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Performance Development of E-Learning Cloud Environment Using User Behavior Analysis Model Based Service Selection Approach

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Abstract: The problem of E-Learning has been well studied in different occasions and there are many approaches has been studied. The Cloud E-Learning environment has the problem of service selection where there exist numerous amount of services available for the same topic of interest. To overcome the issue of service selection, we propose a novel User Behavior Analysis Approach based service selection for the development of cloud E-Learning. The proposed method monitors the behaviors of the E-learning users, in various forms like the service access frequency, the time spent in each E-Learning Tutors, Set of all Actions performed in both implicit and explicit manner. The monitored results are used to perform service selection, by computing the service interest weight which is computed using the frequency of access and the actions performed. The services will be ranked using service weight which is computed based on the service access frequency and the monitored implicit and explicit factors. The proposed approach has produced efficient result in cloud e-learning and reduces the irrelevant results and increases the user interest in cloud e-learning.

Key words: User Behavior Analysis · Implict /Explicit Tracking · E-Learning · Service Ranking · Service Selection

INTRODUCTION

The development of internet technology enables the electronic learning which makes the internet users to learn through the electronic world wide web. The E-Learning is the process of learning any subject or gathering any information through the web and there are many educational institutions enforced e-learning concepts, so that the students of the university could be able to learn through the web upon registration. The growth of cloud computing has been identified as a optimal platform where the resources can be deployed and accessed through internet by the external world.

Generally the same topic of interest may be generated as webinar by different tutors. These webinars are the result of services and the user can view the webinar through the internet or the user can view the web pages which has information about the topic. But not all the seminars of all tutors are accepted and liked by the cloud learners. Some of the seminars presented by certain tutors may be liked and viewed by many peoples or learners. So the problem is to identify the service which returns such webinars and topics to the users, so that the user can learn the topic in efficient manner.

The human nature in learning process is the behavior of the learner, the learner spends more time in the seminar or webinar only if he likes the way of teaching or he understood what the tutor is saying. In sometimes the user may perform number of actions like viewing the service many times, spending more time on that and so on. These are considered as the behavior analysis which can be used to identify the user interest.

The activity of any user can be split into two types namely implicit and explicit. The implicit behaviors are the time spent on the web page, the number of times the user viewing the web page. Similarly the actions like copy, book marking, printing and saving the page can be considered as the explicit actions. These implicit and explicit actions can be used in ranking the cloud services and ranking them accordingly.

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The Elearning services can be ranked by different methods, like number of access, the number of times the user has utilized the service and so on. Eventhough there exist N number of services present in the cloud for the same topic, the method has to select the appropriate service to fulfill the request of the user. The service selection method has to enforce efficient measures in choosing the service. How the service can be selected from large set of similar service is, by ranking them according to any specific measure. The services can be ranked according to their completeness measure and service weight. According to the computed service weight the services can be ranked and viewed to the user, from which the cloud user can choose an optimal service to learn the topic.

Related Works: There are many approaches has been discussed for the development of Cloud E-Learning and Service selection. We discuss few of them here in this section.

Cloud-Based E-Learning: A Proposed Model and Benefits by Using E-Learning Based on Cloud Computing for Educational Institution [1], discuss the current state and challenges in e-learning and then explained the basic concept and previous proposed architectures of cloud computing. In this paper authors also proposed a model of cloud-based e-learning that consists of five layer, namely: (1) infrastructure layer; (2) platform layer; (3) application layer; (4) access layer; and (5) user layer. In addition to this paper we also illustrated the shift paradigm from conventional e-learning to cloud-based e-learning and described the expected benefits by using cloud-based e-learning.

