Project Artificial intelligent

2022 / 2023

Project number : 44

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Id	202000879	202000330	202000873	202000635	202000406	202000344
Level	Level 3	Level 3	Level 3	Level 3	Level 3	Level 3
department	IS	IS	IS	IS	IS	IS
Project number	44					

1. Project Idea

The project idea is Solving Faculty Timetable Scheduling .

A scheduling problem consists of utilizing a set of limited resources to perform a set of tasks. One of the most important scheduling problems is educational timetabling .

Timetabling problems have attracted significant research activities from operations research and artificial intelligence. It is a very well-known problem since many academic researchers are daily confronted with university timetabling .

The general educational timetabling problems commonly refer to both course and examination timetabling which are different in nature. In the examination timetabling, one goal is to spread the different exams for each student as evenly as possible, while in course timetabling the students want an as compact timetable as possible .

It has always been a difficult task for academic offices at universities each semester to manage this problem. The job of course arrangement is a complex system in which various issues must be considered.

Every year in our university, every individual department has to design a new timetable for courses in the coming academic year.

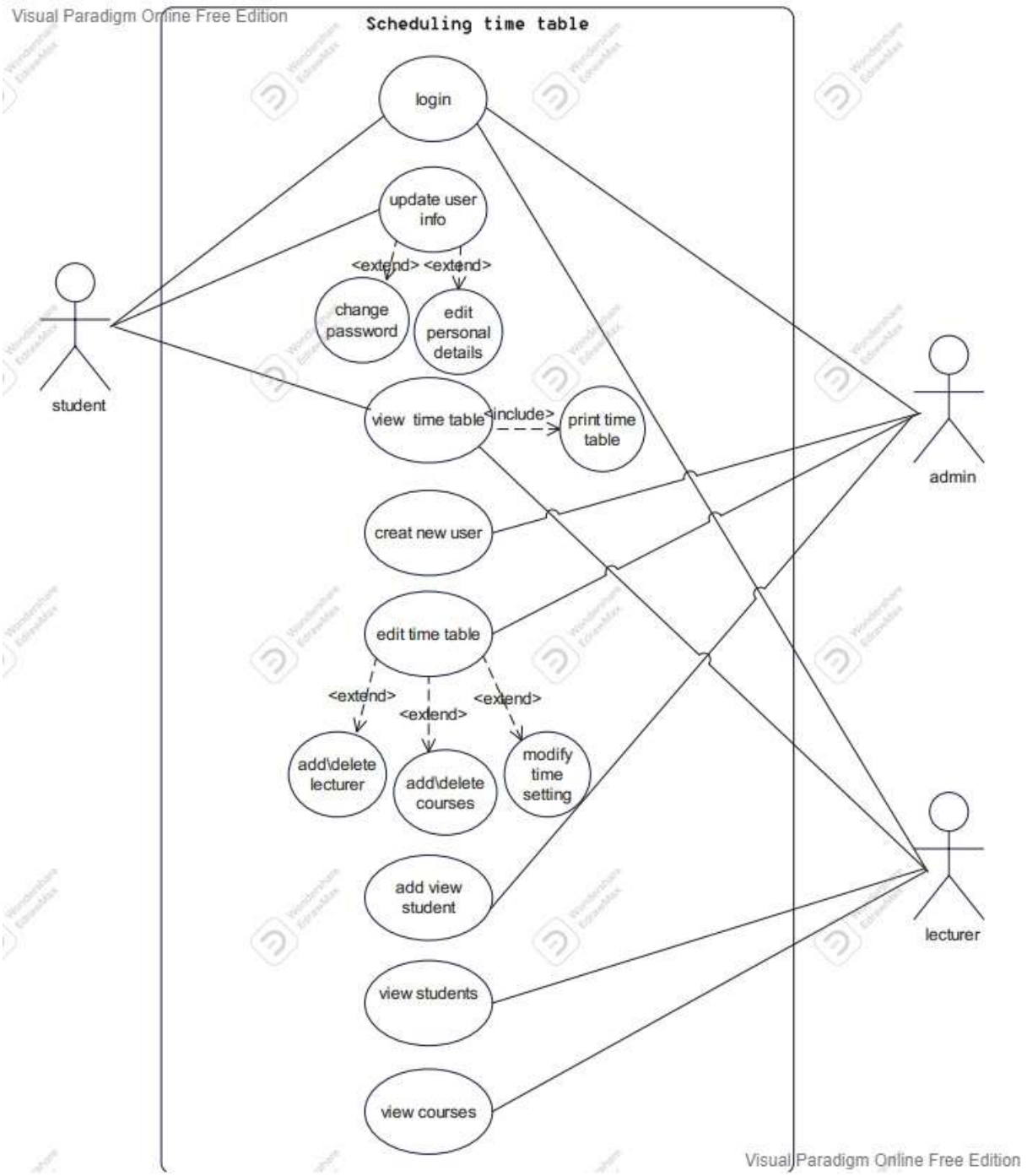
Different kinds of courses are handled differently in scheduling a timetable. For example, major core courses should not overlap one another. A course usually consists of lectures of two or three hours per week . Lecture time which lasts more than two hours is usually split into two sessions, one of one hour and one of two hours.

