company} \\ 0 & \text{O.W} \end{cases}$

$\forall j = 1 \dots 7$

Maximize

$$12x_1 + 21x_2 + 23x_3 + 14x_4 + 5x_5 + 9x_6 + 3x_7$$

$$(8x_1 + 10x_2 + 13x_3 + 9x_4 + 4x_5 + 7x_6 + 8x_7 \leq 30) \text{ in millions}$$

$x_1 \leq x_4$

$x_1 \leq x_5$

$x_2 \leq x_7$

$x_3 \leq 1 - x_1$

$x_3 \leq 1 - x_5$

$x_6 \leq 1 - x_7$

$x_j \in \{0, 1\}$

$\forall j = 1 \dots 7$