Heuristic Optimization Methods, academic year 2020/2021
Fantasy football draft problem

Problem description

Fantasy football is a game where participants serve as managers of virtual football teams. In the Fantasy Premier League (https://fantasy.premierleague.com/) (FPL), you are given a task to pick a squad of real-life football players playing in the English Premier League, who score points for your team based on the their performances in their own real matches. As a manager, you are given a budget of 100 million virtual currency which can be spent on selecting a squad.

A squad has to have 15 players across four different positions: **goalkeepers (GK)**, **defenders (DEF)**, **midfielders (MID)**, and **forwards (FW)**. However, only 11 players will make it to the first team lineup, and 4 players have to serve as substitutes. Points can only be scored by players selected in the first team lineup. Given the list of players with their respective value (price), club, and points scored, your task is to draft a squad of 15 players, and pick the first team lineup, so as to maximize the number of points scored by the selected eleven players on the pitch. The following text describes the format of problem instances (input files), and formulates the objectives and constraints.

Figure 1. Example of the drafted fantasy squad on FPL

Problem instance

Problem instances define the list of players which are available for the draft. These instances were collected from various gameweeks during the course of previous and current football seasons. The data provided in each instance file is defined as follows:

- ID – unique integer representing each player
- Position – player's position on the pitch (i.e., GK, DEF, MID, or FW)
- Name – player's surname
- Club – player's club
- Points – points scored during that season (until the point of creating the instance)
- Price – player's value in virtual currency (in millions)

ID	Position	Name	Club	Points	Price
1	GK	Ederson	Man City	13	6.0
2	GK	Alisson	Liverpool	17	5.9
3	GK	Pope	Burnley	15	5.5
...					
34	DEF	Alexander-Arnold	Liverpool	15	7.5
35	DEF	Robertson	Liverpool	25	7.1
36	DEF	van Dijk	Liverpool	15	6.4
...					
248	MID	Salah	Liverpool	48	12.3
249	MID	Mane	Liverpool	31	11.9
250	MID	Aubameyang	Arsenal	18	11.8
...					
485	FW	Kane	Spurs	60	10.8
486	FW	Agüero	Man City	2	10.4
...					

Player's ID, club, points, and price may vary from instance to instance. Additionaly, some players may be added or removed from the instances.

Problem formulations

The problem defines the following **constraints**:

1. Budget
   - A budget of 100.0 million virtual currency is available for the draft
   - Total cost of the drafted 15 players must not exceed the budget, but can be less than the budget
2. Squad draft
   - A 15 player squad must be drafted, consisting of:
     - 2 goalkeepers
     - 5 defenders
     - 5 midfielders
     - 3 forwards
   - A maximum of 3 players can be selected from a single club

3. First team lineup
   - From the 15 player squad, 11 players must be picked for the first team
   - The players can play in any formation, providing:
     - 1 goalkeeper
     - At least 3 defenders
     - At least 1 forward
   - 4 players must be selected as substitutes
     - 1 goalkeeper must be a substitute
   - Players can only play in positions defined by the instance (i.e., goalkeepers can only play in a goalkeeper position, or sit on the bench)

The main objective is to maximize the sum of points from the players selected for the first team, and find the "best eleven" players in each instance. Points from players placed on the bench are not calculated in the overall score, however, their cost is deducted from the available budget. The solution consists of a list of (15) players drafted, a list of (11) players picked for the first team, the selected formation, and the overall score of the first team squad.

FAQ

1. I am not familiar with the rules of football. What are positions, formations, etc.?

   https://en.wikipedia.org/wiki/Association_football

2. FPL offers additional features when drafting your squad such as selecting the team captain. Does this matter for this problem?

   No.

3. If a player is injured, should he be drafted?

   Injuries are out of consideration for the purpose of this practical implementation.

4. Does the precise player position in the formation (left side, center, right side) matter?

   No.