The Cost Effective Structure For Designing Hybrid Cloud Based Enterprise E-Learning Platform [2], provides a cost effective structure of hybrid cloud architecture that has been implemented the multi-tenant model for enterprise to support customization sharing among different virtualized applications in a tenant area. The schema-sharing and multi-tenant data storage architecture also supports the learning content delivery. The important basis for the design method of software development shall embed with the cost effective structure, such as using multithreads to compute background processing and unzip the content files to reduce brand width usage. Even the file sizes of learning content shall be zipped to the less small size and duplicate to different servers for cutting down the traffic flow of brand width. The detailed calculation of the all I/O computer processing and brand width become the crucial implementation way.

Implementing Motivational Features in Reactive Blended Learning [3], presents a significant advance in a reactive blended learning methodology applied to an introductory control engineering course. This proposal was based on the inclusion of a reactive element (a fuzzy-logic-based controller) designed to regulate the workload for each student according to his/her activity and performance. The contribution of this proposal stands on the inclusion of elements related to motivational factors in the students. Student motivation has been widely identified as a key factor for the academic success of every teaching-learning activity.

E-Iearning as a Service: A New Era for Academic Cloud Approach [5], describes my proposed architecture model of academic cloud and gives the idea of e-learning as a service. This describes how the cloud computing can be used effectively in e-learning process and sharing of resources of the academic institutes and providing the close overlook on protection of open access networks in higher educational institutions and the vision of technology for education.

A Generic Agent Based Cloud Computing Architecture for E-Learning [6], it can serve as academic expert and manages creation of programming environment for learners. There are many characteristics that an E-learning environment has to support; they are Interaction, Data Security, User Personalization, Adaptability, Intelligence, Interoperability, Accessibility and User Authentication. E-learning must also support a few other features like cost effectiveness, reusability, storage capacity, powerful computing and virtualization which can be provided by Cloud computing. Cloud computing is everywhere these days, pick any blogs, journals, papers. The Cloud computing Architecture is built using three models, Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS), which provides a variety of services. This proposed architecture integrates the features of Agents and Cloud Computing to produce an Agent based Cloud Computing Architecture to enhance e-learning.

A Novel Approach for Adopting Cloud based E-learning System [8], presents a framework that specifies a number of steps for academic institutes as well as organizations to adopt cloud computing. The framework is designed by taking into account a range of strategic

issues and technological factors from a broad cross section of areas of expertise in order to ensure a successful cloud computing adoption.

Shareable E-Learning Platform based on Cloud Computing [9], introduces Cloud computing into an e-Learning platform to allow the integration of different e-Learning standards to enhance interoperability of learning objects. By combining the characteristics of e-Learning and approach of Cloud computing, educators have not to re-construct learning objects to satisfy e-Learning environments developed from different e-Learning standards.

Towards an Effective Integrated E-learning System: Implementation, [10], presents a new blended e-learning model and quality assurance framework for an efficient implementation in higher education with concentration on online engineering. In addition, a new integrated competency level is presented to ensure the teacher/instructor readiness for the new e-learning environment. The proposed model and framework successfully incorporates all the above elements.

SOA and Cloud service Provisioning Framework [12], implementing service oriented architecture (SOA) underlines computing as a service by leveraging internet technology such as web service. Cloud computing is promoted as the type of distributing computing that will provide anything from basic computing need to high end delivery of IT services. Hence in this paper we consider two areas of distributed computing architecture, cloud and SOA by discussing the principles and how this fits into our framework to optimised provisioning of SOA over Cloud.

Budget-Aware e-Learning Systems on Cloud Computing Environments: A Genetic Approach [13], algorithm that allows the learner to find the best curriculum that fits his budget is introduced. This algorithm is proposed for cloud computing environments that have the concept of pay-per-use. Genetic algorithms are adopted in the proposed solution. The proposed algorithm is able to find the best set of learning objects that constitute the required curriculum. The returned curriculums have the best available experts' rank and fit learner's budget. Simulation results show that the proposed algorithm is able to find solutions very close to optimal solutions and in most cases identical to them.

A New framework Semantic Web Technologies based E-learning [13], present study about how to extract the useful information on the web and also give the superficial knowledge about semantic web and categories. This paper describes a previous model for E-Learning and proposes a new framework for the same.

