ARTIFICIAL INTELLIGENCE

SEMESTER PROJECT - PHASE I

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Submitted to:

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Exams Schedule Generator Using Genetic Algorithm

Introduction:

The project aims to develop a scheduling solution for universities using Genetic Algorithm (GA), focusing on efficiently allocating exams while adhering to various constraints. By leveraging Python along with Pandas and NumPy libraries, the system reads data from provided Excel files, formulates schedules from scratch, and evaluates solutions through rigorous constraint checks. Through the application of GA principles like roulette wheel selection, crossover, and mutation, the algorithm optimizes exam schedules, ensuring compliance with hard constraints such as exam scheduling, student enrollment, teacher invigilation, and soft constraints like break times and consecutive exams. The report will comprehensively detail the algorithm's components, rationale behind chosen techniques, and demonstrate fulfillment of constraints through fitness values and output presentation.

Implementation:

- Objective: "The project aims to generate a university schedule using a Genetic Algorithm (GA)."

- ***Data Input:***

  - ✓ Utilizes CSV files (courses.csv, studentCourse.csv, studentNames.csv, Teachers.csv) to read course, student, and teacher information.

- Algorithm Overview:

- ***Initialization:***

  - ✓ Initializes classes for courses, students, and teachers.
  - ✓ Generates a population of exam schedules by randomly assigning time slots to courses while ensuring no conflicts.

- ***Fitness Evaluation:***

  - ✓ Defines a fitness function that assesses the feasibility of each schedule based on both hard and soft constraints.

- ***Genetic Operations:***

  - ✓ **Selection**: Implements roulette wheel selection to choose potential solutions for crossover.
  - ✓ **Crossover**: Utilizes single-point crossover to exchange genetic material between parent schedules.
  - ✓ **Mutation:** Introduces random mutations in schedules to enhance diversity.

- ***Constraint Checking:***

  - ✓ Validates hard constraints such as exam scheduling, teacher invigilation, and timing restrictions.
  - ✓ Checks soft constraints including breaks for students and teachers, consecutive exams, and preference for course order.

- ***Implementation:***

  - ✓ Executes the GA over multiple generations, evaluating fitness and evolving schedules.

- ***Input:***

Dataset we used:

Files	***Data***
Courses.csv	Course code, Course name
'studentCourse.csv	Student name, Course code
studentNames.csv	Students' names
Teachers.csv	Teacher's name

