***Case-Study HFT-Stuttgart:*** Master Software-Technology – summer term 2010

Repository: <http://code.google.com/p/timetablinghft>

**Heuristic of an Evolutionary Algorithm to solve the curriculum based course timetabling problem**

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**Idea of the heuristic:**

**Generator:**

Fills up the solution table with feasible solutions generated by the *algorithm of Martin Josef Geiger*[[1]](#footnote-2).

**Solution table**

Concrete Solution

Vote

Solution 1

100

Solution 2

10

…

Solution n

20

Rates

**Evaluator**

Fills up

**Generator**

Writes back

Reads

**“Genetist”**

The generator also brings in new genes into the population during the evolution-process.

**Evaluator:**

Evaluates each solution by one concrete curriculum. Based on this rating the reproduction-strategy will take place. The higher the rating is, the higher is the possibility for reproduction of the concrete solution.

**“Genetist”:**

This module reads several solutions from the solution table and creates new (mostly better) solutions via

* Recombination
* Mutation

This module uses the *Neighborhood Analysis by Zhipeng Lü, Jin-Kao Hao and Fred Glover*[[2]](#footnote-3).

**Voting-mechanism in detail – Negotiation approach:**

3

1

9

1

5

6

1

2

3

…

Solution #

Rank

**1**

**2**

3

**Curr1**

**Curr2**

**Curr3**

The evaluator generates one *“negotiator”* (Curr1, Curr2, …) for each curriculum. Each *“negotiator”* votes for every solution in its own interest.

At the end of the negotiation process the highest rated solutions will be used for recombination and mutation.

**Activity Diagram:**

Adequate solution found

Genetist: Read m solutions based on their ratings.

Genetist: Recombination & Mutation.

Genetist: Eliminate the worst k solutions.

Find a “good” solution

Generator: Fill up the solution table until n feasible solutions.

Evaluator: Give a rating for every solution.

**Definition of fairness:**

For each solution you can calculate the soft constrains for every curriculum.

|  |  |  |  |
| --- | --- | --- | --- |
| **Soft constr. Curr1** | **Soft constr. Curr2** | **Soft constr. Curr3** | **Fairness** |
| 200 | 200 | 200 | 0 |
| 500 | 50 | 50 | 450 |

The fairness points are calculated based on the absolute difference and the average difference to the other curricula.

The lower the fairness points are, the fairer is the solution.

Not only the highest rated solutions, but also the fairest solutions have a higher possibility for reproduction.

**Recombination strategy:**

This recombination strategy performs recombination by taking one half of all courses from one solution and the other half from the other solution.

Of course, multiple hard constraint violations can occur during this procedure. The individual lectures are assigned to the new solution one after the other. When placing each assignment, it is checked if this specific assignment will be hard constraint valid. If it is not, the lecture to be assigned will be stored in a separate list containing all lectures yet to be assigned. The position where that course should be originally assigned is also stored. The same will be done, if a course cannot be placed because there is already another assignment belonging to those provided by the other solution.

At the end of the recombination an attempt is made to assign all remaining lectures. Starting from the original locations where they should have been assigned but where it was not possible, new locations are computed. This is done by first checking the other rooms in the period. If this fails it will be either placed at a lower period or at a higher period. This depends on the distance to the nearest valid empty slot, which will be computed.

If at least one lecture cannot be assigned, <tt>null</tt> will be returned as the result of the recombination. In this case the two solutions can be considered as being not compatible with each other.

1. <http://w1.cirrelt.ca/~patat2008/PATAT_7_PROCEEDINGS/Papers/Geiger-TC1d.pdf> [↑](#footnote-ref-2)
2. <http://www.info.univ-angers.fr/pub/hao/papers/JoH2010.pdf> [↑](#footnote-ref-3)