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Evolutionary computing applied to customer relationship management: A survey

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ABSTRACT

Customer relationship management (CRM) is a customer-centric business strategy which a company employs to improve customer experience and satisfaction by customizing products and services to customers' needs. This strategy, when implemented in totality eventually increases the revenue of the company. Traditionally, data mining (DM) techniques have been applied to solve various analytical CRM tasks. In turn, optimization techniques have long been used for training some of the DM techniques. However, during the past few years, evolutionary techniques have become so powerful and versatile that they can be deployed as a substitute for some DM techniques. This trend caught the attention of the researchers working in the analytical CRM area as they too started solving the CRM tasks using evolutionary techniques alone. In this context, we present a survey of evolutionary computing techniques applied to CRM tasks. In this paper, we surveyed 78 papers that were published during 1998 and 2015, where the application of evolutionary computing (EC) techniques to analytical CRM tasks is the main focus. The survey includes papers involving evolutionary computing techniques applied to the analytical CRM tasks under single- as well as multi-objective optimization framework. The purpose of the survey is to let the reader realize the versatility and power of EC techniques in solving analytical CRM tasks in the service industry and suggesting future directions.

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1. Introduction

"CRM is a strategic process of selecting customers that a firm can most profitably serve and shaping interactions between a company and these customers. The ultimate goal is to optimize the current and future value of customers for the company" (Kumar and Reinartz, 2012). Customer Relationship Management (CRM) advocates a scientific method of identifying new customers, nurturing relationships with them, retaining them by satisfying their financial needs and finally making sure that profitable and loyal customers do not attrite to competition. In Dyche (2002), a business oriented perspective to CRM is very well presented in the form of case studies of some of the well known companies. In Ngai (2005) a literature review and classification of CRM is presented from 1992 to 2002. CRM frequently includes offering new and customized products and services, often in a personalized manner to customers. CRM has primarily three components:

(i) Operational CRM (OCRM), (ii) Analytical CRM (ACRM), and (iii) Collaborative CRM (CCRM). The above mentioned CRM components are briefly described with attributes and measures in Iriana and Buttle (2007). Trends, topics and under researched areas are described in Wahlberg et al. (2009). In operational CRM, the service company executes sales and services through various touch points of customers with the help of the knowledge provided by the Analytical CRM component. In a sense, this component subsuming call centers, which are the face of the firm as far as the sales and services are concerned. On the other hand, in analytical CRM, data mining techniques are utilized, subsuming advanced statistical and machine learning techniques, text mining, and web mining techniques, that are employed on the customer data in order to solve various business problems related to customers. ACRM includes customer segmentation, target marketing, product and service recommendation via Market Basket Analysis, credit scoring, default detection, churn detection, customer lifetime value modeling, fraud detection, customer sentiment analysis, customer profitability analysis, etc. In other words, ACRM is the analytical engine which, by way of solving various business problems, achieves customer satisfaction via gaining customer loyalty

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also known as customer stickiness. ACRM also helps in acquisition of customer knowledge (Xu and Walton, 2005). Link between analytics and CRM is manifested in the form of ACRM in that analytics is exploited to enhance customer service by discovering business insights which cannot be obtained otherwise through standard business rules (Artun and Levin, 2015; Chorianopoulos, 2015; Provost and Fawcett, 2013). Before the advent of these analytical techniques, the business problems were solved in an ad-hoc manner using business rules, thereby missing the science part of the whole thing. Finally, in collaborative CRM, CRM is performed while servicing the customer requirements in almost real time (Kracklauer et al., 2004). This involves the implementation of newer technologies such as real-time data warehousing, in-memory analytics, and geolocation analytics. The entire fabric of CRM subsuming all the three components is called holistic CRM In Teo et al. (2006), holistic CRM is applied to housing and development board of Singapore for offering better services. Given the activities of three types of CRM, it is evident that evolutionary computation has a significant role to play in the analytical CRM component for the obvious reason that all the tasks in the ACRM or the business problems can be collapsed into data mining tasks, such as classification, clustering, forecasting/regression, association rule mining and outlier/anomaly detection. Rygielski et al. (2002) presented several data mining techniques which can be applied to solve CRM tasks. For the purpose of this survey, henceforth, we use CRM and ACRM synonymously.