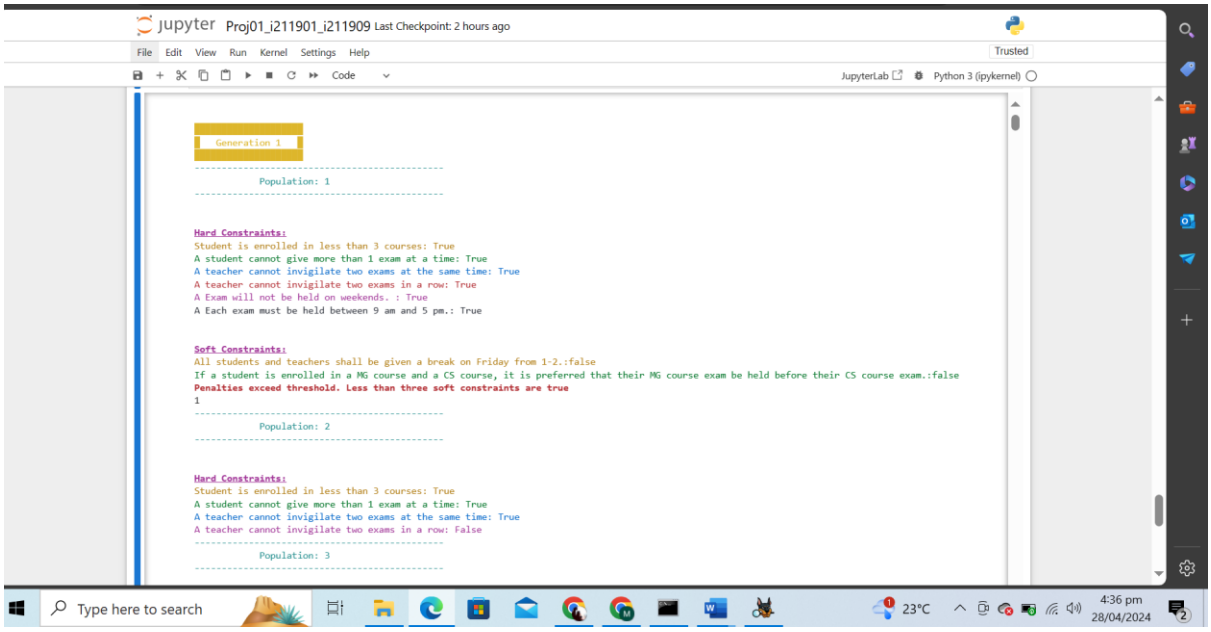
```python
#Libraries we used in our code
import pandas as pd
import numpy as np
import random

# Read input CSV files (given)
courses_df = pd.read_csv('courses.csv')
student_course_df = pd.read_csv('studentCourse.csv')
student_name_df = pd.read_csv('studentNames.csv')
teachers_df = pd.read_csv('Teachers.csv')

# Assume the following parameters for the sake of the example
NUM_WEEKS = 3
NUM_DAYS_PER_WEEK = 5
NUM_HOURS_PER_DAY = 4
NUM_CLASSROOMS = 30
POPULATION_SIZE = 10
NUM_GENERATIONS = 30
CROSSOVER_RATE = 0.7
MUTATION_RATE = 0.9
```

