LIGHTWEIGHT VALUE ASSESSMENT AND CROSS ENTROPY (VACE)-BASED PROFIT IMPROVEMENT SCHEME IN CLOUDS

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Abstract
The fundamental objective of a cloud supplier is to make benefits by offering types of assistance to clients. Existing benefit improvement techniques utilize homogeneous client models in which client character is overlooked, bringing about less benefits and especially outstandingly lower client fulfillment that thusly, prompts less clients and decreased benefits. In this paper, we propose productive character mindful solicitation planning plans to boost the benefit of the cloud supplier under the requirement of client fulfillment. In particular, we first model the assistance demands at the granularity of individual character and propose a customized client fulfillment expectation model dependent on polls. Hence, we plan a character guided whole number direct programming (ILP)-based solicitation booking calculation to boost the benefit under the limitation of client fulfillment, which is trailed by a rough however lightweight worth appraisal and cross entropy (VACE)- based benefit improvement plot. The VACE-based plan is particularly custom fitted for applications with high booking goal.
Index terms – profit maximization, user request scheduling, user personality, multi-server system.

Introduction

Driven by virtual technology, cloud computing has become a popular IT business model that delivers various hardware and software resources to the cloud users on demand in a pay-as-you-go manner over the Internet [1]. Cloud computing has facilitated the development of cloud providers across the globe and has created a variety of computation models for pervasive and ubiquitous applications [2]. In the context of cloud computing, the cloud provider aims at maximizing its profit while users demand a high quality of cloud services. As more and more cloud providers are available to cloud users, maximizing profit while satisfying heterogeneous users in a competitive cloud market has become a huge challenge for cloud providers.

Profit improvement can be achieved by either increasing revenue or reducing cost. Effective pricing mechanisms are used to increase revenue, while diverse cloud resource management schemes are used to reduce costs. With regard to pricing, various models [3], [4], [5] have been proposed to better adapt to changing cloud service demand, which brings great benefits to the increase in cloud providers' revenues. However, existing pricing mechanisms are user independent, thus fail to incorporate user characteristics or personality. User personality in psychology is used to describe the individual differences in the pattern of thinking, emotion, and behavior [6]. In the cloud service market, different users have different requirements for service price and quality of service (QoS). Service price and QoS are two key factors that users are most concerned about. Thus, existing pricing strategies that ignore user personality may result in degraded QoS for users and reduced revenue for cloud providers. With respect to cloud resource management, diverse energy-efficient cloud platform configuration mechanisms and request scheduling schemes [7], [8], [9],[10] [11] [12] have been designed to avoid energy waste incurred by over-provisioning of available resources or inefficient scheduling of requests. However, these works often adopt uniform service level agreements (SLAs) standard that assumes a unified personality or QoS for all customers, leading to increased cloud service platform maintenance costs. To further the profit maximization, we can model and exploit the heterogeneity of user personality via modeling user preference as a function of price and QoS.

In this paper, we investigate a personalized cloud pricing strategy and two service request scheduling mechanisms. Essentially, the cloud provider will greatly benefit by prioritizing resources towards critical users with higher QoS requirements as opposed to the users who could accept a lower QoS. For example, for users who prefer QoS to service price, the cloud provider could provide users with higher QoS and charge a higher service price to increase revenue. For users who prefer service price to QoS, the cloud provider could reduce infrastructure operation costs by using lower configurations of servers and charge users a lower service price. Thus, for users with different personalities, it is crucial to design personalized pricing strategy and judiciously schedule the service requests of personalized users such that the profit of the cloud provider is optimizedwhile personalized user requirements are satisfied.

Literature survey

Most cloud providers adopt static pricing schemes. Under this pricing strategy, service price is fixed, thus opportunities for increasing revenue by raising price under high market demand may be missing. Amazon EC2 has launched a pricing mechanism called "spot pricing" that dynamically adjusts spot price for a virtual machine (VM) to reflect supply and demand in cloud market. However, Xu et al. [3] observe that the spot pricing may not work well to match supply and demand. Thus, they propose a market-driven dynamic pricing scheme to maximize revenue. Similarly, Mac et al. propose a genetic algorithm for dynamic resource pricing by capturing the changes of cloud market. However, the complexity of cloud market greatly increases the computational cost of pricing algorithms and the market details are not readily available.

