REPORT

BASIC IMPLEMENTATION:

- Classes have been created for Exam, Courses and Registration
- Instance of each Exam has been encoded into binary which includes all data members of Exam class represented by six bits
- A unique number is associated to each data-member and that is converted to binary

MAIN Function:

- Reads the csv files and stores data into array
- Randomly generates population size (range = 50-150) and crossover (range = 0.3-1) and mutation probabilities (range = 0.0-0.5)
- Calls function "RunGA"

RUNGA Function:

- Randomly generates population of size and calculates its fitness
- After this a while loop is initiated
- Population is sent to crossover function which returns a new population of double size
- Roulette wheel selection selects individuals from the new population
- While loop terminates when all conditions are fulfilled

APPLY_CROSSOVER Function:

- Performs one-point crossover from the center and applies mutation on the whole population inside a while loop
- Appends already created population with crossover children
- Returns the new population of size = population_size*2 back to RunGA

APPLY_MUTATION Function:

- Randomly replaces a gene inside chromosome
- This gene is a randomly generated schedule of an exam

ROULETTE_WHEEL_SELECTION Function:

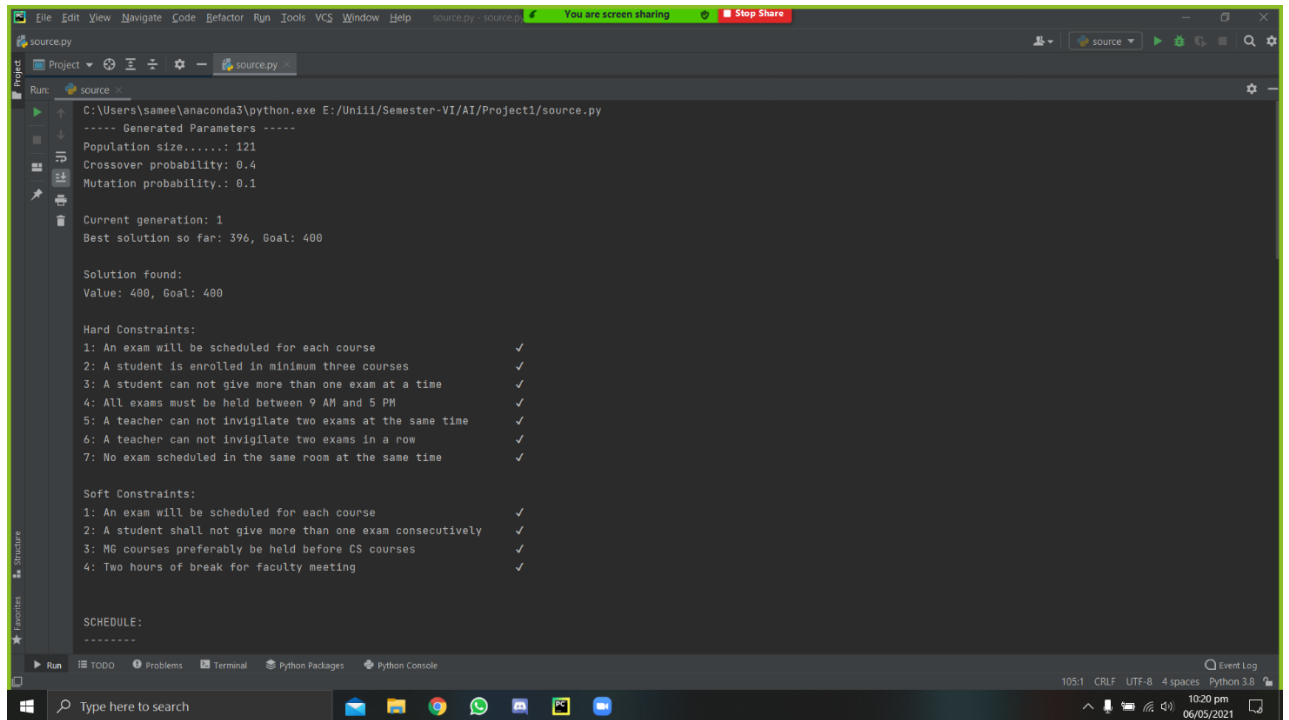- Selects individuals from new population to generate a population of size = population_size
- These individuals are selected by roulette wheel selection

