PART A

A basketball coach is trying to come up with a team for the following match. He has a total of 9 players from which he must select 5 . Assume these 5 players will play the whole game. Consider there are three positions players can play: *guard*, *forward*, and *center*. So the team of 5 players will consist of 2 guards, 2 forwards, and 1 center. Players $1, 2, 3, 4, 8, 9$ can play guard, $3, 4, 5, 6, 7, 8, 9$ can play forward, and $8, 9$ can play center.

Consider the decision variables as x_i for $i \in \{1, \ldots, 9\}$ so that $x_i = 1$ if the coach selects player i , and $x_i = 0$ otherwise and examine the IP below. Note that since there is no objective, we state the linear objective as 0.

The IP formulated below requires that we select five players, and that at least two of these five can play guard; at least two can play forward; at least one can play center. If we solve this integer program, and obtain a feasible integer solution, is the solution guaranteed to produce a feasible five person team?

$$
\left.
\begin{aligned}
\textbf{min} \quad & 0 \\
\textbf{s.t.:} \quad & \\
x_1 + x_2 + x_3 + x_4 + x_8 + x_9 &\geq 2 \ (\textbf{2 Guards}) \\
x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 &\geq 2 \ (\textbf{2 Forwards}) \\
x_8 + x_9 &\geq 1 \ (\textbf{1 Center}) \\
\sum_{i=1}^{9} x_i &= 5 \ (\textbf{5 players}) \\
x_i \in \{0,1\} \quad \forall i \in \{1,\ldots,9\} &\ (\textbf{Binary})
\end{aligned}
\right\}
$$

- (•) False ✔
- ( ) True

EXPLANATION

Solution

False

The above IP isn't a correct formulation for our problem. The constraints do ensure that we have 5 players, 2 of which can play guard, 2 forward and 1 center. However, it doesn't guarantee that we can take these five players (from the optimal solution) and assign two of them as forwards, two of them as guards and the remaining player as center.

For instance, consider the solution that picks players 5,6,7,8,9. Players 5, 6 and 7 can only play forward. That means that the two guards and the center must be chosen from the remaining two players, which is impossible.

Historical note: The above false formulation for the basketball problem was (incorrectly) given as the answer by the staff of 15.053 for a quiz in 15.053. If you didn't see why this model was incorrect, you are definitely not alone.

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