Resource auction is a pricing method that does not need market details and allows users to compete and price freely. Zhang et al. propose an auction mechanism based on smooth analysis and random reduction for dynamic VM pricing in a geographically distributed cloud data center. Also, Jiang et al. design a novel bidding language and an online cloud auction framework to efficiently price cloud resources. However, users may influence the auction results and gain unfair advantages by malicious bidding or hiding their preferences for cloud resources. These behaviors destroy the auction experience of other normal users and significantly reduce the efficiency of auction.

Energy-efficient cloud resource provisioning schemes and user request scheduling mechanisms are important for cloud providers to manage cloud resources. Cao et al. [7] investigate the problem of optimal multiserver configurations (e.g., server size and server speed) to avoid over-provisioning of available resources for profit maximization in cloud computing. However, their multiserver platform is homogeneous. Liu et al. [8] explore cost-minimized heterogeneous multiserver configurations for cloud providers, in which the servers are different in terms of CPU cores, memory sizes, etc. These works adopt simple task scheduling discipline, i.e., First Come First Serve (FCFS), to serve the service requests submitted by users.

Nevertheless, different service request may have different requirements for execution delay, that is, some may be delay-sensitive while some may be delay-insensitive. In this way, FCFS may be an inefficient scheduling scheme to serve requests with different delay requirements. Sundar et al. propose a heuristic algorithm to schedule dependent tasks of an application under the constraints of communication delay and deadline to minimize the cost for cloud providers.

Different from the above works, Yuan et al. [9] investigate cost-effective task scheduling problem in the hybrid cloud environment, and design a temporal task scheduling algorithm to schedule tasks under the constraint of execution delay to reduce energy consumption of cloud data center. These works save the cost of cloud providers via reasonable resource provisioning and efficient task scheduling. However, they ignore the role of customer satisfaction in cloud profit optimization. Customer satisfaction influences customer retention, thus further affects its revenue. Low customer satisfaction will result in a decreased number of customers and reduced revenues of providers. For cloud providers, a naive solution to improving customer satisfaction is over-provisioning of available resources to meet the peak demand of users. However, this solution may result in low resource utilization during periods of low user demand. Thus, a more effective solution is to guarantee customer satisfaction of a limited number of users during peak workloads. Instead of adopting double renting scheme, Cong et al. [4] develop a reward model for users and a penalty model for cloud providers to guarantee service quality and satisfy users. The above works do not take user

UGC Care Group I Journal
Vol-08 Issue-14 No. 01 : 2021

personality into account. In essence, user personality has a great impact on cloud profit optimization since users with different personalities usually have different requirements for service price and QoS with respect to cloud services. In this way, these personalized users would achieve high customer satisfaction at different service prices and QoS levels. Thus, fully exploring the characteristics of user personality is critical for cloud providers to improve customer satisfaction.

Proposed system

Figure 1 presents an overview of our proposed solution to the profit optimization problem. For cloud users, we first study the personality of a user using Big Five personality traits, in which each trait corresponds to a character. The score of each trait could be measured by TIPI, which is a questionnaire consisting of 10 items that inquiry questions about user personality. Based on user personality score, we then explore the effect of user personality on the preference for service price and QoS by investigating user satisfaction under different service price and QoS levels. Finally, we construct a personalized service request model and propose a user satisfaction model to predict QoS and service price users are satisfied with. For the cloud provider, based on personalized service request model and user satisfaction model, we build revenue model and cost model, respectively. Afterwards, we formulate the profit maximization problem for the cloud provider under the constraint of user satisfaction.

To solve the optimization problem, two efficient request scheduling schemes are designed, respectively. The first one is an optimal but time-consuming integer linear programming (ILP)-based algorithm while the second one is an approximate but lightweight value assessment and cross entropy (VACE)-based algorithm. In particular, the VACEbased algorithm adopts the concepts of present value and opportunity cost in economics to evaluate the values of service requests during the scheduling process, thus speeding up the optimization process. If an application demands high scheduling resolution (i.e., small scheduling interval), the VACE-based algorithm is an appropriate option to obtain a near-optimal solution with low time complexity. Otherwise, the ILP-based algorithm could be adopted to obtain an optimal solution at the cost of high time complexity.