CALCULATE_FITNESS Function:

- This function checks all the hard and soft constraints
- The fitness is calculated out of 400
- Functions are individually implemented for each hard and soft constraint that are called inside this function

SCREENSHOTS

Output 1:


```
C:\Users\samee\anaconda3\python.exe E:/Uni11/Semester-VI/AI/Project1/source.py
----- Generated Parameters -----
Population size......: 121
Crossover probability: 0.4
Mutation probability.: 0.1

Current generation: 1
Best solution so far: 396, Goal: 400

Solution found:
Value: 400, Goal: 400

Hard Constraints:
1: An exam will be scheduled for each course                 ✓
2: A student is enrolled in minimum three courses            ✓
3: A student can not give more than one exam at a time        ✓
4: All exams must be held between 9 AM and 5 PM              ✓
5: A teacher can not invigilate two exams at the same time    ✓
6: A teacher can not invigilate two exams in a row           ✓
7: No exam scheduled in the same room at the same time        ✓

Soft Constraints:
1: An exam will be scheduled for each course                 ✓
2: A student shall not give more than one exam consecutively  ✓
3: MG courses preferably be held before CS courses           ✓
4: Two hours of break for faculty meeting                    ✓


SCHEDULE:
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```
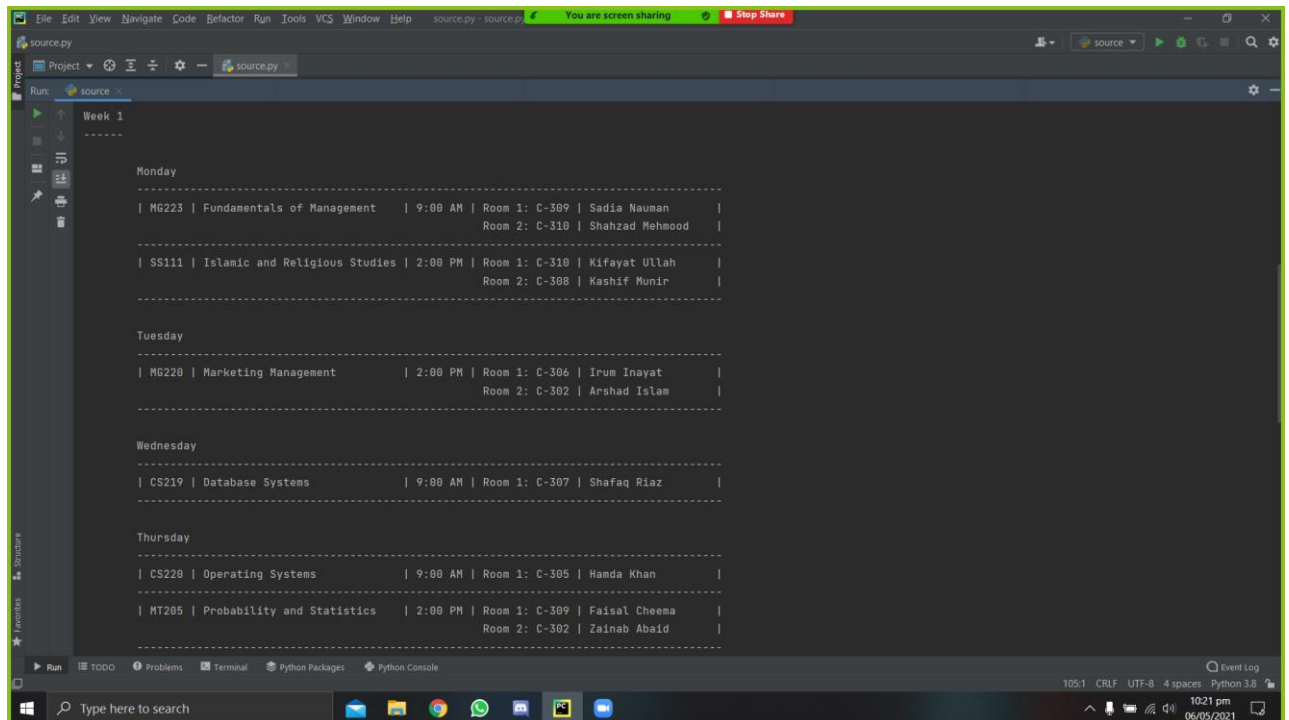


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Week 1
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    Monday
    ------------------------------------------------------------------
    | MG223 | Fundamentals of Management   | 9:00 AM | Room 1: C-309 | Sadia Nauman     |
                                                       Room 2: C-310 | Shahzad Mehmood   |
    ------------------------------------------------------------------
    | SS111 | Islamic and Religious Studies | 2:00 PM | Room 1: C-310 | Kifayat Ullah    |
                                                       Room 2: C-308 | Kashif Munir      |
    ------------------------------------------------------------------

    Tuesday
    ------------------------------------------------------------------
