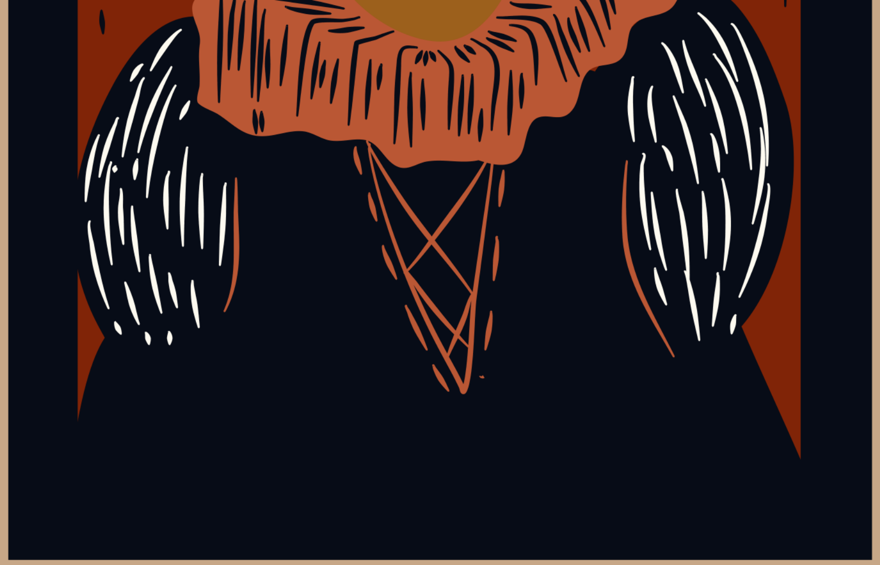
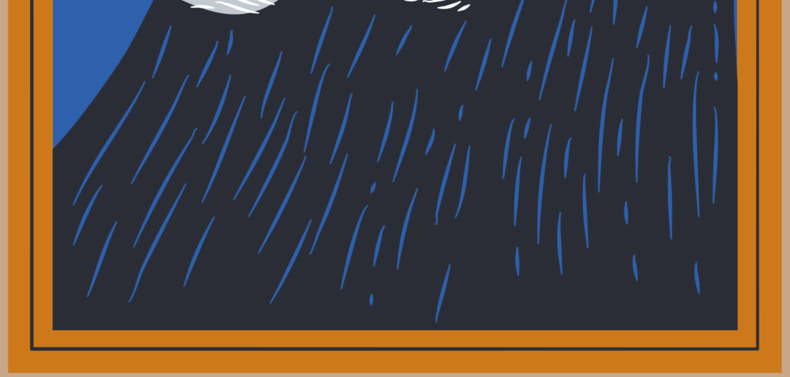




TEMPORARY STAFFING AT GOOD'OLDGOOD'S

OTIMIZATION - M.EIC, FEUP

Filipe Campos, Francisco Cerqueira, Veronija Kodovska

The Problems

ALLOCATION PROBLEM

How to create the allocations given according to the requirements

REPLACEMENT PROBLEM

How to quickly find replacements for missing staff on the day of the event, given the previous allocations

Assumptions

Capabilities

A candidate's capabilities can be represented as a linear combination of their experience and skills

1

2

Regular allocations are the priority

The regular allocations should always have priority over the choice of waiting list members

Waiting list time&travel

The time & travel value only matters for waiting list members, since only they will need to reach the event venue quickly

3

Assumptions

Staff cannot be moved to another position

Once assigned, staff cannot be moved to other positions if there are missing staff

4

5

Waiting list does not count as a working day

The waiting list allocations do not count toward the total count of consecutive working days

Binary skill weight

For each position the weight of each type of skill, presentation or language, has a binary value

6

ASSIGNMENT PROBLEM

DATA

- P - Set of positions.
- D - Set of days.
- C - Set of candidates.
- a_{cd} - Availability of candidate c on day d (binary values).
- r_{pd} - Requirements for position p on day d.
- e_{cp} - Experience on candidate c on position p
- sk_{sc} - Value of skill s in {language, presentation} for candidate c
- t_{c} - Time & travel value for candidate c
- sm_{sp} - Identifies if position p requires skill s (binary values).

