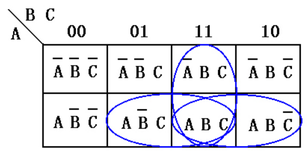
KMVQL: a Graphical User Interface for Boolean Query Specification and Query Result Visualization

Jiwen Huo and William B. Cowan, University of Waterloo

Introduction

KMVQL (Karnaugh Map-based Visual Query Language) is a graphical user interface based on Karnaugh maps. It can be used as a visual query language and as a visualization tool to help users formulating Boolean queries and analyzing the query results.

A Karnaugh map (K-Map) is a two-dimensional tabular layout of a truth table. It represents each of the 2^{2^n} queries from n input variables as one cell of a table making the simplification of Boolean expressions easy and intuitive. Using a K-Map, specifying a Boolean query accounts to selecting cells in the K-Map.

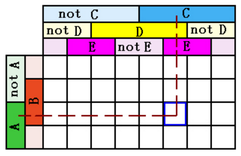


In the left figure, the four selected cells surrounded by three circles represent the Boolean expression:

$BC + AC + AB$.

As the number of input variables increases, the size of a K-Map grows exponentially, making it difficult to understand and use.

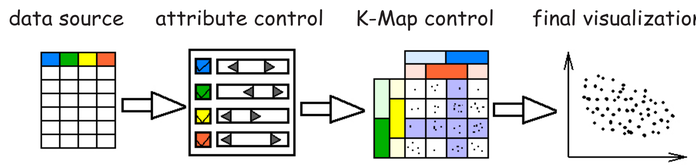
To alleviate this problem, KMVQL uses color coding principle to enhance the K-Map display and make it easier to understand and use.



Components of KMVQL

KMVQL incorporates dynamic query techniques in the form of K-Maps. It is composed of four basic components:

- data source
- attribute value control window
- K-Map control window
- final visualization

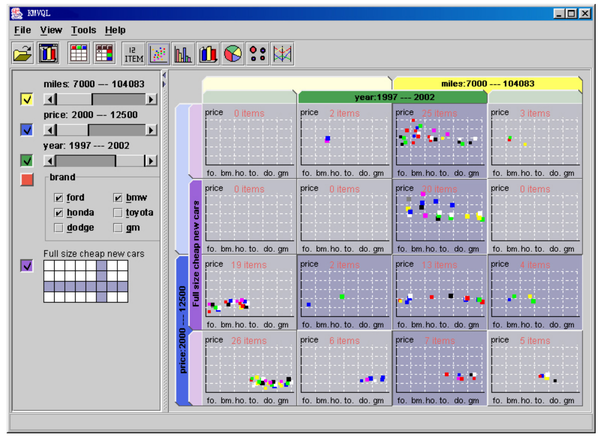


1. Data source is the data set on which users make queries. Besides the initial data source, intermediate query results can also be saved and used as data source for the next query.

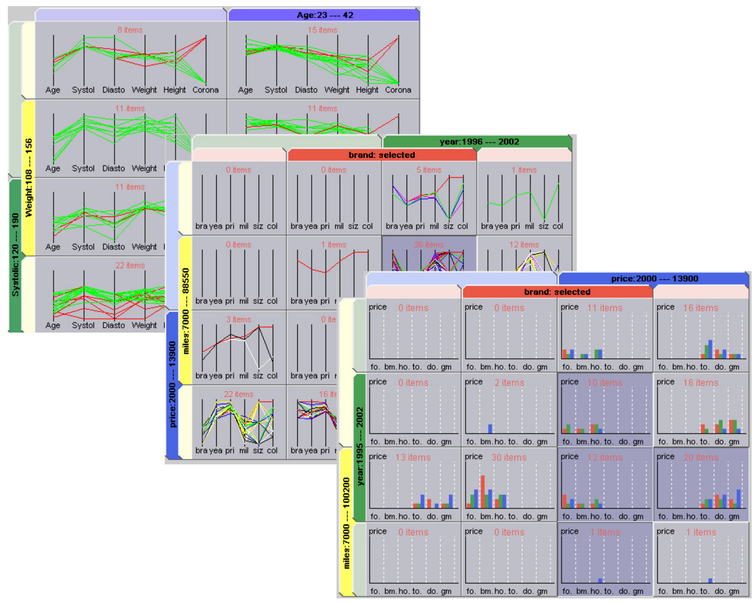
2. Attribute value control window contains a set of selectors (sliders, radio buttons, check boxes, etc.) which are used to specify limits for the query terms. Each of the selectors is assigned a unique color and has a check box related with it. If a check box is checked, the attribute related with it is used as a query term.

3. The K-Map control window displays an enhanced K-Map which is used to specify the Boolean structure of the query and provide an intermediate visualization for the data items. It acts as a middle ware joining the attribute value control and the final visualization. Using K-Map control, arbitrary Boolean queries can be easily formulated.

4. The final visualization only displays the data items that satisfied the query and give users a clear picture of the data they are interested in.



Examples



Features

Visual Query Language

- Specify Boolean queries graphically by selecting cells in the K-Map.
- Construct complex hierarchical queries:
  - Previously constructed K-Maps can be stored.
  - The stored K-Maps can be used as control widgets or data source of a new K-Map to construct hierarchical queries.

Visualization Tool

- Reveals the relationship between query terms and data sets, shows the contribution of each query term to the query results
- Provides a partial ordering of the results
- Can be used as a visualization spreadsheet and incorporate with various visualization methods.