Several constraints have to be considered. For example,

- Different sessions are habitually assigned to different weekdays. Consecutive sessions should be allocated with the same place.
- Only one course is allowed at one period in one classroom. Tutorial time cannot coincide with lecture time .
- Student quotas tell the maximum numbers of students taking the courses. They are used in allocating classrooms since we always want to optimise our resources.
- Class sizes of tutorials are usually much smaller than that of lectures. Thus, smaller classrooms are assigned to tutorials.
- The availability of teachers is also our concern.
- Sessions taught by the same teacher must not overlap one another. Certain periods might not be available for some courses because some teacher might only be able to teach at some specific time
- Every department then sends its drafted timetable to the central administration for the allocation of classrooms. If any conflict arises, rearrangement of sessions of courses will be conducted until the designated number of periods and appropriate places are allocated to all the courses .

A complete timetable is represented by a list, each element of which is a structure that represents a single course. The structure contains course code, teacher name, session pattern, teaching periods, corresponding classrooms, course quota and a list of invalid periods. A session pattern specifies the order of single and double periods.

2. Main Functionalities



Description of the function in the use case :-

1-log in

-This function will log in a user based on a username and password being matched in a MySQL database.

-This function is shared by the three Actor Admin, Student and Lecturer

2-update user info

-This function allows the user to change the password or modify personal information

-This function is available to the student

-It is optional between change password, edit personal details

3-view time table

-This function is shared between the student and the lecturer, and its work is that it displays the time table and shows a second function to print the time table

4-creat new user

-This function is available to the admin and its work is to create a new user in the system

5- Edit time table

-The admin adjusts the student's schedule

- it is optional between Add or delete lectures or add and delete the course itself or update the dates

6- add view student

-The admin allows the student to see on the site what is available to him of grades,

details and information

7-view students

-The lecturer is allowed to see the students who registered the courses with him

in which class they were

their academic status and some information about them

8-view courses

It allows the lecturer to see the existing courses whether he taught them or another lecturer teaches them

3.Applications

EduSys (A comlete solution for institutions)

URL Link : Auto Timetable Generator (2022) - Scheduling Software Free Demo, Price, Features, Review (edusys.co)

Timetable Pro

URL Link : TimeTable Pro - Download (softonic.com)

Timetable Pro is an application that is useful for creating and managing timetable for lectures and lessons. It has basic functionalities that allow users to input a list of classrooms, teachers and subjects. It will then set a link between the subject workloads and teachers. This application allows for automatic or manual generation of timetable that can be exported in Excel for printing

FET

URL LINK : FET - Download (softonic.com)

Designed to be an administrative tool for schools and universities, FET has numerous functionalities for fast and efficient scheduling of timetables.

It allows for both automatic and manual generation of timetables that can aid in organizing students, teachers and rooms. When making timetables, this software provides a flexible students structure, organizing them into groups, subgroups and year levels. It also has flexible selections for space and time constraints. However, it does not provide a step-by-step guide on how to use it

ASC Timetables

URL Link : [aSc TimeTables - School Scheduling. Best timetable software to create school timetable.]

