Logistics Optimization Service Improved with Artificial Intelligence

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Abstract. Today the issue of logistics is a very important within companies to the extent that some have departments devoted exclusively to it. This has evolved over time and today is a fundamental aspect in the fight business seeking to consolidate or remain leaders in their field. With the above we know that logistics can be divided into different classes, however, in this regard, our study is based on the timely distribution to the customer with a lower cost, higher sales and better utilization of space resulting in excellent service. Finally, prepare a comparative analysis of the results with respect to another method of optimization solution space.

Keywords: Logistics, Data Mining, Cultural Algorithms, Population Space, Space of Beliefs, Protocol, Bin Packing, Simplex Method.

1 Introduction

Within the area of distribution of purified water, there isn't methodology to what the Service Logistics and space optimization in delivery vehicles, so that the service within the "La Noria" become at the logic or the need. But not have defined a pattern of optimal service logistics.

The optimization problems have been attacked widely in the area of evolutionary computation; this has been due largely to the kindness they have shown to solve such problems [2] to name a few.

This paper addresses the solution of Logistics Service Based on Data Mining in combination with other techniques such as evolutionary algorithms, as is cultural algorithm, once the tool is implemented together with the Bin Packing is to optimize for the space within distribution vehicles purified water.

At present there are many optimization techniques, such is the case of the Simplex Method, and Simplex Method is an iterative process that progressively allows an optimal solution to linear programming problems [15] to name a few, the main feature of this method is that it attacks the problem by restricting its maximum capacity through the vertices of the same [10] to name a few.

O. Castillo et al. (Eds.): Soft Computing for Intell. Control and Mob. Robot., SCI 318, pp. 57–65.
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2 Methodology

Data mining is a process that uses several data analysis tools to discover patterns and relationships in data that can be used to make valid predictions [16] to name a few. The foundations of data mining is in the artificial intelligence and the statistical and using the models extracted using data mining techniques which addresses the solution to problems of prediction, classification and segmentation [14] to name a few.

The process for conducting the data mining are:

- Selecting the dataset.
- Analysis of the properties of the data.
- Transforming the input data set.
- Select and apply the technique of data mining.
- Evaluate the results. (See Figure 1).

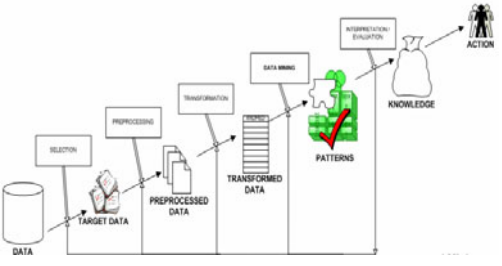

Fig. 1. Diagram of Data Mining

Data mining aims to generate information similar to that which could generate a human analyst: patterns, associations, changes, anomalies and significant structures.

The Cultural algorithms (CA's) are a class of computational models derived from observing the process of cultural evolution in nature as proposed by Reynolds in [11] to name a few. They consist of a population and a belief space as shown in Figure (2). The selected individuals from the population space contribute to cultural knowledge through the role of acceptance [8] to name a few. Cultural knowledge resides in the space of beliefs where it is stored and updated based on individual experiences of either success or failure. The knowledge in the belief space can also be used to influence their individual memories [9] to name a few. The (AC's) in addition to space and space population of beliefs, have a third component of importance: communication protocol, describes how knowledge is exchanged between the first two components [13] to name a few. The population space can support any population based on a computational model, such as Genetic Algorithms and Evolutionary Programming (See Figure 2).

Cultural Algorithms are a dual system of inheritance that characterizes the evolution of human culture in the macro-evolutionary level, which occurs within the

space of beliefs, and micro-evolutionary level, which occurs in the area of population [4] to name a few. The knowledge produced in the population that the space in the micro-evolutionary level is accepted or to be passed to the belief space and used selectively to adjust the knowledge structures there [12] to name a few. This knowledge can then be used to influence the changes made by the population in the next age.

