Embedded Intelligent Elderly Care System Based on Deep Learning

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Abstract: At present, the elderly care service industry has the problems of low information integration and low data utilization. To solve the above problems, building an embedded pension service platform is one of the most effective means. This paper constructs an embedded pension service model based on deep learning. In this paper, a multi-objective optimization recommendation algorithm based on artificial immune is used to generate service recommendation candidate sets. Develop an embedded personalized elderly care service platform according to the candidate set. This paper makes a detailed demand analysis and functional module design of the elderly service recommendation system, and finally designs and implements the embedded elderly service system. The experimental results show that compared with the user based collaborative filtering algorithm and the improved collaborative filtering, the highest accuracy of this method is improved by 0.09 and 0.07 respectively, and the highest service satisfaction is improved by 2.05 and 2.4 respectively. This method has certain reference value for the research of embedded intelligent elderly care system based on deep learning.

Keywords: Pension Service; Embedded Model; Multi-Objective Optimization Recommendation Algorithm; Data Fusion

1. Introduction

At present, the number of old people in China has increased rapidly [1]. In the 20 years since China entered the aging society, the number of old people has increased by 110 million [2-3]. In order to reduce the economic pressure of the elderly on the family and society, and reduce the impact of the elderly on social stability, China's old-age service system is gradually formed. According to the main providers of pension services, the pension service system is divided into family pension service system, community pension service system and social pension service system [4-5]. In order to meet the material and spiritual needs of the elderly, there are a large number of different types of services. China has put forward the service mode of "Internet + elderly care", and many elderly care service platforms have emerged in the society [6]. With the help of Internet technology, it provides the elderly with a variety of elderly care services including medical care, life, social networking, entertainment and finance [7]. In order to quickly find services suitable for the elderly, the platform will provide a recommendation module, and use different recommendation algorithms to recommend services for the elderly. However, most of the platform recommendation strategies have some shortcomings. First of all, in order to improve the accuracy of the recommendation results, most platforms only recommend popular products, resulting in the long tail effect of services [8]. Many unpopular services cannot be found by users independently, greatly reducing the selection range of users. At the same time, the resource utilization rate of the platform also decreases; Secondly, the platform will have a user cold start problem. When a new user logs in to the platform, it will be difficult to recommend because there is no behavior data of the user; In addition, most recommendation systems only focus on the accuracy of recommendation results, ignoring other criteria of recommendation results. Finally, the structure of domestic pension service platform is not perfect, many of them only introduce service products and lack service recommendation modules [9].

The above problems mainly describe the shortcomings of the current recommendation system and technology. In order to solve the problems described above, we need to use the deep learning method to mine the characteristics of the elderly and elderly care services, find the hidden relationship between them, and conduct multi-objective optimization on the recommendation results [10]. Finally, recommend suitable services for the elderly, improve the elderly's dependence on the platform, and also improve the utilization rate of system resources.

2.Methods

Traditional recommendation methods, such as user based collaborative filtering method and item based collaborative filtering method, have the basic idea of calculating the similarity between users and items through user scores or item labels. The user based collaborative filtering method is to find users similar to the target user in the system first, and recommend the services used by users with similar interests but not used by the target user to the target user. The collaborative filtering method based on items is to calculate the similarity between items and recommend services with high similarity to the services used by the target users to users. However, there are many problems in traditional recommendation algorithms. Cold start and data sparsity are common problems in traditional recommendation algorithms. In the field of elderly care services, there will be particularity in the data. The elderly care institutions will grasp the basic information of the elderly and various information such as physical functions. Therefore, only the basic attribute information of the elderly can be used for feature extraction, effectively solving the problem of users' cold start and data sparsity.

The generation model of recommended candidate sets of elderly care services based on deep learning needs to obtain the basic attribute information of the elderly and elderly care services and the user rating information from the elderly care service platform. The content of the elderly includes information such as the gender, age, occupation, self-care ability, spouse and monthly income of the elderly. The content of the elderly care service includes the price, service type and service content information of the elderly care service.

The elderly feature extraction process is as follows:

(1) Input data into embedded layer.We convert the fields of the basic attribute information of the elderly into numbers and use them as indexes of the embedded matrix. In the neural network, the role of the embedding layer is to map the word index to the low-dimensional word vector for representation. Through the embedding layer, the feature vectors of the elderly can be obtained. Each attribute of the elderly is represented by a: {A1, A2, A3,..., an}, and the user attribute feature vector a is obtained through the embedding layer, as shown in formula (1).

$$\overline{a} = ReLU\left(w_1 a + b_1\right) \quad (1)$$

Where ReLU represents the activation function, b1 represents the offset, and w1 represents the weight. In the neural network, the activation function needs to be used so that the output of each layer is nonlinear. If there is no activation function after the input in the neuron, the final output is linear no matter how many layers the neural network has.

