## 16. UNIT WISE-QUESTION BANK

### UNIT-1

### 1. TWO MARKS QUESTION WITH ANSWERS:

**1. What are the uses of multi feature cubes?**

Multi feature cubes, which compute complex queries involving multiple dependent aggregates at multiple granularity. These cubes are very useful in practice. Many complex data mining queries can be answered by multi feature cubes without any significant increase in computational cost, in comparison to cube computation for simple queries with standard data cubes.

**2. Compare OLTP and OLAP Systems.**

If an on-line operational database systems is used for efficient retrieval, efficient storage and management of large amounts of data, then the system is said to be on-line transaction processing. Data warehouse systems serves users (or) knowledge workers in the role of data analysis and decision-making. Such systems can organize and present data in various formats. These systems are known as on-line analytical processing systems.

**3. What is data warehouse metadata?**

Metadata are data about data. When used in a data warehouse, metadata are the data that define warehouse objects. Metadata are created for the data names and definitions of the given warehouse. Additional metadata are created and captured for time stamping any extracted data, the source of the extracted data, and missing fields that have been added by data cleaning or integration processes.

**4. Explain the differences between star and snowflake schema.**

The dimension table of the snowflake schema model may be kept in normalized
Form to reduce redundancies. Such a table is easy to maintain and saves storage space.

**5. In the context of data warehousing what is data transformation?**

`In data transformation, the data are transformed or consolidated into forms appropriate for mining. Data transformation can involve the following:

Smoothing, Aggregation, Generalization, Normalization, Attribute construction

**6. Define Slice and Dice operation.**

The slice operation performs a selection on one dimension of the cube resulting in A sub cube. The dice operation defines a sub cube by performing a selection on two (or) more dimensions.

**7. List the characteristics of a data ware house.**

There are four key characteristics which separate the data warehouse from other major operational systems:

1. Subject Orientation: Data organized by subject
2. Integration: Consistency of defining parameters
3. Non-volatility: Stable data storage medium
4. Time-variance: Timeliness of data and access terms

***8. What are the various sources for data warehouse?***

**Handling of relational and complex types of data**: Because relational databases and data warehouses are widely used, the development of efficient and effective data mining systems for such data is important.

**Mining information from heterogeneous databases and global information systems:** Local- and wide-area computer networks (such as the Internet) connect many sources of data, forming huge, distributed, and heterogeneous databases.

## 2. THREE MARKS QUESTION WITH ANSWERS:

**1. What is data warehouse?**

A data warehouse is a repository of multiple heterogeneous data sources organized under a unified schema at a single site to facilitate management decision making. (Or) A data warehouse is a subject-oriented, time-variant and nonvolatile collection of data in support of management's decision-making process.

**2. Differentiate fact table and dimension table.**

Fact table contains the name of facts (or) measures as well as keys to each of the related dimensional tables. A dimension table is used for describing the dimension. (e.g.) A dimension table for item may contain the attributes item_ name, brand and type.

***3 Briefly discuss the schemas for multidimensional databases.***

**Stars schema**: The most common modeling paradigm is the star schema, in which the data warehouse contains (1) a large central table (fact table) containing the bulk of the data, with no redundancy, and (2) a set of smaller attendant tables (dimension tables), one for each dimension.

**Snowflakes schema:** The snowflake schema is a variant of the star schema model, where

Some dimension tables are normalized, thereby further splitting the data into additional tables. The resulting schema graph forms a shape similar to a snowflake.

**Fact Constellations**: Sophisticated applications may require multiple fact tables to *share* dimension tables. This kind of schema can be viewed as a collection of stars, and hence is called a galaxy schema or a fact constellation.

***4. How is a data warehouse different from a database? How are they similar?***

Data warehouse is a repository of multiple heterogeneous data sources, organized under a unified schema at a single site in order to facilitate management decision-making. A relational database is a collection of tables, each of which is assigned a unique name. Each table consists of a set of attributes (columns or fields) and usually stores a large set of tuples(records or rows). Each tuple in a relational table represents an object identified by a unique key and described by a set of attribute values. Both are used to store and manipulate the data.

***5. What is descriptive and predictive data mining?***

**Descriptive data mining**, which describes data in a concise and summarative manner and presents interesting general properties of the data.

**Predictive data mining**, which analyzes data in order to construct one or a set of models and attempts to predict the behavior of new data sets. Predictive data mining, such as classification, regression analysis, and trend analysis.

***6. Differentiate data mining and data warehousing.***

**Data mining** refers to extracting or "mining" knowledge from large amounts of data. The term is actually a misnomer. Remember that the mining of gold from rocks or sand is referred to as gold mining rather than rock or sand mining. Thus, data mining should have been more appropriately named "knowledge mining from data,"

A **data warehouse** is usually modeled by a multidimensional database structure, where each dimension corresponds to an attribute or a set of attributes in the schema, and each cell stores the value of some aggregate measure, such as count or sales amount

**3. Five-marks questions and answers**

**1) Define data warehouse? Differentiate between operational database systems and data warehouses?**

A) A data warehouse is a subject-oriented, integrated, time-variant and non-volatile collection of data in support of management's decision making process.

| **operational systems** | **data warehousing systems** |
|---|---|
| Operational systems are generally designed to support high-volume transaction processing with minimal back-end reporting. | Data warehousing systems are generally designed to support high-volume analytical processing (i.e. OLAP) and subsequent, often elaborate report generation. |
| Operational systems are generally process-oriented or process-driven, meaning that they are focused on specific business processes or tasks. Example tasks include billing, registration, etc. | Data warehousing systems are generally subject-oriented, organized around business areas that the organization needs information about. Such subject areas are usually populated with data from one or more operational systems. As an example, revenue may be a subject area of a data warehouse that incorporates data from operational systems that contain student tuition data, alumni gift data, financial aid data, etc. |
| Operational systems are generally concerned with current data. | Data warehousing systems are generally concerned with historical data. |
| Data within operational systems are generally updated regularly according to need. | Data within a data warehouse is generally non-volatile, meaning that new data may be added regularly, but once loaded, the data is rarely changed, thus preserving an |

| | |
|---|---|
| | ever-growing history of information. In short, data within a data warehouse is generally read-only. |
| Operational systems are generally optimized to perform fast inserts and updates of relatively small volumes of data. | Data warehousing systems are generally optimized to perform fast retrievals of relatively large volumes of data. |
| Operational systems are generally application-specific, resulting in a multitude of partially or non-integrated systems and redundant data (e.g. billing data is not integrated with payroll data). | Data warehousing systems are generally integrated at a layer above the application layer, avoiding data redundancy problems. |
| Operational systems generally require a non-trivial level of computing skills amongst the end-user community. | Data warehousing systems generally appeal to an end-user community with a wide range of computing skills, from novice to expert users. |

**2) Explain the architecture of data warehouse.**

A) The Design of a Data Warehouse: A Business Analysis Framework

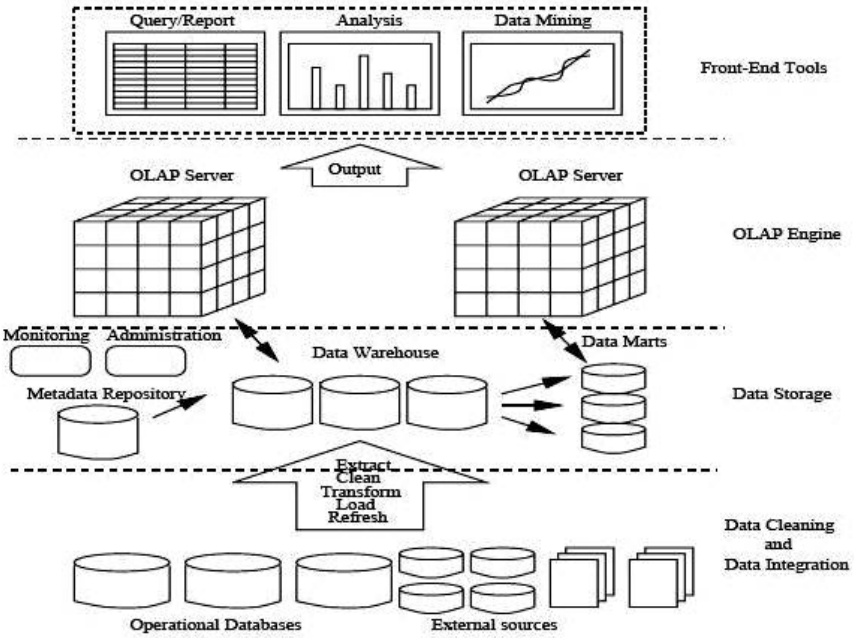
Four different views regarding the design of a data warehouse must be considered: the top-down view, the data source view, the data warehouse view, and the business query view.

The top-down view allows the selection of relevant information necessary for the data warehouse.

The data source view exposes the information being captured, stored and managed by operational systems.

