

Problem Definition

5) Solving the Nurse Scheduling Problem

The nurse scheduling problem (NSP) is the operations research problem of finding an optimal way to assign nurses to shifts, typically with a set of hard constraints which all valid solutions must follow, and a set of soft constraints which define the relative quality of valid solutions. Solutions to the nurse scheduling problem can be applied to constrained scheduling problems in other fields. The nurse scheduling problem involves the assignment of shifts and holidays to nurses. Each nurse has their own wishes and restrictions, as does the hospital. The problem is described as finding a schedule that both respects the constraints of the nurses and fulfills the objectives of the hospital. Conventionally, a nurse can work 3 shifts because nursing is shift work:

- day shift • night shift • late night shift

In this problem we must search for a solution satisfying as many wishes as possible while not compromising the needs of the hospital. There are two types of constraints:

- 1. Hard constraints:** if this constraint fails then the entire schedule is invalid.
- 2. Soft constraints:** it is desirable that these constraints are met but not meeting them does not make the schedule invalid.

Some examples of constraints are:

- A nurse does not work the day shift, night shift and late-night shift on the same day (for obvious reasons).
- A nurse may go on a holiday and will not work shifts during this time.
- A nurse does not do a late-night shift followed by a day shift the next day.

Hard constraints typically include a specification of shifts (e.g. morning, afternoon, and night), that each nurse should work no more than one shift

per day, and that all patients should have nursing coverage. Differences in qualifications between nurses also create hard constraints. Soft constraints may include minimum and maximum numbers of shifts assigned to a given nurse in a given week, of hours worked per week, of days worked consecutively, of days off consecutively, and so on. The shift preferences of individual nurses may be treated as a soft constraint, or as a hard constraint.

Genetic Algorithms

Genetic Algorithm (GA) is a search-based optimization technique based on the principles of Genetics and Natural Selection. It is frequently used to find optimal or near-optimal solutions to difficult problems like our problem, which otherwise would take a lifetime to solve. It is frequently used to solve optimization problems, in research.

We will use this algorithm to solve our problem.

INPUTE :

1- the number of all Nurses

Explain.: nurses count working at a hospital

2-the Holiday request of each nurse

Explain.: each nurse requested specific holiday on week

3- the Population Size

Explain.: the number of the solutions

4 - Evolution Grows number

Explain.: Evolution Grows is the number of best solutions for each generation that we will pass to next generation

5- Evolution loop Size

Explain.: the number of generation that we will be stoped

OUTPUT :

1- validation_state

Explain.: is the final selotion is valid to apply on real word or not

2- fitness of the final solution

Explain.: the fitness is the number which explain how much the solution is good

3- conflect number in solution

Explain.:the number of breaking constrain (hard & soft constrain)

4- the gene type

Explain.: the schedule solution encoded into gene type

5-Conflict Reasons

Explain.: this explain what is the problems in the solution

6 - Final schedule

Explain.: the result

Screenshots of the output :

```
AIProject5 [C:\Users\lenovo\PycharmProjects\AIProject5 - F:\A\college\year 3\AI\project\genetic_algorithm_project.py - PyCharm
File Edit View Navigate Code Help
Run: genetic_algorithm_project x
=====
final Solution
validation_state :True
fitness :0.1429
conflict number : 7
the best Gene :
[['M5', 'A3', 'N9', 'M1', 'A8', 'N10', 'M7', 'A16', 'N6', 'M13', 'A4'], ['M13', 'A15', 'N14', 'M4', 'A8', 'N16', 'M3', 'A5', 'N11', 'M7', 'A12'], ['M15', 'A16', 'N1]]
Conflict Resons :
1 - Unsatisfied holiday for nurse 1 at day 1
2 - Unsatisfied holiday for nurse 8 at day 1
3 - Unsatisfied holiday for nurse 11 at day 4
4 - Unsatisfied holiday for nurse 13 at day 2
5 - Unsatisfied holiday for nurse 14 at day 6
6 - Unsatisfied holiday for nurse 15 at day 5
7 - Unsatisfied holiday for nurse 16 at day 2
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final scedule :
|sat      |sun      |mon      |tue      |wed      |thu      |fri
Nurse 1 : |M        |M        |M        |M        |A        |M        |H
Nurse 2 : |H        |H        |M        |N        |H        |M        |A
Nurse 3 : |A        |M        |H        |A        |M        |H        |H
Nurse 4 : |A        |M        |A        |M        |H        |N        |H
Nurse 5 : |M        |A        |N        |H        |N        |A        |M
Nurse 6 : |N        |H        |A        |A        |H        |M        |N
Nurse 7 : |M        |M        |H        |A        |H        |H        |A
Nurse 8 : |A        |A        |H        |H        |M        |H        |N
Nurse 9 : |N        |H        |H        |H        |M        |H        |M
Nurse 10 : |N        |H        |N        |N        |N        |A        |N
Nurse 11 : |H        |N        |A        |A        |A        |A        |H
Nurse 12 : |H        |A        |M        |H        |A        |N        |H
Nurse 13 : |M        |M        |N        |H        |M        |H        |M
Nurse 14 : |H        |N        |H        |M        |M        |A        |A
Nurse 15 : |H        |A        |M        |H        |A        |N        |A
Nurse 16 : |A        |N        |A        |N        |N        |H        |M

Process finished with exit code 0
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