MATHEMATICAL MODELS AND METHODS BASED ON METAHEURISTIC APPROACH FOR TIMETABLING PROBLEM

Maqsood Ahmad, Christophe Caux, Michel Gourgand
LIMOS ; Université Blaise Pascal

Campus des Cézeaux-BP 10125, 63173 Aubière, France

Plan

- Introduction
- Constraints
- Problem Description
- Formulation
- Solution Techniques

Introduction

- Time Tabling Problem

Timetabling can be generally defined as the activity of assigning, subject to constraints, a number of events to a limited number of time periods and locations such that desirable objectives are satisfied as nearly as possible.

Types of timetabling Problem

- educational timetabling
- employee timetabling
- sport timetabling
- transport timetabling

Educational Timetabling

- Course Timetabling Problem

A course timetabling problem can be defined as the problem of assigning a number of lectures to a limited number of time periods by using specific resources in accordance with a set of constraints.

Constraints

Hard Constraints

their satisfaction is mandatory

For example, lectures taught by the same teacher must be all scheduled in deferent periods.

Soft Constraints

their satisfaction shows quality of solution and is not mandatory

For example, Lectures belonging to a course should be adjacent to each Other on a same day.

ITC 2007:CB-CTT and Generalized Problem

- Our problem is generalization of International Timetabling Competition 2007, track: curriculum based course timetabling problem ITC 2007:CB-CTT

- Days, Timeslots
- Courses and Teachers
- Rooms
- Curricula

Mathematical formulation

- Formulation
- Linear integer programming
- Parameters, Sets, Sub sets, Decision variables
- Objective Function

Memetic Algorithm

Initialization
Evaluation
Extinction
Selection
Cross over
Mutation
Apply proposed local search
Apply infection in population to chromosomes
New population

Chromosome Representation

Room 1…….

	Period 1	Period 2	Period 3	Period 4	Period 5
Day 1	c001	c002	c025	c109	c104
Day 2	c115	c002	c025	c109	c104
Day 3	c105	c002	c125	c425	-
Day 4	-	-	-	-	-
Day 5	-	-	-	-	-

Room 2…….
Room 3…….
.
.
.
Room N…….

	Period 1	Period 2	Period 3	Period 4	Period 5
Day 1	c008	c009	c205	c189	c385
Day 2	c006	c004	c879	-	-
Day 3	-	-	-	-	-
Day 4	-	-	-	-	-
Day 5	-	-	-	-	-

Evaluation and selection

- Used an elitist natural selection operator for timetables eradication.
- Eradicate 20 % of timetables in each generation.
- Roulette wheel selection to choose parents for breeding

Genetic operators

- **Cross over**

We used multiple point cross over. We choose these points randomly. For each gene, randomly choose a number between 0 and cross over rate . We take father or mother gene according to value of this random number.

- **Mutation**

For each gene, Randomly choose a number between 1 and 1000. If the number is less than the mutation rate then randomly choose a gene from the current timetable and swap it with the current gene.

Pseudo Code of Memetic Algorithm

Algorithm Pseudo code for Memetic Algorithm (MA)

Input : A problem instance I
Set the generation counter g := 0
While (solution_colony population_size **< n) do**
Create a timetable by random initialization method
Repair this timetable by proposed repair strategies
Calculate the cost of timetable
Enter timetable to the population colony
End while
While the termination condition is not reached **do**
Replace 20 % members of the colony

While (solution_colony. population_size **< n) do**
Choose two parents via roulette wheel selection
Child solution generated by applying the uniform crossover operator with a cross over probability
Apply mutation over child solution with a mutation probability
Calculate the cost of child solution
Child solution is applied with proposed local search
If cost of local search got child solution is less than cost of child solution, accept it otherwise choose child solution
Enter this timetable to the population colony
End while
g := g + 1
After random number of generations, apply infection to the population colony
End while
Output : The best achieved solution for the problem instance **I**

Thanks for your attention