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MDT-Auction: A New Approach for Decision Making to map the best cloud provider to best cloud user

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***Abstract*—The word Cloud has been a buzzword since last few years but there is been lot of confusion happening in the cloud market with respect to selection of cloud provider at the cheapest prize and achieving the highest resource efficiency for the cloud providers. Its always a difficult decision when a customer has to select a Cloud service provider because there are no established guidelines to help to make a decision. We need to consider several, and often conflicting, criteria to compare different Cloud services from multiple providers, the decision is even more difficult. To address this problem, in this paper we propose a MDT-Auction (Microsoft Decision Tree with Double Sided Auction) algorithm which work like decision making system for cloud provider selection problem. The system is designed based on a combinatorial double auction, and its effectiveness and applicability are evaluated in terms of resource efficiency and monetary benefits to auction participants (e.g., cloud providers and users). The proposed methods apply MDT approach to integrate qualitative predicated data with the auction based mechanism. We demonstrate that the MDT-Auction approach provides a robust analysis for cloud provider selection by appropriately trading off predicted selection with criterion, which would give best decision as compare to other systems in market.**

Keywords*—Cloud provider, Cloud services, Decision model, Auction, Provider selection, Microsoft decision tree

I. INTRODUCTION

The Cloud computing is the distributed computing model which provides computing facilities to the users in an on-demand pay-as-you-use model. The decision making has to be done regarding whether to go for only IaaS(Infrastructure as a Service) or Paas (Platform as a Service) or SaaS (Software as a Service) or all the package of all three models together.

The emergence of Cloud computing over the past few years is one of the breakthrough advances in the history of computing. Cloud providers including Amazon Web Services (AWS), Salesforce.com, Microsoft Azure or Google App Engine give users the option to deploy their application over a network of infinite resource a pool with practically no capital investment and with modest operating cost proportional to the actual use. Due to several obstacles however organizations are gradually migrating to the cloud hosting environment. With being a disruptive technology cloud computing adoption is with risks and obstacles [7]. The probable risk for organizations that put Web applications on cloud is that they can decide to move from one cloud environment to another and this change can damage the business scenario considering the increased migration complexity with Web Applications hosted on cloud. Such a decision depends on many factors, from risks, flexibility , scalability costs to security issues and service level expectations [17]. Another critical problem is the complexity of migrating Web application to the Cloud on a technical level while incorporating economical parameters.

There are several key challenges for cloud provider selection problem. First, outsourcing decisions are complex, consisting of both quantitative and qualitative measurement. Effectively consolidating various assessments into one unified proposal is a challenging mission. Second, outsourcing decisions are often made under ambiguity and curtailed information. Lack of complete decision models and techniques to help managers for taking the systematic decisions may lead to incorrect decision making. In this paper, we propose MDT-Auction algorithm which work like decision making system for taking the best decision to select cloud provider at the lowest cost and high resource efficiency.

In next section II we are presenting the ground wirk done in terms of literature survey. In section III, the proposed system and its main block diagram is demonstrated. In section IV we are presenting the current work done i.e. state of implementation and results obtained. Finally in section V conclusion and future work and enhancements are mentioned.

II. LITERATURE SURVEY

A. *Resource Allocation*

The importance of proper resource allocation has been well discussed in various fields such as wireless industry, energy sector, advertisements field etc... which have proposed the allocation and pricing model of resources (e.g., wireless channels [17], [18], electricity [2], [20], and advertisements [1], [21]) to improve the resource utilization and efficiency. We focus on instances in clouds and consider an instance market where computing resources (e.g., bandwidth, memory ,CPU time) are traded as instances. For the resource allocation, there exist several techniques such as Ant colony that provides a heuristic solution of a complex problem [18]); stochastic programming considering uncertainty [23]; and bio-inspired mechanisms (e.g., genetic algorithm that seeks a Pareto solution of a multi objective problem [9] and game theory finding an equilibrium solution among players [10], [6]. We apply the auction mechanism to design the cloud instance market.