The data warehouse view includes fact tables and dimension tables.

Finally the business query view is the Perspective of data in the data warehouse from the viewpoint of the end user.




**Three-tier Data warehouse architecture**

The bottom tier is ware-house database server which is almost always a relational database system. The middle tier is an OLAP server which is typically implemented using either (1) a Relational OLAP (ROLAP) model, (2) a Multidimensional OLAP (MOLAP) model. The top tier is a client, which contains query and reporting tools, analysis tools, and/or data mining tools (e.g., trend analysis, prediction, and so on).

From the architecture point of view, there are three data warehouse models: the enterprise warehouse, the data mart, and the virtual warehouse

**Enterprise warehouse**: An enterprise warehouse collects all of the information about subjects spanning the entire organization. It provides corporate-wide data integration, usually from one or more operational systems or external information providers, and is cross-functional

in scope. It typically contains detailed data as well as summarized data, and can range in size from a few gigabytes to hundreds of gigabytes, terabytes, or beyond.

**Data mart:** A data mart contains a subset of corporate-wide data that is of value to a specific group of users. The scope is connected to specific, selected subjects. For example, a marketing data mart may connect its subjects to customer, item, and sales. The data contained in data marts tend to be summarized. Depending on the source of data, data marts can be categorized into the following two classes:

(i).Independent data marts are sourced from data captured from one or more operational systems or external information providers, or from data generated locally within a particular department or geographic area.

(ii).Dependent data marts are sourced directly from enterprise data warehouses

**Virtual warehouse**: A virtual warehouse is a set of views over operational databases. For efficient query processing, only some of the possible summary views may be materialized. A virtual warehouse is easy to build but requires excess capacity on operational database servers.

**3). Discuss Extraction-Transformation-loading with neat diagram?**

**A) The ETL (Extract Transformation Load) process**

In this section we will discussed about the 4 major process of the data warehouse. They are extract (data from the operational systems and bring it to the data warehouse), transform (the data into internal format and structure of the data warehouse), cleanse (to make sure it is of sufficient quality to be used for decision making) and load (cleanse data is put into the data warehouse).

The four processes from extraction through loading often referred collectively as Data Staging.

**EXTRACT:** Some of the data elements in the operational database can be reasonably be expected to be useful in the decision making, but others are of less value for that purpose. For this reason, it is necessary to extract the relevant data from the operational database before bringing into the data warehouse. Many commercial tools are available to help with the extraction process. **Data Junction** is one of the commercial products. The user of one of these tools typically has an easy-to-use windowed interface by which to specify the following:

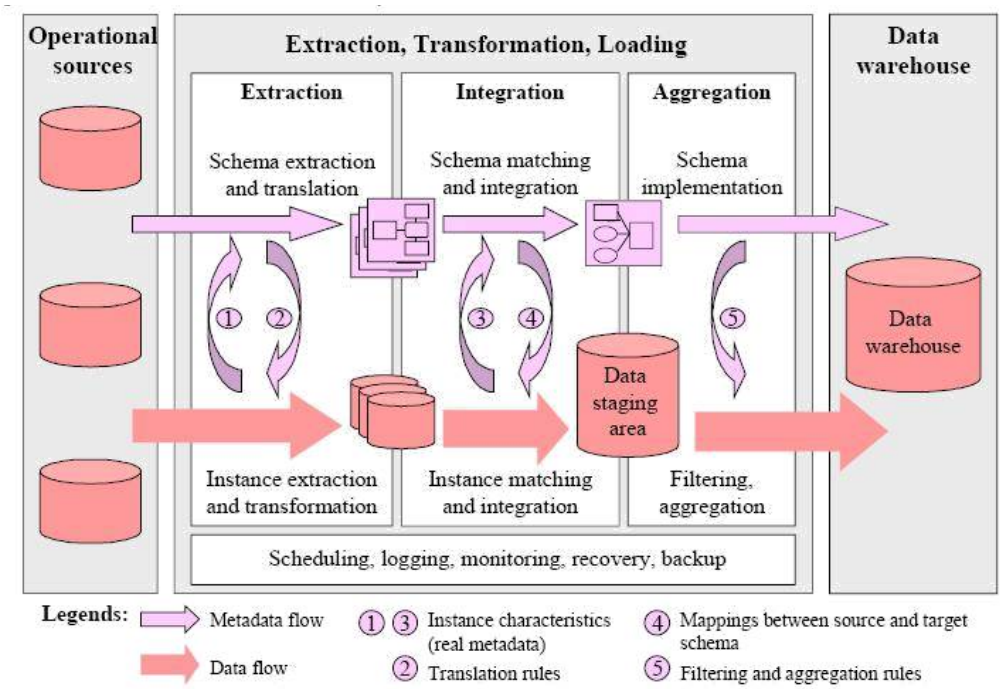



Figure 1. Steps of building a data warehouse: the ETL process

**TRANSFORM**

The operational databases developed can be based on any set of priorities, which keeps changing with the requirements. Therefore those who develop data warehouse based on these databases are typically faced with inconsistency among their data sources. Transformation process deals with rectifying any inconsistency (if any).One of the most common transformation issues is 'Attribute Naming Inconsistency'. It is common for the given data element to be referred to by different data names in different databases. Employee Name may be EMP_NAME in one database, ENAME in the other. Thus one set of Data Names are picked and used consistently in the data warehouse. Once all the data elements have right names, they must be converted to common formats. The conversion may encompass the following:

Characters must be converted ASCII to EBCDIC or vice versa.

Mixed Text may be converted to all uppercase for consistency.

Numerical data must be converted in to a common format.

Data Format has to be standardized.

Measurement may have to convert. (Rs/ $)

Coded data (Male/ Female, M/F) must be converted into a common format.

All these transformation activities are automated and many commercial products are available to perform the tasks. **Data MAPPER** from Applied Database Technologies is one such comprehensive tool.

**CLEANSING**

Information quality is the key consideration in determining the value of the information. The developer of the data warehouse is not usually in a position to change the quality of its underlying historic data, though a data warehousing project can put spotlight on the data quality issues and lead to improvements for the future. It is, therefore, usually necessary to go through the data entered into the data warehouse and make it as error free as possible. This process is known as **Data Cleansing**.

Data Cleansing must deal with many types of possible errors. These include missing data and incorrect data at one source; inconsistent data and conflicting data when two or more source is involved. There are several algorithms followed to clean the data, which will be discussed in the coming lecture notes.

**LOADING**

Loading often implies physical movement of the data from the computer(s) storing the source database(s) to that which will store the data warehouse database, assuming it is different. This takes place immediately after the extraction phase. The most common channel for data

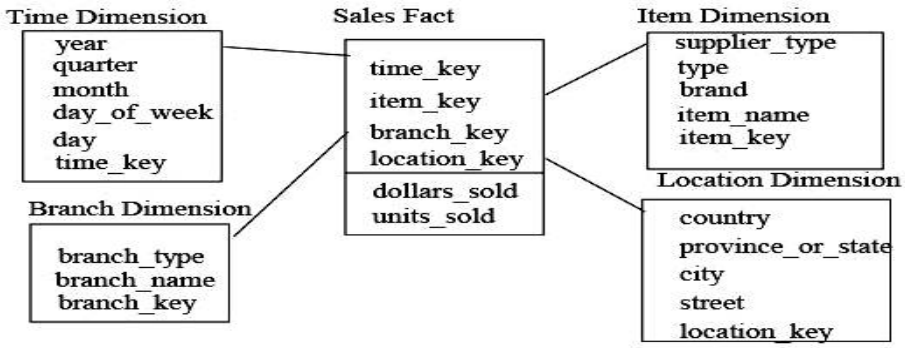
movement is a high-speed communication link. Ex: Oracle Warehouse Builder is the API from Oracle, which provides the features to perform the ETL task on Oracle Data Warehouse.

**4). Discuss schemas for multi-dimensional tables?**

**A)** Schemas for Multidimensional Databases

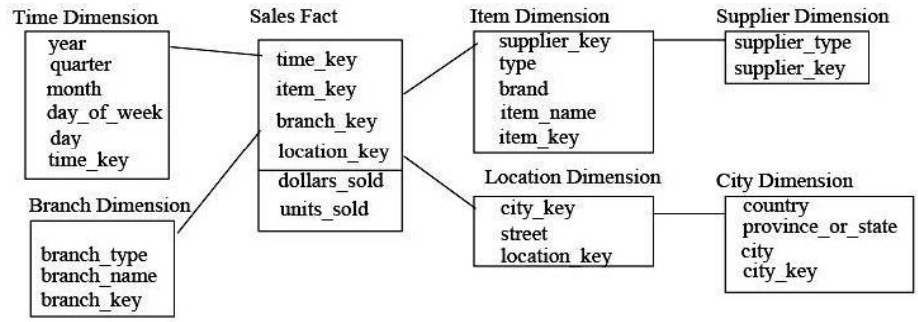
**Star schema**: The star schema is a modeling paradigm in which the data warehouse contains (1) a large central table (fact table), and (2) a set of smaller attendant tables (dimension tables), one for each dimension. The schema graph resembles a starburst, with the dimension tables displayed in a radial pattern around the central fact table.