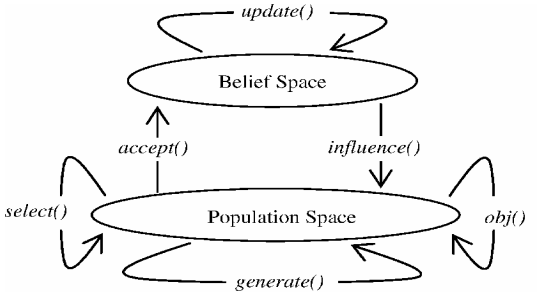

Fig. 2. Diagram Concept of Cultural Algorithms

Cultural algorithms using five kinds of basic knowledge to generate an adequate solution in the search space where the problem is solved. The sources of expertise include regulatory knowledge (ranges of acceptable behavior), situational awareness (or copies of reports of successful or unsuccessful solutions, etc.), domain knowledge (knowledge of objects in the domain of relations they and their interactions), historical knowledge (temporal patterns of behavior), and topographical knowledge (spatial patterns of behavior) [5] to name a few. To make your programming is relatively simple, as shown in the pseudocode in (See Fig 3).

```
Begin
    t = 0;
    initialize B^t, P^t
    repeat
        evaluate P^t {obj()}
        update (B^t, accept(P^t))
        generate (P^t, influence(B^t))
        t = t + 1;
        select P^t from P^(t-1)
    until (termination condition achieved)
End
```

Fig. 3. Cultural Algorithm Pseudocode

The main difference between Cultural Algorithms and Evolutionary Computation other techniques lies in the belief space utilization as well as the cultural influence of the same, as are those that guide us in obtaining optimum best [3] to name a few.

3 Tools Developed

The prototype (see Figure 4) is an intelligent hybrid system developed with the Java programming language that combines data mining techniques to cultural algorithms. He got a map of Fresnillo and divided into 4 zones. To get the coordinates of each colony, then we started building the data warehouse, organized in the following fields: area, district, year, month, day, time and sales.

It was necessary the creation and implementation of algorithms capable of finding information in *n* dimensions, as well as a data clustering algorithm called K-Means [1] to name a few, which generates data pooling, without predefined classes, based on a function of similarity of the values that have different attributes, done in unsupervised [7] to name a few (i.e., discover patterns or trends in the data). K-Means is a partitional clustering method (i.e. we start altogether the particular), where partitioning is performed a database of *n* objects in a set of k groups, seeking to optimize the chosen partitioning criterion. In K-Means each cluster of data is represented by a centroid. K-Means is trying to form k groups with k predetermined before the start of the process. The goal is to minimize the within-group variance [6] to name a few.

With the use of these tools Data Mining, the prototype is able to determine (given a zone and a particular date) in which colonies are more likely to occur at a given time sale. Once these colonies is generated a population of *n* agents (an agent is the computer simulation of a person), which form a society based on cultural algorithms, which are responsible for determining, over the ages, the course optimal performance.

At the time zero (when initializing the program, and the agents beliefs have an empty space), all agents obtain the information generated from each colony, each propose a route, it will lead to negotiations between the agents to select the best route proposed at a certain time, the belief space will be updated only when the proposed route is better than the previously stored in the belief space, beginning a cycle of improvements that will be interrupted when they occur many times *m*(iterations in the behavior of agents) without improvements to the paths or when a stop condition is performed.

Once the data mining software, proceeded to the development of software for Bin Packing, the prototype is a hybrid intelligent system developed in Java, using the technique of Cultural Algorithms.

It began with the taking of measures of distribution vehicle on which the study was conducted to determine the space with which states in m^3 and measuring the various presentations and their respective volume, for in doing so raise the problem and their respective restrictions.

Also token into account the demand of different presentations, to thus more accurately determine a product's usefulness.

