The Teaching Resources Recommendation System Research Based on Java EE

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Abstract: With the growing popularity of teaching resources platform construction, various forms of teaching resource materials more and more, how to provide users with intelligent recommendation of teaching resources is a key issue. This article will be introduced to the trust relationship neighbor recommended an improved algorithm recommendation algorithm, designed to ease cold start recommendation system, we recommend that affect the process of distrust. The recommendation that the improved algorithm is applied to Java EE-based teaching resource recommendation system, effectively improve the system of teaching resources recommended to the user efficiency and accuracy, improve the real-time requirements so that online learning system.

Keywords: Trusts, Recommended Neighbor Algorithm, Java EE

1. Introduction

Personalized recommendation is based on the characteristics of the user's interests or purchase, recommendation information to the user or commodities of interest to the user. Personalized recommendation is to use existing Web user behavior information, establish binary relations between Web users and product information by Web users and Web users, between Web users and information products similar, relevance and relationships to dig discovery process for each potential user interest in information products, and then to Web users personalized recommendation service, is essentially an information filter, screening [1]. It is based on Web user's preferences, interests, etc., to provide information on its products with personalization features recommendations to help Web users information product selection decisions, reducing the Web user's time and effort, improve decision-making efficiency [2].

March 1995, Carnegie Mellon University's Robert Armstrong et al proposed a personalized navigation system WebWatcher in American Association for Artificial Intelligence (AAAI) spring session, through the user select the "link" or "site" in tracking learning, improve the quality of navigation. At the meeting, the personalized recommendation system LIRA by Stanford University, Marko Balabanovic et al Release rate [3]. At present, the distance learning mode to some extent to break the limitations of time and space teaching activities, but there are still some problems. Student users can not quickly and accurately choose their study materials is an important issue which needs to be addressed. Based on Java EE framework, is a country with advanced technology and the concept of teaching resources recommendation system, students can use the system to understand the architecture-related courses, view and download handouts, courseware and other relevant learning materials; teachers over the network systems management related teaching resources upload courseware and related materials. Java EE development platform widely used e-commerce platform, its market share has the absolute advantage, most large enterprise information platform will choose Java EE platform to build. It has a stable performance and high scalability, maintainability.

2. Java EE and MVC

Java EE (Java Platform, Enterprise Edition) is dominated by the SUN JAVA Enterprise Edition JCR making. Java EE is the follow-up version of the J2EE version of the newborn and the development of J2EE technology. Java EE technology has all

the features of the J2SE platform, but also provides full support for EJB, Servlet, JSP, XML and other technologies. The ultimate goal is to become a Java EE architecture to support enterprise-level application development, enterprise solutions simplify the development, deployment and management of complex issues [4]. It uses a multi-layer distributed application model, application logic into components according to function: the first controller component that provides a front-end controller core, which is responsible for intercepting a user request and forwards the request to the user to achieve the controller components. The controller component responsible for processing method calls the business logic, process user requests; the second type of business logic components that implement business logic system, generally use Session Bean to achieve. In general, a business logic corresponding to a user operation method. A business logic methods should be an integral, called for increased transactional business logic methods [5]. Business logic method is only responsible for implementing business logic, database access is not recommended; the third category EAO components, namely Enter Access Object, physical access to the object, which provides the system Entity (entities) increased, query, modify, delete and other operations, these operation corresponds to the data table CRUD and other atomic operations; fourth category Entity objects, Entity abstract object model of the system, under normal circumstances, the status of these areas must be objects stored in the database, so that each Entity mapped to one or a plurality of data tables; fifth presentation layer components, is responsible for collecting user input data to the client system status. Now more common presentation layer technology is JSP, can also have Velocity, FreeMarke technology complete [6].

