

Buying Point Recommendation for E-Commerce Systems

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Table of contents

- Introduction
- Related Work
- Similar Price Pattern Search
- Buying Point Recommendation Method
- Performance Experiment
- Design of a Goods Recommendation System
- Conclusions

Introduction [1/2]

- The Present State of the Internet Shopping Malls
 - Provide various services for customers to choose the best
 - most of those systems are only considering prices or customer's preferences
 - Customer needs to know when is the best buying point
 - if the shopping mall can be able to recommend appropriate buying points
 - it will be greatly helpful for the customer

Introduction [2/2]

- Propose a method that recommend buying points
 - Use a database that contains past prices data of items
 - Provide buying points for an item
 - search past time series patterns from the database using normalized similarity, which are similar to the current time series pattern of the item
 - analyze the retrieved past patterns and predict the future price pattern of the item
 - use the future price pattern, the buying point of the item is recommended
- Design a goods recommendation system with a buying point recommendation agent

Related Work [1/3]

- Item Recommendation
 - The Internet shopping malls have been widely used recently
 - Recommend appropriate items to customers
 - Use the preference and the past sales history data
 - As the item price often changes, it is important to decide the buying point of the item

Related Work [2/3]

- Similarity Measurement
 - Time Series Data
 - Consist of continuous real-values of items
 - Ex> stock data, foreign exchange data, temperature data, item sale data, etc.
 - Search Method for Similar Time Series Data
 - Euclidean distance, normalization, moving average, time warping, shape-based retrieval, etc.

Related Work [3/3]

- Similarity Measurement (cont.)
 - Calculation of Euclidean Distance
 - The straight line distance between two points
 - K-Moving Average Transformation
 - Average of continuous k-data arranged in order
 - Normalized Transformation Method
 - Similar pattern retrieval becomes easy by transforming absolute value into relative value

Similar Price Pattern Search [1/4]

- Definition of Time Series Data
 - D : entire time series data of sale price
 - Q : basis time series data
 - S : part of time series data
- Search Procedure of Similar Time Series Data
 - Select Q in D (where, size of Q is n)
 - Compare Q with S in D (where, size of S is n)
 - Search S of similar sale price pattern that satisfies similarity condition

Similar Price Pattern Search [2/4]

- Price Pattern Search Method
 - Repeat normalization and similarity of time series data
 - Normalization of Time Series Data [Step 1]
 - Execute k-moving average transform process to reduce noise influence in D
 - K-Moving Average Transformation
 - $S_{k,j} = \frac{1}{k} \times \sum_{i=j}^{j+k-1} S_i$
 - * S = time series data ($0 \leq i < \text{Len}(S)$)
 - * k = moving average coefficient ($1 \leq k < \text{Len}(S)$)
 - * $S_{k,j}$ = k-moving average transform time series ($0 \leq j < \text{Len}(S) - k + 1$)

Similar Price Pattern Search [3/4]

- Normalization of Time Series Data (cont.) [Step 2]
 - Execute normalization transformation process to analyze easily similar pattern in D
 - Normalization Transformation Process
 - $S'[i] = \frac{S_{k,i} - \text{Min}(S)}{\text{Max}(S) - \text{Min}(S)}$
 - * $S[i]$ = time series data ($0 \leq i < \text{Len}(S)$)
 - * $S'[i]$ = normalization transformation time series ($0 \leq i < \text{Len}(S)$)

Similar Price Pattern Search [4/4]

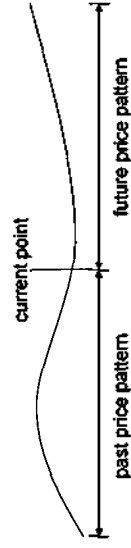
- Similarity of Time Series Data
 - Calculate Euclidean distance of Q and S (where, size of S is n)
 - Search S that satisfies similarity condition
 - Calculate Euclidean distance for the similarity measurement of Q and S

$$- L(S, Q) = \sqrt{\sum_{i=1}^n (a_i - b_i)^2}$$

- * $S = (a_1, a_2, a_3, \dots, a_n)$, $Q = (b_1, b_2, b_3, \dots, b_n)$

Buying Point Recommendation Method [1/3]