Towards a Cloud-Based Data Storage Medium for E-learning Systems in Developing Countries [14], propose a cloud computing data storage model for E-Learning systems in developing countries. Cloud computing is an information technology platform that refers to services which provide data storage, collaboration and software execution hosting services via the Internet. Cloud computing is a technology trend that has a significant impact on the teaching and learning environment. The idea behind this research work therefore is to enhance the storage capacity and utilize resources of E-learning system for universities in developing countries. This platform incorporates cloud data storage medium to accommodate/store all educational content/files on the E-learning system.

Enhanced Federation and Reuse of E-Learning Components Using Cloud Computing [15], explores cloud computing for federating and combining the e-learning components to achieve the benefits of cloud computing: its low cost, its storage capacity, its high security and its availability. This paper proposes an approach based on the cloud computing technology for the federation of personalization efforts. Through this approach the user can easily access the reusable learning components from anywhere and anytime.

All the above discussed approaches has the problem of identifying the exact E-Cloud services and has to problem in constructing the service than verify them.

Proposed System: The proposed user behavior analysis based service selection approach has different stages namely User Behavior Analysis, Service Ranking, Service Selection. We explain each of the functional component in detail in this section.

The Figure 1, shows the architecture of the proposed system and it shows the functional components which will be discussed in detail here in this section.

User Behavior Analysis: At this stage, the method monitors the user activity in E-learning. Whatever the service is being accessed by the cloud learner, the method identifies what service the user is using the how long he is using the service and the actions like copy, save, bookmark on the web content of the cloud service. The identified implicit and explicit behaviors are generated as a feature vector and added to the service trace, which will be used in performing service selection in future.