EJB (Enterprise Java Bean) is the core of the whole Java EE platform specifications, business processes and other related support. 2005 Sun released the Java EE 5 specification (by the J2EE 1. 5 edition changed its name from), the biggest change is the simplified EJB specification: EJB3 0, contains the JSF 1. 2 specification, is formally introduced JSF the MVC solution. EJB 3 is released, absorbing the advantages of Spring, Hibernate and other open source frameworks, abandoned the much-criticized Entity Bean, JPA specification to use as a persistence layer solutions, it supports Annotatio dependency injection, also supports the interceptor mechanism, on the nature of the interceptor mechanism is a lightweight AOP (Aspect Oriented Programming) implementation. EJB architecture is developed based on a component architecture and configuration of distributed business application components using the EJB architecture developed applications are scalable, transactional, multi-user security [7] [8].

The MVC (Model, View and Controller) is Xerox PARC in the 1980 s as a programming language Smalltalk - 80 invention of a software design pattern, has been widely used Web application framework. MVC (Model, View, Controller) is a software design pattern Xerox PARC in the 1980s as the programming language Smalltalk-80 of the invention, it has been widely used Web application framework. MVC is not the Java language specific design ideas, is not a Web application

specific ideology, it is all object-oriented programming language should comply with the norms. MVC process: first controller receives the user's request, and to determine the main system management application interfaces with the outside world. On the one hand it provides a means for the external input and triggering application logic run; on the other hand, it is in turn the result of the logic operation is displayed to the outside world in some form [9]. The controller is the link between the model and the view, the view controller extracts the external information transmitted by coming in, and turn it into a response to the call to your model for processing, then the model handle user requests and return data, and finally call the appropriate controller view model data is returned, and presented to the user through the presentation layer. JSF (Java Server Faces) by well-constructed MVC design pattern into its architecture to ensure that the application has more maintainable [10].

3. Personalized Recommendation Algorithm

With the rapid development of Internet technology, Internet products has been greatly popular in the world. People use a lot of history along with the produce. How to effectively use a user's history, digging. User preferences become a big issue. Birth recommendation system is to recommend to the user like a real user body. After ten years of development, the system has now recommended in many areas has been successfully applied.

3.1. Preparation

Similarity. Similarity refers to the number of specific indicators relative unity scale, Applying Fuzzy principle, to determine the reference value, draw a similarity with the standard value of items on different indicators, accordingly judge a prediction score of the article method. The similarity measure is the degree of similarity between two individuals [11]. There are many similarity calculation method, according to the characteristics of this article, this article uses the similarity Pearson (Pearson Correlation, PC), this method is a method to eliminate the difference between the mean and variance effects. This method takes into account Rating intersection standard deviation, as shown in equation (1),

$$PC(i, j) = \frac{\sum_{u \in u_{ij}} (r_{ui} - \overline{r_i})(r_{uj} - \overline{r_j})}{\sqrt{\sum_{u \in u_{ij}} (r_{ui} - \overline{r_i})^2 (r_{uj} - \overline{r_j})^2}} \qquad (1)$$

r_{ui} is the user u of the item i score, r_{uj} is the user u of the item j score, $\overline{r_i}$, $\overline{r_j}$ is the average value of all ratings for the evaluation of items i and items j, u_{ij} said at the same time by the user u score items i and items j.

Nearest neighbor selection. Nearest neighbor method was first proposed by Cover and Hart in 1968, the basic idea is:

Given a test document, the system has been classified a good training set to find its nearest K neighbors, according to the category distribution of these neighbors get test document category [12]. This article selects K nearest neighbor selection method is Top-N method, which refers to the similarity in descending order among users, select the highest similarity K user group consisting of the target user's neighborhood [13].