Another comprehensive scheduling tool with a free version is ASC Timetables. Among its prominent features are automatic timetable generation with the option for manual adjustment and a powerful algorithm that can quickly check for any conflict in schedules. It also has a simple interface with a simple data entry procedure. With one click, you could publish and share the schedule with students and teachers on their smartphones or other mobile devices

Wise Timetable

URL Link : [Wise Timetable: Complete scheduling solution (wtimetable.com)]

Even large and complex timetables can easily be handled using Wise Timetable. One of the formidable features of this software is its automatic or manual multiple-week course scheduling. This feature is especially useful for colleges and universities to ensure that there will be no conflicts in the schedules for teachers and students. It

also allows for Web access and Web-sharing of completed timetables.

Prime Timetable

URL Link : School scheduling software for Mac, PC, tablet and phone - Prime Timetable

Prime Timetable is a comprehensive application with numerous capabilities that can be useful for effective scheduling, such as automatic timetable generation and customized cards which let you choose your preferred text, color, borders and text position for your timetable.

Once your timetable is done, it also allows you to share it with colleagues and teachers with pre-assigned privileges.

Mimosa Scheduling Software

URL Link : Mimosa Scheduling Software Free Edition - Free download and software reviews - CNET Download

Regardless of the type and size of your school or university, Mimosa Scheduling Software can handle the scheduling task for you. This application has an intuitive and user-friendly interface which allows you to make timetables with ease. It has an enormous capacity to create and manage up to 300,000 timetables. It can also be used by several school departments whose schedules can be later merged into a network. Best of all, if you purchase the premium version of this application, you are entitled to free lifetime software updates.

Lantiv Scheduling Studio 7

URL Link : SCHEDULING STUDIO™ 2023: Course Scheduling Software | College Scheduling Software | University Scheduling Software | Course Scheduling System | Academic Scheduler | Online Education Scheduling (lantiv.com)

Lantic Scheduling Studio 7 has numerous useful features for quick and efficient scheduling. It allows for the creation of groups and subgroups for proper hierarchy of activities. Even subjects can also be grouped into different hierarchies for easy reference.

Additionally, this software has features that let you define room capacity as well as distances between school buildings and rooms. These features and many others allow users to make detailed timetables that can be used as a guide for students and faculty

Time Tabler

URL Link : Page not found - TimeTabler

Time Tabler is a powerful tool that can help you in scheduling teachers. It can be used to schedule part-time teachers, schedule staggered breaks, set consortium days, and manage school events. One of its special features is its self-checking capability which is useful for avoiding conflicting schedules. For instance, it will not allow you to book one teacher in different classes at one time. Actual scheduling can be done automatically, manually or with a

combination of both. It also features FIT which gives you other options if your schedule won't fit into an existing one.

4.Literature

1. **Branimir Sigl, Marin Golub, Vedran Mornar Faculty of Electrical Engineering and Computing, University of Zagreb Unska 3, 10000 Zagreb, Croatia**

Abstract. In this paper a genetic algorithm for solving timetable scheduling problem is described. The algorithm was tested on small and large instances of the problem. Algorithm performance was significantly enhanced with modification of basic genetic operators, which restrain the creation of new conflicts in the individual.

2. **Applying Constraint Satisfaction Technique in University Timetable Scheduling**

document (psu.edu)

Abstract Planning and scheduling are often NP-complete problems. There have been different approaches to tackle these problems. With the emergence of constraint logic programming, the constraint satisfaction approach has started to attract attention due to its effectness in solving these real-life problems. In this paper, we report our experience of applying constraint logic programming to fully automate the time table scheduling process in our faculty, which has been a tedious task for the administration. The system consists of a core for scheduling as well as an X-window user interface. Implemented in CHIP,

the system consists of 1500 lines of codes, 80% of which are an X-window user interface. The system is able to produce a time table for the whole faculty in just a few seconds. Our experience shows that applying constraint logic programming is a practical viable means for time table scheduling in a university

3. **SUBMITTED TO COMPUTATIONAL OPTIMIZATION AND APPLICATIONS JOURNAL A GENETIC ALGORITHM TO SOLVE THE TIMETABLE PROBLEM**
   download-with-cover-page-v2.pdf (d1wqtxts1xzle7.cloudfront.net)

Abstract : In this paper we present the results of an investigation of the possibilities offered by genetic algorithms to solve the timetable problem. This problem has been chosen since it is representative of the class of multi-constrained, NP-hard, combinatorial optimization problems with real-world application. First we present our model, including the definition of a hierarchical structure for the objective function and the generalized genetic operators which can be applied to matrices representing timetables. Then we report about the outcomes of the utilization of the implemented system to the specific case of the generation of a school timetable. We compare two versions of the genetic algorithm (GA), with and without local search, both to a handmade timetable and to two other approaches based on simulated annealing and tabu search. Our results show that GA with local search and tabu search with relaxation both outperform simulated annealing and handmade timetables.

