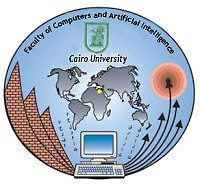
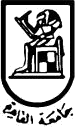
**** **Cairo University**

**Facult Faculty of Computers and Artificial Intelligence**

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**Resource Management / Assignment**

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| **contents** |
| **1.Intro** |
| **2.How to solve the problem** |
| **3.The Model** |
| **4.Implementation of Code** |
| **5.Conclusion** |

**Introduction**

Numerous recent papers have dealt with the problem of achieving racial balance in predominantly urban school districts [1], [2]. These models have used various mathematical programming procedures to devise plans for assigning students and/or designing busing policies. In contrast, there does not seem to be a great deal of literature dealing with the problems of the predominately nonurban school district. Though these types of dis- tricts also have some racial balance problems, a major concern tends to be one of efficiency of transportation. This is true in many of the consolidated school districts of upstate New York. These districts usually have several elementary schools and often cover large geographical areas. It is also a policy of these school districts to use busing to transport the great majority of the students. For these reasons, a major point of interest for the school administrators is the rising fuel costs. Of secondary interest is the falling attendance levels and the resulting need to use the available classrooms efficiently or to decide which schools to close.

This paper describes a study in using a large scale linear program- ming routine to assign to schools in a way that the total stu miles traveled in the district were minimized. The research on which this paper is based was a part of Mr. Workman's MBA Management Science Field Project and was directed by Professor McKeown at the School of Business, State Unviersity of New York at Albany. A suburban upstate dis- trict cooperated in this study by providing data on their students. The re- sults of this study were extremely promising. However, due to data collection problems, the results were not conclusive. It is hoped that a further study may be funded in order to enlarge and validate these preliminary results.

**Developing a Model**

The problem of assigning students to schools efficiently can be con- sidered to be a modification of the public location model discussed by Revelle.

## How to Solve Linear Programming Problems?

The most important part of solving linear programming problem is to first formulate the problem using the given data. The steps to solve linear programming problems are given below:

* **Step 1:** Identify the decision variables.
* **Step 2:** Formulate the objective function. Check whether the function needs to be minimized or maximized.
* **Step 3:** Write down the constraints.
* **Step 4:** Ensure that the decision variables are greater than or equal to 0. (Non-negative restraint)
* **Step 5:** Solve the linear programming problem using either the simplex or graphical method.

Let us study about these methods in detail in the following sections.

**Problem Statement**

This case study will focus on the assignment of students to elementary schools since there are more elementary

schools than middle or high schools. The PSD classifies the 400 sq mile county into 6 geographical clusters, each

with 11-15 elementary schools. These schools are further classified as Area A and Area B schools based on several

socioeconomic identifiers. Also, students are designated as residing in an Area A or Area B neighborhood based on

their home address. Area A neighborhoods contain low-income, low-education, and high-minority populations while

Area B neighborhoods have income, education, and/or minority racial populations above those of Area A

neighborhoods. As per the current PSD assignment plan, 15-50% of each school’s population must reside in an Area

A neighborhood. Parents of children going to the PSD system’s schools can request two Area A schools and two

Area B schools within their cluster as their four preferences to send their children. The parents’ first preference in

the Area A schools category and first preference in the Area B schools category are considered to be their first set of

preferences. Similarly their second preference in the Area A schools category and their second preference in the area

B schools category are considered to be their second set of preferences. Currently there are students who are not

assigned to any of their four preferred schools; however statistics are not currently available regarding the

percentage of students assigned to a non-preferred school. The assignment process of students to schools should be

based on distance traveled, parental preference, and balancing the utilization of the various schools.

Currently students can be assigned to any school in the district. Bus transportation is provided by the PSD. Because

students who live next door to each other can be assigned to different schools, the bus transportation system contains

several school bus depots where students transfer from the bus that picked them up at their house, to the bus that will

deliver them to their school. When the new school assignment system implementation started, the PSD received

many complaints from parents about long bus rides and children getting on and off the wrong buses at the depots.

Hence the PSD is currently trying to find a solution to these issues. The dissatisfaction from the current system

arises from the factors below:

• Students not getting assigned to their first choice schools.

• Students traveling long distances and spending too much time on the buses.

• Students getting on and off the wrong buses at the depots.

Solving these problems while maintaining the school system’s diversity, which is one of the top of goals of the

PSD’s management, is the objective of this study. The dissatisfaction of the parents, if not resolved, can lead to the

possibility of discontinuing the district's nationally recognized integration plan. For example, school systems with

similar diversity plans, such as Wake County (Raleigh) NC, have recently abandoned these plans in favor of

neighbor schools at the request of parents [2].

Therefore, the goals of this study are:

• To minimize the total distance traveled on the buses.

• To meet parental satisfaction by assigning students to their preferred schools.

• To maintain the PSD diversity goal 15-50% of each school’s population must be from A neighborhoods.

There are some expected trade-offs among these goals. Since each school has a limited capacity, it is the case that

not every student will be assigned to their first preference school. In addition, some students might choose to travel

more in order to attend their first preference school which will increase the total distance traveled. School utilization

is another important factor. A situation should not occur where some schools are underutilized while the others are

being overburdened. These considerations will have effects both on parental satisfaction and distance traveled.

**Implementation of Code:**

this code, the objective\_function represents your specific objective function that calculates the fitness of a given resource assignment. You'll need to customize this function based on your problem. The initialize\_population function initializes the population with random assignments. The differential\_evolution function implements the differential evolution algorithm, where F is the differential weight and CR is the crossover probability. The algorithm iterates for max\_generations and updates the population based on the mutation and crossover operations. Finally, the best solution found is returned.

Note that you need to replace the objective\_function with your own objective function that is appropriate for the resource assignment problem you're working on. Additionally, you may need to adapt the code to match the specific constraints and requirements of your problem.

**Conclusions**

The objective of this project was to develop a student assignment plan for a Public Schools District that can consider parental preferences for schools, minimize total distance traveled by students and ensure that each school meets the PSD’s diversity requirements.

**List of References:**

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