- ***Output:***

  - ✓ Presents the best schedule achieved, detailing teacher and student schedules in tabular format.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Code
JupyterLab Python 3 (ipykernel)
Generation 1
Population: 1
Hard Constraints:
Student is enrolled in less than 3 courses: True
A student cannot give more than 1 exam at a time: True
A teacher cannot invigilate two exams at the same time: True
A teacher cannot invigilate two exams in a row: True
A Exam will not be held on weekends. : True
A Each exam must be held between 9 am and 5 pm.: True
Soft Constraints:
All students and teachers shall be given a break on Friday from 1-2.:false
If a student is enrolled in a MG course and a CS course, it is preferred that their MG course exam be held before their CS course exam.:false
Penalties exceed threshold. Less than three soft constraints are true
1
Population: 2
Hard Constraints:
Student is enrolled in less than 3 courses: True
A student cannot give more than 1 exam at a time: True
A teacher cannot invigilate two exams at the same time: True
A teacher cannot invigilate two exams in a row: False
Population: 3
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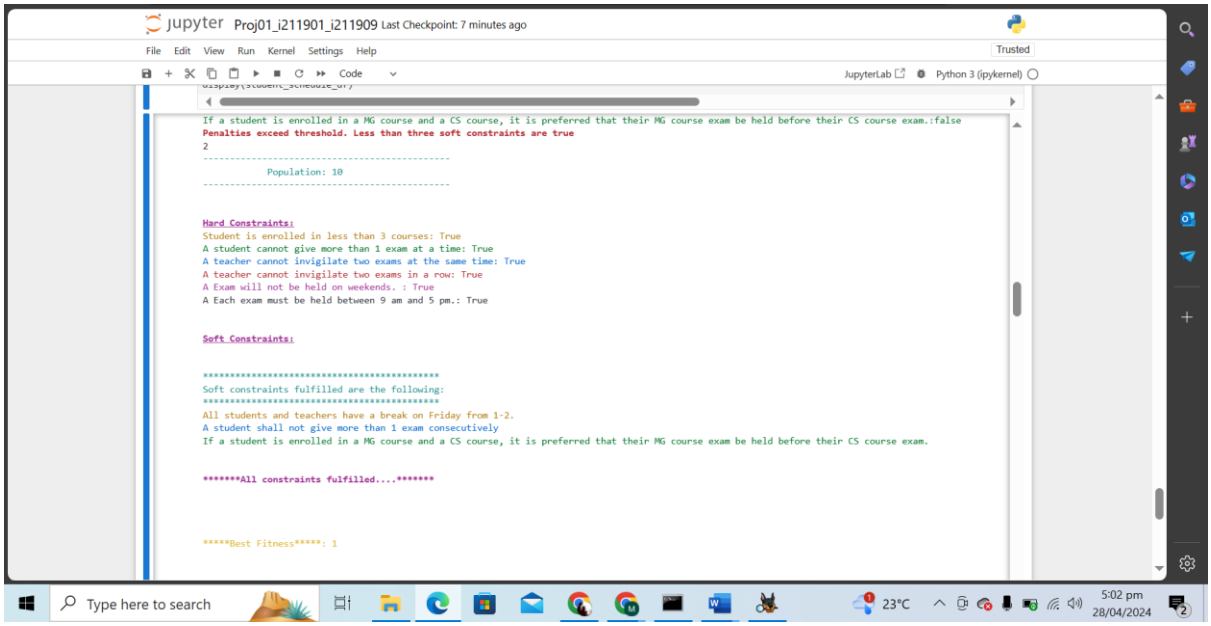
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Code
JupyterLab Python 3 (ipykernel)
If a student is enrolled in a MG course and a CS course, it is preferred that their MG course exam be held before their CS course exam.:false
Penalties exceed threshold. Less than three soft constraints are true
2
Population: 10
Hard Constraints:
Student is enrolled in less than 3 courses: True
A student cannot give more than 1 exam at a time: True
A teacher cannot invigilate two exams at the same time: True
A teacher cannot invigilate two exams in a row: True
A Exam will not be held on weekends. : True
A Each exam must be held between 9 am and 5 pm.: True
Soft Constraints:
****
Soft constraints fulfilled are the following:
****
All students and teachers have a break on Friday from 1-2.
A student shall not give more than 1 exam consecutively
If a student is enrolled in a MG course and a CS course, it is preferred that their MG course exam be held before their CS course exam.
*******All constraints fulfilled....*******
*****Best Fitness*****: 1
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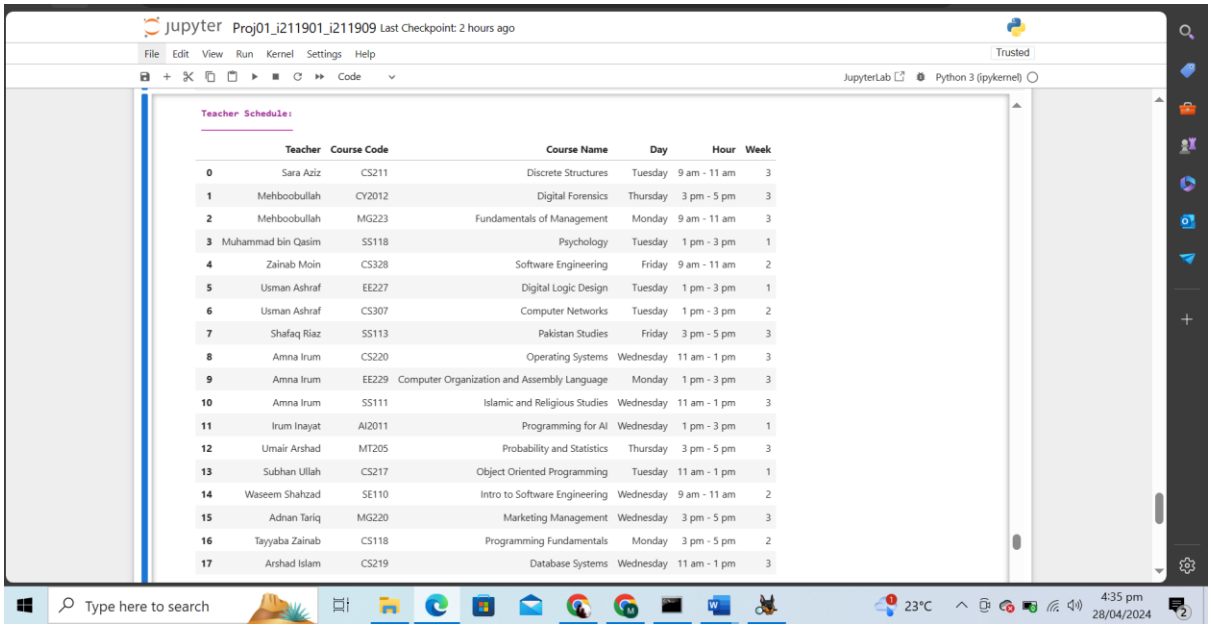
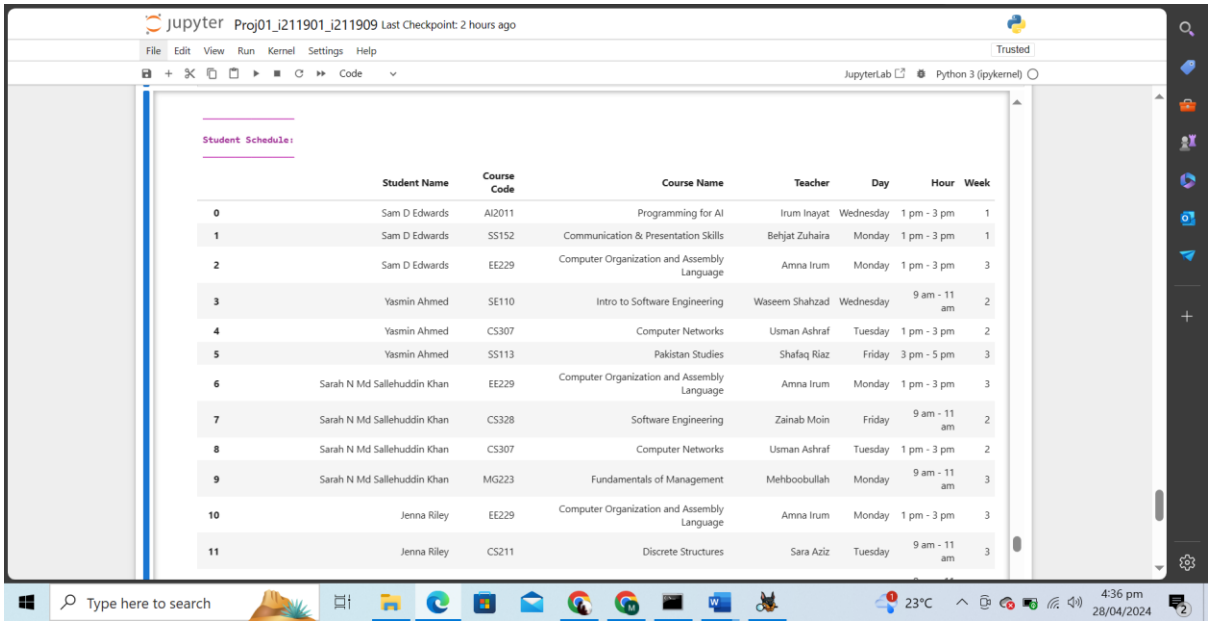