4. International Journal of Research in Industrial Engineering

Link for article : International Journal of Research in Industrial Engineering - Articles List (riejournal.com)

A B S T R A C T : This paper considers the problem of university course timetabling. In this problem, there are a set of courses, lecturers and classrooms. The objective is to assign schedule courses so as to maximize the total preference of lecturer-course, lecturer-day and course-day. The paper first formulates the problem in form of linear integer programming model. Using the model and commercial software, the small sized instances are optimally solved. Then, the paper proposes three different algorithms based on imperialist competitive algorithm, simulated annealing and variable neighborhood search. The algorithms employ several novel procedures such as encoding scheme, move operator, crossing operators. The algorithms are tuned and evaluated with optimal solutions found by the model. Then, they are evaluated by comparing their performance. The results show that imperialist competitive algorithm outperforms the other algorithms.

5.Algorithm Details

Genetic algorithms are adaptive systems inspired by natural evolution. They can be used as techniques for solving complex problems and for searching of large problem spaces.

Genetic algorithms are belonging to guided random search techniques, which try to find the global optimum.

The power of genetic algorithms and other similar techniques (simulated annealing, evolutionary strategies) lies in the fact that they are capable to find global optimum in multi-modal spaces (spaces with many local optimums).

Classical gradient methods will always gravitate from starting position to some local optimum, which could also be global, but it can not be determined for certain.

Genetic algorithms are working with the set of potential solutions, which is called population. Each solution item (individual) is measured by fitness function. The fitness value represents the quality measure of an individual, so the algorithm can select individuals with better genetic material for producing new individuals and further generations.

The simulation of evolution allows survival of better individuals and extinction of inferior ones.

- Evolution's goal is to find better individuals in each generation. The process of evolution is maintained by selection, crossover and mutation. In terms of genetic algorithms those processes are called genetic operators.

- The selection chooses superior individuals in every generation and assures that inferior individuals extinct.

- The crossover operator chooses two individuals from current population (parents) and creates a new individual (child) based on parents' genetic material. Selection and crossover operators will expand good features of superior individuals through the whole population. They will also direct the search process towards a local optimum.