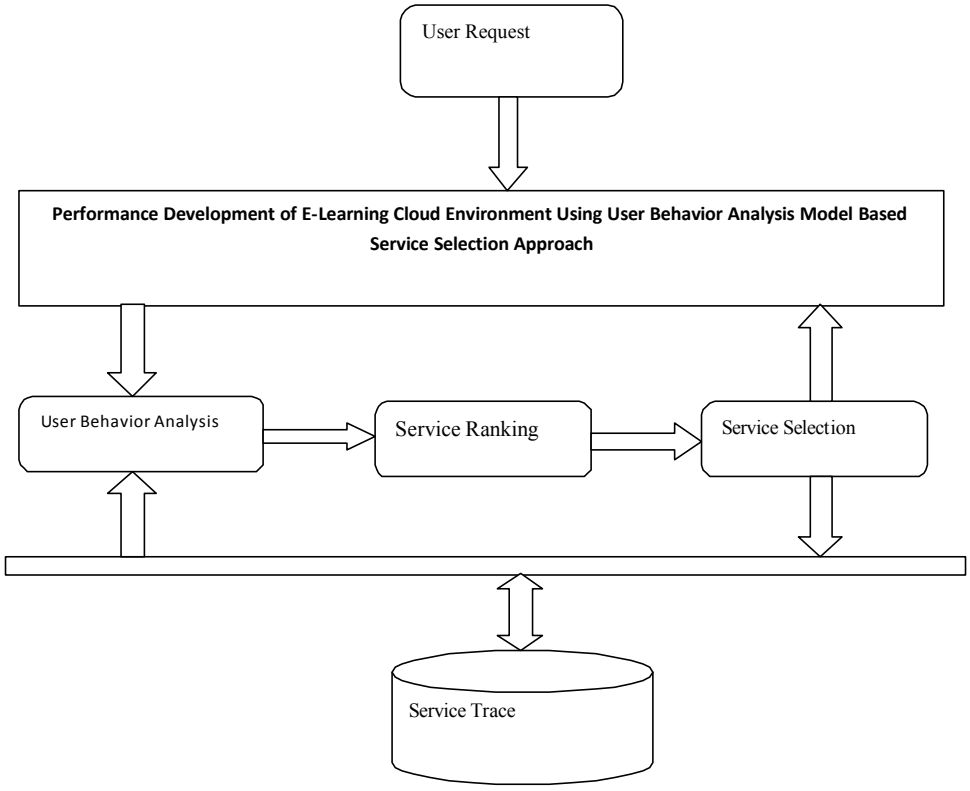


Fig. 1: Proposed System Architecture

Algorithm:
Input: Service Request Sr.
Output: Feature Vector Fv.
Start

Send the service request to the user.
Compute the time spent on the service page Ts = (*Time.Start – Time. Stop*)
Compute Actions performed ActSet = $\sum${*copy, save, bookmar*} >> *webinar*
generate feature vector fv = {serviced, Ts, ActSet}.

Stop.

Service Selection: Service selection is performed according to the analyzed user behavior in each service by the user. For each service the method computes the service access weight using the features like copy, save, book mark and the time spent and the frequency of service being accessed. Using all these the method computes the service access weight or service interest weight for each of the unique service. The computed value will be given to the service ranking algorithm which ranks the service according to the service weight and based on the ranked service the result will be produced.

Algorithm:
Input: Service Trace St, Service Request Sr.
Output: Result Rs.
Start

Identify similar services SS = $\sum_{i=1}^{size(St)} St(i).serviceId == Sr.Serviceid$

for each service Si from SS

Compute service access frequency SAF = $\frac{\sum_{i=1}^{size(St)} St(i).serviceId == Si}{size(St)}$

compute number of actions performed Nap.

Nap = $\frac{\sum_{i=1}^{size(St)} \sum(St(i).serviceId == Si) \cup \sum ActSet(Si)}{\sum(St(i).serviceId == Si)}$

Compute Average Time Spent ATs = $\frac{\sum_{i=1}^{size(St)} \sum(St(i).serviceId == Si) \cup \sum Ts(St(i))}{\sum(St(i).serviceId == Si)}$

Compute Service Interest Weight SIW = SAF× $\frac{ATs}{Nap}$

Add to Results set Rs = $\sum ServiceWeight(Rs) \cup SIW$

End

Stop.

Service Ranking: Service ranking is the process of ordering similar services according to the service weight, so that the cloud user can choose an optimal and efficient service. From the given service interest weight set, the method ranks the services according to the service being accessed with more service access rate. With the service access rate, the method computes the repeated interest score for each of the service. Using both the measures the services are ranked and popped to the user.

Algorithm:
Input: Service Access Rate Set SARset, Service Set SS
Output: Ranked Results RR.
Start

for each service Si from SS

compute repeated interest score RIS = $\frac{\sum_{i=1}^{size(St)} \sum st(i).serviceId == Si \cup St(i).user == UID}{Size(\sum st(i).serviceId == Si)}$

Compute Service Population Score SPS = SAR(Si)×RIS

End

Sort the services according to SPS.

Populate the Services.

Stop

RESULTS AND DISCUSSION

The proposed user behavior analysis approach based service selection and ranking approach has been implemented and tested for its efficiency. The proposed method has produced efficient results in all the factors of quality of service.

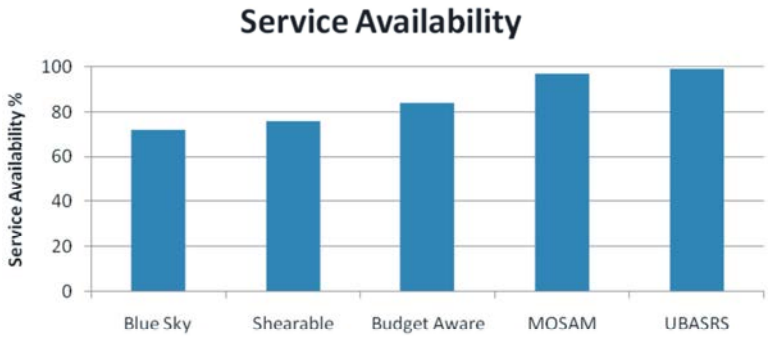
The Table 1, shows the implementation details of the proposed multi objective self analysis model for efficient E-Learning in cloud environment. There are 500 e-learning services available and I consider about 5000 users. The services are deployed in Hadoop environment and the lookup has been performed by advanced java.