Trust. Today, the Internet age, we believe that trust is the object of the transaction to comply with trading rules on the basis of objective facts of past transactions based on subjective probability forecast [14]. Trust is a measure of the size of this possibility. This article contains the local trust and confidence in global trust, trust in local preferences indicate the differences between the two users, namely the preferences of the same user has a strong local trust, the formula is:

$$T_1(u,v) = \frac{Correct(u,v)}{Total(u,v)} \tag{2}$$

$Total(u,v)$, which indicates that the user u and v have a common score of the number of projects, $Correct(u,v)$ said users u and vtwo have scores of projects, the number of users of u to make the right to recommend v users. While the global trust that users in the whole system activity, formula:

$$T_2(u) = \frac{2(1 - \frac{1}{\ln f_u})(1 - \frac{1}{\ln(q_u + 3)})}{2 - \frac{1}{\ln f_u} - \frac{1}{\ln(q_u + 3)}} \tag{3}$$

Among them, f_u is the total number of user u in the system, q_u is the number of users u to become the nearest neighbors of other users [15].

3.2. Recommendation Algorithm Based on Nearest Neighbor

Collaborative filtering method depends on the content of the system in the system by other users to score [18, 31, 49, 52, 67, 73, 82]. The key point is that if the user u and user v in other items on the score is very similar, then the user u on the new item i score and another user von the new item i score is similar. Similarly, if other users of the item j and item i to a similar score, then the user u will give these two items similar ratings [16]. Collaborative filtering methods can be roughly divided into two categories: Based on nearest neighbor method and model based method. Based on the nearest neighbor algorithm is widely used and collaborative recommendation method, because it is a simple and effective algorithm.

Neighbor user recommendation method to predict user u on new items i score based on r_{ui}, and the user is the use u in the same items i as scores of users, these users and user u with similar interests called nearest neighbor. Assume that ω_{uv} is used to express the user u and v in the same degree. K of user u nearest neighbor, that is, K and user u similarity. ω_{uv} maximum user v can be expressed as $N(u)$. Also in

these users only on item i made a score of user can't be used in evaluation score r_{ui}, so we consider K and user u interest and close to the items i have made a score of user instead of the original k nearest neighbor definition, and writing $N_i(u)$ [17]. Therefore, these weights can be standardized, so that the predictive score r_{ui} can be used to obtain the average score of i of the nearest neighbor.

$$\hat{r}_{ui} = \frac{\sum_{v \in N_i(u)} \omega_{uv} r_{vi}}{\sum_{v \in N_i(u)} |\omega_{uv}|} \tag{4}$$

3.3. Improved Recommendation Algorithm

The success of collaborative filtering recommendation depends on a large number of rich and efficient user ratings in the system. But if the user - item rating matrix is very sparse, it becomes difficult to find similar users, which can lead to the sparse problem of collaborative filtering recommendation method. In addition collaborative filtering recommendation may also suffer from the cold start of new users or new resources, because there is no relevant scoring information in the system and can not get the forecast information [18]. The cold start problem will influence the recommender system performance, thereby affecting the trust of users of the system, so the goal of this paper is to get more accurate teaching resources recommendation system, through continuous research and summary, this article will trust algorithm into neighborhood-based user rating recommendation, aims to give personality to recommend better recommendation algorithm.

Compound formula recommended improvement algorithm process can be divided into steps: Step 1, collect users get the corresponding data; step 2, with the formula (1) similarity algorithm to get the similarity of users, user similarity matrix; step 3, by the formula (2) and (3) the user trust model and get the user trust degree matrix; Step 4, the sparse user similarity matrix and user trust degree matrix composite dense composite matrix, composite matrix value for the current user generated recently adjacent network, adopting the combination method such as equation (5) shown; Step 5, the user generated recommendation list, the list of users in descending order of scores of resources.

$$H(u,v) = \alpha \times S(u,v) + (1 - \alpha) \times T_{uv} \tag{5}$$

Among them, $S(u,v)$ is the user v and user u similarity, T_{uv} is the user u and user v trust, α is the composite coefficient, $\alpha \in [0,1]$, α of the specific value, this paper choose to 0.5.

