Primitives that Define a Data Mining Task

- Task-relevant data
  - Database or data warehouse name
  - Database tables or data warehouse cubes
  - Condition for data selection
  - Relevant attributes or dimensions
  - Data grouping criteria
- Type of knowledge to be mined
  - Characterization, discrimination, association, classification, prediction, clustering, outlier analysis, other data mining tasks
- Background knowledge
- Pattern interestingness measurements
- Visualization/presentation of discovered patterns

Primitive 3: Background Knowledge

- A typical kind of background knowledge: Concept hierarchies
- Schema hierarchy
  - E.g., street < city < province_or_state < country
- Set-grouping hierarchy
  - E.g., {20-39} = young, {40-59} = middle_aged
- Operation-derived hierarchy
  - email address: hagonzal@cs.uiuc.edu

    login-name < department < university < country
- Rule-based hierarchy
  - low_profit_margin (X) <= price(X, P_1) and cost (X, P_2) and (P_1 - P_2) < $50

Primitive 4: Pattern Interestingness Measure

- Simplicity

  e.g., (association) rule length, (decision) tree size

- Certainty

  e.g., confidence, P(A|B) = #(A and B)/ #(B), classification reliability or accuracy, certainty factor, rule strength, rule quality, discriminating weight, etc.

- Utility

  potential usefulness, e.g., support (association), noise threshold (description)

- Novelty

  not previously known, surprising (used to remove redundant rules, e.g., Illinois vs. Champaign rule implication support ratio)

Primitive 5: Presentation of Discovered Patterns

- Different backgrounds/usages may require different forms of representation
  - E.g., rules, tables, crosstabs, pie/bar chart, etc.
- Concept hierarchy is also important
  - Discovered knowledge might be more understandable when represented at high level of abstraction
  - Interactive drill up/down, pivoting, slicing and dicing provide different perspectives to data
- Different kinds of knowledge require different representation: association, classification, clustering, etc.

DMQL—A Data Mining Query Language

- Motivation
  - A DMQL can provide the ability to support ad-hoc and interactive data mining
  - By providing a standardized language like SQL
    - Hope to achieve a similar effect like that SQL has on relational database
    - Foundation for system development and evolution
    - Facilitate information exchange, technology transfer, commercialization and wide acceptance
- Design
  - DMQL is designed with the primitives described earlier

An Example Query in DMQL

Example 1.11 Mining classification rules. Suppose, as a marketing manager of *AllElectronics*, you would like to classify customers based on their buying patterns. You are especially interested in those customers whose salary is no less than $40,000, and who have bought more than $1,000 worth of items, each of which is priced at no less than $100. In particular, you are interested in the customer's age, income, the types of items purchased, the purchase location, and where the items were made. You would like to view the resulting classification in the form of rules. This data mining query is expressed in DMQL[3] as follows, where each line of the query has been enumerated to aid in our discussion.

```
use database AllElectronics_db
use hierarchy location_hierarchy for T.branch, age_hierarchy for C.age
mine classification as promising_customers
in relevance to C.age, C.income, I.type, I.place_made, T.branch
from customer C, item I, transaction T
where I.item_ID = T.item_ID and C.cust_ID = T.cust_ID
        and C.income ≥ 40,000 and I.price ≥ 100
group by T.cust_ID
having sum(I.price) ≥ 1,000
display as rules
```