Formal Logic Research in Mobile Service Recommendation Model Based on Situation Calculus

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ABSTRACT

Aiming at the shortcomings of formal logic research in the domain of service recommendation, this paper proposes a mobile service recommendation model MSR-SC based on situation calculus. On the basis of the basic method and the general process of mobile service recommendation, the logical theory system of situation calculus is introduced. With the initial situation as the starting point, much situation in specific action domain, fluent domain and situation domain are dynamically evolved according to certain rules. Finally, in order to verify the logical validity of the model, a formal description of a mobile service recommendation instance using MSR-SC is given. As can be seen from the example, the model has logic validity and correctness.

INTRODUCTION

At present, the popularity of mobile Internet services [1], the relevant research mostly concentrated in the numerical optimization level, although the numerical optimization method has the advantages of easy to use and the phenomenon of intuitive, must be in a specific environment and specific data set to have a better result. In addition, the numerical optimization method cannot delve deeper into the dynamic evolution process and evolution of mobile service recommendation activities from the logical level [2-6]. In view of this problem, this paper constructs...
the mobile service recommendation model based on situation calculus MSR-SC. Based on the theory of situation calculus, this model analyzes the composition of the internal situation context elements in the mobile service recommendation process. A moment state of the mobile service recommendation process as a scene, through the action to achieve changes in the situation, while characterizing the conditions of action and state of the subsequent changes in the situation, and then you can use a series of situation to represent the mobile service recommended internal process.

THE CONSTRUCTION OF MSR-SC MODEL

This article uses the data set MovieLens 1M to id 3, the age of 25 years old, usually often like to see each movie has a score of the user Billy. This article uses the user gender, age and occupation to represent the user's internal information.

Situation Initialization

MSR-SC with get to get the user's information, capture action is divided into two types: get_inner and get_outter. Each refinement action is defined as (1) and (2).

\[
\text{get}_{\text{inner}}(u,i_1)
\]

\[
\text{get}_{\text{outer}}(u,i_2)
\]

The \( u \) represents the user, \( u \in U \), where \( U \) is the set of users. \( i_1 \) represents the intrinsic personalized attribute information of user \( u \), \( i_1 \in \{g,a,h,w,o,m\} = I \), where \( g \) is the sex of \( u \), \( g \in \{0,1\} \) (0 for females, 1 for men). \( a \) is the age of \( u \), \( a \in \{x \mid x \in (199) \cap x \in \mathbb{N}\} \). \( h \) is the height of \( u \), \( h \in \{x \mid x \in (0,2.00) \cap x \in \mathbb{Q}\} \). \( w \) is the weight of \( u \), \( w \in \{x \mid x \in (0,300) \cap x \in \mathbb{Q}\} \). \( o \) is \( u \)'s occupation, \( o \in \{x \mid x \in [1,17] \cap x \in \mathbb{N}\} \). \( m \) is the mood of \( u \), \( m \in \{x \mid x \in [1,5] \cap x \in \mathbb{N}\} \). \( i_2 \) denotes the external environment information of user \( u \), \( i_2 \in \{t, l, wea\} = O \), in which \( t \) is time, \( t \in \{x \mid x \in [1,24] \cap x \in \mathbb{N}\} \). \( wea \) is weather, \( wea \in \{x \mid x \in [1,16] \cap x \in \mathbb{N}\} \). \( l \) is the position of \( u \), \( l \in \{(x, y) \mid x \in [-180,180], y \in [-90,90]\} \).

Secondly, set is used to construct a matrix or matrix reorganization, as defined by equations (3) and (4).

\[
\text{set}_{\text{new}}(\alpha, \text{mat}(m,n))
\]

\[
\text{set}_{\text{re}}(\alpha, R, \text{num})
\]

The \( \alpha \) is the matrix name, \( \text{mat}(m,n) \) constructs a new empty matrix of \( m \) rows and \( n \) columns. \( R \) is the matrix reordering rule \( R \in \{\text{row}, \text{col}\} \), \( \text{num} \) represents the
number of rows or columns. Instance application initialization situation is as follows.

Create initialization information
¬getting_inner(Billy,i1, σ0),
¬getting_inner(Billy,i1, σ0),
setting_new(Data,mat(m,n), σ0).

1) Obtain the target user's internal and external information
get_inner(u,i1) ∪ get_outer(billy,i2)=get_inner(billy,g) ∪ get_inner(billy,a) ∪ get_inner(billy,o) ∪ get_outer(billy,t)= (billy, 0,25,15, 978298147)

2) Build Target User Multidimensional Context
set_new(B_situ,mat(1,4))
put(B_situ,0,0, 978298147) ∪ put(B_situ, 0,1, 0) ∪ put(B_situ,0,2, 25) ∪ put(B_situ,0,3, 15)= B_situ=[978298147,0,25,15]

Data Filtering and Matrix Assignment and Extraction

MSR-SC uses sel to do the data filtering action, it assigned the value, selected in the matrix a, to the corresponding position of the matrix v, as follows (5):

\[
\text{sel}(a,i,j,v)
\] (5)