- Types of a Basis Pattern
 - Sale price increasing pattern (/)
 - Sale price steady pattern (=)
 - Sale price decreasing pattern (\)
- Past Price Pattern and Future Price Pattern



Buying Point Recommendation Method [2/3]

- **Window Size of Past Price Pattern**
 - Unit of time series pattern size is a week
 - Time series pattern size = window size
 - Calculate Euclidean distance of past price pattern and S (where, window size is from 3 to 6)
 - Search similar price patterns
- **Window Size of Future Price Pattern**
 - Analyze future price pattern based on similar price pattern which is searched in past sale price
 - Window size of future price pattern is from 1 week to 5 weeks

Buying Point Recommendation Method [3/3]

- Method of Buying Point Recommendation

Pattern	Buying Point Recommendation
Increasing (/)	Buying at the current point
Steady (—)	Buying any time
Decreasing (\)	Wait for buying

Performance Experiment [1/3]

- **Experiment Environment**
 - Use the used car sale information
 - 554 sale cases for one year
 - 50 time series data
 - average of sale prices per one week
 - Choose 10 basis time series patterns for experiment

Performance Experiment [2/3]

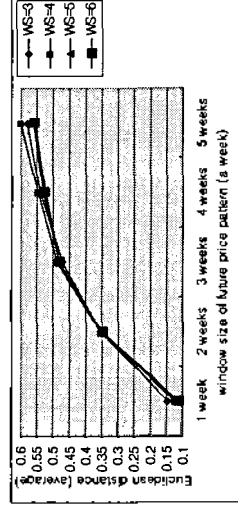


Fig. 1. Similarity of Future Price Patterns

Performance Experiment [3/3]

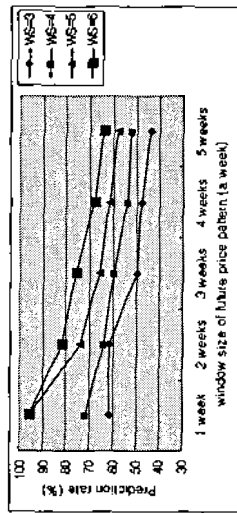


Fig. 2. Prediction Rate of Future Prices Patterns

Design of a Goods Recommendation System [1/2]

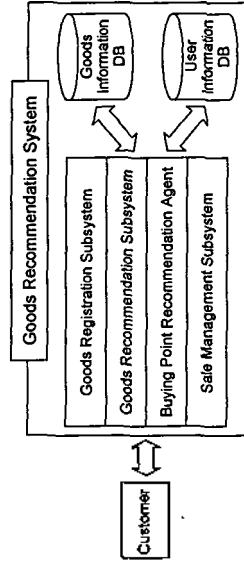


Fig. 3. Structure of a Goods Recommendation System

Design of a Goods Recommendation System [2/2]

- Procedure of a Goods Recommendation System
 - Goods Registration Subsystem
 - manage to register goods in goods information database
 - Goods Recommendation Subsystem
 - provide the best buying point information and goods information for customers
 - Buying Point Recommendation Agent
 - search the best buying point information using methods we propose
 - Sale Management Subsystem
 - manages all information of goods sale

Conclusions [1/2]

- Propose the best buying point recommendation method
 - Search similar sale price pattern in the past sale prices
 - Analyze future sale prices pattern based on sale price pattern searched
 - Recommend buying points according to sale price pattern change
 - Design a goods recommendation system, which recommends buying point through performance experiment

Conclusions [2/2]

- Customers can buy cheap items at the best buying point
 - Convenience and efficiency are provided
- Future Work
 - Experiment with a lot of future price pattern is required
 - Research to efficiency of buying point recommendation is required

References

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