(2) Each attribute feature is input to the full connection layer. The basic information feature vector of the elderly is transferred to the full connection layer, and the attribute features of the elderly are combined to obtain the final elderly feature. The ei formula of the elderly feature value is shown in formula (2).

$$e_i = concat\left(\overline{a}\right) \quad (2)$$

The function of concat layer is to splice the input data.

Research on multi-objective optimization of elderly care service recommendation algorithm

In the recommendation system, most of the traditional recommendation methods only care about the accuracy of the recommendation results, but only considering the accuracy can not fully meet the needs of users. And for the recommendation system itself, it is not advisable to use the accuracy to measure the quality of a recommendation system. In order to meet the accuracy of recommendation, many platforms generally recommend popular services, which makes it difficult for users to find many services, resulting in long tail of services, waste of resources and low utilization. Therefore, this paper proposes a multi-objective optimization recommendation algorithm based on artificial immune. The purpose is to recommend accurate and novel

services to users, and improve the utilization rate of resources and the surprise degree of users. There are many evaluation indicators for the results of the recommendation system, including the accuracy, recall, F-harmonic rate, novelty and diversity of the recommendation results.

The accuracy of the recommendation result represents the user's satisfaction with the final recommendation result of the system. The accuracy of the recommendation result indicates that the quality of the recommendation system is high and can meet the user's needs. The accuracy expression of the recommendation result is shown in formula (3).

$$Precision = \frac{\sum_{u \in U} |R \cap T|}{\sum_{u \in U} |R|} \quad (3)$$

Where precision represents the accuracy of the recommendation result, R represents the service recommended by the system for the user, and T represents the service actually used by the user.

The novelty of the recommendation result indicates the ability of the recommendation system to recommend non popular items to the user. The expression of the novelty of the recommendation result is shown in formula (4).

$$NOV(u) = \frac{|R|}{\sum_{i \in R} k(i)} \quad (4)$$

Where NOV represents the novelty of the recommendation result, R represents the service recommended by the system for the user, and k (i) represents the novelty of the ith service in the recommendation list, that is, the number of people who have evaluated the service. The fewer people have used the service, the smaller k (i) and the higher the novelty.

The candidate set is taken as the initial population of the multi-objective optimization recommendation model in this chapter. The specific steps of the algorithm are as follows:

Step 1: randomly generate N antibodies as population Ct, t = 0, and set the maximum number of iterations as gmax;

Step 2: calculate the affinity between Ct antibodies of the population, and find out the dominant antibody according to Pareto optimization to form the dominant population Dt;

Step3: when t ≥ gmax, the algorithm ends and output Dt; otherwise, t = t + 1, proceed to step 4;

Step4: Clone according to the proportion, cross with the crossover probability Pc, and mutate with the mutation probability Pm to obtain the population Bt;

Step5: merge the population Bt and Dt into Ct, and return to step 2;

According to the above steps, the pseudo code of the multi-objective optimization recommendation model is shown in Table 1.

The experimental parameter settings are shown in Table 2. The candidate set size is the candidate set set size output by the deep learning model, and the value is 300; The crossing probability is generally 0.9-0.95, and the variation probability is generally 0.001-0.1. The parameters are adjusted for the experiment. In this paper, when the crossing probability is 0.9 and the variation probability is 0.1, the experimental effect is the best; The maximum number of iterations is 200; The length of the recommendation list is 10; Accounting for 20% of the superior species; The clone population was 50.

3. Results

The overall structure design of the elderly care service recommendation system mainly includes the following four parts: (1) elderly care service recommendation: the main function is to provide the recommendation function for the user. According to the data type required by the feature extraction model, define the import data type. The system will obtain the basic information of the user, the basic information of the elderly care service and the user rating information. First, we should obtain the basic information of the elderly and pension services, and preprocess the data; Use the processed data to establish a feature extraction model for the elderly and a feature extraction model for the elderly service. After selecting the appropriate elderly service, the elderly service recommendation model can provide the user with the recommendation function, and the final recommendation results can be viewed; The system includes the management of recommendation logs and system logs. (2) Interactive interface: including platform portal browsing, pension service information viewing, recommendation results viewing, pension service provider information

viewing, data acquisition and log viewing. The elderly can view the provider information through the elderly service recommendation system to understand the elderly service information provided by the elderly service provider. After logging in to the platform, the service provider executes the elderly care service recommendation process according to the obtained data, establishes a recommendation model, and obtains and views the final recommendation results. The interactive interface of the elderly service recommendation system displays information to users through the platform portal. (3) Data center: the data center stores all data of the elderly care service recommendation system, including basic data, elderly care service data, recommendation model, user data, scoring data and service provider data.