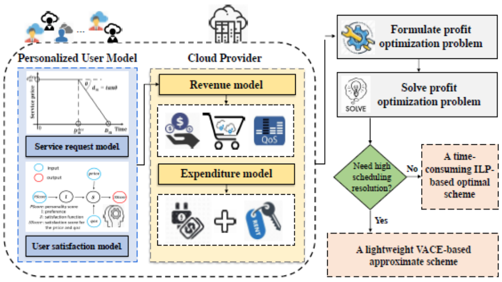

Fig. 1: An overview of the proposed approach.

Implementation Modules

Cloud Users

- In this module, the cloud users are two type 1. owner and 2. user.
- In this users are register and login to the system.
- In this cloud user view the services and send the service request to the cloud providers.
- The cloud provider view the users requests and renting the resources from infrastructure providers.
- Then the owner is upload the data to cloud server based allocated resources and the user can access the data from cloud server.

Cloud Providers

- In this module, heterogeneous users submit their service requests to the cloud provider, receive the desired results from the cloud provider, and pay for the service based on service amount and service quality.
- The cloud provider handles users' service requests by renting resources (e.g., servers) from the infrastructure provider.

- In this, cloud provider login to system, view users and authorize, add cloud resources, add server information, view uploaded data, view user requests, and view all transactions details.

Infrastructure Provider

- In this module, heterogeneous servers are modeled as a multi-server system, in which each server is characterized by a given supply voltage-frequency pair.
- A service request queue with infinite capacity is maintained by the multi-server system for waiting requests when all the servers are busy.
- In this, the infrastructure provider login and view the users, view server status, and view the requests of the cloud provider.

Algorithm 1: ILP-based profit maximization algorithm

Input: User request set Γ, server set Φ, and scheduling vector $T \triangleq [T_1, T_2, ..., T_K]$
Output: Total profit T_{Profit} generated in all time slots

$T_{Profit} = 0$;
for $i = 1$ *to* K **do**
  Update request set Γ in service request queue Q;
  Set request properties based on user personality;
  Update state of servers in Φ by calculating servers' available time;
  Generate request allocation $\Gamma \to S$ by addressing the problem defined in Eqs. (23)-(31) using ILP solver;
  Calculate $Profit_i$ using Eq. (13);
  $T_{Profit} = T_{Profit} + Profit_i$;
  $i = i + 1$;
end
return T_{Profit};

Algorithm 2: VACE-based profit maximization

Input: User request set Γ and server set Φ
Output: Schedule X and resultant profit γ
Initialize PDF to $f(x, p_0)$ and iteration count t to 1;
while $t \le t_{max}$ **do**
  Generate Z allocations based on PDF $f(x, p_{t-1})$ using Latin Hypercube Importance Sampling;
  for Z allocations **do**
    Assess values of requests on servers by Eq. (39);
    Prioritize requests based on value assessment;
    Generate request schedule;
  end
  Select K schedules satisfying the constraint in Eq. (26);
  Calculate the profits of K schedules using Eq. (13);
  Select N_{elite} schedules with maximum profit;
  Update the profit threshold γ_t using Eq. (34);
  Update PDF $f(x, p_t)$ of the next iteration by Eq. (35);
  if $\gamma_{t-k} = \gamma_{t-k+1} = ... = \gamma_t$ **then**
    break;
  end
  $t = t + 1$;
end
return γ_t and corresponding schedule;

Conclusion

In this paper, we propose efficient personality-guided user request scheduling schemes for cloud profit maximization. More specifically, we first establish personalized user model and cloud provider model, based on which a profit optimization problem is formulated. Then, we propose a user personality-guided satisfaction prediction technique based on questionnaires. Subsequently, we formulate a satisfaction constrained profit maximization problem and design a time consuming ILP-based optimal request scheduling scheme, which is followed by a lightweight VACE-based approximate scheme tailored for applications with higher scheduling resolution.

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