**Figure Star schema of a data warehouse for sales.**




**Snowflake schema**: The snowflake schema is a variant of the star schema model, where some dimension tables are normalized, thereby further splitting the data into additional tables. The resulting schema graph forms a shape similar to a snowflake. The major difference between the snowflake and star schema models is that the dimension tables of the snowflake model may be kept in normalized form. Such a table is easy to maintain and also saves storage space because a large dimension table can be extremely large when the dimensional structure is included as columns.

**Figure: Snowflake schema of a data warehouse for sales.**



**Fact constellation**: Sophisticated applications may require multiple facttables to share dimension tables. This kind of schema can be viewed as a collection of stars, and hence is called a galaxy schema or a fact constellation.

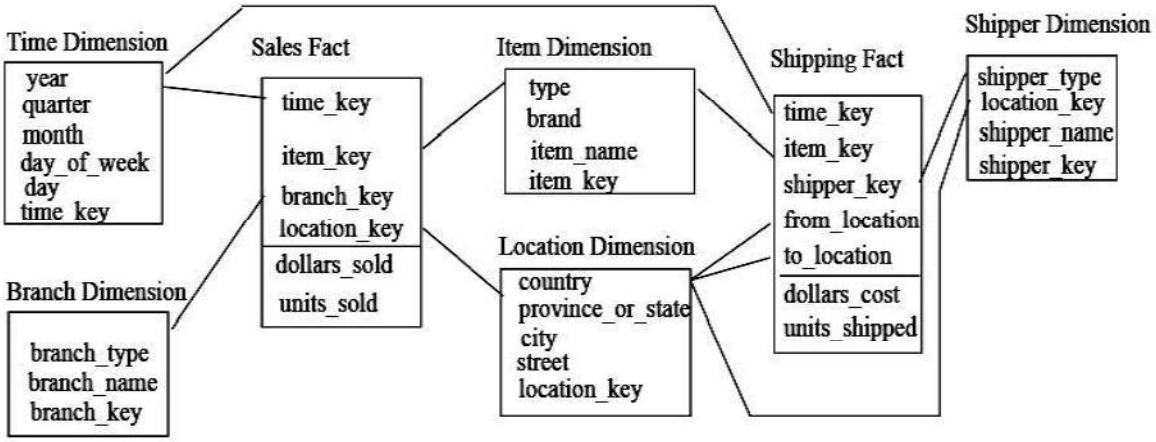



**Figure Fact constellation schema of a data warehouse for sales and shipping**

**5) Discuss OLAP operations?**

**A) OLAP operations on multidimensional data.**

**Roll-up**: The roll-up operation performs aggregation on a data cube, either byclimbing-up a concept hierarchy for a dimension or by dimension reduction. Figure shows the result of a roll-up operation performed on the central cube by climbing up the concept hierarchy for location. This hierarchy was defined as the total order street < city < province or state <country.

**Drill-down**: Drill-down is the reverse of roll-up. It navigates from less detaileddata to more detailed data. Drill-down can be realized by either stepping-down a concept hierarchy for a dimension or introducing additional dimensions. Figure shows the result of a drill-down operation performed on the central cube by stepping down a concept hierarchy for time defined as day < month < quarter < year. Drill-down occurs by descending the time hierarchy from the level of quarter to the more detailed level of month.

**Slice and dice:** The slice operation performs a selection on one dimension of thegiven cube, resulting in a sub cube. Figure shows a slice operation where the sales data are selected from the central cube for the dimension time using the criteria

time=”Q2". The dice operation defines a sub cube by performing a selection on two or more dimensions.

4. **Pivot (rotate):** Pivot is a visualization operation which rotates the data axes in view in order to provide an alternative presentation of the data. Figure shows a pivot operation where the item and location axes in a 2-D slice are rotated.

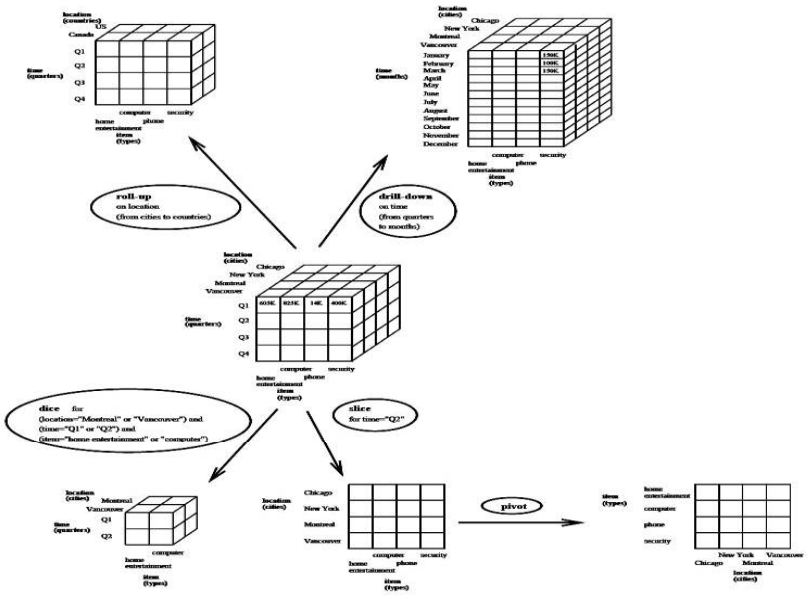



**Figure: Examples of typical OLAP operations on multidimensional data.**

**4. Objective question with answers**

1. The full form of OLAP is

A)Online Analytical Processing

B) Online Advanced Processing

C) Online Advanced Preparation

D) Online Analytical Performance

2. …… is a subject-oriented, integrated, time-variant, nonvolatile collection or data in support of management decisions.

A) Data Mining

B) Data Warehousing

C) Document Mining

D) Text Mining

3. The data is stored, retrieved and updated in ……..

A) OLAP

B) OLTP

C) SMTP

D) FTP

4. An …… system is market-oriented and is used for data analysis by knowledge workers, including managers, executives, and analysts.

A) OLAP

B) OLTP

C) Both of the above

D) None of the above

5. …… is a good alternative to the star schema.

A) Star schema

B) Snowflake schema

C) Fact constellation

D) Star-snowflake schema

6. The …… exposes the information being captured, stored, and managed by operational systems.

A) top-down view

B) data warehouse view

C) data source view

D) business query view

7. The type of relationship in star schema is ……

A) Many to many

B) one to one

C) one to many

D) many to one

8. The …… allows the selection of the relevant information necessary for the data warehouse.
A) top-down view
B) data warehouse view
C) data source view
D) business query view

9. Which of the following is not a component of a data warehouse?

A) Metadata
B) Current detail data
C) Lightly summarized data
D) Component Key

10. Which of the following is not a kind of data warehouse application?
A) Information processing
B) Analytical processing
C) Data mining
D) Transaction processing

**Answers:**

| | |
|---|---|
| 1-A | 6-C |
| 2-B | 7-C |
| 3-B | 8-A |
| 4-A | 9-D |
| 5-C | 10-D |

**5. Fill in the blanks questions with answers.**

1. _____ is a subject-oriented, integrated, time-variant, nonvolatile collection of data in support of management decisions.
2. The data Warehouse is_____..
3. Expansion for DSS in DW is_____

4. The important aspect of the data warehouse environment is that data found within the data warehouse is_____.
5. The time horizon in Data warehouse is usually _____.
6. The data is stored, retrieved & updated in _____..
7. _____describes the data contained in the data warehouse.
8. _____predicts future trends & behaviors, allowing business managers to make proactive,
knowledge-driven decisions.
9. _____ is the heart of the warehouse.
10. _____ is the specialized data warehouse database.

**Answers:**

| | |
|---|---|
| 1. Data Warehousing.. | 6. OLTP. |
| 2. Read only. | 7. Metadata |
| 3. Decision Support system | 8. Data mining. |
| 4. subject-oriented, time-variant, integrated. | 9. Data warehouse database servers |
| 5. 5-10 years. | 10. Redbrick |

## UNIT-2

## 1. TWO MARKS QUESTION WITH ANSWERS:

**1. What is the need for preprocessing the data?**

Incomplete, noisy, and inconsistent data are commonplace properties of large real world databases and data warehouses. Incomplete data can occur for a number of reasons. Attributes of interest may not always be available, such as customer information for sales transaction data. Other data may not be included simply because it was not considered important at the time of entry. Relevant data may not be recorded due to a misunderstanding, or because of equipment malfunctions. Data that were inconsistent with other recorded data may have been deleted. Furthermore, the recording of the history or modifications to the data may have been overlooked. Missing data, particularly for tuples with missing values for some attributes, may need to be inferred.