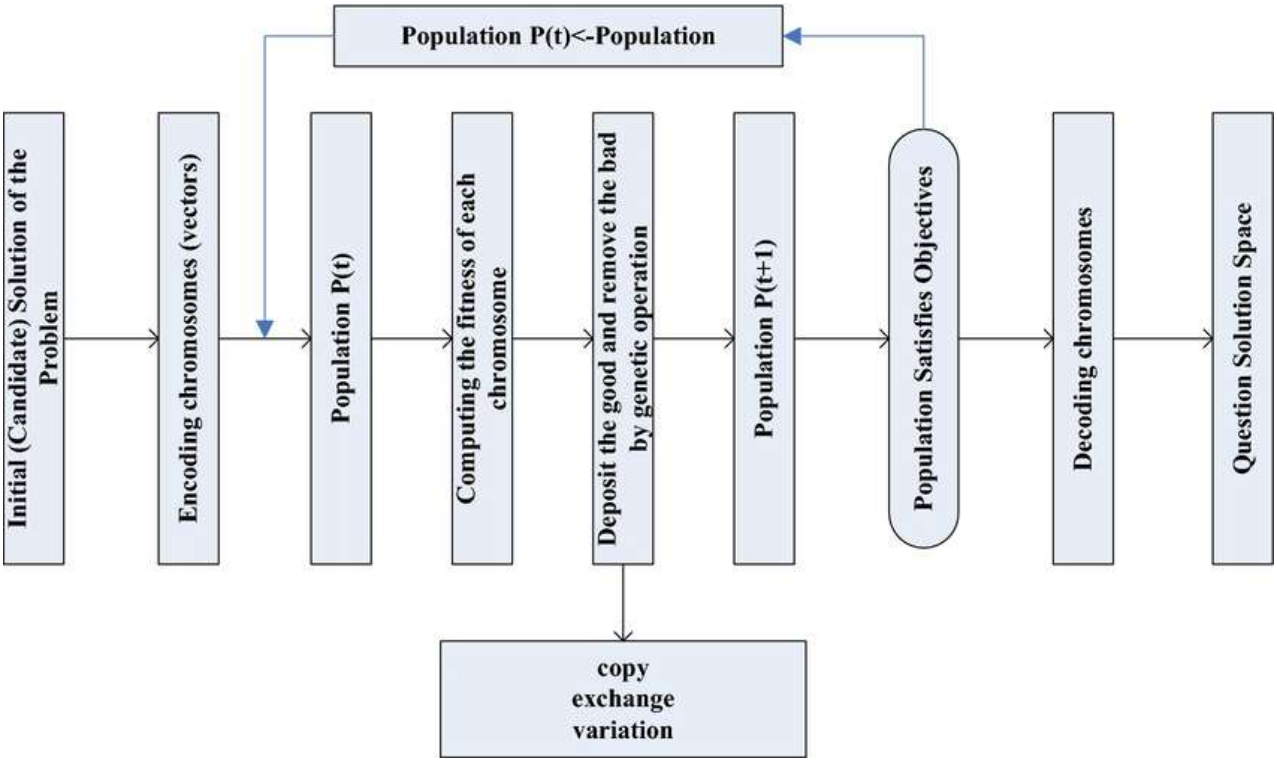
- The mutation operator changes the value of some genes in an individual and helps to search other parts of problem space

- In the algorithm presented here, each individual in the population represents one timetable. The algorithm starts from an infeasible timetable, and tries to get the feasible one