1.1. Customer lifecycle

Typically there are three phases of the customer lifecycle as depicted in Fig. 1. Understanding customer lifecycle is critical to the successful employment of EC techniques in solving the business problems in an analytical way.

1.1.1. Acquire new customers

Acquiring new customers no longer follows mass marketing, that is, wherein every customer, irrespective of his/her needs would be contacted while selling/offering a product or a service. This simply backfires as the optimal customer acquisition method would gather all the customer data, identify an appropriate customer segment, identify their needs and accordingly, customize the products or suggest the available products to the group of customers. This is the concept behind target marketing. Thanks to the availability of sophisticated technologies such as social media analytics, geo-location analytics, and faster analytical techniques, by which nowadays even personalized marketing is feasible. This strategy is being implemented in several service industries.

1.1.1.1. Customer segmentation. Segments are homogeneous gatherings of comparative buyers with comparative needs and desires (Greenberg, 2009). Customer segmentation is the division of customer base into a small number of homogeneous groups that have comparable qualities or attributes. Customer segmentation is an effective tool for recognizing unfulfilled customer needs. Organizations can identify underserved segments and then beat the

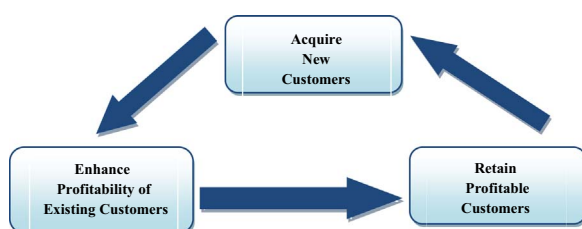


Fig. 1. Customer life cycle.

competition by serving them suitably and growing remarkably in the whole process. Customer segmentation can be termed successful when an organization caters to those segments that are the most profitable. It helps organization practice target marketing and eventually leading to personalized marketing. Amazon, Google, and other such companies already practice one-to-one or personalized marketing. This prioritization can help organizations evaluating techniques to both high- and low-benefit clients (Greenberg, 2009).

1.1.1.2. Direct marketing, customer campaigning and service marketing. Direct Marketing is performed by purchasing the database of customer profiles and immediately showcasing the product to a specific group of customers, whereas, customer campaigning is performed by presenting a product to the customers by way of advertisements, rebates and regular mails (Kotler and Keller, 2012).

Service marketing incorporates showcasing of services to the customer, for example, information transfer services, financial services, rental services, insurance services, expert services, etc. (Kotler and Keller, 2012).

1.1.2. Enhance profitability of existing customers

Profitability of existing customers is enhanced in the following CRM tasks:

1.1.2.1. Customer lifetime value (CLV). CLV or CLTV is also called lifetime customer value (LCV), or lifetime value (LTV). It is one of the important CRM tasks. It is an expectation of the net revenue, through tangible or intangible benefit obtained by future association with a customer. It is the present value of money streams associated with the customer by his/her whole relationship with the organization (Greenberg, 2009). This can be estimated by the recency, frequency and monetary (RFM) aspects of his/her association with the company.

1.1.2.2. Customer profiling based on credit scoring. Credit scoring assessment results in a numerical expression taking into account the individual's credit documents that speak financial status of the individual. The rating is arrived at basically from the credit report data normally sourced from credit agencies. It can also be utilized to profile customers (Greenberg, 2009). Credit scoring assesses the credit worthiness of a customer.

1.1.2.3. Market Basket Analysis (MBA). Market Basket Analysis is based on the hypothesis that many customers tend to purchase a certain group of things together (Han et al., 2011). Therefore, after applying association rule mining algorithms on the customers' transactional data, we obtain association rules which together represent the knowledge. Using this knowledge, the customers who purchased a subset of those products, can also be cross-sold other products, which are not yet purchased by them. Cross-sell and up-sell constitute the MBA. While cross-sell involves recommending those products not already held by a customer, up-sell typically involves recommending the upgraded products in the same category.

1.1.2.4. Fraud detection. Fraud is deliberately acting to deny another from claiming his/her worth for one's own specific benefit. Fraud manifests itself in diverse forms. On the other hand, of late, the technological advancements while providing a lot of comfort and convenience to the customer also leave ample scope for perpetrating technology driven fraud. Detecting and identifying fraud becomes very critical to the profitability and reputation of a firm (Palshikar, 2002).

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