

An object-oriented framework for creating offerings

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Abstract

Many benefits can be obtained with the union of consumers into consumer groups. Reduced prices, gifts, auto-financing, and time-sharing are some of the usual benefits. One of the main goals of the object-oriented framework VGroups is to discover the most appealing offerings for consumers who want to participate in a consumer group transaction. An online retailer is able to create marketing campaigns more efficiently with the framework VGroups. An instantiated application called Bundles.com uses some data mining techniques and evolutionary software agents to build a tool that automatically generates offerings. This tool turns out to be very useful, since it is able to select the best offerings to the future consumer groups.

Keywords: Object-oriented frameworks, e-commerce, consumer groups, evolutionary software agents

1. Introduction

E-commerce applications have introduced a new paradigm in the way companies are making business. An important aspect about e-commerce is that every transaction done is also digitally stored. This opens a great opportunity for marketing. The millions of transactions that are saved in databases, together with some relevant information about customers, can be converted into extremely important information for decision-making persons in an organization. Based on this information they can improve the efficiency of their companies' marketing campaigns.

The object-oriented framework [1] *VGroups* [2] uses the transaction history and customer information to help create consumer groups for marketing campaign purposes. In this paper, we will illustrate the methodology involved and present an application that creates offerings to specific consumer groups. We use target marketing [3] and software agents [4] [5] to build a tool that automatically selects the best offerings for the target consumer group.

Target marketing is conceptually based on the construction of personalized offerings for specific market segments. These market segments are groups of consumers that share common characteristics, such as people

who live in a same neighborhood, or even persons that share the same consumption patterns and have similar lifestyle. Market segmentation [3] is the process of dividing a market into several segments. After applying market segmentation, a retailer must decide which market segments he is willing to offer services and goods. Usually, this decision is based on the profitability that the retailer can obtain with the chosen segments.

Multi-Agent Systems [4] [5] is a new technology that has been recently used in many simulators and intelligent systems that help humans on several tasks. To achieve the system's goal, agents have to react to events, define strategies, interact, and participate in organizations. Recently, software agents have been used in e-Commerce applications for negotiation purposes [6] [7] and we believe that they can also be used to simulate marketplaces. The simulation can help predict many properties related to consumers and their consumption patterns.

2. The framework *VGroups*

The main goal of the object-oriented framework *VGroups* is to create instantiated applications that encourage consumers to form groups and buy personalized offerings. The union of these consumers give them power to

obtain benefits that would never be achieved by a consumer on his own, such as: reduced prices; gifts; auto-financing; and time-sharing.

The framework has been divided into two subsystems. One is in charge of creating customized offerings, and another creates organizations to encourage people to perform a consumer group transaction.

In this paper, we explore only the *Offering Creation Subsystem*. The main goal of this subsystem is to detect the most appealing offerings for the potential consumer groups. In order to do this, we use software agents, market segmentation and detection of consumption patterns based solely on transactions history and consumer records.

3. The Offering Creation Subsystem

The process of offering creation is the same as predicting what kind of products the consumers are willing to buy in the future. As our prediction tool, we use a multi-agent system that simulates a marketplace and its consumption patterns.

In our system, the sellers of offerings are modeled as software agents. Their goal is to sell the most possible amount of offerings to consumer groups in the marketplace. On the other hand, consumer groups have been modeled as objects and provide a service that is capable of deciding how many persons and total revenue can be obtained by an offering. Therefore, software agents use this service to obtain information of how many consumers would buy the offering.

However, to simulate the decision process of a consumer group, a marketing model has to be developed. This marketing model needs specific data and information. In a digital context, these knowledge pieces are usually obtained through data mining techniques. In our system, a consumer group is considered as a partition of a market segment and every property that can be found for this segment also applies to the consumer group.

Therefore, market segmentation needs to be done in order to discover the key

properties of each segment. We use clustering algorithms in our framework to detect market segments and stereotypical consumption patterns. To obtain additional information about every encountered segment, we perform some extra queries.

The object-oriented framework hot spots [1] of this subsystem are: (1) The segmentation algorithm and the results obtained - different algorithms and diverse data models can produce varied results; (2) Information about the goods that will make up the offerings - a good specification depends on the business a seller is participating; (3) The agent and consumer group in the simulator - this has been made flexible so that different simulators can be constructed.

4. The Bundles.com application

This instantiated application implements the concepts described in the offering creation subsystem. Our first step involves the use of a clustering algorithm for the segmentation process. The chosen algorithm is *Isodata* [8] [9], a very simple and quick implementation of a clustering algorithm. The result obtained is a group of segments, also known as clusters, and the characteristics of each segment.

We use some queries to obtain the following additional information for each segment: number of consumers; total number of transactions; total revenue; distribution of revenue per product class; Minimum dollar amount; Maximum dollar amount. The Minimum (Maximum) dollar amount is the minimum (maximum) price of product class in which all (no) consumers in this segment would be willing to buy it.

The construction of offerings can be considered as an optimization problem. The aim of this problem is to find out the best group of offerings that maximize total return. Our heuristic is to search for the ones that maximize their own fitness (revenue; profit; etc.). Hence, we would like to have an algorithm capable of finding not only the global maximum but several local maxima too.