3.4. Evaluation Algorithm

After the implementation of the teaching resources recommendation system, this paper carries on the

evaluation experiment to the recommendation model, selects the MAE algorithm and the NDCG algorithm two kinds of evaluation algorithms as the evaluation algorithm of this system. MAE algorithm is the average value of the error, which is an off-line evaluation algorithm, used to predict the results and the actual user of the deviation between the scoring. Formula for:

$$MAE = \sqrt{\frac{1}{|\tau|} \sum_{(u, i) \in \tau} (\hat{r}_{ui} - r_{ui})^2} \qquad (6)$$

NDCG algorithm is a kind of online evaluation method to evaluate the correlation between search results and users' search [19]. Formula for:

$$DCG = \frac{1}{N} \sum_{u=1}^{N} \sum_{j=1}^{J} \frac{g_{ui_j}}{\max (1, \log_b j)} \qquad (7)$$

$$NDCG = \frac{DCG}{DCG^*} \qquad (8)$$

4. The System Structure and Implementation

4.1. Structure of Teaching Resource Recommendation System

Based on the characteristics and needs of users of teaching resources, the system includes the following modules: user management module and teaching resource management module, its functional modules as shown in Figure 1. User management module includes management of user rights and add and delete user management functions. Resource management module is the key to teaching resources system, is mainly responsible for resource search, resource evaluation, recommended resources, resource upload and download resources to meet the needs of users.
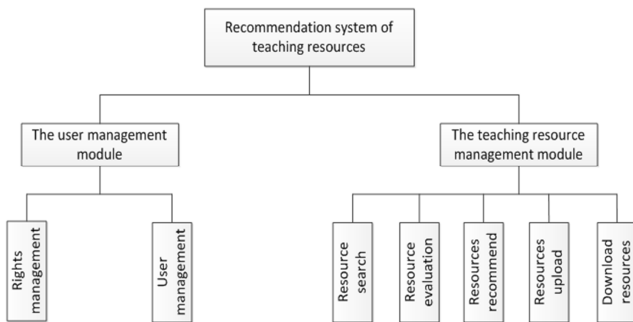

Figure 1. Teaching resources system function module chart.

Users of the system, including system administrator, teacher and student. The system administrator is responsible for teaching resources for processing, it is also responsible for the management of users, management and rights management resources. Student user permissions are searching resources, browse resources, evaluation resources. Teachers user permissions are uploaded resources, resource search, browse resources, evaluation resources.

The system provides functions including browsing resources, retrieve the resource, Resources and Evaluation resources. Users can browse resources in accordance hobby interest resources. When users browse or search the teaching resources of interest when, under the authority resource settings, you can open a browser directly, you can also be downloaded. At the same time, users can used to evaluate teaching resources. Resource evaluation feature allows users to participate in the supervision of the quality of teaching resources, it can also get interest on certain types of resources from the user's evaluation information. The more resources evaluation system to give the user more accurate recommendation [20].

4.2. Implementation of Teaching Resource Recommendation System

4.2.1. Persistence Layer

JPA is a Java-based persistence solutions, mainly to solve the various ORM - is not compatible between the (object-relational) Framework issues. It is proposed in the Java EE specification persistence interface, while it also brings together the advantages of the existing categories of Java persistence solution, the main purpose is to standardize and simplify the Java object persistence window.

The total of 34 entities for teaching resources Recommended system data table, the table corresponding to the entity class needs to provide Getters / Setters, that is to create a POJO (Plain Old Java class), such as:

```
public class User {
private Integer userId;
private String userName;

public Integer getUserId() {
return this. userId;
}
public void setUserId(Integer userId) {
this. userId = userId;
}
public String getUserName() {
return this. userName;
}
public void setUserName(String userName) {
this. userName = userName;
}
}
```

This system annotation is used to implement the ORM, this method is flexible and convenient, but also for sexual characteristics. Such as the @ Entity annotation defined Entity class, edit runtime containers will be responsible for the persistence and the management maintenance;@Table annotation specifies the database tables by mapping, such as the userName entities and the user in the database. Table to establish a mapping relationship, in defining the userName entities, using the @Table, such as @Table (name =

"userName"); For example the relationship between entities in the @OnetoMany, @ ManyToOne, @ OneToOne, @ ManyToMany annotation one-to-many, and many-to-one, one-to-one and many-to-many relationships.