The put is used to assign an element to the score matrix and assign the value v to the elements of i row and j column of a. The relative action extrac will fetch the data from i row and j row of the matrix a.

\[
\text{put}(a,i,j,v)
\] (6)

\[
\text{extrac}(a,i,j)
\] (7)

1) Filter similar users based on multi-dimensional situation
sel(Data,:,4:,B_situ[1:])= same_user=[[929,1193,4, 975190137,0,25, 15],…]

sel(Data,:,0,same_user[:,0])=sel(Data,:,0,[3,228,….5988])=data_same=[[3,2081,4 , 978298504,0,25, 15],[…]]

Similarity Calculation and Scoring Prediction

The cal is used to calculate similarity and predictive scores. And the action cal is further refined to cal_sim and cal_pre, which are used to calculate the similarity between the users and the predicted score of the target user for a certain service.

\[
\text{cal_sim}(vec_i,vec_j,f)
\] (8)

\[
\text{cal_pre}(sim_i,vec,k,f)
\] (9)
The vector and vector represent the score vectors of two users for the same service. The simi and vector represent the similarity of the target user to other users and the ratings of other users to the target service.

1) Extract similar user ratings from historical data
\[
\text{set\_re(same\_user,col,0)[0,0]=user\_max=2649}
\]
\[
\text{set\_re(Data,col,0)[0,1]=serv\_max=3952}
\]
\[
\text{set\_new(US,mat(2649,3952))}
\]
\[
\text{put(US, data\_same[:,0], data\_same[:,1], data\_same[:,2])=US=[[3,5,...,2]...[...]]}
\]
2) Calculate target user similarity based on rating
\[
\text{set\_re(UU,row,0)[:10]
}\]
\[
\text{put(UU, 0,j,cal\_sim(B\_sco,US[j,:],pear))}
\]
\[
\text{=put(UU,0,[0,1,2,...,2649],cal\_sim([nan,nan,...,4,...,nan],[[3,5,...,2]...[...]]),j,:),pear)}
\]
\[
\text{=put(UU,0,[0,1,2,...,2649],cal\_sim([nan,nan,...,4,...,nan],[[3,5,...,2]...[...]]),j,:),pear)}
\]
\[
\text{=U}\text{U}=[0.248,0.736,...,0.418]
\]
3) Select N Nearest Neighbor Users according to similarity
\[
\text{set\_re(UU,row,0)[:10]=[0.94,0.93,...,0.163][:10]=user\_same=[0.94,0.932,...,0.917]}
\]
4) Filter the target user’s unrated service
\[
\text{sel(Data,:,0)=B\_data=[[3.2355,5,978298430,0,25,15][...]]}
\]
\[
\text{set\_new(B\_sco,mat(1,3952))}
\]
\[
\text{put(B\_sco,0,B\_data[:,1],B\_data[:,2])}
\]
\[
\text{=put(B\_sco,0,[2355,1197,...,2081],[5,5,...,4])=B\_sco=[nan,nan,...,4,...,nan]}
\]
\[
\text{sel(B\_sco,:,nan)=sel([nan,nan,...,4,...,nan],...,[nan,nan,...,4,...,nan],...,[nan,nan,...,4,...,nan])=serv\_no=[0,1,...,2649]}
\]
5) Calculate the forecast score for the unrated service
\[
\text{put(B\_sco,0,serv\_no[0,j],cal\_pre(user\_same,US[:,0,j],F))}
\]
\[
\text{=put(B\_sco,0,[0,1,...,2649],cal\_pre(user\_same,US[:,0,1,...,2649][0,j],F))(j \in serv\_no)}
\]
\[
\text{=B\_sco=[2.63,4.31,...,3.75]}
\]

**VALIDITY ANALYSIS OF THE MSR-SC MODEL**

Follow the behavioral axiom, calculate according to the above situation evolution logic, and finally select the N highest scores from the data set, and sort to recommend the output to the user.

1) Select the N highest ratings service
\[
\text{set\_re(B\_sco,row,0)[:10]=set\_re([2.63,4.31,...,3.75],row,0)[:10]=[4.83,4.72,...,1.73][:10]=[4.83,4.72,...,4.59]}
\]
\[
\text{B\_sco[1]=B\_mov=[3479,1405,...,2417]}
\]
2) Show the service to the target user
\[
\text{dis(B\_mov)=[Ladyhawke (1985), Beavis and Butt-head Do America (1996),...]}\]

Analysis of the above example results can be found that this model not only have a highly useful value, but also have the general nature of the recommended process. So the use of MSR-SC can accurately, efficiently and clearly describe the internal changes in mobile services recommended process.
CONCLUSIONS

This paper constructs the mobile service recommendation model MSR-SC based on situation calculus. The state of the moment as a situation, through the action to achieve changes in the situation, while characterizing the preconditions and state of the subsequent changes in the situation, and then you can use a series of situation to represent the mobile service recommended internal process.

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