    | MG220 | Marketing Management         | 2:00 PM | Room 1: C-306 | Irum Inayat      |
                                                       Room 2: C-302 | Arshad Islam      |
    ------------------------------------------------------------------

    Wednesday
    ------------------------------------------------------------------
    | CS219 | Database Systems             | 9:00 AM | Room 1: C-307 | Shafaq Riaz      |
    ------------------------------------------------------------------

    Thursday
    ------------------------------------------------------------------
    | CS220 | Operating Systems            | 9:00 AM | Room 1: C-305 | Hamda Khan       |
    ------------------------------------------------------------------
    | MT205 | Probability and Statistics   | 2:00 PM | Room 1: C-309 | Faisal Cheema    |
                                                       Room 2: C-302 | Zainab Abaid      |
    ------------------------------------------------------------------
```

```
Friday
-----------------------------------------------------------------------------
| EE227 | Digital Logic Design       | 9:00 AM | Room 1: C-310 | Shoaib Mehboob   |
                                                | Room 2: C-303 | Hammad Majeed    |
-----------------------------------------------------------------------------
| SS113 | Pakistan Studies           | 2:00 PM | Room 1: C-306 | Arshad Islam     |
                                                | Room 2: C-310 | Shehreyar Rashid |
-----------------------------------------------------------------------------

Week 2
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    Monday
    -----------------------------------------------------------------------------
    | AI2011 | Programming for AI     | 2:00 PM | Room 1: C-302 | Farwa Batool     |
                                                 | Room 2: C-301 | Mehreen Alam     |
    -----------------------------------------------------------------------------

    Wednesday
    -----------------------------------------------------------------------------
    | CS218 | Data Structures         | 9:00 AM | Room 1: C-302 | Farwa Batool     |
                                                 | Room 2: C-305 | Ejaz Ahmed       |