JPA entity is responsible for managing the only entity class and mapping between data table, but the JPA cannot know which database operation, It's need to configure the persistence. xml persistence unit. Must be in the META-INF/persistence. xm. The XML, to indicate the outline of the persistent version is as follows:

```
<?xml version="1. 0" encoding="UTF-8"?>
<persistence version="2. 0"
xmlns="http://java. sun. com/xml/ns/persistence"
xmlns:xsi="http://www. w3. org/2001/XML
Schema-instance"
xsi:schemaLocation="http://java. sun. com/
xml/ns/persistence
http://java. sun. com/xml/ns/
persistence/persistence_2_0. xsd">
...
</persistence>
```

Listed below is the basic configuration, persistence unit code is as follows:

```
<persistence-unit       name="student">       <provider>org.
hibernate. ejb. HibernatePersistence
  </provider>
  <jta-data-source>jdbc/studyms</jta-data-source>
  <class>com. studyms. entity. Resource</class>
  <class>com. studyms. entity. Resourcecomments</class>
  <class>com. studyms. entity. Resourcemessage</class>
  <class>com. studyms. entity. Resourcescore</class>
  <class>com. studyms. entity. Resourcetype</class>
  <class>com. studyms. entity. User</class>

  <properties>
  <property name="hibernate. dialect"
  value="org. hibernate. dialect. MySQL5Dialect"/>
  <property name="hibernate. connection. driver_class"
  value="com. mysql. jdbc. Driver" />
  <property   name="hibernate.   connection.   username"
value="root" />
  <property   name="hibernate.   connection.   password"
value="root" />
  <property name="hibernate. connection. url"
  value="jdbc:mysql://localhost:3306/studyms"/>
  <property name="hibernate. hbm2ddl. auto"
  value="update" />
  </properties>
</persistence-unit>
```

<persistence-unit> element's name attribute to provide when creating EntityManagerFactory keywords, <provider> element specifies the javax. mail. Persistence. PersistenceProvider the fully qualified name of a class of the interface, <jta-data-source> element is used to refer to the data source, <class> element shows listed entity class, <properties> element is vendor-specific properties, here basically is to use Hibernate configuration, the configuration database driver and database name, database password, and database url, etc.

4.2.2. Business Logic Layer

Business logic from the presentation layer accepts user requests input, convert it into a business process needs to start conditions, depending on the business logic and orderly manner sending the data request to the data layer and the data layer returns required data interpretation and combined into user information returned to the user interface layer, play a role in connecting link

Business logic of the system package business logic built using EJB technology, and as a presentation layer technology, JSF entrance. Because stateless EJB's simple and efficient characteristics, so the use of stateless Bean to handle CRUD JPA entities (add, delete, modify, query) operation. Stateless EJB best suited in a single method call must finish the job of work, no state services provided independently, without information or status from one request to another request. Stateless Session Bean survival in a container, all the services you can use container-managed, such as dependency injection, management and other things. The @persistencecontext annotation is dedicated to inject the entity manager's reference, stateless session Bean can directly enjoy the persistence context, the benefits of the transaction management. Using the @Stateless annotation POJO would turn into a Stateless session Bean, such as:

```
@Stateless
public class UserService{
@PersistenceContext（unitName="student"）
private EntityManager em;
}
```

Such as the src/com. Studyms. Service/UserService. Java used to handle user entity CRUD operations, the code is as follows:

```
...
public UserService() {
}
@SuppressWarnings("unchecked")
public List<User> findUsers() {
Query query = em. createNamedQuery("findAllUsers");
return query. getResultList();
}
...
public User createUser(User user) {
em. persist(user);
return user;
}

public void deleteUser(User user) {
user = em. merge(user);
em. remove(user);
}

public User updateUser(User user) {
return em. merge(user);
}
```

Which findUsers () is used to return all users, createUser

(User User) is to create User, deleteUser (User User) used to delete users, updateUser (User User) is used to update the User.

