



# ARTIFICIAL INTELLIGENCE (AI) SOLUTION TO OPTIMALLY MATCH GROUPS OF STUDENTS TO PLACEMENTS

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## Abstract

**This paper proposed for optimally match the group of students to their placements by considering many criteria whilst matching each student to their placement which improves the quality of student placements by using artificial intelligence. Currently the matching of students to available placements is done manually by administrative staff who must consider many criteria whilst matching each student which is complex and time consuming. This paper discuss about the development and implementation an AI solution to find the optimum placement pairings for a group of students based on a prioritized list of constraints using the Genetic Algorithm.**

**Index Terms: Genetic Algorithm, Artificial Intelligence, Students Placements, Evolutionary Computation.**

## I. INTRODUCTION

ADVANCES in the computer science field of technology have drastically changed the ease and effectiveness of programming applications for finding solutions for complex problems. Now the use of artificial intelligence has made solving problems that were impossible before a reality. Concepts like Genetic algorithms and Artificial Neural Networks are being widely used in many fields like pattern recognition, prediction and constraint satisfaction problems [1]. This project will take a task that is difficult and time intensive for humans to do and use AI to generate a software solution.

Genetic Algorithm (GA) is search-based optimization technique. Genetic Algorithm is powerful which is mainly because of Genetics and Natural Selection for finding the solutions

that are optimal and sufficient amount of time[2]. Genetic algorithm can be generally be used in any areas where problems are Harder to solve and problems that would take very long time to solve.

Matching group of Students to placement is gets harder as the number of students and placements increases where each of the students should be compared with every placements available along with the prioritized criteria's listed. The University Administrative staff currently places students to their placements manually by considering all criteria's listed.

## II. METHODOLOGY

Basic Genetic Algorithm works as initially generating groups of possible solutions for a given problem[5]. These groups of possible solutions undergoes selection, recombination, and mutation which mirrors the natural selection. This generational process is repeated until a termination condition has been reached. Each individual solution is assigned a fitness value and the fitter individuals are given a higher chance to mate and yield more "fitter" individuals. The theme of GA is "Survival of the Fittest".

For optimally placing the students to placement, Genetic Algorithm can be considered as best choice. Genetic Algorithm (GA) is a search optimization technique based on the principles of Natural Genetics and Natural Selection. They combine survival of the fittest among the population and over the generations GA will able to find the best combination of students to placements pairings. At the end of iterations GA guaranties that an optimal or near optimal solution will be available.

A. Genetic Encoding

To Represent a Gene so that could be used in the genetic algorithm we chose structure show in the figure 1. The Structure contains the linear array of students where index represents the placement for which corresponding student is assigned for that placements.

For each of the student and placement pair there will be a fitness value that measures the how good a placement is based on the criteria given. Their might be situation where the students many be lesser than the placement, for such case we consider dummy students with least fitness value. The fitness of whole gene depends on the combined fitness of all the students and placements pairing contained in that gene. The

figure 1 shows that six students placed to six different placements.

Placement	1	2	3	4	5	6
Students Gene	S6	S1	S5	S4	S3	S2

Figure 1

B. Criteria's

The criteria's is a list of rules that are need to be considered during placement. This criteria's are being used while evaluating the fitness of a gene. The criteria includes the priority rating and is criteria optional or required such conditions along with the name. The Criteria's may be like distance between students and placements should be lesser than 50 km. The other criteria s are like the student should have a same subject as placement has, Pupil premium of student must be have a good range from past history. Each Students must go to different placements which are not visited before.

C. Initialization

Initial population is created by using the available list of students and placements. The students and placements are randomly combined to create the genes. After the creation of gene we evaluate the fitness of students to placement pairing and then evaluating the students to placements. The number of genes in the population is based on the population size.

D. Genetic operators

1. Selection

This paper uses the Tournament selection method for the genetic algorithm that randomly selects small part of the population and selects the best two gene in that

population which is used in the selection of the parent gene for generating the offspring's.

2. Crossover

Crossover is used to yield fitter chromosomes over the generation, from one generation to next generation. The crossover operator is analogous to reproduction and biological crossover. The new Chromosome shares many of the characteristics of its parents.

Crossover that is produced by combining the parents' gene which are selected by selection method from the population and generate a new gene using the two point crossover method. While crossover the parent 1 gene and parent 2 gene are chosen, then the two crossover points are randomly selected. Parent1 gene's first part and last parte are used as it is in the child gene. But parent2's gene section from crossover point1 to crossover point 2 is placed only if it is in both parent otherwise students are randomly placed[3].

		Crossover point1				Crossover point2		
Placement	1	2	3	4	5	6	7	8
Parent 1 gene	S6	S1	S2	S4	S2	S3	S8	S7
Parent 2 gene	S1	S7	S5	S4	S3	S2	S5	S2
Child gene	S6	S1	S5	S4	S3	S2	S8	S7

Figure 2

3. Mutation

Mutation is used to maintain genetic diversity from one generation to next, which mimics the biological mutation. Mutation operation alters one or more gene values in a chromosome from its initial state. Here mutation operation that can modify the gene by swapping one students with other student based on the mutation probabilities which normally would be very small.

