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가중치 기반의 순차패턴 탐사를 이용한 추천서비스에 관한 연구

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요 약

유비쿼터스 컴퓨팅 환경하에서 전자상거래 대규모가 대형화되고 취급되는 항목제품들도 다종 다양해지고 있는 것이 현실이다. 이러한 유비쿼터스 상거래 시스템은 편리하고 신속하게 제공되어야 하고 다이나믹한 환경에서 실시간성과 민첩성이 요구되고 있다. 데이터마이닝에서 추출한 지식을 적극적으로 활용하는 기법들이 전자상거래에서 구매 촉진을 증진시키는 마케팅 전략으로 활용되고 있다. 본 연구에서는 유비쿼터스 컴퓨팅 환경 하에 지능형 모바일 단말기를 이용한 추천을 위한 가중치기반 순차패턴 탐사를 이용한 추천서비스f를 제안하였다. 본 연구에서는 추천의 정확성을 향상시키고 구매력이 높은 항목제품 및 서비스를 추천하기 위해서 FRAT 세분화 기법을 이용한 가중치기반 순차패턴 탐사를 이용한 추천서비스를 제안하였다. 성능평가를 위해 현업에서 사용하는 인터넷 화장품 쇼핑몰의 데이터를 기반으로 데이터 셋을 구성하여 기존의 방법과 비교 실험을 통해 성능을 평가하여 효용성과 타당성을 입증하였다. 유비쿼터스 상거래에서 시간과 장소에 제약을 받지 않는 모바일 웹앱을 이용한 추천서비스를 위해서 이전방법보다 개선된 방법으로 추천서비스을 구현하였다.

키워드 : 전자상거래, 데이터마이닝, 순차패턴탐사, 추천서비스

A Study of Recommending Service Using Mining Sequential Pattern based on Weight

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Abstract

Along with the advent of ubiquitous computing environment, it is becoming a part of our common life style that the demands for enjoying the wireless internet using intelligent portable device such as smart phone and iPad, are increasing anytime or anyplace without any restriction of time and place. The recommending service becomes a very important technology which can find exact information to present users, then is easy for customers to reduce their searching effort to find out the items with high purchasability in e-commerce. Traditional mining association rule ignores the difference among the transactions. In order to do that, it is considered the importance of type of merchandise or service and then, we suggest a new recommending service using mining sequential pattern based on weight to reflect frequently changing trends of purchase pattern as time goes by and as often as customers need different merchandises on e-commerce being extremely diverse. To verify improved better performance of proposing system than the previous systems, we carry out the experiments in the same dataset collected in a cosmetic internet shopping mall.

Keywords : e-commerce, Ubiquitous computing, Data Mining, Sequential Pattern, Recommending Service

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1. Introduction

Utilizing techniques methods of knowledge extract from Datamining is widely used all round the world at e-Commerce marketing strategy for promote purchasing of goods. Along with the advent of ubiquitous computing environment, it is becoming a part of our common life style that the demands for enjoying the wireless internet using intelligent portable device such as smart phone and iPad, are increasing anytime or anyplace without any restriction of time and place. When use techniques methods of pattern oriented, we find classification of similar purchasing pattern, provide personalized service and various policy and plan for practical reference value[5]. Sequential pattern exploring technique of datamining is pattern exploring technique frequently occurred in the course of collection of sequence patterns. Purchasing pattern of customer for goods need tidal flow setting each other, Generally all item(article par article) set different weighted value like price. Mundanely same weight value of all of item are not at all realistic at e-commerce recommendation[5]. And each processing web page at web analysis environment have different importance, Dynamic weighted pattern mining can play important role at practical application because gene information of the specific gravity revelation upon inherited character different setting[11]. Research apply datamining of segmentation method oriented[1-4] go smoothly progress actively for reflection of sequence and attribute at recommendation. Purchasing pattern of customer for goods. This paper suggest recommendation service using sequence pattern exploring of weight oriented at ubiquitous computing environment. Composition of this paper is as in the following of chapter1 Introduction, chapter2 Related research, chapter3 suggestion recommendation system, chapter4 experiment and performance evaluation, chapter5 conclusion and henceforth research.

2. Related Research

2.1 Segmentation method

Customer segmentation for establishment of strategy through customer tendency and behavioral data go progress research ubiquitous e-commerce [6]. RFM(Recency, Frequency, Monetary) analysis model

carry out concentrically marketing strategy, produce profit toward excellent customer of high purchasing possibility. FRAT(Frequency, Recency, Amount and Type of merchandise/ Service) research of segmentation model go progress improved better than RFM(Recency, Frequency, Monetary) analysis model.