Table 1. Product Description

PRODUCT	CAPACITY	% DEMAND	VOLUME	UTILITY
1	20 lt	45	36500cm ^{3}	$ 10.00
2	1.5 lt	15	26731cm ^{3}	$ 26.50
3	1 lt	15	18435cm ^{3}	$ 21.60
4	500 lt	25	18177cm ^{3}	$ 38.50

Once the measurements were made, it was necessary to create an algorithm capable of finding the right mix in terms of cargo is concerned, so as to optimize the gain of the pickup and hence of the company, the algorithm uses a population basis, and initializes the other as an area of belief at that time its value is unknown.

It makes adjusting the demands for this way fine-tune the value, which based on the percentage of sales of products. Initial population is evaluated based on the problem and the same restriction as shown in the table 1.

$$\text{Max } z = \quad r_1 m_1 + r_2 m_2 + \ldots + r_n m_n$$

$$\text{Subject to} \quad v_1 m_1 + v_2 m_2 + \ldots + v_n m_n <= V \ (1)$$

$$m_1, m_2 \ldots m_n > = 0 \text{ Integer}$$

$$V = 1138425 \text{cm}^3$$

Where:

r: Profit per unit.
v: Volume of each unit.
m: Are the units of each product type.
V: Maximum volume capacity.

Any condition which violates the restrictions will be penalized so that only the best combinations are obtained and thus we get an average by which we can have the best individuals and thus influence the next generation based on the mean individuals.

The result (Epochs) is the proposed solution will stop condition from which is repeated 7 times without change, i.e., be = > to previous.

4 Results

The prototype used a database of sales generated at random, with it launched the system functions: information classification, clusters, the generation of routes (see Figure 4).

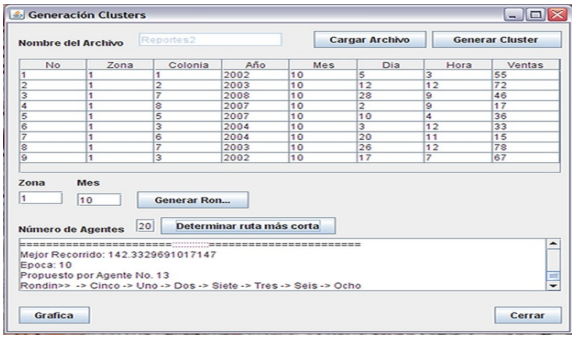

Fig. 4. Generating optimal routes

The system will determine the colonies in which sales have been registered within the specified date range. Based on the number of colonies and vehicle using the K-Means algorithm clusters to be generated immediately after being delivered to a society formed by artificial intelligent agents (representatives of a group of individuals), which will determine the most optimal route for each cluster (see Fig 5).

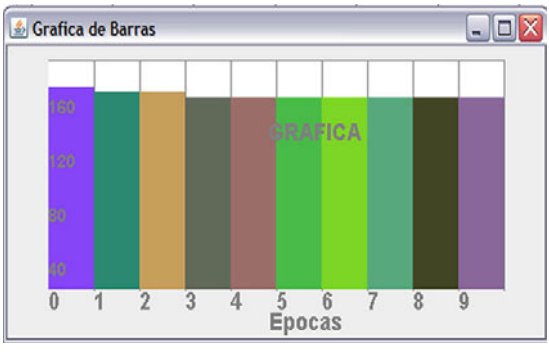

Fig. 5. Graphic Convergence Times represented in époques

Moreover, the software for the Bin Packing use an initial population of 100 individuals and an area of beliefs with the same number of individuals, and that they could launch the system where the initial population is initialized, the Space of Beliefs, evaluated the results thus able to apply variation operators under the influence of belief space and get different times to achieve the status of unemployment or the convergence of results.

The program determines the best combination of load so as to maximize his profit, that based on the volumes handled for each presentation and the capacity of trucks in m^3 and the demand for each presentation (see figure 6).