    | DS3011 | Big Data Analytics      | 2:00 PM | Room 1: C-306 | Shahzad Mehmood  |
                                                  | Room 2: C-305 | Zohaib Iqbal     |

    Thursday
    -----------------------------------------------------------------------------
    | CS211 | Discrete Structures      | 9:00 AM | Room 1: C-303 | Zeeshan Qaiser   |
```
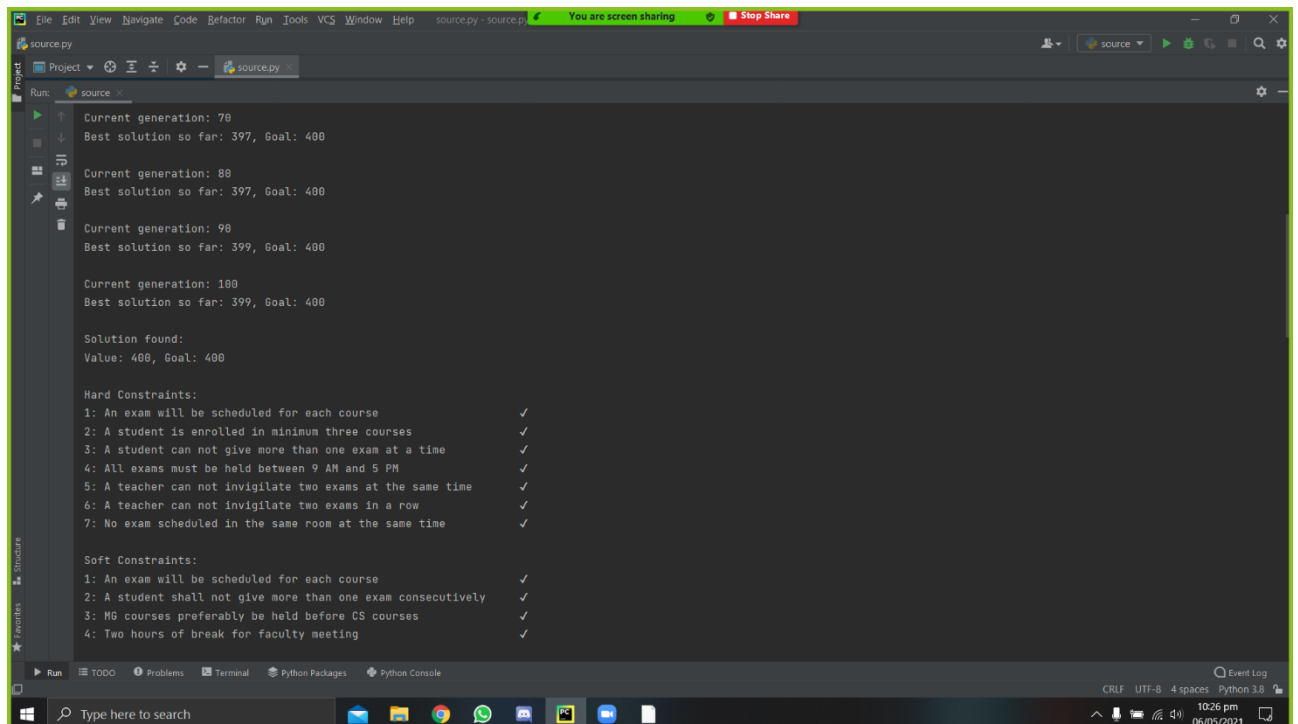
```
    | AI2011 | Programming for AI     | 2:00 PM | Room 1: C-302 | Farwa Batool     |
                                                 | Room 2: C-301 | Mehreen Alam     |
    -----------------------------------------------------------------------------

    Wednesday
    -----------------------------------------------------------------------------
    | CS218 | Data Structures         | 9:00 AM | Room 1: C-302 | Farwa Batool     |
                                                 | Room 2: C-305 | Ejaz Ahmed       |
    -----------------------------------------------------------------------------
    | DS3011 | Big Data Analytics      | 2:00 PM | Room 1: C-306 | Shahzad Mehmood  |
                                                  | Room 2: C-305 | Zohaib Iqbal     |
    -----------------------------------------------------------------------------

    Thursday
    -----------------------------------------------------------------------------
    | CS211 | Discrete Structures      | 9:00 AM | Room 1: C-303 | Zeeshan Qaiser   |
                                                  | Room 2: C-301 | Farwa Batool     |
    -----------------------------------------------------------------------------
    | CS328 | Software Engineering     | 2:00 PM | Room 1: C-305 | Khadija Farooq   |
                                                  | Room 2: C-307 | Hasan Mujtaba    |
    -----------------------------------------------------------------------------

    Friday
    -----------------------------------------------------------------------------
    | CY2012 | Digital Forensics       | 9:00 AM | Room 1: C-305 | Maheen Arshad    |
    -----------------------------------------------------------------------------

Process finished with exit code 0
```