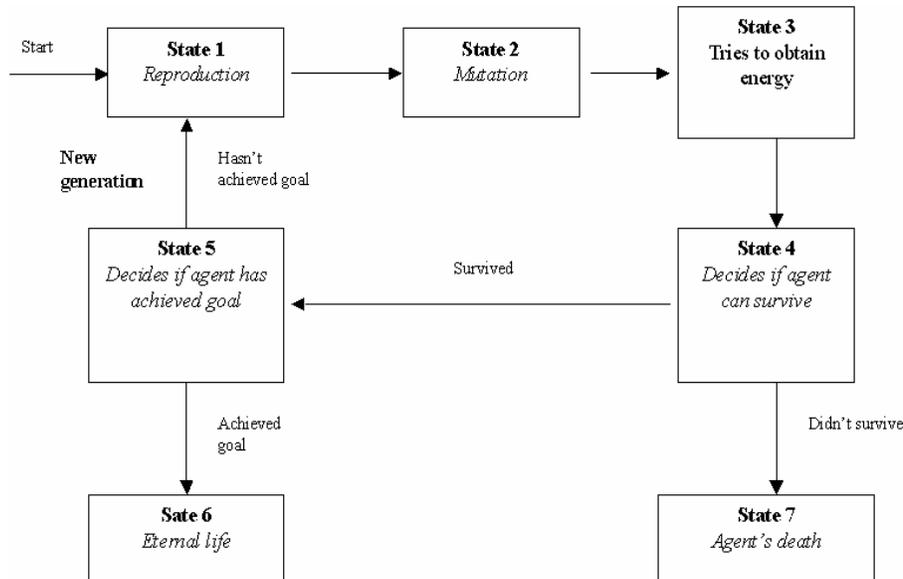


Figure 1 - The agent's state machine

Therefore, we design the agents in our marketplace simulator such that they are capable to discover these offerings, sell them to the consumer groups and maximize the revenue obtained. We use evolutionary agents in our application. These agents are inspired by natural evolution [10]. Only the agents with the best fitness (the same as the offering) survive in the system. The state machine of each agent is in the figure 1.

For every generation that the agent survives, the first state corresponds to reproduction. In this state, an agent swaps products with another agent to create a new offering and an agent offspring. The second state corresponds to mutation, and the new offspring has the same products as his creator but with different characteristics (for example, price). In the third state, the agent tries to sell the offering to a target-consumer group and receives energy equivalent to the amount of revenue obtained. If the agent doesn't have enough energy to survive to the next generation (one of the initial parameters of this system), the agent is auto-eliminated. Otherwise, the agent survives for another generation, and undergoes all the states again. If an agent is able to achieve a certain energy threshold (initial

parameter), this agent and his corresponding offering earn "eternal life". When the agent reaches this state, it stops undergoing states changes involved in the generation. Instead, it only stays in the system for reproduction purposes. In this way, the system can use these "eternal life" agents to produce even better offerings for the consumer groups.

The multi-agent system typically undergoes through the stages described in the graph in figure 2. In the first stage, the energy is abundant and the consumer groups are greedy to obtain offerings from the agents. This causes an initial steep slope in the curve that corresponds to the offerings that have been bought by the consumer groups. In the second stage, there isn't much energy in the system, which forces the agents to evolve and produce better offerings for the consumer groups. In the third stage, the agents have passed through evolution and now possess better offerings. The agents use their offerings to compete for the energy left in the consumer groups. When the residual energy in all the objects is too small, evolution is stopped. Agents that survive until the last generation, output their offerings.

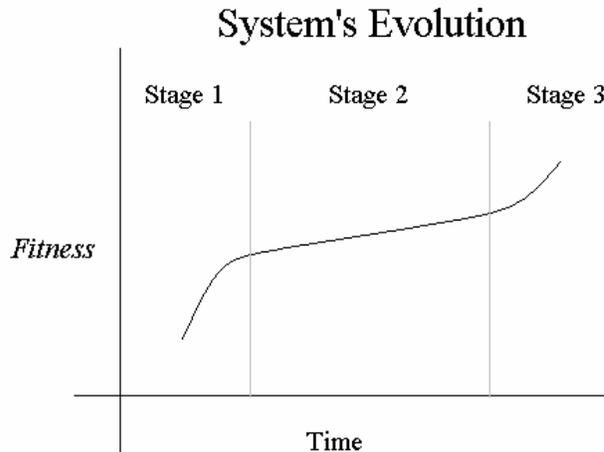


Figure 2 - The system's evolution

5. Final Comments

Using multi-agent system is a good strategy to simulate markets and obtain interesting characteristics from them. In our application, we use the natural evolution paradigm to obtain a list of offerings that can be sold to consumer groups in the future. This technique works very well, but the quality of results is sensitive to: (1) The data mining process - an incorrect information can lead to a very bad simulation in the multi-agent system; (2) The marketing model used in the

consumer group object - if the object is not capable of predicting consumer decisions, the multi-agent system will produce inappropriate results.

The system's evolution graph should have a smooth slope in the first stage. The greedy behavior can be diminished if the consumer group objects are able to analyze a group of offerings before deciding which one to buy. An alternative is to use also agents to represent the consumer groups. This is easily incorporated into *VGroups*.

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