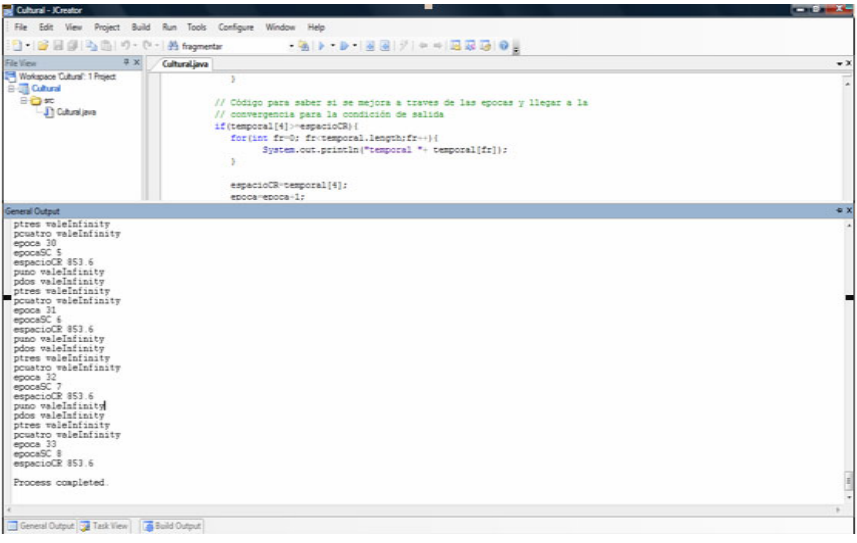

Fig. 6. Generation of Bin Packing

At the time 33 was found the best result after 8 times without change, that the following responses:

Table 2. Results

PRESENTATION	20lt	1.5lt	1lt	500 lt
QUANTITY	16	6	6	9
NET PROFIT $ 853.60				

However, making a comparison with what is the Simplex Method, we can see that this method gives us less effective results, as we see in Table 3.

Table 3. Result of the Simplex Method

	14:37:33		Friday	April	17	2009		
	Decision Variable	Solution Value	Unit Cost or Profit c(j)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c(j)	Allowable Max. c(j)
1	X1	0.0225	10.0000	0.2250	0	basic	0	M
2	X2	0.1000	26.5000	2.6500	0	basic	0	M
3	X3	0.1500	21.6000	3.2400	0	basic	0	M
4	X4	0.5000	38.5000	19.2500	0	basic	0	M
	Objective	Function	(Max.) =	25.3650				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	0.4500	<=	0.4500	0	0.5000	0	615.8346
2	C2	0.1500	<=	0.1500	0	17.6667	0	63.1710
3	C3	0.1500	<=	0.1500	0	21.6000	0	61.0709
4	C4	0.2500	<=	0.2500	0	77.0000	0	31.1428
5	C5	15,348.1000	<=	1,138,425.0000	1,123,077.0000	0	15,348.1300	M

As we can see from the table, the maximum utility proposed by the Simplex Method is $ 615.8346, i.e. less than the $ 237.76 proposed by our program.

5 Conclusions

This research is being used within the purified "La Noria" trying to demonstrate that data mining can be used to increase sales and have a better logistics services, this software has a high value added for the generation and analysis logistics coupled with cultural algorithms responsible for the creation of routes, founded as a tool for decision making, based on the data generated daily by mobile sales. This is intended to provide the product to the larger population that requires service.

Similarly, using Bin Packing algorithm optimizes the space within the distribution units and thus provide the company a way to optimize new and creative through the use of this heuristic.

It concludes with the work that has been done for this kind of logistics in terms of logistics service and space optimization of delivery vehicles is satisfactory and allows the tool to see implemented are good choices. These tools have a high added value because it had not previously been used for this purpose, this further if we consider that until recently there was no practical implementation of these algorithms.

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