

Problem:

Shift scheduling.

Scenario: A big business with a set of positions and a set of workers. Each worker has a corresponding subset of positions which they are qualified to work. For example, the set of positions could be {chef, waiter, bar staff} and the set of workers could be {Barry: [bar staff, waiter], Omri: [Chef]}. Each worker gives their availability for a given week in advance. Given constraints detailed by the business based on the amount of workers needed in each position at each time of the week, assign each worker there schedule for the week.

Other things to consider:

- Several branches
- Each worker needs a minimum and maximum number of hours
- Experience
- Alternate schedules
- Scale of availability
- Worker specified constraints: can work 2 out of 5 days for example
- Best alternative if no solution found

### Our problem

We are going to implement our CSP for a busy ski business. The business is open 7 days a week and each day is divided into 3 shifts; morning, afternoon and evening. The variables are going to be the workers and the shifts. The positions a worker can have are cashier (1), ski gear expert (2), snowboarding expert, (3) women's clothing expert (4), manager, shop maintenance (5), slope maintenance (6), paramedic crew (7). For our problem we will have 30 workers and each worker will be given a unique 4 digit id to identify them, a subset of the positions that they are qualified in and level of experience on a scale of 1-5. As an input, the problem takes in the availability of each worker for the week.

Example:

Worker 1001: Monday morn, all day Tuesday etc.

Worker ID	Positions Qualified To Work At	Level of Experience
1001	1	1
1002	1	2
1003	1	3
1004	1, 2	5
1005	2, 3	4
1006	1, 2, 3, 4	4
1007	4	
1008	4	
1009	4	



Sun morning, Sun afternoon, Sun evening

Worker 1, ..., Worker n

Constraints:

$N_e$ : sum of shifts that the employee e cannot work = 0

$P_{ps}$  : sum of employees in position p at shift S  $\geq$  (input threshold)

For every shift, the range of number of workers required for each position (Hard Constraint)

\*we don't have to worry about the availability of the workers (specific shifts that they can work in) since we define it during the construction of the csp problem for every week (as the domain of every variable).

Worker specific constraints: worker 1001 can only work a maximum of 4 shifts a week and will not work with worker 1002 (soft)

For every position in every shift we need at least one worker with experience

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Each worker has a limit on the number of shifts they can work

\*\*\*\* need to change implementation of constraints to function and take care of has\_support function.