FRAT is extended model of RFM analysis. FRAT be added to one element of item kind at RFM. FRAT composed of F(frequency:), R(recency:), A(amount), T(type of merchandise /service.: When reflect improved segment analysis element, FRAT value is maximum 5 point, minimum 0 point. Sum of points added to T element, include of giving weighted value at each element. When Robert Kestnbaum's consulting to company got better result than RFM method[7]. Future purchasing behavior forecast through fact of customer order some item lately. Customer sorting is very important. not only application of data analysis but also accounting of sum of points[8].

This paper classify and analysis application of weight value treatment item, customer of point oriented, use recommendation.

Calculating formula FRAT point is as in the following

$$\text{FRAT point} = (A*F + B*R + C*A + D*T) \quad (1)$$

Weighted value of FRAT point(A, B, C, D) can be change consider of management status and management strategy. Sum of FRAT points compose of maximum 100 point and minimum 0 point. F,R,A,T element using FRAT point can be intensive variable of power of prediction. FRAT is one type of segmentation method, analysis technique for selection high purchasing possibility and item.

2.2 Sequence pattern mining

Sequence pattern mining is extracting most using data sequence of dataming technique from data using transaction by relation rule added time concept. Sequence pattern mining is extracting technique frequently arising pattern of data collection have sequence. That is, Sequence pattern mining is extracting datamining technique commonly frequently arising sequence(element, event, pattern) at sequential database consist of saving a series of sequencing element according to thingly changing time

Sequence_id	Sequence
10	<(a)(abc)(ac)(d)(cf)>
20	<(ad)(c)(bc)(ae)>
30	<(ef)(ab)(df)(c)(b)>
40	<(e)(g)(af)(c)(b)(c)>

<Table 1> Sequential Database

Primary technique of sequence pattern extracting is

GSP[9]. GSP generate candidate sequence extracting stage, get approval rating for each candidate item from database. And Apriori Algorithm of frequent occurrence pattern extracting applied making item of high frequency after remove approval rating smaller than beforehand defined minimum approval rating[5]. And this process iterate until undiscover some item have high frequency. We must extract frequent pattern through possible all forecasting sequence pattern. But GSP technique using Apriori Algorithm generate many item number because analyst need a lot of database scan, when extract long sequence pattern, need to extract short sequence patten.

Representative technique of sequence pattern extracting is PrefixSpan[10]. PrefixSpan extract pattern, no generation of forecasting sequence pattern extracting collection.

Extracting method of PrefixSpan is as in the following. First, frequent first item extract through search database using Apriori property(important principle of extracting is all partial gathering occur frequently). Second, generate projection database for first item using frequent first item pattern. Projection database define prefix frequent item, suffix represent except common prefix of each sequence[2]. That is, information of the remainder sequence except included pattern commonly each sequence. Third, we extract sequence pattern from small pattern item to big pattern item through determine suffix and generate projection database recursively and extend item number of pattern to extract sequence item from projection database again

After finished extracting, we can extract all complete frequent sequence pattern. But exsisting sequence pattern extracting method have problem because weight of each item is same value. Therefore, analysts studied weight pattern extracting technique after assign different weight each item. Weighted pattern mining is pattern extracting technique through approval rating represent consider weight each item[4].

when analyze sequence pattern mining must apply different weight each item. If we assign same weight, barely suitable for pattern mining analysis.

3. Weighted-oriented sequence pattern mining for recommendation

This chapter use FRAT point method for each item attribute analysis. Importance of correct item must reflect according to changing time to realtime application using FRAT point This parer is going to explain frequent pattern mining method included weighted value for recommendation service suggestion using weighted-oriented sequence pattern mining. Then, weighted-oriented sequence pattern mining algorithm describe using customer data and purchasing record data. this paper applied recommendation seavice. This study apply to measure reliability, approval ranking, improvement lift, sequence pattern of weighted-oriented sequence pattern mining. All sequence pattern mining method apply that pattern mining satisfied sequence pattern generate using weighted-oriented sequence pattern mining, and user-oriented minimum approval ranking.

[Definition 1] item pattern: If itemset(pattern of goods item through item define in according to time sequence) is $I=\{i_1, i_2, ...,i_n\}$, $1 \leq j \leq n$ (i_j: one cosmetics's expression)

[Definition 2] SPs: Sequential Patterns: sequence pattern through define in according to time sequence, SPs is partial pattern of transaction satisfied threshold value, Minsup. Sequence item pattern mining from goods sequence data define in according to time sequence, is mining collection of all sequence item satisfied beforehand appointed Minsup.

