

AI PROJECT-1

REPORT



SHAHEER ALI 18I-0587 MUHAMMAD ABDULALH 18I-0499

Abstract:

Solving exam scheduling problems for large set of data is a complex problem which is usually solved manually by specific person on universities. Such process often takes days or even weeks of iterations of finding better and better solution. This report describes implementation and results of work presented.

Genetic algorithm:

Genetic algorithm is a type of evolutionary algorithm which is a search heuristic that is same as the process of natural selection in biology. This method is often used to find satisfying solutions to complex problems which cannot be solved using standard methods because of too big computational complexity.

The population is a set of individuals called as chromosomes. Each individual represents a solution to the given problem and in our case, population is composed of potential solutions. Each chromosome represents a timetable. The initial population is a population of randomized timetables full of clashes.

Next, a number of genetic operators issued till the termination condition is met. This algorithm consists of selection, crossover and mutation operators. The selection operator chooses Individuals which are then cloned to fill up new generation. The crossover operator takes two individuals and mixes them up (e.g. swaps half of individuals). The mutation operator takes one individual and randomly changes some of its parts (e.g. flips a bit or randomize value in particular range). The terminate constraint is based on maximum generations or

In this algorithm we have chosen one-point crossover, which occurs with a given probability. It swaps one part of two individuals randomly.

The fitness function basically takes an individual and returns an inversion of fitnessvalue. Particular individual is calculated by adding up all conflicts and returning decimal value of (1.0 / ((conflicts)+1.0)) \*100 The constrtaints are defined as:

• An exam will be scheduled for each course.

• A student is enrolled in at least 3 courses. A student cannot give more than 1 exam at a time.

• Exam will not be held on weekends.

• Each exam must be held between 9 am and 5 pm

• Each exam must be invigilated by a teacher. A teacher cannot invigilate two exams at the same

time.

• A teacher cannot invigilate two exams in a row.

The above-mentioned constraints must be satisfied.

Results:

maximum generations: 137

> Generation 0

+-------+-----------+--------------------+

| Table | conflicts | fitness |

+-------+-----------+--------------------+

| 0 | 102 | 0.9708737864077669 |

| 1 | 109 | 0.9090909090909091 |

| 2 | 122 | 0.8130081300813009 |

| 3 | 125 | 0.7936507936507936 |

| 4 | 126 | 0.7874015748031495 |

| 5 | 126 | 0.7874015748031495 |

| 6 | 129 | 0.7692307692307693 |

| 7 | 133 | 0.7462686567164178 |

| 8 | 139 | 0.7142857142857143 |

| 9 | 146 | 0.6802721088435374 |

| 10 | 151 | 0.6578947368421052 |

| 11 | 155 | 0.641025641025641 |

| 12 | 165 | 0.6024096385542169 |

| 13 | 173 | 0.5747126436781609 |

| 14 | 188 | 0.5291005291005291 |

+-------+-----------+--------------------+

Current generation..: 0

Best solution so far:

+-------+-----------+-------------+--------------------+

| Room | Time | Course Code | Invigilator |

+-------+-----------+-------------+--------------------+

| C305 | M2(9-12) | CS217 | Sumera Abbas |

| C306 | M2(9-12) | EE227 | Mehwish Hassan |

| C309 | SN1(2-5) | CS211 | Noor ul Ain |

| C304 | SN2(9-12) | SE110 | Rohail Gulbaz |

| C305 | F1(9-12) | CS118 | Usman Rashid |

| C303 | S2(9-12) | CS219 | Sanaa Ilyas |

| C306 | F1(2-5) | CS220 | Zohaib Iqbal |

| C305 | SN2(2-5) | CS302 | Sehrish Hassan |

| C304 | F1(2-5) | CY2012 | Hammad Majeed |

| C302 | TH2(2-5) | CS307 | Sara Aziz |

| C303 | TH2(2-5) | CS328 | Waseem Shahzad |

| C303 | T1(9-12) | EE229 | Hamda Khan |

| C3010 | F1(9-12) | AI2011 | Usman Ashraf |

| C309 | W1(9-12) | DS3011 | Faisal Cheema |

| C301 | M2(9-12) | CS328 | Amna Irum |

| C309 | S1(2-5) | CS218 | Hasan Mujtaba |

| C301 | TH1(9-12) | EE229 | Usman Rashid |

| C3010 | S2(9-12) | CS211 | Ayesha Bano |

| C305 | T2(9-12) | MT224 | Shams Farooq |

| C308 | TH1(2-5) | SS113 | Irum Inayat |

| C304 | F2(2-5) | MG220 | Muhammad Usman |

| C304 | F2(2-5) | MG223 | Tayyab Nadeem |

| C301 | M1(2-5) | SS111 | Arshad Islam |

| C3010 | S2(9-12) | SS152 | Ejaz Ahmed |

| C304 | T2(2-5) | SS118 | Muhammad bin Qasim |

| C301 | W1(9-12) | MT205 | Khadija Farooq |

+-------+-----------+-------------+--------------------+

> Generation 20

+-------+-----------+--------------------+

| Table | conflicts | fitness |

+-------+-----------+--------------------+

| 0 | 65 | 1.5151515151515151 |

| 1 | 66 | 1.4925373134328357 |

| 2 | 67 | 1.4705882352941175 |

| 3 | 71 | 1.3888888888888888 |

| 4 | 72 | 1.36986301369863 |

| 5 | 85 | 1.1627906976744187 |

| 6 | 87 | 1.1363636363636365 |

| 7 | 89 | 1.1111111111111112 |

| 8 | 96 | 1.0309278350515463 |

| 9 | 103 | 0.9615384615384616 |

| 10 | 107 | 0.9259259259259258 |

| 11 | 120 | 0.8264462809917356 |

| 12 | 132 | 0.7518796992481203 |

| 13 | 135 | 0.7352941176470588 |

| 14 | 149 | 0.6666666666666667 |

+-------+-----------+--------------------+

Current generation..: 20

Best solution so far:

+------+-----------+-------------+----------------+

| Room | Time | Course Code | Invigilator |

+------+-----------+-------------+----------------+

| C308 | F2(9-12) | CS217 | Shoaib Mehboob |

| C306 | SN2(2-5) | EE227 | Muhammad Usman |

| C306 | TH1(9-12) | CS211 | Asma Nisa |

| C307 | W2(9-12) | SE110 | Asma Nisa |

| C303 | M2(9-12) | CS118 | Hasan Mujtaba |

| C305 | SN1(9-12) | CS219 | Behjat Zuhaira |

| C306 | F1(2-5) | CS220 | Zohaib Iqbal |

| C301 | TH2(2-5) | CS302 | Mehwish Hassan |

| C304 | T1(2-5) | CY2012 | Hassan Mustafa |

| C307 | M1(2-5) | CS307 | Sajid Khan |

| C302 | SN2(2-5) | CS328 | Tayyab Nadeem |

| C304 | S2(9-12) | EE229 | Sehrish Hassan |

| C304 | TH2(2-5) | AI2011 | Rohail Gulbaz |

| C306 | T1(2-5) | DS3011 | Farah Naz |

| C307 | T2(2-5) | CS328 | Waseem Shahzad |

| C305 | F1(2-5) | CS218 | Ejaz Ahmed |

| C306 | F2(9-12) | EE229 | Javaria Imtiaz |

| C308 | T2(2-5) | CS211 | Zainab Abaid |

| C304 | W1(9-12) | MT224 | Asif Naeem |

| C303 | SN1(2-5) | SS113 | Zeeshan Qaiser |

| C309 | W2(2-5) | MG220 | Tayyaba Zainab |

| C307 | SN1(9-12) | MG223 | Shoaib Mehboob |

| C301 | M1(2-5) | SS111 | Arshad Islam |

| C307 | S2(9-12) | SS152 | Mehwish Hassan |

| C305 | W1(2-5) | SS118 | Irum Inayat |

| C304 | M2(2-5) | MT205 | Tayyaba Zainab |

+------+-----------+-------------+----------------+

> Generation 40

+-------+-----------+--------------------+

| Table | conflicts | fitness |

+-------+-----------+--------------------+

| 0 | 53 | 1.8518518518518516 |

| 1 | 53 | 1.8518518518518516 |

| 2 | 65 | 1.5151515151515151 |

| 3 | 65 | 1.5151515151515151 |

| 4 | 72 | 1.36986301369863 |

| 5 | 77 | 1.282051282051282 |

| 6 | 79 | 1.25 |

| 7 | 79 | 1.25 |

| 8 | 84 | 1.1764705882352942 |

| 9 | 90 | 1.098901098901099 |

| 10 | 95 | 1.0416666666666665 |

| 11 | 113 | 0.8771929824561403 |

| 12 | 125 | 0.7936507936507936 |

| 13 | 127 | 0.78125 |

| 14 | 137 | 0.7246376811594203 |

+-------+-----------+--------------------+

Current generation..: 40

Best solution so far:

+------+-----------+-------------+-----------------+

| Room | Time | Course Code | Invigilator |

+------+-----------+-------------+-----------------+

| C308 | F2(9-12) | CS217 | Shoaib Mehboob |

| C306 | SN2(2-5) | EE227 | Muhammad Usman |

| C306 | TH1(9-12) | CS211 | Asma Nisa |

| C306 | F1(9-12) | SE110 | Behjat Zuhaira |

| C303 | M2(9-12) | CS118 | Hasan Mujtaba |

| C303 | M1(2-5) | CS219 | Maimoona Rassol |

| C306 | F1(2-5) | CS220 | Zohaib Iqbal |

| C301 | TH2(2-5) | CS302 | Mehwish Hassan |

| C304 | T1(2-5) | CY2012 | Hassan Mustafa |

| C307 | M1(2-5) | CS307 | Sajid Khan |

| C302 | SN2(2-5) | CS328 | Tayyab Nadeem |

| C304 | S2(9-12) | EE229 | Sehrish Hassan |

| C304 | TH2(2-5) | AI2011 | Rohail Gulbaz |

| C306 | T1(2-5) | DS3011 | Farah Naz |

| C306 | S1(9-12) | CS328 | Asma Nisa |

| C305 | F1(2-5) | CS218 | Ejaz Ahmed |

| C306 | F2(9-12) | EE229 | Javaria Imtiaz |

| C308 | T2(2-5) | CS211 | Zainab Abaid |

| C308 | W1(2-5) | MT224 | Asif Naeem |

| C303 | SN1(2-5) | SS113 | Zeeshan Qaiser |

| C309 | W2(2-5) | MG220 | Tayyaba Zainab |

| C307 | SN1(9-12) | MG223 | Shoaib Mehboob |

| C303 | M1(9-12) | SS111 | Tayyaba Zainab |

| C307 | S2(9-12) | SS152 | Mehwish Hassan |

| C305 | W1(2-5) | SS118 | Irum Inayat |

| C304 | M2(2-5) | MT205 | Tayyaba Zainab |

+------+-----------+-------------+-----------------+

> Generation 60

+-------+-----------+--------------------+

| Table | conflicts | fitness |

+-------+-----------+--------------------+

| 0 | 52 | 1.8867924528301887 |

| 1 | 53 | 1.8518518518518516 |

| 2 | 65 | 1.5151515151515151 |

| 3 | 66 | 1.4925373134328357 |

| 4 | 68 | 1.4492753623188406 |

| 5 | 71 | 1.3888888888888888 |

| 6 | 75 | 1.3157894736842104 |

| 7 | 79 | 1.25 |

| 8 | 81 | 1.2195121951219512 |

| 9 | 81 | 1.2195121951219512 |

| 10 | 88 | 1.1235955056179776 |

| 11 | 94 | 1.0526315789473684 |

| 12 | 120 | 0.8264462809917356 |

| 13 | 120 | 0.8264462809917356 |

| 14 | 156 | 0.6369426751592357 |

+-------+-----------+--------------------+

Current generation..: 60

Best solution so far:

+------+-----------+-------------+-----------------+

| Room | Time | Course Code | Invigilator |

+------+-----------+-------------+-----------------+

| C308 | F2(9-12) | CS217 | Shoaib Mehboob |

| C307 | S2(2-5) | EE227 | Arshad Islam |

| C306 | TH1(9-12) | CS211 | Asma Nisa |

| C306 | F1(9-12) | SE110 | Behjat Zuhaira |

| C303 | M2(9-12) | CS118 | Hasan Mujtaba |

| C303 | M1(2-5) | CS219 | Maimoona Rassol |

| C306 | F1(2-5) | CS220 | Zohaib Iqbal |

| C301 | TH2(2-5) | CS302 | Mehwish Hassan |

| C304 | T1(2-5) | CY2012 | Hassan Mustafa |

| C307 | M1(2-5) | CS307 | Sajid Khan |

| C302 | SN2(2-5) | CS328 | Tayyab Nadeem |

| C303 | W2(9-12) | EE229 | Sara Aziz |

| C304 | TH2(2-5) | AI2011 | Rohail Gulbaz |

| C306 | T1(2-5) | DS3011 | Farah Naz |

| C306 | S1(9-12) | CS328 | Asma Nisa |

| C305 | F1(2-5) | CS218 | Ejaz Ahmed |

| C306 | F2(9-12) | EE229 | Javaria Imtiaz |

| C308 | T2(2-5) | CS211 | Zainab Abaid |

| C308 | W1(2-5) | MT224 | Asif Naeem |

| C303 | SN1(2-5) | SS113 | Zeeshan Qaiser |

| C309 | W2(2-5) | MG220 | Tayyaba Zainab |

| C301 | TH1(2-5) | MG223 | Umair Arshad |

| C303 | M1(9-12) | SS111 | Tayyaba Zainab |

| C307 | S2(9-12) | SS152 | Mehwish Hassan |

| C305 | W1(2-5) | SS118 | Irum Inayat |

| C304 | M2(2-5) | MT205 | Tayyaba Zainab |

+------+-----------+-------------+-----------------+

> Generation 80

+-------+-----------+--------------------+

| Table | conflicts | fitness |

+-------+-----------+--------------------+

| 0 | 49 | 2.0 |

| 1 | 49 | 2.0 |

| 2 | 49 | 2.0 |

| 3 | 70 | 1.4084507042253522 |

| 4 | 70 | 1.4084507042253522 |

| 5 | 76 | 1.2987012987012987 |

| 6 | 79 | 1.25 |

| 7 | 93 | 1.0638297872340425 |

| 8 | 96 | 1.0309278350515463 |

| 9 | 99 | 1.0 |

| 10 | 102 | 0.9708737864077669 |

| 11 | 106 | 0.9345794392523363 |

| 12 | 116 | 0.8547008547008548 |

| 13 | 171 | 0.5813953488372093 |

| 14 | 184 | 0.5405405405405406 |

+-------+-----------+--------------------+

Current generation..: 80

Best solution so far:

+------+-----------+-------------+-----------------+

| Room | Time | Course Code | Invigilator |

+------+-----------+-------------+-----------------+

| C308 | F2(9-12) | CS217 | Shoaib Mehboob |

| C307 | S2(2-5) | EE227 | Arshad Islam |

| C306 | TH1(9-12) | CS211 | Asma Nisa |

| C306 | F1(9-12) | SE110 | Behjat Zuhaira |

| C306 | T2(2-5) | CS118 | Zohaib Iqbal |

| C303 | M1(2-5) | CS219 | Maimoona Rassol |

| C303 | F1(9-12) | CS220 | Waseem Shahzad |

| C301 | TH2(2-5) | CS302 | Mehwish Hassan |

| C304 | T1(2-5) | CY2012 | Hassan Mustafa |

| C307 | M1(2-5) | CS307 | Sajid Khan |

| C302 | SN2(2-5) | CS328 | Tayyab Nadeem |

| C303 | W2(9-12) | EE229 | Sara Aziz |

| C304 | TH2(2-5) | AI2011 | Rohail Gulbaz |

| C306 | T1(2-5) | DS3011 | Farah Naz |

| C306 | S1(9-12) | CS328 | Asma Nisa |

| C305 | F1(2-5) | CS218 | Ejaz Ahmed |

| C306 | F2(9-12) | EE229 | Javaria Imtiaz |

| C308 | T2(2-5) | CS211 | Zainab Abaid |

| C308 | W1(2-5) | MT224 | Asif Naeem |

| C303 | SN1(2-5) | SS113 | Zeeshan Qaiser |

| C309 | W2(2-5) | MG220 | Tayyaba Zainab |

| C305 | M2(9-12) | MG223 | Sadia Nauman |

| C303 | M1(9-12) | SS111 | Tayyaba Zainab |

| C307 | S2(9-12) | SS152 | Mehwish Hassan |

| C305 | W1(2-5) | SS118 | Irum Inayat |

| C304 | M2(2-5) | MT205 | Tayyaba Zainab |

+------+-----------+-------------+-----------------+

> Generation 100

+-------+-----------+--------------------+

| Table | conflicts | fitness |

+-------+-----------+--------------------+

| 0 | 48 | 2.0408163265306123 |

| 1 | 49 | 2.0 |

| 2 | 49 | 2.0 |

| 3 | 50 | 1.9607843137254901 |

| 4 | 61 | 1.6129032258064515 |

| 5 | 66 | 1.4925373134328357 |

| 6 | 72 | 1.36986301369863 |

| 7 | 79 | 1.25 |

| 8 | 85 | 1.1627906976744187 |

| 9 | 85 | 1.1627906976744187 |

| 10 | 92 | 1.0752688172043012 |

| 11 | 100 | 0.9900990099009901 |

| 12 | 111 | 0.8928571428571428 |

| 13 | 116 | 0.8547008547008548 |

| 14 | 119 | 0.8333333333333334 |

+-------+-----------+--------------------+

Current generation..: 100

Best solution so far:

+------+-----------+-------------+-----------------+

| Room | Time | Course Code | Invigilator |

+------+-----------+-------------+-----------------+

| C304 | F2(9-12) | CS217 | Tayyaba Zainab |

| C307 | S2(2-5) | EE227 | Arshad Islam |

| C306 | TH1(9-12) | CS211 | Asma Nisa |

| C306 | F1(9-12) | SE110 | Behjat Zuhaira |

| C306 | T2(2-5) | CS118 | Zohaib Iqbal |

| C303 | M1(2-5) | CS219 | Maimoona Rassol |

| C303 | F1(9-12) | CS220 | Waseem Shahzad |

| C301 | TH2(2-5) | CS302 | Mehwish Hassan |

| C304 | T1(2-5) | CY2012 | Hassan Mustafa |

| C307 | M1(2-5) | CS307 | Sajid Khan |

| C302 | SN2(2-5) | CS328 | Tayyab Nadeem |

| C303 | W2(9-12) | EE229 | Sara Aziz |

| C304 | TH2(2-5) | AI2011 | Rohail Gulbaz |

| C306 | T1(2-5) | DS3011 | Farah Naz |

| C306 | S1(9-12) | CS328 | Asma Nisa |

| C305 | F1(2-5) | CS218 | Ejaz Ahmed |

| C306 | F2(9-12) | EE229 | Javaria Imtiaz |

| C308 | T2(2-5) | CS211 | Zainab Abaid |

| C306 | SN1(9-12) | MT224 | Subhan Ullah |

| C303 | SN1(2-5) | SS113 | Zeeshan Qaiser |

| C309 | W2(2-5) | MG220 | Tayyaba Zainab |

| C305 | M2(9-12) | MG223 | Sadia Nauman |

| C303 | M1(9-12) | SS111 | Tayyaba Zainab |

| C307 | S2(9-12) | SS152 | Mehwish Hassan |

| C305 | W1(2-5) | SS118 | Irum Inayat |

| C304 | M2(2-5) | MT205 | Tayyaba Zainab |

+------+-----------+-------------+-----------------+

> Generation 120

+-------+-----------+--------------------+

| Table | conflicts | fitness |

+-------+-----------+--------------------+

| 0 | 48 | 2.0408163265306123 |

| 1 | 48 | 2.0408163265306123 |

| 2 | 66 | 1.4925373134328357 |

| 3 | 68 | 1.4492753623188406 |

| 4 | 75 | 1.3157894736842104 |

| 5 | 83 | 1.1904761904761905 |

| 6 | 89 | 1.1111111111111112 |

| 7 | 90 | 1.098901098901099 |

| 8 | 93 | 1.0638297872340425 |

| 9 | 96 | 1.0309278350515463 |

| 10 | 100 | 0.9900990099009901 |

| 11 | 100 | 0.9900990099009901 |

| 12 | 119 | 0.8333333333333334 |

| 13 | 152 | 0.6535947712418301 |

| 14 | 199 | 0.5 |

+-------+-----------+--------------------+

Current generation..: 120

Best solution so far:

+------+-----------+-------------+-----------------+

| Room | Time | Course Code | Invigilator |

+------+-----------+-------------+-----------------+

| C304 | F2(9-12) | CS217 | Tayyaba Zainab |

| C307 | S2(2-5) | EE227 | Arshad Islam |

| C306 | TH1(9-12) | CS211 | Asma Nisa |

| C306 | F1(9-12) | SE110 | Behjat Zuhaira |

| C306 | T2(2-5) | CS118 | Zohaib Iqbal |

| C303 | M1(2-5) | CS219 | Maimoona Rassol |

| C303 | F1(9-12) | CS220 | Waseem Shahzad |

| C301 | TH2(2-5) | CS302 | Mehwish Hassan |

| C304 | T1(2-5) | CY2012 | Hassan Mustafa |

| C307 | M1(2-5) | CS307 | Sajid Khan |

| C302 | SN2(2-5) | CS328 | Tayyab Nadeem |

| C303 | W2(9-12) | EE229 | Sara Aziz |

| C304 | TH2(2-5) | AI2011 | Rohail Gulbaz |

| C306 | T1(2-5) | DS3011 | Farah Naz |

| C306 | S1(9-12) | CS328 | Asma Nisa |

| C305 | F1(2-5) | CS218 | Ejaz Ahmed |

| C306 | F2(9-12) | EE229 | Javaria Imtiaz |

| C308 | T2(2-5) | CS211 | Zainab Abaid |

| C306 | SN1(9-12) | MT224 | Subhan Ullah |

| C303 | SN1(2-5) | SS113 | Zeeshan Qaiser |

| C309 | W2(2-5) | MG220 | Tayyaba Zainab |

| C305 | M2(9-12) | MG223 | Sadia Nauman |

| C303 | M1(9-12) | SS111 | Tayyaba Zainab |

| C307 | S2(9-12) | SS152 | Mehwish Hassan |

| C305 | W1(2-5) | SS118 | Irum Inayat |

| C304 | M2(2-5) | MT205 | Tayyaba Zainab |

+------+-----------+-------------+-----------------+

2.272727272727273