Introduction

Introduction

1. Multi-objective transportation problem

The transportation problem (TP) is a special type of linear programming. It will be considered as a minimum cost flow problem. That is, we want to transfer a quantity of products from plants to warehouses to minimize the transportation cost. TP usually involves an objective function or multiple objective functions. This last type of problem is called multi-objective transportation problem (MOTP). We can describe multi-objective transportation problem with an example as follows: A given supply of the commodity is available at a number of sources m, there is a specified demand for the commodity at each of a number of destinations n. The sources may be factors, warehouses, etc. and they are characterized by available quantities denoted $a_1,\ldots,a_m$. The destination may be warehouses, sales outlets, etc. and they are characterized by available quantities denoted $b_1,\ldots,b_n$. . The transportation cost between a given source i to a given destination j pair is the penalty C_{ij} . The unknown quantity to be transported between the source-destination pair (i, j) denoted X_{ij} In the simplest case, the unit transportation cost is constant. The transportation problem is to find the optimal distribution plan for shipments from sources to destinations that minimizes the total transportation cost, in the same time, it seeks to find an optimal distribution plan for a single commodity. The mathematical form of MOTP can be stated as follows:

$$P_1 \Rightarrow \text{ Min } F^k(X) = \sum_{i=1}^{m} \sum_{j=1}^{n} C_{ij}^k X_{ij} \qquad (0.1)$$

subject to

$$\sum_{j=1}^{n} X_{ij} = a_i \quad i = 1, 2, \ldots, m \qquad (0.2)$$

$$\sum_{i=1}^{m} X_{ij} = b_j \quad j = 1, 2, \ldots, n \qquad (0.3)$$

$$X_{ij} \geq 0 \; ; \; i = 1, \ldots, m \; ; \; j = 1, \ldots, n \; ; \; k = 1, \ldots, K \qquad (0.4)$$

where $F^k(X)$ is the multiple objective functions, it is a vector of K objective functions. The above MOTP form is known as the canonical form, by changing the pair of equality in (0.2) and (0.3) to a pair of inequality, it results the equivalent problem which is in standard form. Every minimization problem can be appeared as a maximization problem and vice versa. That is, to minimize the objective function maximize its negative instead and then change the sign of the answer.

2. The aim of this thesis

- Present visualizations of the basic ideas about the multi-objective transportation problem.
- Provide the user with visual illustrations of the genetic algorithm method of solving the multi-objective transportation problem using Java.
- Enable the user to use several solution approaches for the MOTP

1. Interactive algorithms.
2. Fuzzy programming approach.
3. Interactive fuzzy Goal Programming approach.
4. Pareto-based approach.

- Comparing between all the solution’s approaches solved the multi-objective transportation problem.

3. Thesis organization

The thesis is structured as follows:

In chapter 1, a brief review on visualization was given. In that chapter some different methods are described to visualize an algorithm and also some examples are given on the visualization.

In chapter 2, the basic concepts of multi-objective optimization and evolutionary algorithms are discussed. We first give some important definitions, then we give a simple review on some of multi-objective optimization techniques then, we give brief summery on the concepts of the genetic algorithm.

In chapter 3, in which our main effort is to present in one applet java program and the four approaches for solving the multi objective transportation problem. The program is built based on the java programming language to the model of multi-objective transportation problem. In addition, the researcher compared between the performances of the approaches based on the linear compromise solution.

Chapter 4 introduces visualizations of the basic ideas about the multi-objective transportation problem. The purpose is to provide the user with an impressive visual illustrations of the genetic algorithm method of solving the multi-objective transportation problem using java.