[Definition 3] Weighted Support for weighted sequence pattern mining P(sequence pattern) is as in the following.

$$\text{Wsupport (P)} = \text{Weight (P)} * \text{Support} \quad (2)$$

$$\text{Weight (P)} = \sum_{i=1}^{N} \frac{Weight_i}{N} \quad (3)$$

패턴 P의 Wsupport: Weighted Support of pattern P is Weight (P) * SupportWsupport(P) like expression 2.

When value large or equal(>=) than Minimum Threshold), pattern P = weighted sequence pattern.

For example, if item 'a' weight and support is 0.6, 4 each, if item 'b' weight and support is 0.2, 5 each, if item collection 'ab' support is 3, according to expression 4 and expression 5, weight of "ab" is (0.6 + 0.2)/2 = 0.4, weight support is 0.4 × 3 = 1.2.

Weight support of 'a', 'b' is 0.6 × 4 = 2.4 and 0.2 × 5 = 1.0.

If threshold of weight support at weight sequence pattern =2, item "b" is no weight sequence pattern, but item collection "ab" is weight sequence pattern.

WSpan[13] researched applied weight at sequence pattern mining.

Weight is useful can be applied at dynamic weight environment change according to time sequence[11].

This paper have a object that dynamic weight mining recommend through accounting dynamic weight, consider of importance of various purchasing item at ubiquitous e-commerce environment required realtime and change according to time sequence

3.1 weight-oriented sequence pattern mining

Weight sequence pattern mining be applied customer purchasing data-oriented for purchasing pattern forecasting at recommendation system.

Goods FRAT point-oriented set for reflection of attribute of item, and treating of different importance value changing according to time even if same item.

Prosesure Algorithm of Mining Sequential Pattern based on Weight is as in the following.

Step 1: Item FRAT point grade set-up
Step 2: Distribution weight calculate for FRAT point by customer grade each number. Sum of weight constitute 1
Step 3: Distribution weight apply for relevant item of purchasing number
Step 4:. Generate weight sequence pattern rule through weight-oriented sequence pattern mining
Step 5: Wsupport = Weight (P) * Support
Step 6: Generate weight sequence pattern whole all customer have w-support, w-confidence, w-lift through weight-oriented sequence pattern mining.
Step 7: High purchasing power recommend according to measure of weight sequence pattern of threshold

<Table 2> Prosesure Algorithm of Mining Sequential Pattern based on Weight

Item point grade composition set as in the following for Item weight calculation of item FRAT score by customer grade purchasing item number market share weight calculation.

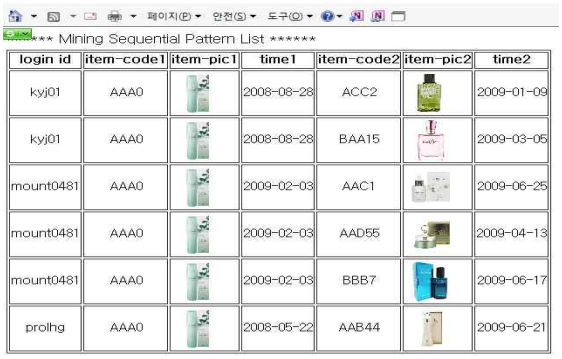
Item score section compose as in the following.

section1 (score >= 90), section2 (score >= 80 and score < 90), section3 (score >= 60 and score < 80), ..., section6 (score < 20). section6 can't set purchasing fell through (score < 20). maximum purchasing number of the score section is section5 (score >= 20 and score < 40) When calculate percentage 261number, purchasing rate=61%.

We can see section5 is most be composed of purchasing.. whole cosmetic item of purchasing is 428 number, score by section purchasing item number represented 14, 36, 32, 95, 261, 0 number.

Item weight calculate market share of purchasing item number. when calculate whole sum of weight = 1, by section weight is 0.01, 0.08, 0.08, 0.22, 0.61. We can find calculation 5 grade finally.

Result table using sequence pattern mining of web is as in the following.