**2. What is parallel mining of concept description? (OR) What is concept description?**

Data can be associated with classes or concepts. It can be useful to describe individual classes and concepts in summarized, concise, and yet precise terms. Such descriptions of a class or a concept are called class/concept descriptions. These descriptions can be derived via (1) data characterization, by summarizing the data of the class under study (often called the target class) in general terms, or (2) data discrimination, by comparison of the target class with one or a set of comparative classes (often called the contrasting classes), or (3) both data characterization and discrimination.

**3. What is dimensionality reduction?**

In dimensionality reduction, data encoding or transformations are applied so as to obtain a reduced or "compressed" representation of the original data. If the original data can be reconstructed from the compressed data without any loss of information, the data reduction is called lossless.

**4. Mention the various tasks to be accomplished as part of data pre-processing. (Nov/ Dec 2008)**

1. Data cleaning
2. Data Integration
3. Data Transformation
4. Data reduction

**5. What is data cleaning? (May/June 2009)**

Data cleaning means removing the inconsistent data or noise and collecting necessary information of a collection of interrelated data.

**6. Define Data mining. (Nov/Dec 2008)**

Data mining refers to extracting or "mining" knowledge from large amounts of data. The term is actually a misnomer. Remember that the mining of gold from rocks or sand is referred to as gold mining rather than rock or sand mining. Thus, data mining should have been more appropriately named "knowledge mining from data,"

**7. What are the types of concept hierarchies? (Nov/Dec 2009)**

A concept hierarchy defines a sequence of mappings from a set of low-level concepts to higher-level, more general concepts. Concept hierarchies allow specialization, or drilling down, where by concept values are replaced by lower-level concepts.

## 2. THREE MARKS QUESTION WITH ANSWERS:

**1. List the three important issues that have to be addressed during data integration.**

**(OR)**

**List the issues to be considered during data integration.**

There are a number of issues to consider during data integration. **Schema integration** and **object matching** can be tricky. How can equivalent real-world entities from multiple data sources be matched up? This is referred to as the entity identification problem.

**Redundancy** is another important issue. An attribute (such as annual revenue, for instance) may be redundant if it can be "derived" from another attribute or set of attributes. Inconsistencies in attribute or dimension naming can also cause redundancies in the resulting data set.

**A third important** issue in data integration is the **detection and resolution of data value conflicts.** For example, for the same real-world entity, attribute values from different sources may differ. This may be due to differences in representation, scaling, or encoding. For instance, a weight attribute may be stored in metric units in one system and British imperial units in another.

**2. Write the strategies for data reduction. (May/June 2010)**

1. Data cube aggregation
2. Attribute subset selection
3. Dimensionality reduction
4. Numerosity reduction
5. Discretization and concept hierarchy generation.

**3. Why is it important to have data mining query language? (May/June 2010)**

The design of an effective data mining query language requires a deep understanding of the power, limitation, and underlying mechanisms of the various kinds of data mining tasks.

A data mining query language can be used to specify data mining tasks. In particular, we examine how to define data warehouses and data marts in our SQL-based data mining query language, DMQL.

**4. List the five primitives for specifying a data mining task. (Nov/Dec 2010)**

The set of *task-relevant data* to be mined the *kind of knowledge* to be mined:

The *background knowledge* to be used in the discovery process the *interestingness measures and thresholds* for pattern evaluation

The expected *representation for visualizing* the discovered pattern

**5. What is data generalization? (Nov/Dec 2010)**

It is process that abstracts a large set of task-relevant data in a database from relatively low conceptual levels to higher conceptual levels 2 approaches for Generalization.

1) Data cube approach 2) Attribute-oriented induction approach

**6. How concept hierarchies are useful in data mining? (Nov/Dec 2010)**

A concept hierarchy for a given numerical attribute defines a discretization of the attribute. Concept hierarchies can be used to reduce the data by collecting and replacing low-level concepts (such as numerical values for the attribute age) with higher-level concepts (such as youth, middle-aged, or senior). Although detail is lost by such data generalization, the generalized data may be more meaningful and easier to interpret.

**7. How do you clean the data? (Nov/Dec 2011)**

Data cleaning (or data cleansing) routines attempt to fill in missing values, smooth out noise while identifying outliers, and correct inconsistencies in the data. For Missing Values

1. Ignore the tuple
2. Fill in the missing value manually
3. Use a global constant to fill in the missing value
4. Use the attribute mean to fill in the missing value:
5. Use the attribute mean for all samples belonging to the same class as the given tuple
6. Use the most probable value to fill in the missing value For Noisy Data

    1. Binning: Binning methods smooth a sorted data value by consulting its "neighborhood," that is, the values around it.
    2. Regression: Data can be smoothed by fitting the data to a function, such as with Regression
    3. Clustering: Outliers may be detected by clustering, where similar values are organized into groups, or "clusters.

**3. Five-marks question and answers**

**1. What is data mining?**

Data mining refers to extracting or mining "knowledge from large amounts of data. There are many other terms related to data mining, such as knowledge mining, knowledge extraction, data/pattern analysis, data archaeology, and data dredging. Many people treat data mining as a synonym for another popularly used term, Knowledge Discovery in

Databases or KDD

Essential step in the process of Knowledge Discovery in Databases.

Knowledge discovery as a process is depicted in following figure and consists of an iterative sequence of the following steps:

- Data cleaning: to remove noise or irrelevant data
- Data integration: where multiple data sources may be combined
- Data selection: where data relevant to the analysis task are retrieved from the database
- Data transformation: where data are transformed or consolidated into forms appropriate for mining by performing summary or aggregation operations
- Data mining :an essential process where intelligent methods are applied in order to extract data patterns
- Pattern evaluation to identify the truly interesting patterns representing knowledge based on some interestingness measures
- Knowledge presentation: where visualization and knowledge representation techniques are used to present the mined knowledge to the user.

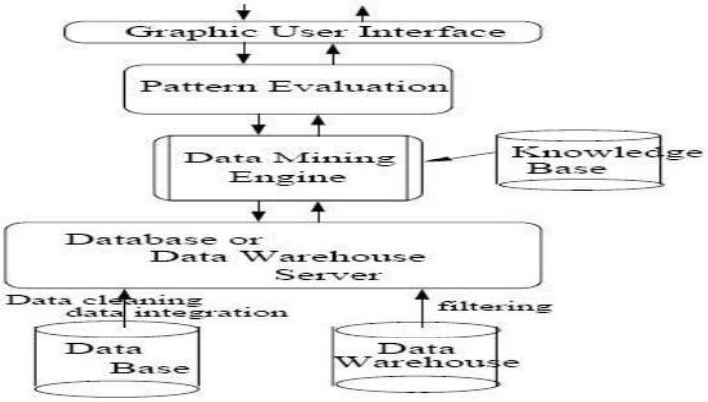
**2. Describe the Architecture of a typical data mining system/Major Components?**

Data mining is the process of discovering interesting knowledge from large amounts of data stored either in databases, data warehouses, or other information repositories. Based on this view, the architecture of a typical data mining system may have the following major components:

- A database, data warehouse, or other information repository, which consists of the set of databases, data warehouses, spreadsheets, or other kinds of information repositories containing the student and course information.
- A database or data warehouse server which fetches the relevant data based on users' data mining requests.
- A knowledge base that contains the domain knowledge used to guide the search or to evaluate the interestingness of resulting patterns. For example, the knowledge base may contain metadata which describes data from multiple Heterogeneous sources.

- A data mining engine, which consists of a set of functional modules for tasks such as classification, association, classification, cluster analysis, and evolution and deviation analysis.

- A pattern evaluation module that works in tandem with the data mining modules by employing interestingness measures to help focus the search towards interestingness patterns. A graphical user interface that allows the user an interactive approach to the data mining system.
- A graphical user interface that allows the user an interactive approach to the data mining system.




Architecture of a typical data mining system.

**3. How is a data warehouse different from a database? How are they similar?**

Differences between a data warehouse and a database: A data warehouse is a repository of information collected from multiple sources, over a history of time, stored under a unified schema, and used for data analysis and decision support; whereas a database, is a collection of interrelated data that represents the current status of the stored data. There could be multiple heterogeneous databases where the schema of one database may not agree with the schema of another. A database system supports ad-hoc query and on-line transaction processing. For more details, please refer to the section "Differences between operational database systems and data warehouses."

Similarities between a data warehouse and a database: Both are repositories of information, storing huge amounts of persistent data.

**4. List out Data mining tasks?**

The two "high-level" primary goals of data mining, in practice, are *prediction* and *description*.

1. **Prediction** involves using some variables or fields in the database to predict unknown or future values of other variables of interest.
2. **Description** focuses on finding human-interpretable patterns describing the data.