A Block diagram

to represent

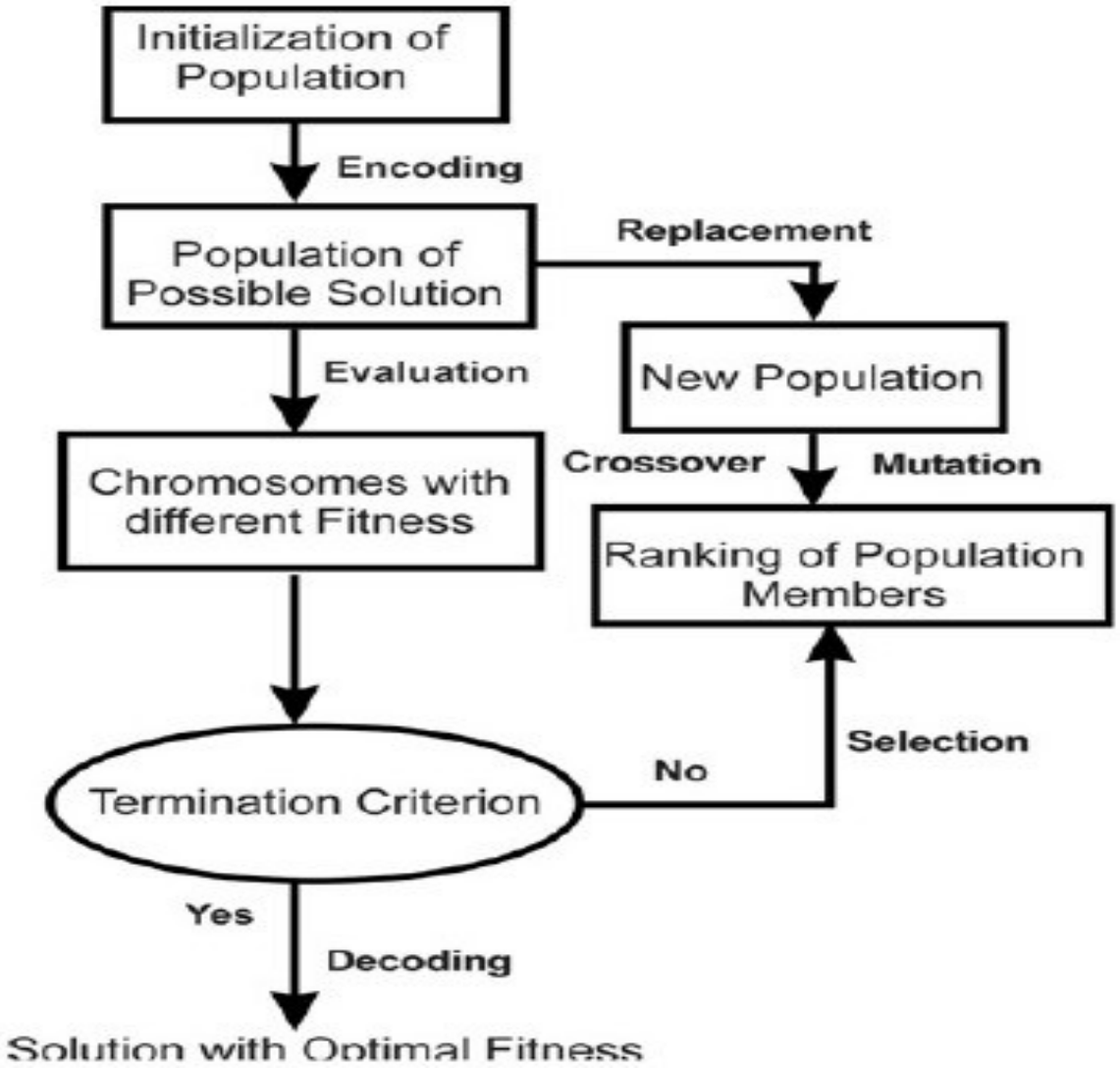
the genetic algorithm



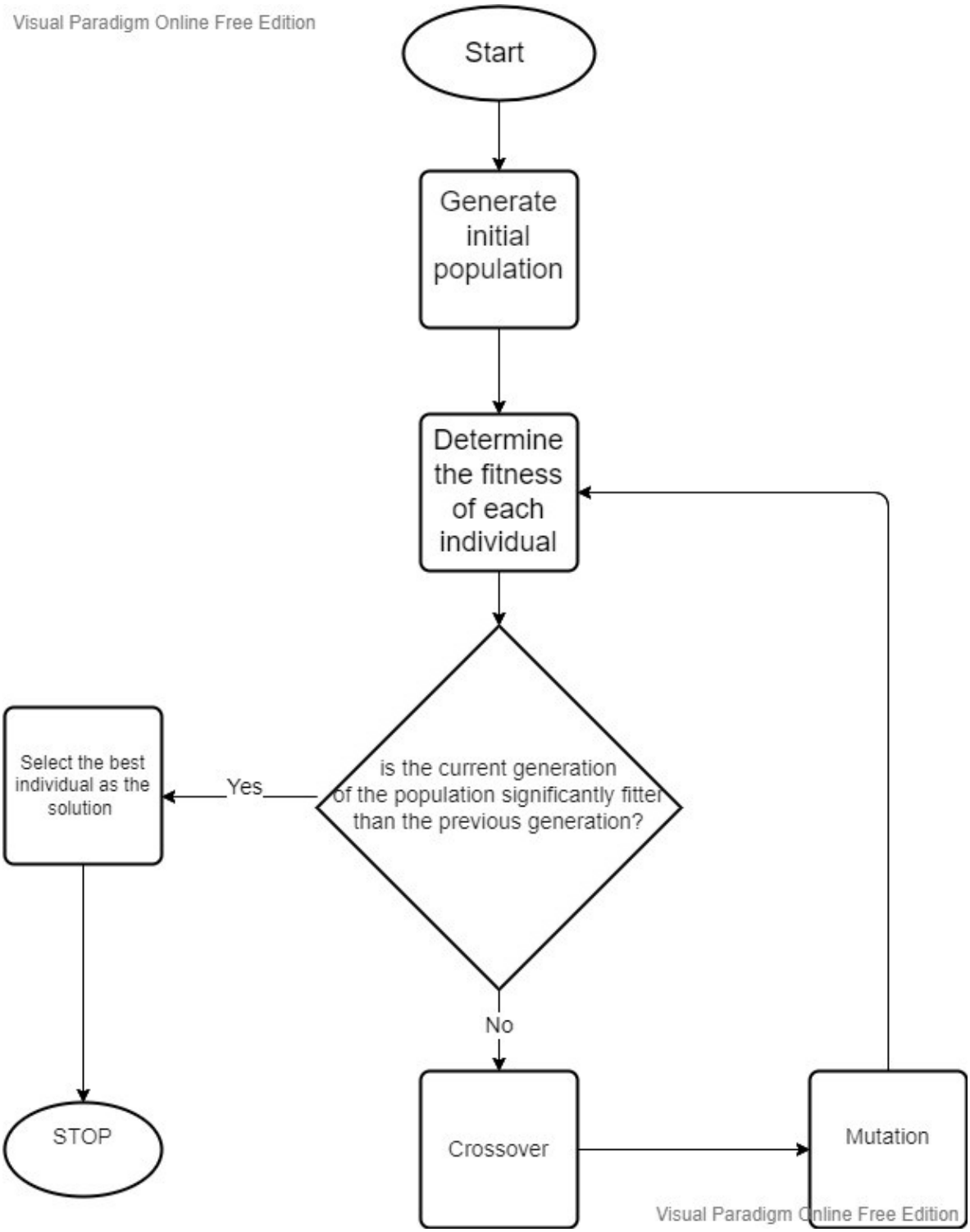
A Block diagram

to represent

the genetic algorithm



A Flowchart to represent the genetic algorithm



Analysis Disscusion And Future Work

Advantages :

- It helps to create a timetable in the very best output to facilitate students time management in campus .

Disadvantages :

- It doesnot apply the optimal but only the best output schedule .

The algorithm behaved very well in the timetable generation , the future modification will be adjusting the code to afford more inputs and adjust the gui output trying to improve the program more and more .

Plots No results : There was no dataset for testing used so no plot diagrams

Here are some insights about the project :

Class #	Dept	Course(number , max # of students)	Room (Capacity)	Instructor	TimeAvilable
0	MATH	325K (C1, 25)	R3 (70)	Dr.Mohamed (I2)	12:00 to 2:00 (Mt2)
1	MATH	462K (C3, 25)	R1 (50)	Dr. Ahmed (I1)	10:00 to 12:00 (Mt1)
2	EE	319K (C2, 35)	R2 (88)	Dr. Ahmed (I1)	12:00 to 2:00 (Mt2)
3	EE	464K (C4, 30)	R3 (70)	Dr.Taha (I4)	10:00 to 12:00 (Mt1)
4	EE	360C (C5, 35)	R1 (50)	Dr.Taha (I4)	12:00 to 2:00 (Mt2)
5	PHY	303K (C6, 45)	R2 (88)	Dr.Mostafa (I3)	10:00 to 12:00 (Mt1)
6	PHY	303L (C7, 45)	R1 (50)	Dr.Taha (I4)	2:00 to 4:00 (Mt3)

schedule #	fitness	# of conflicts	classes[dept,class,room,instructor]