*** Mining Sequential Pattern List ******

login id	item-code1	item-pic1	time1	item-code2	item-pic2	time2
kyj01	AAA0		2008-08-28	ACC2		2009-01-09
kyj01	AAA0		2008-08-28	BAA15		2009-03-05
mount0481	AAA0		2009-02-03	AAC1		2009-06-25
mount0481	AAA0		2009-02-03	AAD55		2009-04-13
mount0481	AAA0		2009-02-03	BBB7		2009-06-17
prolhg	AAA0		2008-05-22	AAB44		2009-06-21

(Figure 1) The Result for Using Mining Sequential Pattern of Web

3.2 Application and analysis of weight sequence pattern mining

This phrase is analysis for application of odinary weight-oriented sequence pattern mining. Result of process analyze proposal weight sequence pqttern mining. applied at sequence pattern mining and suggestion method based on original whole sale data. We study validity analysis of mining for recommendation apply in this result of process. Result of mining process performance measure using mining measure on the same condition is as in the following. Weight sequence pattern mining and suggestion method can see sequence pattern better than result of sequence pattern mining based on original whole data, high approval rating number, rule number, approval rating, improvement lift.

	sale count	support count	Rule count	average sup rate	average conf rate	average lift rate
Proposal	1,600	16,908	1,606	0.249	34.487	6.024
Ordinary	1,600	15,570	406	0.227	41.379	5.233

<Table 3> Performance Result of Mining

Mining of stage 1, whole sale data processing time is similar time before processing

result[5], Stage 2 be added to new data consistantly through weight sequence pattern mining of generating sequence pattern method. Stage 2 expect fast data process based on generating tool no scan for original whole sale data because mining get accomplished for add data. As a result, mining processing result of stage 1, whole average reliability of mining come out low 6.9% but come out high result as a sequence pattern approval rating number, rule number, approval rating, improvement lift in other whole result of suggestion. Specially, we can see drawing a high result of four times at application rule number based on approval number at recommendation system applied.

4. Experiment and Performance Evaluation

4.1 experiment environment

Implementation and experiment environment studied web server environment of Window Operating System for performance evaluation.

Web Server: Apache HTTP Server Version 2.2.8 / WAP 2.0 , j2sdk 1.7.0_11 as Java environment, server-side: JSP/PHP 5.2.12, JQuery*Mobile, client-script: XML/ XHTML4.0/HTML5.0/CSS3/JAVASCRIPT, C#.net framework 2.0 , jakarta-tomcat 5.0.28 -http://jakarta.apache.org/

4.2 Experiment data composition

Recommendation system using weight-oriented sequence pattern mining for customer purchasing pattern prediction construct data base for internet cosmetics shopping mall in Window environment. Composition of experiment data for evaluation system customer information of 319 persons(utilizing shoppingmall) and P co, 580unit cosmetic(sell goods current). This study research using their recommendation goods purchasing sale data of 1600unit during 1 year and test set sale data of 3 months[5].

4.3 Analysis and Performance Evaluation

Whole performance evaluation of recommendation system use MAE(Mean Absolute Error) method, expression difference between predict value and to real value for evaluation of performance MAE is a most using method for decision of correct prediction. This paper testified suggestion method application system and former method application system. First of all, first experiment evaluated performance of prediction by MAE method. We use MAE for evaluating of correctness of predict value, calculated like expression 4[14].

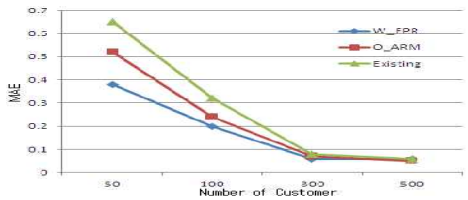
$$MAE = \frac{\sum_{i=1}^{N} |\epsilon_i|}{N} \quad (4)$$

N is whole prediction of the number of times, ε_i is

error between predict value and to real value I is each prediction stage. <Table4> represented result of correct evaluation of prediction value using expression 4

	P_count	Proposal (W_FPA)	previous (W_ARM)	Existing
MAE	50	0.38	0.47	0.65
	100	0.20	0.23	0.32
	300	0.06	0.07	0.08
	500	0.06	0.05	0.06

<Table 4> Suggestion and performance evaluation by MAE of exsisting system



<Figure 2> Suggetion and performance evaluation by MAE of exsisting system

Next, second experiment is testing for accuracy, recall factor, F-measure. Performance

go progress effectiveness of cosmetics recommendation and whole performance evaluation direction based on social data.

First of all, effectiveness of cosmetics recommendation be accomplished through purchasing sale data of participation customer at experiment,

This paper studied using applied precision and recall (general accessment scale) for accuracy evaluation of recommendation.

This paper recommended Top-N unit of high preference, evaluated accuracy, recall factor, F-measure for recommendation list of N. Accuracy is evaluation method to some degree accuracy of recommendation.

Accuracy is actually customer purchasing goods proportion of all recommendation goods by recommendation system.

