Sprint Plannig - Integer Linear Optimization

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Problem descriptionIn

A small startup follows the SCRUM methodology for their software development process. The process is devided in weekly *sprints*. Multiple feature suggestions are being recorded in a *backlog* and before each sprint the team gets together to estimate the amount of work needed to be donw by every team member (*frontend developer*, *backend developer* and *designer*) for every feature. In addition, every feature has a number attached to it, indicating (not like in real SCRUM) the importance of a given feature to the business. One of the startup's core principles beyond building the business is a sustainable work/life balance, so no team member works more than 40 hours - the availability of team members is known upfront.

Our goal is to decide which features to work on in a given sprint so that we achieve the maximum amount of story point.

Backlog and team availabilities

Feature	Points	Frontend (h)	Backend (h)	Design (h)
f1	3	5	3	2
f2	8	10	10	4
f3	13	0	25	0
f4	5	18	6	3
f5	1	8	6	12
f6	21	10	4	8
f7	13	2	10	4
f8	2	4	6	2

Team availabilities for the given week

- Backend developer: 35 hours
- Designer: 40 hours
- Frontend developer: 40 hours

Integer Linear Optimization Problem

Features $f_i, i \in [1..8]$ will be decision variables. The objective is to maximize the amount of story points, team member availbilities are constraints. The problem is a special case of *Integer Linear Optimization - Binary Integer Optimization* where we can decide if we implement or not implement a feature. The variables thus can only take values of 0 and 1.

$$max. 3f_1 + 8f_2 + 13f_3 + 5f_4 + 1f_5 + 21f_6 + 13f_7 + 2f_8$$

$$s.t.$$

$$5f_1 + 10f_2 + 18f_4 + 8f_5 + 10f_6 + 2f_7 + 4f_8 \leq 40$$

$$3f_1 + 10fv2 + 25f_3 + 6f_4 + 6f_5 + 4f_6 + 10f_7 + 6f_8 \leq 30$$

$$2f_1 + 4f_2 + 3f_4 + 12f_5 + 8f_6 + 4f_7 + 2f_8 \leq 38$$

$$f_i \in \{0, 1\} \forall i \in [1..8]$$

Solving the problem

The problem was solved using the *pulp* packege. The code is available in the GitHub repository (https://github.com/ilyakrasnov/lp-project).

Result and Weekly Plan

The maximum amount of story points that can be achieved under the constraints is *47* and can be done by implementing features f_2, f_4, f_6 and f_7. The resulting weekly plan for the coming sprint is:

Feature	Story Points	Frontend (h)	Backend (h)	Design (h)
f2	8	10	10	4
f4	5	18	6	3
f6	21	10	4	8
f7	13	2	10	4
Total	**47**	**40**	**30**	**19**

Runtime

The performance of the package for the given problem (having only 3 constraints) was acceptable. However other users report the package being slow for a large number of constraints: *'..[t]aking 3 minutes to add only 1500 constraints…'* (https://groups.google.com/forum/#!topic/pulp-or-discuss/DgI25x_zvL8)