0	0.5	1	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt3},{PHY,C7,R1,I4,Mt3},
1	0.333	2	{MATH,C1,R2,I2,Mt3},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt3},{PHY,C7,R1,I4,Mt3},
2	0.25	3	{MATH,C1,R3,I2,Mt2},{MATH,C3,R3,I1,Mt2},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I3,Mt3},{EE,C5,R3,I4,Mt3},{PHY,C6,R1,I3,Mt2},{PHY,C7,R2,I4,Mt1},
3	0.25	3	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I1,Mt1},{EE,C2,R3,I3,Mt3},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt3},{PHY,C7,R1,I4,Mt3},
4	0.25	3	{MATH,C1,R2,I1,Mt1},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I2,Mt3},{EE,C4,R3,I3,Mt2},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt2},{PHY,C7,R2,I4,Mt1},
5	0.25	3	{MATH,C1,R3,I2,Mt2},{MATH,C3,R3,I2,Mt2},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt3},{PHY,C7,R1,I4,Mt3},
6	0.2	4	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I1,Mt2},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I3,Mt2},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt3},{PHY,C7,R2,I4,Mt1},
7	0.2	4	{MATH,C1,R3,I2,Mt2},{MATH,C3,R3,I2,Mt2},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt3},{PHY,C7,R3,I4,Mt2},
8	0.167	5	{MATH,C1,R3,I1,Mt3},{MATH,C3,R3,I1,Mt2},{EE,C2,R3,I3,Mt3},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt3},{PHY,C7,R1,I4,Mt3},
9	0.143	6	{MATH,C1,R2,I1,Mt2},{MATH,C3,R3,I1,Mt2},{EE,C2,R1,I1,Mt3},{EE,C4,R3,I3,Mt2},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt2},{PHY,C7,R1,I4,Mt3},

