Discovery of Frequent Patterns in Large Data Collections

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Abstract

Data mining, or knowledge discovery in databases, aims at finding useful reg-
ularities in large data sets. Interest in the field is motivated by the growth
of computerized data collections and by the high potential value of patterns
discovered in those collections. For instance, bar code readers at supermar-
kets produce extensive amounts of data about purchases. An analysis of
this data can reveal useful information about the shopping behavior of the
customers. Association rules, for instance, are a class of patterns that tell
which products tend to be purchased together.

The general data mining task we consider is the following: given a class of
patterns that possibly have occurrences in a given data collection, determine
which patterns occur frequently and are thus probably the most useful ones.
It is characteristic for data mining applications to deal with high volumes of
both data and patterns.

We address the algorithmic problems of determining efficiently which pat-
terns are frequent in the given data. Our contributions are new algorithms,
analyses of problems, and pattern classes for data mining. We also present
extensive experimental results. We start by giving an efficient method for
the discovery of all frequent association rules, a well known data mining
problem. We then introduce the problem of discovering frequent patterns
in general, and show how the association rule algorithm can be extended to
cover this problem. We analyze the problem complexity and derive a lower
bound for the number of queries in a simple but realistic model. We then
show how sampling can be used in the discovery of exact association rules,
and we give algorithms that are efficient especially in terms of the amount
of database processing. We also show that association rules with negation

and disjunction can be approximated efficiently. Finally, we define episodes, a class of patterns in event sequences such as alarm logs. An episode is a combination of event types that occur often close to each other. We give methods for the discovery of all frequent episodes in a given event sequence.

The algorithm for the discovery of association rules has been used in commercial data mining products, the episode algorithms are used by telecommunication operators, and discovered episodes are used in alarm handling systems.

Computing Reviews (1991) Categories and Subject Descriptors:

H.3.1	Information Storage and Retrieval: Content Analysis and Indexing
I.2.6	Artificial Intelligence: Learning
F.2.2	Analysis of Algorithms and Problem Complexity: Nonnumerical Algorithms and Problems

General Terms:
Algorithms, Theory, Experimentation

Additional Key Words and Phrases:
Data mining, Knowledge discovery, Association rules, Episodes