ASSIGNMENT PROBLEM
DECISION VARIABLES

$$x_{dcp} = \begin{cases} 1, & \text{if on day } d \text{ candidate } c \text{ is assigned to position } p \\ 0, & \text{otherwise} \end{cases}$$

$$d, c, p \in D, C, P$$

$$s_{\text{num-workers}} \in \mathbb{Z}^{\geq}$$

ASSIGNMENT PROBLEM
CAPABILITY

$$
\begin{aligned}
capability_{pc} = (& \\
& w_{\text{experience}} \cdot e_{cp} && + \\
& w_{\text{language}} \cdot sk_{\text{language},c} \cdot sm_{\text{language},p} && + \\
& w_{\text{presentation}} \cdot sk_{\text{presentation},c} \cdot sm_{\text{presentation},p} && + \\
& (1 - sm_{\text{language},p}) \cdot w_{\text{language}} \cdot e_{cp} && + \\
& (1 - sm_{\text{presentation},p}) \cdot w_{\text{presentation}} \cdot e_{cp} && \\
&),\ \text{for } p, c \in P, C
\end{aligned}
$$

ASSIGNMENT PROBLEM

OBJECTIVE FUNCTION

$$\text{lex max} \;\; Z_1, Z_2$$

$$\mathbf{Z_1} = capability\_value_{\text{normalized}} - s_{\text{num-workers}} \cdot p_{\text{extra-worker-penalty}}$$

$$\mathbf{Z_2} = avg_{\text{wl\_capability}} \cdot w_{wl-capability} + waiting\_list\_travel \cdot w_{wl-travel}$$

ASSIGNMENT PROBLEM

CONSTRAINTS

All decision variables are positive

Each candidate can only be assigned to 1 position per day

Each position's requirements must be satisfied

Candidates can only be hired if they are available

For each candidate the maximum number of consecutive working days cannot exceed a predefined value

ASSIGNMENT PROBLEM
CONSTRAINTS

The number of workers has to be less or equal to:

target-num-workers + slack-num-workers

The slack-num-workers decision variable has to be less or equal to:

max-num-workers - target-num-workers

RESULTS - ASSIGNMENT PROBLEM

Setup	Z_1	Z_2	$n_{workers}$	avg_{exp}	avg_{ls}	avg_{ps}
Default	2.8166	2.8261	**250**	4.6009	2.8506	3.0745
Unlimited workers	2.8695	2.7326	302	**4.7003**	2.9061	3.2107
Unlimited consecutive days	2.8291	2.8286	**250**	4.6350	2.8608	3.0335
Better skills	2.6370	2.7552	**250**	4.2929	**3.2060**	**3.7849**
Lower worker penalty	2.8415	2.6816	270	4.6826	2.9047	3.1778

Table 8. Comparison of different solution's metrics. Note that the objective function values are not comparable across all the setups

REPLACEMENT PROBLEM

DATA

Compared to the previous problem we add three new data variables:

- current_day - The current day as a string
- missing_staff - A set of ids of staff that were previously assigned to the current_day but are missing
- prev - The decision variable x obtained using the previous solver.

REPLACEMENT PROBLEM
DECISION VARIABLES & OBJECTIVE FUNCTION

$$x_{dcp} = \begin{cases} 1, & \text{if on day } d \text{ candidate } c \text{ is assigned to position } p \\ 0, & \text{otherwise} \end{cases}$$

$$d, c, p \in D, C, P$$

$$s_{\text{num-workers}} \in \mathbb{Z}^{\geq}$$

$$\mathbf{Z_1} = \mathit{capability\_value}_{\text{normalized}}$$

$$s_{\text{num-workers}} \cdot p_{\text{extra-worker-penalty}}$$

REPLACEMENT PROBLEM
CONSTRAINTS

The assignments for days different than current_day must remain unchanged

Candidates that are already assigned cannot be moved to another position

Missing staff cannot work

Staff that are not working on this day cannot be re-assigned

All the constraints from the previous problem still hold

RESULTS - REPLACEMENT PROBLEM

For each day we sampled 30 combinations with n% missing staff members. We assumed that the percentage of missing staff follows a normal distribution $n_{\text{missing\_percentage}} \sim \mathcal{N}(4,\ 5)$

For the default assignment problem setup we obtained the following results:

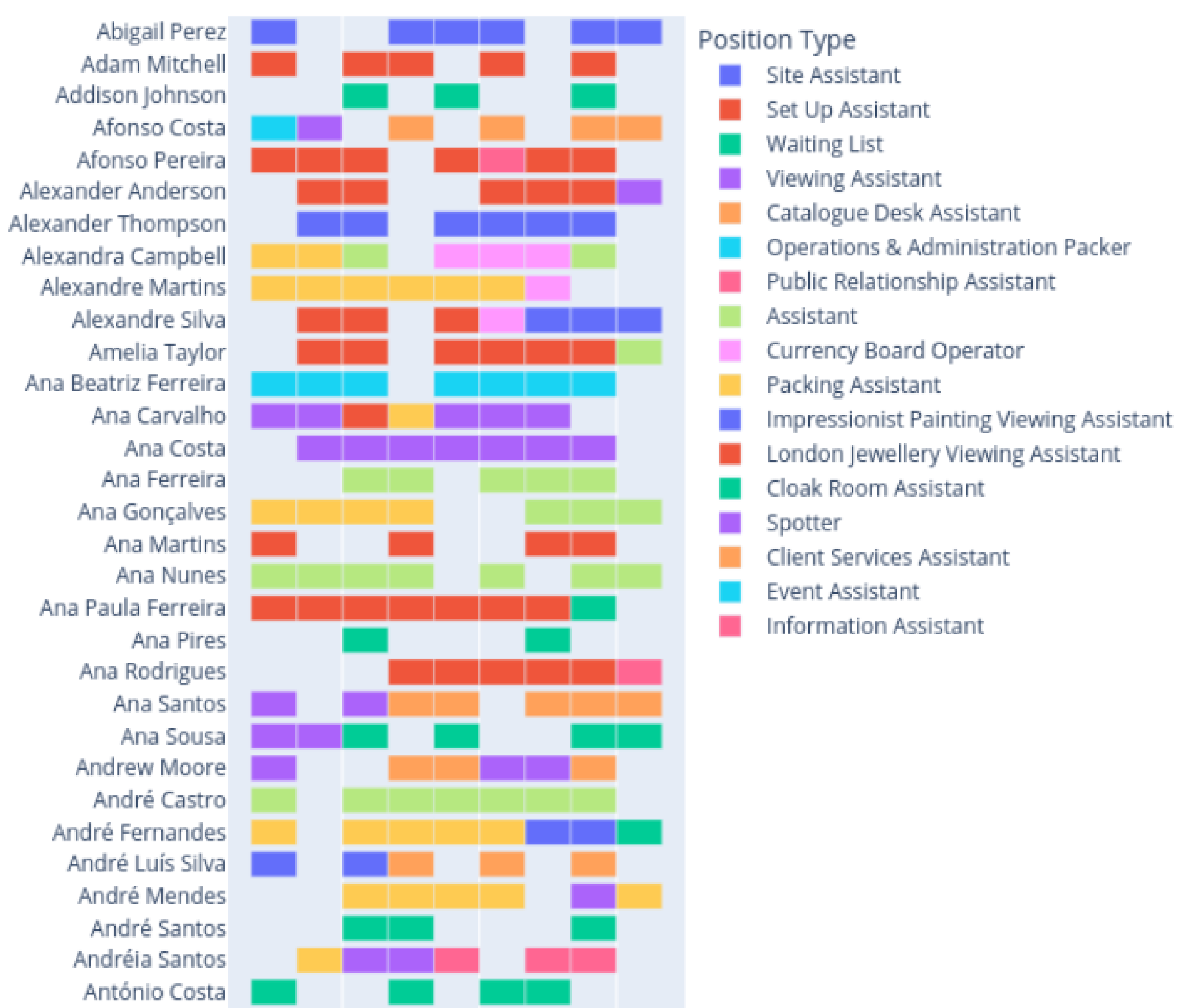
- Average replacement capability = 2.6367 ± 0.0685
- Average time & travel value = 1.6642 ± 0.7761

CONCLUSIONS

- Based on the issued information, we define a set of assumptions under which our tool functions.
- We define two problems:
    - Allocating staff, which combines experience, skills and other constraints to create a possible solution;
    - Replacing staff, to allow for a quick and efficient replacement of missing staff members during the days of the event.
- We also analyze and propose different solutions to the problem that can be proposed to the company's human resources expert.

THANK YOU FOR LISTENING!

Don't hesitate to ask any questions!


Abigail Perez
Adam Mitchell
Addison Johnson
Afonso Costa
Afonso Pereira
Alexander Anderson
Alexander Thompson
Alexandra Campbell
Alexandre Martins
Alexandre Silva
Amelia Taylor
Ana Beatriz Ferreira
Ana Carvalho
Ana Costa
Ana Ferreira
Ana Gonçalves
Ana Martins
Ana Nunes
Ana Paula Ferreira
Ana Pires
Ana Rodrigues
Ana Santos
Ana Sousa
Andrew Moore
André Castro
André Fernandes
André Luís Silva
André Mendes
André Santos
Andréia Santos
António Costa
Position Type
Site Assistant
Set Up Assistant
Waiting List
Viewing Assistant
Catalogue Desk Assistant
Operations & Administration Packer
Public Relationship Assistant
Assistant
Currency Board Operator
Packing Assistant
Impressionist Painting Viewing Assistant
London Jewellery Viewing Assistant
Cloak Room Assistant
Spotter
Client Services Assistant
Event Assistant
Information Assistant