schedule #	fitness	# of conflicts	classes[dept,class,room,instructor]
0	0.5	1	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt3},{PHY,C7,R1,I4,Mt3},
1	0.5	1	{MATH,C1,R3,I1,Mt2},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I2,Mt1},{EE,C4,R3,I3,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R1,I3,Mt2},{PHY,C7,R1,I4,Mt3},
2	0.5	1	{MATH,C1,R3,I2,Mt2},{MATH,C3,R2,I1,Mt3},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R1,I3,Mt2},{PHY,C7,R1,I4,Mt3},
3	0.5	1	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt3},{PHY,C7,R1,I4,Mt3},
4	0.333	2	{MATH,C1,R3,I2,Mt3},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt1},{PHY,C7,R1,I4,Mt3},
5	0.333	2	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I1,Mt1},{EE,C2,R1,I3,Mt3},{EE,C4,R3,I3,Mt1},{EE,C5,R1,I4,Mt2},{PHY,C6,R2,I1,Mt1},{PHY,C7,R1,I4,Mt1},
6	0.333	2	{MATH,C1,R3,I2,Mt3},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt1},{PHY,C7,R2,I4,Mt2},
7	0.333	2	{MATH,C1,R3,I2,Mt3},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt1},{PHY,C7,R1,I4,Mt3},
8	0.25	3	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I2,Mt2},{EE,C2,R2,I2,Mt1},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R1,I3,Mt2},{PHY,C7,R1,I4,Mt3},
9	0.167	5	{MATH,C1,R2,I2,Mt1},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I2,Mt1},{EE,C4,R2,I3,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt3},{PHY,C7,R1,I4,Mt3},

schedule #	fitness	# of conflicts	classes[dept,class,room,instructor]
0	1.0	0	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R1,I4,Mt2},{PHY,C6,R2,I3,Mt1},{PHY,C7,R1,I4,Mt3},
1	0.5	1	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt3},{PHY,C7,R1,I4,Mt3},
2	0.333	2	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I1,Mt2},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt1},{PHY,C7,R1,I4,Mt3},
3	0.333	2	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R1,I4,Mt2},{PHY,C6,R2,I3,Mt1},{PHY,C7,R1,I4,Mt1},
4	0.333	2	{MATH,C1,R3,I2,Mt3},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt1},{PHY,C7,R1,I4,Mt3},
5	0.25	3	{MATH,C1,R3,I2,Mt2},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R1,I4,Mt2},{PHY,C6,R2,I1,Mt1},{PHY,C7,R1,I4,Mt1},
6	0.25	3	{MATH,C1,R3,I2,Mt3},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I2,Mt1},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt1},{PHY,C7,R1,I4,Mt3},
7	0.2	4	{MATH,C1,R3,I2,Mt3},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I1,Mt1},{PHY,C7,R1,I4,Mt1},
8	0.167	5	{MATH,C1,R3,I1,Mt3},{MATH,C3,R3,I2,Mt2},{EE,C2,R2,I2,Mt1},{EE,C4,R2,I3,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I3,Mt1},{PHY,C7,R3,I4,Mt1},
9	0.143	6	{MATH,C1,R3,I1,Mt1},{MATH,C3,R1,I1,Mt1},{EE,C2,R2,I1,Mt2},{EE,C4,R3,I4,Mt1},{EE,C5,R3,I4,Mt3},{PHY,C6,R2,I1,Mt2},{PHY,C7,R2,I4,Mt2},

```
input number of rooms3
R1
50
R2
88
R3
70
input number of Meetings3
Mt1
10:00 to 12:00
Mt2
12:00 to 2:00
Mt3
2:00 to 4:00
input number of Instructors4
I1
Dr. Ahmed
I2
Dr.Mohamed
I3
Dr.Mostafa
I4
Dr.Taha
```

Thank You