4.2.3. Presentation Layer

The content of the presentation layer is used to display to the user, the link between the presentation layer and business logic layer [21].

The presentation layer of the managed Bean. Through the managed Bean to invoke the EJB corresponding interface, to deal with the real business logic.

The presentation layer of this system is implemented through the JSF, mainly composed of Facelets template. In JSF1. X version, Facelets only used as a substitute based on JSP view. Since JSF2. 0, Facelets has replaced the JSP, JSF default view technologies. In the use of Facelets tag, need in the JSF page add a namespace declaration as follows:

xmlnsLui=”http://java. sun. com/jsf/facelets”

Every Web application has its own unique style, all pages within a Web site has the same layout and style. Facelets will jointly layout and style of packaging in a template, so, can change the template to update the look of your web site, without the need to update web pages one by one.

For example, define base Templet template, the template to use HTML < table > tags define the page layout. Among them, the top part of a display logo, header section is responsible for the display page menu, leftmenu partly responsible for the display on the left menu, content section is responsible for the display page body content, bottom part is responsible for displaying the copyright information. The role of the < UI: insert > tag is inserted into the content into the template.

```
<h:head>
<h:outputStylesheet library="css" name="styles. css" />
<title><ui:insert name="windowTitle">
<h:outputText value="Recommendation system of teaching resources" />
</ui:insert></title>
</h:head>
<h:body>
<ui:insert name="javascript">
</ui:insert>
<table class="layout">
<tbody>
<tr>
<td colspan="2" class="layouttop"><ui:insert name="top" />
<h:graphicImage url="#{resource['images/logo. png']}"
title="Recommendation system of teaching resources"
height="107" width="123"/></td>
</tr>
<tr>
<td colspan="2" class="layoutheader"><ui:insert
name="header" /></td>
</tr>
<tr>
<td class="layoutmenu"><ui:insert name="leftmenu"
/></td>
```

```
<td class="layoutbody">
<h:messages layout="table" style="margin-left:
auto;margin-right:auto;"
errorClass="msgs error" fatalClass="msgs fatal"
infoClass="msgs info" warnClass="msgs warn" />
<br />
<ui:insert name="content" />
</td>
</tr>
<tr>
<td colspan="2" class="layoutfooter"><ui:insert
name="bottom">
<h:outputText value="Copyright information here " />
</ui:insert></td>
</tr>
</tbody>
</table>
</h:body>
```

According to different roles, define different templates. Administrator user, for example, you can use the basic template, the header of a page based on this template definition, leftmenu part and bottom part [22] [23].

5. The Experimental Results and Analysis

This data is 20 users teaching resources recommendation system test. Due to the number of users is not many, the data is less, and there are random errors, but the data still can objectively shows the effect of the algorithm. Algorithm is compared with the system is based on the contents of the recommendation algorithm and rule-based recommendation system. The MAE algorithm results are shown in Figure 2:
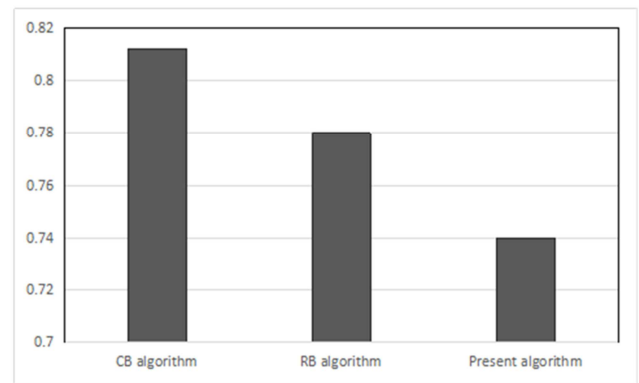