Auction-based Mechanism

Resources	Allocation Methods	
	Auction-based	Others
Electricity	[2, 20]	-
Wireless Spectrum	[17, 18,22]	-
Cloud instances	Our work [3,15, 24, 26]	[9,10,11,18,19, 23]
Others	[7,12,13]	-

Table 1: Summary of related work

Auction-based mechanisms have been proposed in various fields such as wireless networks in order to investigate how participants behave in a competition for resources; and different classes of auctions such as sequential second price auction [17], double auction [26], Vickrey auction [16], and combinatorial auction [15] have been considered in the design of the mechanisms. However, none of them considers a group auction and the participants' cooperation. We propose a combinatorial double auction implemented in a group-buying model to analyze the optimal allocation by observing participants' cooperative decisions in a group formation approach.

Collaboration

Collaboration is one of the important concepts to improve the resource efficiency. The distributed the resource management schemes in computational grid were developed with negotiation algorithm [19] and coalition formation algorithm [11]. These schemes allows rational agent managing a server farms to form the collaboration to share resources. The co-operative task scheduling has been proposed in [8]. It was shown that it is always possible to obtain collaborative solution which can improve the total system performance. We are proposing the design to achieve the both cost and resource efficiency. None of the previous work done considered a dynamic auction based allocation by forming a group .

Cloud Instance Market

The proposed work differs from the major cloud hosting services such as Spot Cloud [24], AmazonEC2's Spot Instance [3]. [3] Tries to sells the residual resource to cloud users to achieve high resource utilization. Users join an auction to reserve instance and pays for the resources at a dynamically changing on the spot price offered based on the supply demand circumstances.

B. Data Mining Model Algorithms

Data mining algorithms are the foundation from which mining models are created.

- **Microsoft Decision Trees**: The Microsoft Decision Trees algorithm supports both classification and regression and it works well for predictive modeling. Using the MDT algorithm, you can predict both continuous and discrete attributes.
- **Microsoft Clustering**: Microsoft Clustering algorithm uses iterative techniques to group records from a dataset into clusters containing similar characteristics. Using these clusters, you can explore the data, learning more about the relationships that exist, which may not be easy to derive logically through casual observation. You can also create predictions from the clustering model created by the algorithm.
- **Microsoft Naïve Bayes :** Microsoft Naïve Bayes algorithm quickly builds mining models that can be used for classification and prediction. It calculates probabilities for each possible state of the input attribute, given each state of the predictable attribute, which can later be used to predict an outcome of the predicted attribute based on the known input attributes. The probabilities used to generate the model are calculated and stored during the processing of the cube. The algorithm supports only discrete or discretized attributes, and it considers all input attributes to be independent**.**

III. PROPOSED WORK

Auction System: The main controller records the offers and bids collected from cloud providers and users respectively, and computes how to allocate resources to which users. Figure 3 is a flowchart of the proposed group auction system and shows how the main controller works.

The system undertakes three main tasks such as the allotment computation (Labels 1 and 2), reporting of the results (Labels 3 and 4), and the payment module (Label 5).

Whenever the main controller receives new bids/offers from users/providers, it updates their information at backend database and computes the best allocation model(Label 1) adopting a concept of collaboration among users and providers (described in the following section). If the controller closes the bid/offer submission (Label 2), it reports the recently computed instance allocation to providers(Label 3) and announces who are the winners/losers of the double auction (Label 4). Once the payment module is complete (Label 5), users and providers get connected with each other to run/host services (Label 6).

The instance allocation is formulated as a social welfare problem and the solution is obtained by the proposed group auction algorithm. The formation of both allocation approach and price determination are considered to satisfy major three auction properties as follows:

1. An allocation is efficient if there are no participants who gain utility from decreasing others' utility.
2. An allocation is individually rational if participants are never charged more than their valuations as a result of the allocation.
3. An allocation is best-cost-balanced if the total profits of providers are the same as the total payments by users.