The relative importance of prediction and description for particular data mining applications can vary considerably. However, in the context of KDD, description tends to be more important than prediction. This is in contrast to pattern recognition and machine learning applications (such as speech recognition) where prediction is often the primary goal of the KDD process.

The goals of prediction and description are achieved by using the following primary **data mining tasks**:

1. **Classification** is learning a function that maps (classifies) a data item into one of several predefined classes.
2. **Regression** is learning a function which maps a data item to a real-valued prediction variable.
3. **Clustering** is a common descriptive task where one seeks to identify a finite set of categories or clusters to describe the data.
    - Closely related to clustering is the task of *probability density estimation* which consists of techniques for estimating, from data, the joint multi-variate probability density function of all of the variables/fields in the database.
4. **Summarization** involves methods for finding a compact description for a subset of data.
5. **Dependency Modeling** consists of finding a model which describes significant dependencies between variables.
   Dependency models exist at two levels:
    1. The *structural* level of the model specifies (often graphically) which variables are locally dependent on each other, and
    2. The *quantitative* level of the model specifies the strengths of the dependencies using some numerical scale.

**Change and Deviation Detection** focuses on discovering the most significant changes in the data from previously measured or normative values.

**5. What do you mean by Attribute sub selection / Feature selection?**

Feature selection is a must for any data mining product. That is because, when you build a data mining model, the dataset frequently contains more information than is needed to build the model. For example, a dataset may contain 500 columns that describe characteristics of customers, but perhaps only 50 of those columns are used to build a particular model. If you keep the unneeded columns while building the model, more CPU and memory are required during the training process, and more storage space is required for the completed model.

In which select a minimum set of features such that the probability distribution of different classes given the values for those features is as close as possible to the original distribution given the values of all features

Basic heuristic methods of attribute subset selection include the following techniques, some of which are illustrated below:

**Step-wise forward selection:** The procedure starts with an empty set of **attributes.** Thebest of the original attributes is determined and added to the set. At each subsequent iteration or step, the best of the remaining original attributes is added to the set.

**Step-wise backward elimination:** The procedure starts with the full set of **attributes.** At each step, it removes the worst attribute remaining in the set.

**Combination forward selection and backward elimination:** The step-wise **forward** selection and backward elimination methods can be combined, where at each step one selects the best attribute and removes the worst from among the remaining attributes.

**Decision tree induction:** Decision tree induction constructs a flow-chart-like structure where each internal (non-leaf) node denotes a test on an attribute, each branch corresponds to an outcome of the test, and each external (leaf) node denotes a class prediction. At each node, the

algorithm chooses the “best" attribute to partition the data into individual classes. When decision tree induction is used for attribute subset selection, a tree is constructed from the given data. All attributes that do not appear in the tree are assumed to be irrelevant. The set of attributes appearing in the tree form the reduced subset of attributes.

**Wrapper approach/Filter approach:**

The mining algorithm itself is used to determine the attribute sub set, then it is called wrapper approach or filter approach. Wrapper approach leads to greater accuracy since it optimizes the evaluation measure of the algorithm while removing attributes.

**Data compression**

In data compression, data encoding or transformations are applied so as to obtain a reduced or “compressed" representation of the original data. If the original data can be reconstructed from the compressed data without any loss of information, the data compression technique used is called lossless. If, instead, we can reconstruct only an approximation of the original data, then the data compression technique is called lossy. Effective methods of lossy data compression:

**4. Objective question with answers**

1…… is an essential process where intelligent methods are applied to extract data patterns.

A) Data Warehousing

B) Data mining

C) Text mining

D) Data selection

2. Data mining can also applied to other forms such as ……

i) Data streams
ii) Sequence data
iii) Networked data
iv) Text data
v) Spatial data

A) i, ii, iii and v only
B) ii, iii, iv and v only
C) i, iii, iv and v only
D) All i, ii, iii, iv and v

3. Which of the following is not a data mining functionality?
A) Characterization and Discrimination
B) Classification and regression
C) Selection and interpretation
D) Clustering and Analysis

4 …….. is a summarization of the general characteristics or features of a target class of data.
A) Data Characterization

B) Data Classification

C) Data discrimination

D) Data selection

5 …….. is a comparison of the general features of the target class data objects against the general features of objects from one or multiple contrasting classes.

A) Data Characterization

B) Data Classification

C) Data discrimination

D) Data selection

6. Strategic value of data mining is ……

A) cost-sensitive

B) work-sensitive

C) time-sensitive

D) technical-sensitive

7. …….. is the process of finding a model that describes and distinguishes data classes or concepts.

A) Data Characterization

B) Data Classification

C) Data discrimination

D) Data selection

8. The various aspects of data mining methodologies is/are ……

i) Mining various and new kinds of knowledge

ii) Mining knowledge in multidimensional space

iii) Pattern evaluation and pattern or constraint-guided mining.

iv) Handling uncertainty, noise, or incompleteness of data

A) i, ii and iv only

B) ii, iii and iv only

C) i, ii and iii only

D) All i, ii, iii and iv

9. The full form of KDD is ……

A) Knowledge Database

B) Knowledge Discovery Database

C) Knowledge Data House

D) Knowledge Data Definition

10. The out put of KDD is ……

A) Data

B) Information

C) Query

D) Useful information

Answer:

| | |
|---|---|
| 1. B | 6. C |
| 2. D | 7. B |
| 3. C | 8. D |
| 4. A | 9. B |
| 5. C | 10. D |

**5. Fill in the blanks questions with answers.**

1. ..... is an essential process where intelligent methods are applied to extract data patterns.
2. Data mining can also applied to other forms such as.....
3. Which of the following is not a data mining functionality?
4. ..... is a summarization of the general characteristics or features of a target class of data.
5..... is a comparison of the general features of the target class data objects against the general features of objects from one or multiple contrasting classes
6. Strategic value of data mining is.....
7..... is the process of finding a model that describes and distinguishes data classes or concepts.
8. The various aspects of data mining methodologies is/are.....
9. The full form of KDD is .....
10. The output of KDD is.....

Answer:

| | |
|---|---|
| 1. Data mining | 6. C |
| 2. D | 7. B |
| 3. C | 8. D |
| 4. A | 9. B |
| 5. C | 10. D |

**UNIT-3**

## 1. TWO MARKS QUESTION WITH ANSWERS:

### 1. Define frequent set and border set. (Nov/Dec 2007)

A set of items is referred to as an itemset. An itemset that contains k items is a k-itemset. The set Of computer, antivirus software is a 2-itemset. The occurrence frequency of an itemset is the number of transactions that contain the itemset. This is also known, simply, as the frequency, support count, or count of the itemset.Where each variation involves "playing" with the support threshold in slightly different way.The variations, where nodes indicate an item or itemset that has been examined, and nodes with thick borders indicate that an examined item or itemset is frequent.

### *2. How is association rule mined from large databases? (Nov/Dec 2007)*

Suppose, however, that rather than using a transactional database, sales and related information are stored in a relational database or data warehouse. Such data stores are multidimensional, by definition. For instance, in addition to keeping track of the items purchased in sales transactions, a relational database may record other attributes associated with the items, such as the quantity purchased or the price, or the branch location of the sale. Additional relational information regarding the customers who purchased the items, such as customer age, occupation, credit rating, income, and address, may also be stored.

### *3. List two interesting measures for association rules. (April/May 2008) (OR) Rule support and confidence are two measures of rule interestingness.*

They respectively reflect the usefulness and certainty of discovered rules. A support of 2% for Association Rule (5.1) means that 2% of all the transactions under analysis show that computer and antivirus software are purchased together. A confidence of 60% means that 60% of the customers who purchased a computer also bought the software. Typically, association rules are considered interesting if they satisfy both a minimum support threshold and a minimum confidence threshold. Such thresholds can be set by users or domain experts. Additional analysis can be performed to uncover interesting statistical correlations between

associated items.

***4. What are Iceberg queries? (April/May 2008)***

It computes an aggregate function over an attribute or set of attributes in order to find aggregate values above some specified threshold. Given relation R with attributes a1,a2,?..,an and b, and an aggregate function, agg_f, an iceberg query is the form.

```
Select
R.a1,R.a2,?..R.an,
agg_f(R,b)    From
relation R

Group  by
R.a1,R.a2
,?.,R.an
Having
agg_f(R.b
)>=threho
ld
```

***5. What is over fitting and what can you do to prevent it? (Nov/Dec 2008)***

Tree pruning methods address this problem of over fitting the data. Such methods typically use statistical measures to remove the least reliable branches. An unpruned tree and a pruned version of it. Pruned trees tend to be smaller and less complex and, thus, easier to comprehend. They are usually faster and better at correctly classifying independent test data (i.e., of previously unseen tuples) than unpruned trees.