Figure 2. *MAE algorithm comparison chart.*

Can be seen from the above results in the recommendation algorithm used in this system than the other two algorithm precision. MDCG algorithm results are shown in Figure 3:
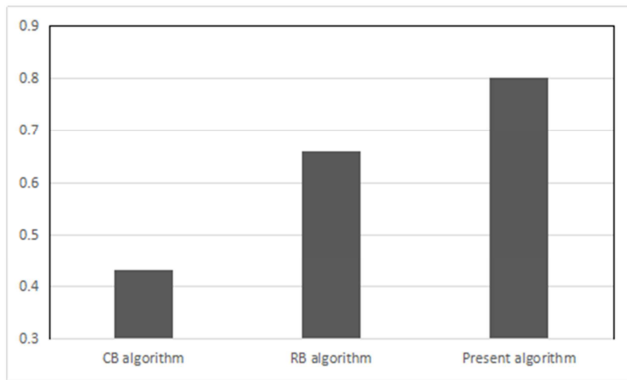
Figure 3. MDCG algorithm comparison chart.

This system can be seen from the above algorithm is much bigger than that of the contrast of the algorithm. MAE algorithm to describe the accuracy of recommendation algorithm, and NDCG algorithm can describe the order of the recommended results, two algorithms complement each other, meet the needs of the system, can be applied to the system.

6. Conclusion

In this paper, Java EE technology-based, constructed a teaching resource recommendation system. System according to the specific circumstances of the student user is the user recommended teaching resources, to achieve a personalized education for students with a good learning environment, according to each student's specific circumstances, recommend learning content to meet the learning needs of students. Teaching methods to overcome the single-sided disadvantage. Its use can effectively shorten the time for each student learning, improve teaching quality and efficiency, optimize the teaching objectives. Table 1 is a result of specific Java EE experiment, Table 2 for the SSH results, in order to facilitate comparison of the experimental results, this paper produced a line chart.

Table 1. Java EE experimental result table.

Number of User	MS
20	2537
40	2702
60	3403
80	3740
100	4402
120	6096
140	10020
160	14023

Table 2. SSH experimental result table.

Number of User	MS
20	2325
40	2406
60	2670
80	2889
100	3107
120	4156
140	6102
160	10010

Figure 4 shows the average response time based on the Java EE framework and SSH systems, test scenario is the client information query program.
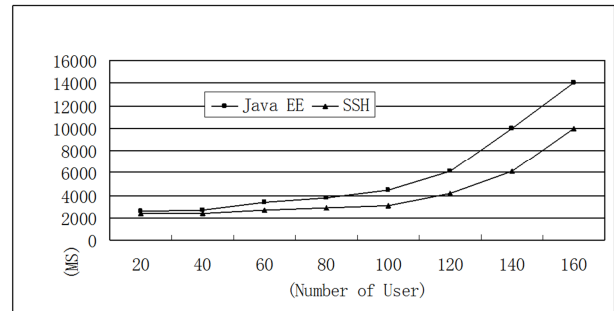

Figure 4. AART curve.

In analysis, curve in figure 4 we can find that, this paper puts forward the solution of the system response time according to the curve of slow increase, until you reach 100 users, growth curve. My solution compared with synthetic solution, the solution of SSH framework of system response time increases according to the linear way, until you reach about 100 users, while the Java EE framework of solutions of the system response time is growing faster than SSH, is relatively stable. Through the analysis of the changing trend of curve, in performance test, maximum limit the number of users is 100, so meet the needs of the application service.

The Java EE framework and SSH framework and there is no essential difference, the difference between them before just the differences of implementation technology, and the Java EE framework suitable for application in large enterprises, while the SSH framework suitable for application in small and medium enterprises.

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