Output 2:


```
Current generation: 70
Best solution so far: 397, Goal: 400

Current generation: 80
Best solution so far: 397, Goal: 400

Current generation: 90
Best solution so far: 399, Goal: 400

Current generation: 100
Best solution so far: 399, Goal: 400

Solution found:
Value: 400, Goal: 400

Hard Constraints:
1: An exam will be scheduled for each course                          ✓
2: A student is enrolled in minimum three courses                     ✓
3: A student can not give more than one exam at a time                ✓
4: All exams must be held between 9 AM and 5 PM                       ✓
5: A teacher can not invigilate two exams at the same time            ✓
6: A teacher can not invigilate two exams in a row                    ✓
7: No exam scheduled in the same room at the same time                ✓

Soft Constraints:
1: An exam will be scheduled for each course                          ✓
2: A student shall not give more than one exam consecutively          ✓
3: MG courses preferably be held before CS courses                    ✓
4: Two hours of break for faculty meeting                             ✓
```
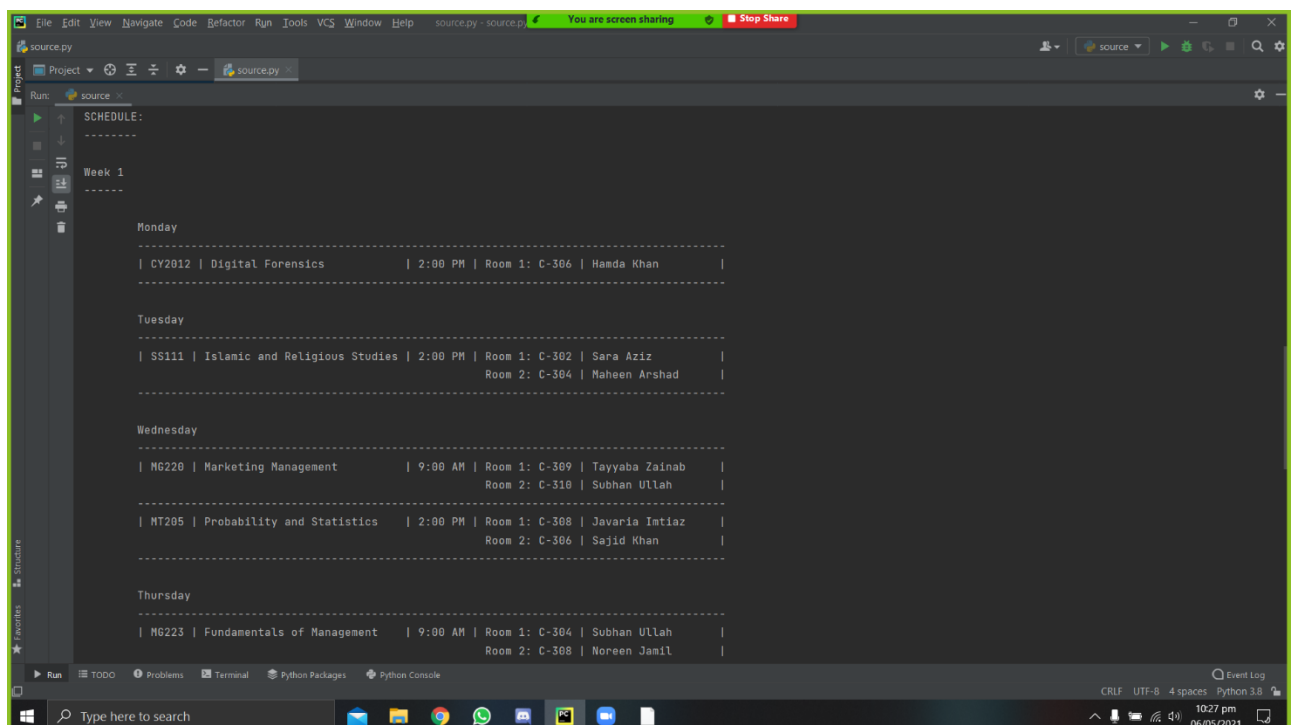