In this system server takes N number of customers or users. In Proposed System we investigate various bidding strategies of participants and also different price determination schemes to know how they impact the monetary benefits to the participants. Those are pre-determined in the current system. This system improves the scalability of our algorithms to accommodate more participants in a reasonable time.

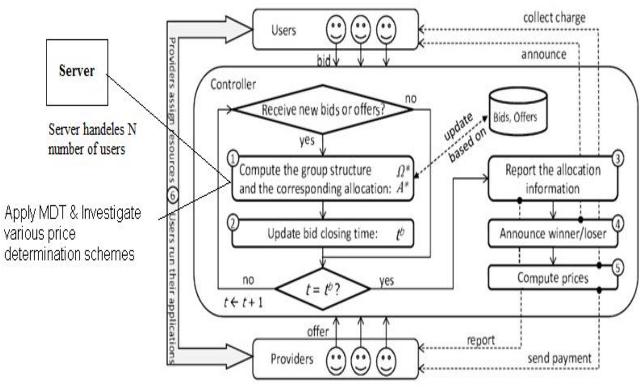

Fig 1: System Architecture

Microsoft Decision Tree (MDT): The Microsoft Decision Trees algorithm provided by Microsoft SQL Server Analysis Services is a classification and regression algorithm for use in predictive modeling of both discrete and continuous attributes.

For discrete attributes, the algorithm makes predictions based on the relationships between input columns in a sample dataset. It uses the values, known as states, of those columns to predict the states of a column that you designate as predictable. Specifically, the algorithm identifies the input columns that are correlated with the predictable column. For example, in a scenario to predict which customers are likely to purchase a cycle, if nine out of ten younger customers buy a cycle, but only two out of ten older customers do so, the algorithm infers that age is a good predictor of cycle purchase. The decision tree makes predictions based on this tendency/pattern toward a particular outcome.

For continuous attributes, the algorithm uses linear regression to determine where a decision tree splits. If more than one column is set to predictable, or if the input data contains a nested table that is set to predictable, the algorithm builds a separate decision tree for each predictable column.

MDT-Auction Algorithm:

Step 1: Gather overall requirements from the cloud user (such as no of CPU requires, storage space , RAM required etc..) and provider (such as total services/offers available, costing details) forming the problem definition.

For example select cloud provider based on key elements like price, availability, reliability etc...

Step 2: Apply MDT based on the criteria gathered from the users/providers and existing dataset i.e. past transactional data of our system consisting of earlier decisions being made by users for selecting best cloud provider and auction results based on best fitment of pricing and resource allocation.

Step 4: Apply double sided auction along with MDT

System S take user requirement as input then apply MDT methodology on it, if same requirements users are found then form group structure then cloud provider decide who is winner or loser and allocate resources to that group of users.

S=Ɛ{MDT, GF, W}
S= System
MDT= Microsoft Decision Tree
GF= group formation
W= winner/ looser

- Cloud Users

A cloud user i submits a bid defined by bi = (~di, ~ℓi, vi) where ~di = (d1i , d2i , . . . , dKi)T is a demand, and dki indicates the number of instances of type k. ~ℓi = (ℓi, ts i ,tei)T is a demand period whereℓi indicates a length of time that the user i wants to reserve a bundle of the instances between starting time tsi and ending time tei .