## 2. THREE MARKS QUESTION WITH ANSWERS:

***1.* in classification trees, what are surrogate splits, and how are they used?**

Decision trees can suffer from repetition and replication, making them overwhelming to interpret. Repetition occurs when an attribute is repeatedly tested along a given branch of the tree (such as "age < 60?" followed by "age < 45"? and so on). In replication, duplicate sub trees exist within the tree. These situations can impede the accuracy and comprehensibility of a decision tree. The use of Tree pruning methods addresses this problem of over fitting the data. Such methods typically use statistical measures to remove the least reliable branches. An unpruned tree and a pruned version of it. Pruned trees tend to be smaller and less complex and, thus, easier to comprehend. They are usually faster and better at correctly classifying independent test data (i.e., of previously unseen tuples) than unpruned trees.

***2.* Explain the market basket analysis problem. (May/June 2009)**

Market basket analysis, which studies the buying habits of customers by searching for sets of items that are frequently purchased together (or in sequence). This process analyzes customer buying habits by finding associations between the different items that customers place in their "shopping baskets". The discovery of such associations can help retailers develop marketing strategies by gaining insight into which items are frequently purchased together by customers. For instance, if customers are buying milk, how likely are they to also buy bread (and what kind of bread) on the same trip to the supermarket? Such information can lead to increased sales by helping retailers do selective marketing and plan their shelf space.

***3.* Give the difference between Boolean association rule and quantitative Association rule.**

Based on the types of values handled in the rule: If a rule involves associations between the presence or absence of items, it is a Boolean association rule. For example, the following three rules are Boolean association rules obtained from market basket analysis.

Computer => antivirus software [support = 2%; confidence = 60%] buys(X, "computer") => buys(X, "HP printer")

buys(X, “laptop computer”) => buys(X, “HP printer”)

Quantitative association rules involve numeric attributes that have an implicit ordering among values (e.g., age). If a rule describes associations between quantitative items or attributes, then it is a quantitative association rule. In these rules, quantitative values for items or attributes are partitioned into intervals. Following rule is considered a quantitative association rule. Note that the quantitative attributes, age and income, have been discretized.

age(X, “30: : :39”)^income(X, “42K....48K”) => buys(X, “high resolution TV”)

***4. List the techniques to improve the efficiency of Apriori algorithm.***

- Hash based technique
- Transaction
- Reduction
- Portioning
- Sampling
- Dynamic item counting

***5. What is FP growth? (May/June 2010)***

FP-growth, which adopts a divide-and-conquer strategy as follows. First, it compresses the database representing frequent items into a frequent-pattern tree, or FP-tree,which retains the itemset association information. It then divides the compressed database into a set of conditional databases (a special kind of projected database), each associated with one frequent item or “pattern fragment,” and mines each such database separately.

## 2. FIVE MARKS QUESTION WITH ANSWERS:

### 1. Explain Association rule?

It is an important data mining model studied extensively by the database and data mining community.

Assume all data are categorical. No good algorithm for numeric data. Initially used for Market Basket Analysis to find how items purchased by customers are related.

Bread $\rightarrow$ Milk [sup = 5%, conf = 100%]

$I = \{i_1, i_2, \ldots, i_m\}$: a set of *items.*

Transaction $t$ :$t$ a set of items, and $t \subseteq I$.

Transaction Database $T$: a set of transactions $T = \{t_1, t_2, \ldots, t_n\}$.

A transaction $t$ contains $X$, a set of items (itemset) in $I$, if $X \subseteq t$.

An association rule is an implication of the form:

$X \rightarrow Y$, where $X, Y \subset I$, *and* $X \cap Y = \varnothing$

An itemset is a set of items.

- E.g., X = {milk, bread, cereal} is an itemset.

A $k$-itemset is an itemset with $k$ items.

- E.g., {milk, bread, cereal} is a 3-itemset

Rule strength measures:

Support: The rule holds with support *sup* in $T$ (the transaction data set) if sup% of transactions contain $X \cup Y$.

- $sup = \Pr(X \cup Y)$.

Confidence: The rule holds in *T* with confidence *conf* if *conf*% of tranactions that contain *X* also contain *Y*.

- $conf = \Pr(Y \mid X)$

An association rule is a pattern that states when *X* occurs, *Y* occurs with certain probability.

Support count: The support count of an itemset*X*, denoted by *X.count*, in a data set *T* is the number of transactions in *T* that contain *X*. Assume *T* has *n* transactions.

Then,

$$support = \frac{(X \cup Y).count}{n}$$

$$confidence = \frac{(X \cup Y).count}{X.count}$$

**2). Describe Apriori algorithm?**

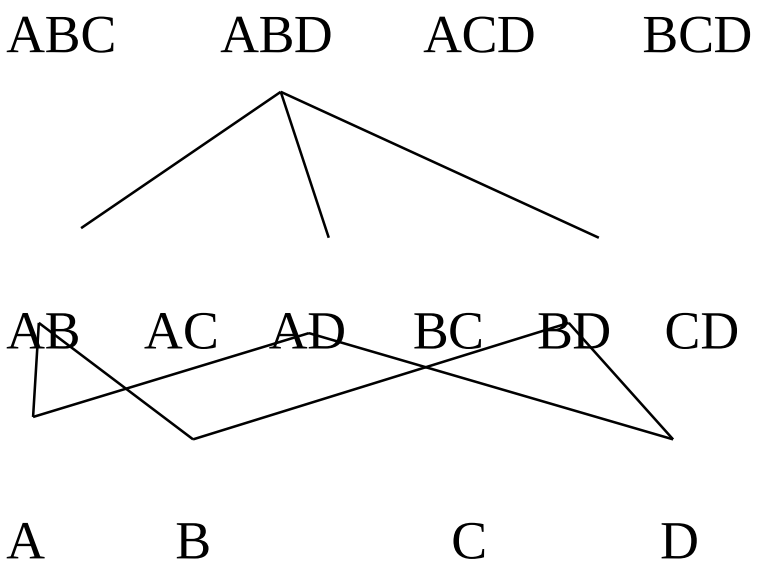
**It involves Two steps**:

a. Find all itemsets that have minimum support (*frequent itemsets*, also called large itemsets).
b. Use frequent itemsets to generate rules.

Step 1: Mining all frequent itemsets

A frequent *itemset* is an itemset whose support is $\geq$ minsup.

Key idea: The apriori property (downward closure property): any subsets of a frequent itemset are also frequent itemsets




Iterative algo. (also called level-wise search): Find all 1-item frequent itemsets; then all 2-item frequent itemsets, and so on.

In each iteration *k*, only consider itemsets that contain some *k*-1 frequent itemset.

Find frequent itemsets of size 1: $F_1$

From $k = 2$

- $C_k$ = candidates of size *k*: those itemsets of size *k* that could be frequent, given $F_{k-1}$
- $F_k$ = those itemsets that are actually frequent, $F_k \subseteq C_k$(need to scan the database once).

Example –

Finding frequent itemsets

Minsup=0.5 dataset t

itemset:count

1. scan T ➔ $C_1$: {1}:2, {2}:3, {3}:3, {4}:1, {5}:3

➔ $F_1$: {1}:2, {2}:3, {3}:3, {5}:3

➔ $C_2$: {1,2}, {1,3}, {1,5}, {2,3}, {2,5}, {3,5}

2.scan T ➔ $C_2$: {1,2}:1, {1,3}:2, {1,5}:1, {2,3}:2, {2,5}:3, {3,5}:2

➔ $F_2$: {**1,3**}:2, {**2,3**}:2, {**2,5**}:3, {**3,5**}:2

➔ $C_3$:{2, 3,5}

3. scan T ➔ $C_3$: {**2, 3, 5**}:2 ➔ $F_{3:}$ {**2, 3, 5**}

| TID | Items |
|---|---|
| T100 | 1, 3, 4 |
| T200 | 2, 3, 5 |
| T300 | 1, 2, 3, 5 |
| T400 | 2, 5 |

Ordering of Items:

The items in *I* are sorted in lexicographic order (which is a total order).

The order is used throughout the algorithm in each itemset.

{*w*[1], *w*[2], …, *w*[*k*]} represents a *k*-itemset*w* consisting of items *w*[1], *w*[2], …, *w*[*k*], where *w*[1] <*w*[2] < … <*w*[*k*] according to the total order.

**Algorithm Apriori(*T*)**

$C_1 \leftarrow$ init-pass($T$);

$F_1 \leftarrow \{f \mid f \in C_1, f.\text{count}/n \geq minsup\}$; // n: no. of transactions in T

**for** ($k$ = 2; $F_{k-1} \neq \emptyset$; $k$++) **do**

$C_k \leftarrow$ candidate-gen($F_{k-1}$);

**for** each transaction $t \in T$ **do**

**for** each candidate $c \in C_k$ **do**

**if** $c$ is contained in $t$ **then**

$c.count$++;

**end**

**end**

$F_k \leftarrow \{c \in C_k \mid c.count/n \geq minsup\}$

**end**

return $F \leftarrow \bigcup_k F_k$;

Apriori candidate generation

The candidate-gen function takes $F_{k-1}$ and returns a superset (called the candidates) of the set of all frequent $k$-itemsets. It has two steps

- *join* step: Generate all possible candidate itemsets $C_k$ of length $k$
- *prune* step: Remove those candidates in $C_k$ that cannot be frequent.