Placement	1	2	3	4	5	6	7	8
Before Mutation	S6	S1	S5	S4	S3	S2	S8	S7
After Mutation	S6	S1	S8	S4	S3	S2	S5	S7

Figure 3

E. Elitism

Elitism is a concept of allowing the best genes from the current generation to carry over to the next, unaltered. This strategy is known as elitist selection and guarantees that the solution quality obtained by the GA will not decrease from one generation to the next. Here I have used elitism based on the elitism probability.

F. Termination

This Evolutions process or generations is repeated until a termination condition has been reached. Terminating condition here employed is that we have a maximum number of generations that generations can be evolved and minimum number of evolution or iteration that generation should be evolved[4]. Termination can also occur when the fitness is greatest or if the similar result for continuously for many generations.

III. IMPLEMENTATION, ANALYSIS AND RESULTS

We have built a web service so that any client can make call to the server with students, placements and criteria's and gives back the result with list of student placement pairs using the JSON format. In order to evaluate the gene fitness we must compute some of the properties that are being used while evaluation based on the criteria. Such as distance so on. For some evaluation we use API calls for direction and distance server.

To illustrate the concept we have tried many Test case which 95% of the students have been correctly placed to their respective placements. Figure 1 shows the first test case where we included four students and seven placements with single criteria that all students who are near to the placements must be placed to such placements. The figure shows that all students' properties are similar except for the location for even Placements also have the same properties except place property.

As per Required result three students must be placed and in figure 1 we can see all the required students are been placed.

Students whos are near to placement should be placed							
All same propertys except Location							
Students							
StudentId	Previous Key Stage	Previous Pupil Premium	Previous Ofsted Grades	Mode Of Transport	Location	Required result	Actual result
1	1	50	5	Car	51.553009	Placed	Placed
2	1	50	5	Car	51.464117	Placed	Placed
3	1	50	5	Car	51.564962	Placed	Placed
4	1	50	5	Car	51.191695	UnPlaced	UnPlaced
Placement							
PlacemntId	KeyStage	Pupil Premium	Ofsted Grade	SchoolId	Place		
1	1	50	5	1	51.417893, -1.857850		
2	1	50	5	2	51.411041, -1.400544		
3	1	50	5	3	51.613596, -0.141236		
4	1	50	5	4	51.065405, -1.959473		
5	1	50	5	5	51.075760, -0.514771		
6	1	50	5	6	51.688576, 0.221313		
7	1	50	5	7	51.830529, -0.550477		

Figure 4

Students who are travelling by public transport should be placed							
All same criteria except transport mode							
Students							
StudentId	Previous Key Stage	Previous Pupil Premium	Previous Ofsted Grades	Mode Of Transport	Location	Required result	Actual result
1	1	50	5	Car	51.540959	Either	UnPlaced
2	1	50	5	Car	51.540959	Either	UnPlaced
3	1	50	5	Car	51.540959	Either	UnPlaced
4	1	50	5	Car	51.540959	Either	Placed
5	1	50	5	Car	51.540959	Either	UnPlaced
6	1	50	5	Car	51.540959	Either	UnPlaced
7	1	50	5	Public Tra	51.540959	Placed	Placed
8	1	50	5	Public Tra	51.540959	Placed	Placed
9	1	50	5	Public Tra	51.540959	Placed	Placed
10	1	50	5	Public Tra	51.540959	Placed	Placed
Placement							
PlacemntId	KeyStage	Pupil Premium	Ofsted Grade	SchoolId	Place		
1	1	50	5	1	51.527291, -0.106332		
2	1	50	5	2	51.527291, -0.106333		
3	1	50	5	3	51.527291, -0.106334		
4	1	50	5	4	51.527291, -0.106335		
5	1	50	5	5	51.527291, -0.106336		

Figure 5

Another output is shows in the figure 2 which contains ten students and five placements with all other properties similar and for students except the mode of travel all other properties are similar. We want all who are travelling by the public transport must be placed and our solution output has all the required public transport are placed. Other than the students have public transport as mode of travel may be or may not be placed.

IV. FUTURE SCOPE

The Future scope of this paper is to developing some kind of Rules based engine that allows users to dynamically define the rules used when

matching students. These rules can then be loaded and evaluated when matching students with placements without needed to be specified criteria's at early stages.

## **V. CONCLUSION**

This project successfully places students to placements based on the prioritized list of constraints and produces an optimal or near optimal solution using the Genetic algorithm. This method improves the quality of student placement using Artificial intelligence. The fitness function is carefully designed so the solution yields optimal pairs of students and placements. The Genetic Algorithm for an optimal solution mainly depends on the fitness evaluation function and how we design the fitness function. Tournament selection is best suited for this problem which gets the best set of parents for genetic operations from a collection of genes. Our crossover makes a child gene with the best features of both the genes and gets better and better as each generation gets evolves and progresses. The Analysis shows that this approach works very well for finding student and placement combinations with the least number of iterations or evolutions.

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