The system developed in this paper adopts B / S architecture and MVC development mode as a whole. The page adopts portal style, JSP layout and CSS rendering. The background is developed using the wake framework based on MVC and spring.

The functional modules of the elderly service recommendation system are divided into: system portal module, data acquisition module, feature extraction module, service recommendation module and system information management module. The system portal module and data acquisition module are the interaction modules between the elderly service recommendation system and the outside world. The recommendation process of the system includes the feature extraction module and the service recommendation module. The background of the system is the system information management module.

System portal module: This module mainly displays platform related information for users. Users can view platform portal information, elderly care service information and service provider information through the platform. The home page of the platform shows the main information and functions of the system. On the platform, the elderly and their families can view the trends of elderly care services, relevant news, News Express and recommend better elderly care services for them. At the same time, you can view the specific information of elderly care services to better understand the service content and service provider information.

Data acquisition module: This module mainly imports the information required by the recommendation process into the system, including the basic information of the elderly, the basic information of the elderly service and the user rating information. In order to establish the elderly service recommendation model, the system will set the corresponding data format and type. You can upload XML files to obtain the data of the elderly service platform. Before the recommendation process, the service provider completes the data acquisition operation by logging in to the elderly service recommendation platform.

Feature extraction module: This module mainly establishes a feature extraction model for generating the recommended candidate set of elderly service, including data preprocessing, elderly feature extraction model, elderly service feature extraction model and feature extraction model management. The system preprocesses the observed data obtained from the elderly care service platform, establishes the user feature extraction model and the elderly care service feature extraction model through the neural network and the text extraction network, and manages the generated model.

Service recommendation module: This module is mainly used to manage the elderly care service recommendation process, including the management of the recommendation log of the recommendation model and the recommendation of elderly care services for the elderly. First, according to the elderly feature extraction model and the elderly service feature extraction model, select the elderly service that is more suitable for the target users, establish a multi-objective optimization recommendation model, complete the elderly service recommendation process, and the elderly service provider can view the final recommendation results, and the system can manage the elderly service recommendation model and recommendation log.

System information management module: This module is mainly used by administrators to manage system related information, including user information management, elderly care service information management, platform basic data management and system log management.

According to the detailed design of the main functional modules of the elderly service recommendation system, the corresponding database tables are designed. The database tables of the main functional modules are shown in Table 3.

ESRS_user is an information table for the elderly, which includes fields such as number, age, gender, self-care ability, monthly income, occupation, etc. This table establishes foreign key constraints in the service provider table. ESRS_service is an information table of aged care services, which includes fields such as number, service name, service type, service provider, service content, service price and address, etc. This table establishes foreign key constraints with the service provider table. ESRS_score is a scoring information table, including user id, service id, comment time, scoring and other fields. User scoring information establishes a foreign key constraint relationship with basic information table of users and basic information table of old-age services, and user scoring has a one-to-many relationship with users and old-age services. ESRS_provider is a service provider information table, which includes fields such as number, establishment time, name, region, etc.

4. Conclusion

In this paper, through in-depth research on the elderly service recommendation algorithm, the generation model of the elderly service recommendation candidate set based on deep learning is established according to the basic information of the elderly and the elderly service, and the multi-objective optimization recommendation algorithm based on artificial immune is realized. The business process of the elderly service recommendation system is analyzed. And realize each function. To a certain extent, the cold start problem of users is solved and the quasi novelty and accuracy of recommendation are improved.

Table 1. Pseudo code of multi-objective optimization recommendation model

Input: initial population
Output: recommended results
begin
Pop = round (rand (NP, n)) / / initialize the antibody population
g1= 0;// Iterate
While (termination condition is not met) / / judge whether the maximum number of iterations has been reached
affinity (NP,1);// Calculate affinity
sortpop = pop(index,:);// Sort by affinity
NC = repmat (sortpop (i,:), 1) / / cloning
Cross operation with PC probability
Mutation operation with PM probability
final_ Pop = zeros (1, NP) / / the iteration ends and the affinity is calculated
final_ Pop (1:10) / / output the first 10 solutions
End / / end the algorithm

Table 2. Parameter setting

Parameters	Name	Value
r	Candidate set size	300
Pc	Crossover probability	0.9
Pm	Mutation probability	0.1
gmax	Maximum number of iterations	200
L	Recommended list length	10
N	Dominant population size	20
Nc	Clonal population size	50

Table 3. Get data module database table

Table name	Describe
ESRS_user	Elderly information form
ESRS_seance	Elderly care service information form
ESRS_score	Scoring information table

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