**Function** candidate-gen($F_{k-1}$)

$C_k \leftarrow \emptyset$;

**forall** $f_1, f_2 \in F_{k-1}$

with $f_1 = \{i_1, \ldots, i_{k-2}, i_{k-1}\}$

and $f_2 = \{i_1, \ldots, i_{k-2}, i'_{k-1}\}$

and $i_{k-1} < i'_{k-1}$ **do**

$c \leftarrow \{i_1, \ldots, i_{k-1}, i'_{k-1}\}$; // join $f_1$ and $f_2$

$C_k \leftarrow C_k \cup \{c\}$;

**for**each ($k$-1)-subset $s$ of $c$ **do**

**if** ($s \notin F_{k-1}$) **then**

delete $c$ from $C_k$; // prune

**end**

**end**

return $C_k$;

Step 2: Generating rules from frequent itemsets

Frequent itemsets≠ association rules. One more step is needed to generate association rules. For each frequent itemset $X$, For each proper nonempty subset $A$ of $X$,

- Let $B$ = X - $A$

- $A \rightarrow B$ is an association rule if
  - Confidence($A \rightarrow B$) $\geq$ minconf,

support($A \rightarrow B$) = support($A \cup B$) = support(X)

confidence($A \rightarrow B$) = support($A \cup B$) / support(A)

Generating rules:

To recap, in order to obtain $A \rightarrow B$, we need to have support($A \cup B$) and support(A). All the required information for confidence computation has already been recorded in itemset generation. No need to see the data *T* anymore. This step is not as time-consuming as frequent itemsets generation.

**3. Write The MSapriori algorithm?**

**Algorithm MSapriori(*T*, *MS*)**

*M*←sort(*I*, *MS*);
*L*←init-pass(*M*, *T*);
$F_1$← {{*i*} | *i*∈*L*, *i.count/n*≥MIS(*i*)};
**for** (*k* = 2; $F_{k-1} \neq \emptyset$; *k*++) **do**
**if***k*=2 **then**
$C_k$← level2-candidate-gen(*L*)
**else***C*$_k$←MScandidate-gen($F_{k-1}$);
**end;**
**for** each transaction *t*∈*T***do**
**for** each candidate *c*∈$C_k$**do**
**if***c* is contained in *t***then**
*c.count*++;
**if***c* – {*c*[1]} is contained in *t***then**
*c.tailCount*++
**end**
**end**

$F_k \leftarrow \{c \in C_k \mid c.count/n \geq MIS(c[1])\}$

**end**

return $F \leftarrow \bigcup_k F_k$;

Candidate itemset generation

- Special treatments needed:
  - Sorting the items according to their MIS values
  - First pass over data (the first three lines)
    - Let us look at this in detail.
  - Candidate generation at level-2
    - Read it in the handout.
  - Pruning step in level-*k* (*k*> 2) candidate generation.
    - Read it in the handout.

First pass over data

It makes a pass over the data to record the support count of each item.

It then follows the sorted order to find the first item *i* in *M* that meets MIS(*i*).

- *i* is inserted into *L*.
- For each subsequent item *j* in *M* after *i*, if *j.count*/*n*≥MIS(*i*) then *j* is also inserted into *L*, where *j.count* is the support count of *j* and *n* is the total number of transactions in *T*. Why?

*L* is used by function level2-candidate-gen

**4. Explain Partioin Algorithm?**

The pseudocode of PAM algorithm is shown below:

**Algorithm 1: PAM Algorithm Input:** E = {e1,e2,...en} (dataset to be clustered or matrix of dissimilarity)

k (number of clusters)

metric (kind of metric to use on dissimilarity matrix)

diss (flag indicating that E is the matrix of dissimilarity or not)

**Output:** M = {m1,m2,...,mk} (vector of clusters medoids)

L = {l(e) | e = 1,2,...,n} (set of cluster labels of E)

**foreach** $m_i$ € M **do**

$m_i \leftarrow e_j$ € E; (e.g. random selection)

**end if** diss ≠ true

Dissimilarity ← CalculateDissimilarityMatrix(E, metric);

**else**

Dissimilarity ← E;

**end repeat**

**foreach** $e_i$ € E **do**

$l(e_i) \leftarrow$ argmin Dissimilarity($e_i$, Dissimilarity, M);

**end**

changed ← false;

**foreach** $m_i \in M$ **do**

Mtmp ← SelectBestClusterMedoids(E, Dissimilarity, L);

**end**

**if** Mtmp ≠ M

M ← Mtmp;

changed ← true;

**end**

until changed = true;

In the R programming language, the PAM algorithm is available in the cluster package and can be called by the following command:

pam(x, k, diss, metric, medoids, stand, cluster.only, do.swap, keep.diss, keep.data,trace.lev)

Where the parameters are:

**x:** numerical data matrix representing the dataset entities, or can be the dissimilarity matrix, it depends on the value of the diss parameter. In case x is a data matrix each row is an entity and each column is an variable, and in this case missing values are allowed as long as every pair of entities has at least one case not missing. In case x is a dissimilarity matrix it is not allowed to have missing values.

**k:** number of clusters that the dataset will be partitioned where 0 < k < n, where n is the number of entities.

**diss:** logical flag, if it is TRUE x is used as the dissimilarity matrix, if it is FALSE, then x will be considered as a data matrix.

**metric:** an string specifying each of the two metrics will be used to calculate the dissimilarity matrix, the metric variable can be "euclidean" to use the Euclidean distance, or can be "manhattan" to use the Manhattan distance.

**stand:** logical flag, if it is TRUE then the measurements in x will be standardized before calculating the dissimilarities. Measurements are standardized for each column, by subtracting the column's mean value and dividing by the variable's mean absolute deviation. If x is a dissimilarity matrix then this parameter is ignored.

**cluster.only:** logical flag, if it is TRUE, only the clustering will be computed and returned.

**do.swap:** logical flag, indicates if the swap phase should happen (TRUE) or not (FALSE).

**keep.diss:** logical flag indicating if the dissimilarities should (TRUE) or not (FALSE) be kept in the result.

**keep.data:** logical flag indicating if the input data x should (TRUE) or not (FALSE) be kept in the result.

**trace.lev:** an numeric parameters specifying a trace level for printing diagnostics during the build and swap phase of the algorithm. Default 0 does not print anything.

The PAM algorithm returns a pam object that contains the information about the result of the execution of the algorithm.

**5. Illustrate FP-Growth algorithm?**

The FP-Growth Algorithm is an alternative way to find frequent itemsets without using candidate generations, thus improving performance. For so much it uses a divide-and-conquer strategy. The core of this method is the usage of a special data structure named frequent-pattern tree (FP-tree), which retains the itemset association information.

In simple words, this algorithm works as follows: first it compresses the input database creating an FP-tree instance to represent frequent items. After this first step it divides the compressed database into a set of conditional databases, each one associated with one frequent pattern. Finally, each such database is mined separately. Using this strategy, the FP-Growth reduces the search costs looking for short patterns recursively and then concatenating them in the long frequent patterns, offering good selectivity. In large databases, it's not possible to hold the FP-tree in the main memory. A strategy to cope with this problem is to firstly partition the database into a set of smaller databases (called projected databases), and then construct an FP-tree from each of these smaller databases.

The next subsections describe the FP-tree structure and FP-Growth Algorithm, finally an example is presented to make it easier to understand these concepts.

**FP-Tree structure**

The frequent-pattern tree (FP-tree) is a compact structure that stores quantitative information about frequent patterns in a database

Han defines the FP-tree as the tree structure defined below

1. One root labeled as "null" with a set of item-prefix sub trees as children, and a frequent-item-header table (presented in the left side of Figure 1);
2. Each node in the item-prefix sub tree consists of three fields:

    1. Item-name: registers which item is represented by the node;
    2. Count: the number of transactions represented by the portion of the path reaching the node;

3. Node-link: links to the next node in the FP-tree carrying the same item-name, or null if there is none.

1. Each entry in the frequent-item-header table consists of two fields:

    1. Item-name: as the same to the node;
    2. Head of node-link: a pointer to the first node in the FP-tree carrying the item-name.

The original algorithm to construct the FP-Tree defined by Han in [1] is presented below in Algorithm 1.

***Algorithm 1: FP-tree construction***

*Input*: A transaction database DB and a minimum support threshold ?.

*Output*: FP-tree, the frequent-pattern tree of DB.

*Method*: The FP-tree is constructed as follows.