Recall factor is actually customer purchasing goods proportion of all recommendation goods by recommendation system. F-measure is used whole performance evaluation scale as a combined method for complementary measures of accuracy and recall factor

$$\text{accuracy} = \frac{customer\ purchasing\ No.}{recommendation\ No.} \quad (5)$$

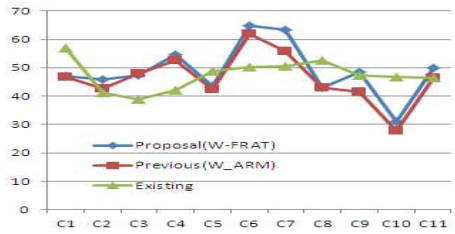
$$\text{recall factor} = \frac{customer\ purchasing\ No.\ out\ of\ recommendation\ system}{customer\ purchasing\ No.} \quad (6)$$

$$\text{F-Measure} = \frac{2(accuracy * recall\ factor)}{recommendation\ No.} \quad (7)$$

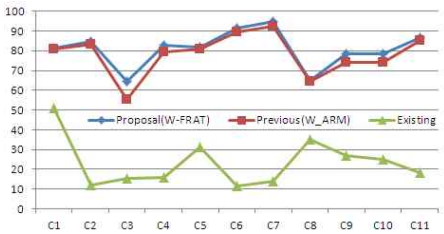
This study use group data. Group data is composed of specific log-in customer and that is the object of the getting recommendation and customer classification code same, data of goods point composed of most distribution.

Cluster	Proposal(W_FRAT)			Previous(W_ARM)			Existing		
	Precision1	Recall1	F-measure1	Precision2	Recall2	F-measure2	Precision3	Recall3	F-measure3
1	47.12	81.22	59.64	46.82	80.66	59.25	56.98	50.89	50.21
2	45.83	84.96	59.54	42.73	83.13	56.44	41.29	11.90	17.51
3	47.36	64.73	54.70	48.00	55.27	51.38	38.97	15.18	20.88
4	54.52	82.86	65.77	52.67	79.26	63.28	42.08	16.07	22.34
5	43.50	81.95	56.84	42.23	80.66	55.44	48.79	31.32	35.64
6	64.89	91.43	75.90	61.88	89.63	73.21	50.22	11.74	18.28
7	63.30	94.64	75.86	55.91	92.59	69.72	50.60	13.88	21.03
8	42.92	65.23	51.77	42.81	64.52	51.47	52.49	34.98	39.75
9	48.57	78.57	60.03	41.58	74.08	53.26	47.41	26.81	32.26
10	31.09	78.57	44.55	27.72	74.08	40.34	46.68	25.19	30.28
11	49.94	86.47	63.32	46.39	85.19	60.07	46.53	18.32	25.10

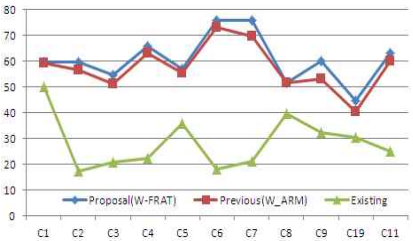
<Table4> analysis result of accuracy and recall factor from group recommendation



<Figure 3> recommendation evaluation result of accuracy



<Figure 4> recommendation evaluation result of recall factor



<Figure 5> recommendation evaluation result of F-measure

<Figure3>. <Figure4>. <Figure5> is F-measure의 performance evaluation through result of <Table4>.

Group accuracy, recall factor, suggestion system come out improvement result of 3.1% in whole performance than before no weight system.

Group average accuracy improve 1.54% than existing system. But result of group average recall factor is 57.67%, result of group average F-measure is 32.24%.

This result is result of high performance. Therefore, result of experiment with weight application suggestion system represented improvement result. better than exsisting system.. Next, <Figure6> is represent site of recommendation system using weight-oriented sequence pattern mining in web. Suggestion system of recommendation system have no use for repeated database approach because generate sequence pattern have no candidate collection

When analyst recommend connection item, provide based on sequence pattern. Therefore, result provided convenience, can be attained realtime required extemporaneity

<Figure 6> cosmetics recommendation site

5. Conclusion and henceforth task

Lately, e-commerce of big scale become bigger, various requirement of customer required on ubiquitous computing environment.

Recommendation service required improvement of extemporaneity and accuracy of recommendation on dynamic ubiquitous e-commerce environment

This paper suggested recommendation service for recommendation of high purchasing power goods iem & service using weight-oriented sequence pattern mining through FRAT segmentation method. This study proved effectiveness and validity through comparison experiment between existing method and to weight-oriented method, evaluated performance based on internet cosmetics shopping mall data. This study can be realized recommendation service using mobile web more better improved method than existing method, unenthralled time and place on ubiquitous e-commerce.

Henceforth task is going to study recommendation method using Periodicity Analysis for season marketing analysis with sequence pattern mining.

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