	Teacher	Course Code	Course Name	Day	Hour	Week
0	Sara Aziz	CS211	Discrete Structures	Tuesday	9 am - 11 am	3
1	Mehboobullah	CY2012	Digital Forensics	Thursday	3 pm - 5 pm	3
2	Mehboobullah	MG223	Fundamentals of Management	Monday	9 am - 11 am	3
3	Muhammad bin Qasim	SS118	Psychology	Tuesday	1 pm - 3 pm	1
4	Zainab Moin	CS328	Software Engineering	Friday	9 am - 11 am	2
5	Usman Ashraf	EE227	Digital Logic Design	Tuesday	1 pm - 3 pm	1
6	Usman Ashraf	CS307	Computer Networks	Tuesday	1 pm - 3 pm	2
7	Shafaq Riaz	SS113	Pakistan Studies	Friday	3 pm - 5 pm	3
8	Amna Irum	CS220	Operating Systems	Wednesday	11 am - 1 pm	3
9	Amna Irum	EE229	Computer Organization and Assembly Language	Monday	1 pm - 3 pm	3
10	Amna Irum	SS111	Islamic and Religious Studies	Wednesday	11 am - 1 pm	3
11	Irum Inayat	AI2011	Programming for AI	Wednesday	1 pm - 3 pm	1
12	Umair Arshad	MT205	Probability and Statistics	Thursday	3 pm - 5 pm	3
13	Subhan Ullah	CS217	Object Oriented Programming	Tuesday	11 am - 1 pm	1
14	Waseem Shahzad	SE110	Intro to Software Engineering	Wednesday	9 am - 11 am	2
15	Adnan Tariq	MG220	Marketing Management	Wednesday	3 pm - 5 pm	3
16	Tayyaba Zainab	CS118	Programming Fundamentals	Monday	3 pm - 5 pm	2
17	Arshad Islam	CS219	Database Systems	Wednesday	11 am - 1 pm	3