Table 1: Implementation Details of proposed method.

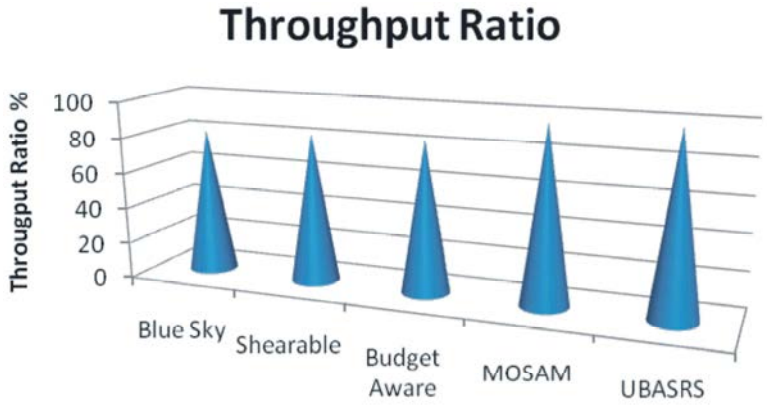
Parameter	Value
Domain of Implementation	Hadoop
Programming Language	Advanced Java
Number of services	500
Number of users	5000

The Graph 1 shows the comparison of service availability measured between different methods. It shows clearly that the proposed method has produced higher service availability than other methods.

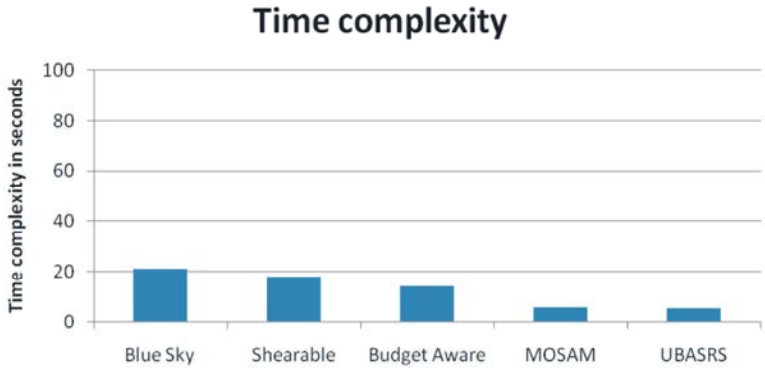
Throughput Ratio: The throughput is the ratio computed based on number of times the service has been assigned and the number of times it has finished successfully.



Graph 1: Comparison of service availability



Graph 2: Comparison of throughput ratio



Graph 3: Comparison of time complexity of different methods.

Throughput Ratio TR = $\frac{Number\ of\ times\ finished\ successfully}{Total\ number\ of\ times\ assigned.} \times 100$

The Graph 2 shows the comparison of throughput ratio achieved by different methods. It shows clearly that the proposed method has produce more throughput than others.

The Graph 3, shows the comparison of time complexity produced by different methods and it shows that the proposed method has produced less time complexity than others.

CONCLUSION

We proposed a novel user behavior analysis model based service selection and ranking framework to improve the performance of E-Cloud learning system. The method computes the service access rate using various attributes of service from the service history. The method uses the time spent, actions performed, the access rate of each service to compute the service access rate. Based on computed service access rate, the method selects a small set of services to be ranked. The ranking algorithm computes the service repeated interest score for each of

the score using the service access rate, it computes the service population score. Based on the service population score the services are ordered and populated to the user. The proposed method produces efficient results in all the factors of quality of service of cloud computing. The proposed method has reduced the time complexity of service access than other methods.

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