- Cloud Providers

A cloud provider j submits an offer defined by oj = (~sj , ~ wj ,Qj) where ~sj = (s1j , s2j , . . . , sKj)Tis a supply and skj indicates the number of instances of type k that provider j can provide per time slot. ~ wj = (tsj, tej)T is a supply period2. wj≡tej −tsj denotes a length of time that a provider is able to provide the instances between tsj and tej. Qj is provider j's valuation3 for the supply as an offering price curve, which indicates the minimum of a unit price of the offered instances that the provider wishes to sell. It is defined by a set of vectors over different number of instances and instance types as follows: Qj = (~q1j , ~q2j , . . . , ~qKj) where ~qkj = (qkj [1], . . . , qkj [nkj])T ,and qkj [n] indicates the offering price when n instances of type k are sold by provider j, andqkj [0] = +∞. ~qkj holds a condition qkj [1] ≥ • • • ≥qkj [nkj]. Let Qj[~nj] denote an extraction of the price curve when ~ nj = (n1j , n2j , . . . , nKj) instances are sold, which is represented as a row vector
Qj[~nj] = (q1j [n1j], q2j [n2j], . . . , qKj [nKj]).

- Group structure

Group structure is denoted by t is represented as a partition _t with a set of associated links Lt between users and providers. The partition is a set of groups defined by _t = (G0,G1, . . . ,Gm, . . . ,GM) where Gm = {Gum,Gp m}, the m-th group of users Gum and providers Gp m. G0 indicates a group of users without provider.

IV. RESULTS AND ANALYSIS

Here we have shown result analysis of our system, which is better than existing/manual systems. Following graph shows comparison between MDT and manual search system based on time taken on web. In Following graph parameter describes as x axis represents No. of providers and y axis represents as time taken by system to give best cloud decisions.

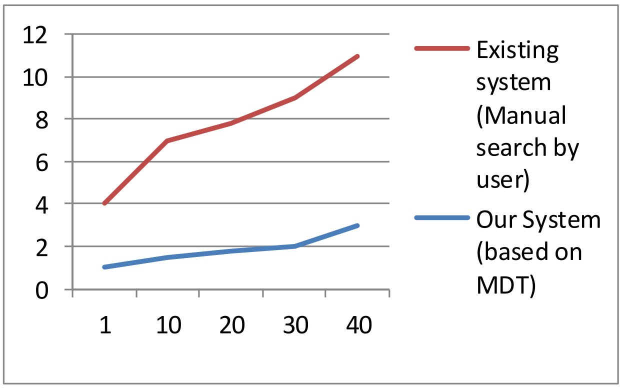

Fig 2: Comparison between systems

Following graph shows comparison between MDT-Auction with MDT decision making system. Graph shows time taken by system to give decision cloud to user. In graph x axis represents no. of user in system and y axis represents time taken by system to give decision resources to users. Graph shows group auction system is more time efficient than existing system.

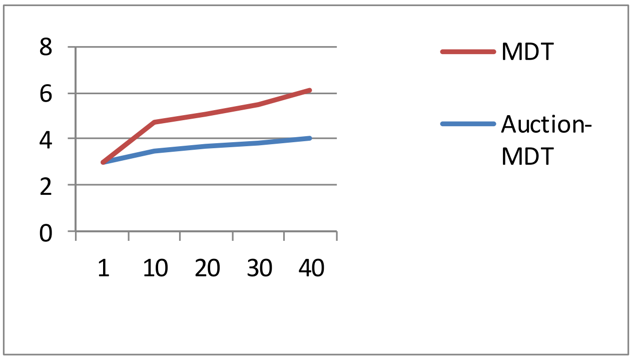

Fig 3: Time efficiency of Auction-MDT

V. Conclusion

The research work and various publications consider that Cloud Computing has benefits, issues, risks, and challenges. But all agree that organizations suffer when choosing which Cloud services they will contract, which reveals a generic and important problem. So as part of the solution to this problem we have implemented MDT-Auction algorithm, which gives best decision to user to achieve the highest cost efficiency and resource efficiency.

Regarding future work, more research effort related to the different Cloud models could be used in order to create criteria catalogues that could be applied to different Cloud models, such as SaaS, PaaS, and IaaS. In addition, our proposal can be further improved by developing a software tool with the professional real time tie up with various cloud service providers in market.

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