	Student Name	Course Code	Course Name	Teacher	Day	Hour	Week
0	Sam D Edwards	AI2011	Programming for AI	Irum Inayat	Wednesday	1 pm - 3 pm	1
1	Sam D Edwards	SS152	Communication & Presentation Skills	Behjat Zuhaira	Monday	1 pm - 3 pm	1
2	Sam D Edwards	EE229	Computer Organization and Assembly Language	Amna Irum	Monday	1 pm - 3 pm	3
3	Yasmin Ahmed	SE110	Intro to Software Engineering	Waseem Shahzad	Wednesday	9 am - 11 am	2
4	Yasmin Ahmed	CS307	Computer Networks	Usman Ashraf	Tuesday	1 pm - 3 pm	2
5	Yasmin Ahmed	SS113	Pakistan Studies	Shafaq Riaz	Friday	3 pm - 5 pm	3
6	Sarah N Md Sallehuddin Khan	EE229	Computer Organization and Assembly Language	Amna Irum	Monday	1 pm - 3 pm	3
7	Sarah N Md Sallehuddin Khan	CS328	Software Engineering	Zainab Moin	Friday	9 am - 11 am	2
8	Sarah N Md Sallehuddin Khan	CS307	Computer Networks	Usman Ashraf	Tuesday	1 pm - 3 pm	2
9	Sarah N Md Sallehuddin Khan	MG223	Fundamentals of Management	Mehboobullah	Monday	9 am - 11 am	3
10	Jenna Riley	EE229	Computer Organization and Assembly Language	Amna Irum	Monday	1 pm - 3 pm	3
11	Jenna Riley	CS211	Discrete Structures	Sara Aziz	Tuesday	9 am - 11 am	3

- ***Evaluation:***

  - ✓ Monitors the fulfillment of constraints and optimizes soft constraints to a certain extent.

- ***Conclusion:***

  - ✓ The GA successfully generates a university schedule that satisfies all hard constraints and optimizes soft constraints, contributing to efficient resource allocation and scheduling management.

Summary:

The project is to use a Genetic Algorithm (GA) to develop a university scheduling system with the goal of meeting both hard and soft constraints. The solution is written entirely in Python and only makes use of the Pandas and NumPy modules. It reads data from supplied Excel files. Exam scheduling for every course, guaranteeing that students are enrolled in a minimum of three courses, and preventing exam overlaps are examples of hard limitations. Soft limitations include things like student preference for exam sequencing and break periods. The GA iteratively optimizes schedules using crossover, mutation, and roulette wheel selection procedures. A chromosome that satisfies constraints and displays fulfilled constraints, together with fitness values at each iteration, are included in the result.

THE END....