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SCHEDULE:
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Week 1
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        Monday
        ------------------------------------------------------------------------
        | CY2012 | Digital Forensics        | 2:00 PM | Room 1: C-306 | Hamda Khan      |
        ------------------------------------------------------------------------

        Tuesday
        ------------------------------------------------------------------------
        | SS111 | Islamic and Religious Studies | 2:00 PM | Room 1: C-302 | Sara Aziz       |
                                                          Room 2: C-304 | Maheen Arshad   |
        ------------------------------------------------------------------------

        Wednesday
        ------------------------------------------------------------------------
        | MG220 | Marketing Management      | 9:00 AM | Room 1: C-309 | Tayyaba Zainab  |
                                                        Room 2: C-310 | Subhan Ullah    |
        ------------------------------------------------------------------------
        | MT205 | Probability and Statistics | 2:00 PM | Room 1: C-308 | Javaria Imtiaz  |
                                                         Room 2: C-306 | Sajid Khan      |
        ------------------------------------------------------------------------

        Thursday
        ------------------------------------------------------------------------
        | MG223 | Fundamentals of Management | 9:00 AM | Room 1: C-304 | Subhan Ullah    |
                                                         Room 2: C-308 | Noreen Jamil    |
```

```
Friday
--------------------------------------------------------------------------
| CS219 | Database Systems          | 9:00 AM | Room 1: C-309 | Sajid Khan    |

| CS218 | Data Structures          | 2:00 PM | Room 1: C-304 | Irum Inayat   |
                                              Room 2: C-302 | Gul e Aisha   |

--------------------------------------------------------------------------

Week 2
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    Monday
    --------------------------------------------------------------------------
    | CS211 | Discrete Structures      | 9:00 AM | Room 1: C-306 | Rohail Gulbaz  |
                                                  Room 2: C-301 | Hasan Mujtaba  |

    | EE227 | Digital Logic Design     | 2:00 PM | Room 1: C-307 | Amna Irum      |
                                                  Room 2: C-308 | Umair Arshad   |
    --------------------------------------------------------------------------

    Tuesday
    --------------------------------------------------------------------------
    | DS3011 | Big Data Analytics      | 9:00 AM | Room 1: C-303 | Sumera Abbas   |
                                                  Room 2: C-302 | Hamda Khan     |

    | CS220 | Operating Systems        | 2:00 PM | Room 1: C-301 | Shafaq Riaz    |
    --------------------------------------------------------------------------

    Wednesday
    --------------------------------------------------------------------------
```

```
    | EE227 | Digital Logic Design     | 2:00 PM | Room 1: C-307 | Amna Irum      |
                                                  Room 2: C-308 | Umair Arshad   |
    --------------------------------------------------------------------------

    Tuesday
    --------------------------------------------------------------------------
    | DS3011 | Big Data Analytics      | 9:00 AM | Room 1: C-303 | Sumera Abbas   |
                                                  Room 2: C-302 | Hamda Khan     |

    | CS220 | Operating Systems        | 2:00 PM | Room 1: C-301 | Shafaq Riaz    |
    --------------------------------------------------------------------------

    Wednesday
    --------------------------------------------------------------------------
    | CS328 | Software Engineering     | 9:00 AM | Room 1: C-302 | Aqeel Shahzad  |
                                                  Room 2: C-307 | Zeeshan Qaiser |
    --------------------------------------------------------------------------

    Thursday
    --------------------------------------------------------------------------
    | SS113 | Pakistan Studies         | 9:00 AM | Room 1: C-303 | Farwa Batool   |
                                                  Room 2: C-308 | Khadija Farooq |

    | AI2011 | Programming for AI      | 2:00 PM | Room 1: C-304 | Kashif Munir   |
                                                  Room 2: C-305 | Gul e Aisha    |
    --------------------------------------------------------------------------

Process finished with exit code 0
```