1. Scan the transaction database DB once. Collect F, the set of frequent items, and the support of each frequent item. Sort F in support-descending order as FList, the list of frequent items.
2. Create the root of an FP-tree, T, and label it as "null". For each transaction Trans in DB do the following:

- Select the frequent items in Trans and sort them according to the order of FList. Let the sorted frequent-item list in Trans be [ p | P], where p is the first element and P is the remaining list. Call insert tree([ p | P], T ).
- The function insert tree([ p | P], T ) is performed as follows. If T has a child N such that N.item-name = p.item-name, then increment N 's count by 1; else create a new node N , with its count initialized to 1, its parent link linked to T , and its node-link linked to the nodes with the same item-name via the node-link structure. If P is nonempty, call insert tree(P, N ) recursively.

By using this algorithm, the FP-tree is constructed in two scans of the database. The first scan collects and sort the set of frequent items, and the second constructs the FP-Tree.

**FP-Growth Algorithm**

After constructing the FP-Tree it's possible to mine it to find the complete set of frequent patterns. To accomplish this job, Han in [1] presents a group of lemmas and properties, and thereafter describes the FP-Growth Algorithm as presented below in Algorithm 2.

**Algorithm 2: FP-Growth**

*Input*: A database DB, represented by FP-tree constructed according to Algorithm 1, and a minimum support threshold?.

*Output*: The complete set of frequent patterns.

*Method*: call FP-growth (FP-tree, null).

Procedure FP-growth (Tree, a) {

if Tree contains a single prefix path then { // Mining single prefix-path FP-tree

let P be the single prefix-path part of Tree;

let Q be the multipath part with the top branching node replaced by a null root;

for each combination (denoted as ß) of the nodes in the path P do

generate pattern ß ∪ a with support = minimum support of nodes in ß;

letfreq pattern set(P) be the set of patterns so generated;

}

else let Q be Tree;

for each item ai in Q do { // Mining multipath FP-tree

generate pattern ß = aiU a with support = ai .support;

constructß's conditional pattern-base and then ß's conditional FP-tree Tree ß;

if Tree ß ≠ Ø then

call FP-growth(Tree ß , ß);

letfreq pattern set(Q) be the set of patterns so generated;

}

Return (freq pattern set(P) Ufreq pattern set(Q) U (freq pattern set(P) × freq pattern set(Q)))

}

**4. Objective question with answers**

1. Data modeling technique used for data marts is
   A) Dimensional modeling
   B) ER – model
   C) Extended ER – model
   D) Physical model
   E) Logical model.

2. A warehouse architect is trying to determine what data must be included in the warehouse. A meeting has been arranged with a business analyst to understand the data requirements, which of the following should be included in the agenda?
   A) Number of users
   B) Corporate objectives
   C) Database design
   D) Routine reporting
   E) Budget.

3. An OLAP tool provides for
   A) Multidimensional analysis
   B) Roll-up and drill-down
   C) Slicing and dicing
   D) Rotation
   E) Setting up only relations.

4. The Synonym for data mining is
   A) Data warehouse
   B) Knowledge discovery in database
   C) ETL
   D) Business intelligence
   E) OLAP.

5. Which of the following statements is true?

A) A fact table describes the transactions stored in a DWH

B) A fact table describes the granularity of data held in a DWH

C) The fact table of a data warehouse is the main store of descriptions of the transactions stored in a DWH

D) The fact table of a data warehouse is the main store of all of the recorded transactions over time

E) A fact table maintains the old records of the database.

6. Most common kind of queries in a data warehouse

A) Inside-out queries

B) Outside-in queries

C) Browse queries

D) Range queries

E) All (a), (b), (c) and (d) above.

7. Concept description is the basic form of the

A) Predictive data mining

B) Descriptive data mining

C) Data warehouse

D) Relational data base

E) Proactive data mining.

8. The apriori property means

A) If a set cannot pass a test, all of its supersets will fail the same test as well

B) To improve the efficiency the level-wise generation of frequent item sets

C) If a set can pass a test, all of its supersets will fail the same test as well

D) To decrease the efficiency the level-wise generation of frequent item sets

E) All (a), (b), (c) and (d) above.

9. Which of following form the set of data created to support a specific short lived business situation?

A) Personal data marts

B) Application models

C) Downstream systems

D) Disposable data marts

E) Data mining models.

10. What is/are the different types of Meta data?

I. Administrative.

II. Business.

III. Operational.

A) Only (I) above

(b) Both (II) and (III) above

(c) Both (I) and (II) above

(d) Both (I) and (III) above

(e) All (I), (II) and (III) above.

**Answers:**

| | |
|---|---|
| 1 A | 6 A |
| 2 D | 7 B |
| 3 C | 8 B |
| 4 C | 9 D |
| 5 D | 10 E |

**5. Fill in the blanks questions with answers**

1. _____ is a process of determining the preference of customer's majority.
2. Strategic value of data mining is _____.
3. _____ proposed the approach for data integration issues.
4. The terms equality and roll up are associated with _____.
5. Exceptional reporting in data warehousing is otherwise called as _____.
6. _____ is a metadata repository.
7. _____ is an expensive process in building an expert system.
8. The full form of KDD is _____.
9. The first International conference on KDD was held in the year _____.
10. Removing duplicate records is a process called _____.

ANSWER: B

| | |
|---|---|
| 1. Referencing. | 6. Prism solution directory manager. |
| 2. In for time directory | 7. Information collection. |
| 3. Ralph Kimball | 8. Knowledge discovery in database. |
| 4. Data mart. | 9. 1995 |
| 5. Alerts. | 10. data cleaning |

**UNIT-4**

## 2. TWO MARKS QUESTION WITH ANSWERS:

**1. What is tree pruning?**

Tree pruning attempts to identify and remove such branches, with the goal of improving classification accuracy on unseen data.

**2. List the requirements of clustering in data mining.**

Mining data streams involves the efficient discovery of general patterns and dynamic changes within stream data. For example, we may like to detect intrusions of a computer network based on the anomaly of message flow, which may be discovered by clustering data streams, dynamic construction of stream models, or comparing the current frequent patterns with that at a certain previous time.

**3. What is classification? (April/May 2008) (May/June 2009)**

Classification is the process of finding a model (or function) that describes and distinguishes data classes or concepts, for the purpose of being able to use the model to predict the class of objects whose class label is unknown. The derived model is based on the analysis of a set of training data (i.e., data objects whose class label is known).

**4. What is the objective function of the K-means algorithm?**

The k-means algorithm takes the input parameter, k, and partitions a set of n objects into k clusters so that the resulting intra cluster similarity is high but the inter cluster similarity is low. Cluster similarity is measured in regard to the mean value of the objects in a cluster, which can be viewed as the cluster's centroid or center of gravity.

First, it randomly selects k of the objects, each of which initially represents a cluster mean or center. For each of the remaining objects, an object is assigned to the cluster to which it is the most similar, based on the distance between the object and the cluster mean. It then computes the new mean for each cluster. This process iterates until the criterion function converges.

Typically, the square-error criterion is used, defined as where E is the sum of the square error for all objects in the data set; p is the point in space representing a given object; and mi is the mean of cluster Ci (both p and mi are multidimensional).

**5. The naïve Bayes classifier makes what assumption that motivates its name?**

Studies comparing classification algorithms have found a simple Bayesian classifier known as the naïve Bayesian classifier to be comparable in performance with decision tree and selected neural network classifiers.

Bayesian classifiers have also exhibited high accuracy and speed when applied to large databases. Naïve Bayesian classifiers assume that the effect of an attribute value on a given class is independent of the values of the other attributes. This assumption is called class conditional independence. It is made to simplify the computations involved and, in this sense, is considered "naïve."

**2. THREE MARKS QUESTION WITH ANSWERS:**

***1*. What is an outlier? (May/June 2009) (OR)**

**Define outliers. List various outlier detection approaches. (May/June 2010)**

A database may contain data objects that do not comply with the general behavior or model of the data. These data objects are outliers. Most data mining methods discard outliers as noise or exceptions. These can be categorized into four approaches: the statistical approach, the distance-based approach, the density-based local outlier approach, and the deviation-based approach.

**2. Compare clustering and classification. (Nov/Dec 2009)**

Clustering techniques consider data tuples as objects. They partition the objects into groups or clusters, so that objects within a cluster are "similar" to one another and "dissimilar" to objects in other clusters. Similarity is commonly defined in terms of how "close" the objects are in space, based on a distance function. The "quality" of a cluster may

be represented by its diameter, the maximum distance between any two objects in the cluster. Outliers may be detected by clustering, where similar values are organized into groups, or "clusters." Intuitively, values that fall outside of the set of clusters may be considered outlier**s.**

**3. What is meant by hierarchical clustering? (Nov/Dec 2009)**

A hierarchical method creates a hierarchical decomposition of the given set of data objects. A hierarchical method can be classified as being either agglomerative or divisive, based on how the hierarchical decomposition is formed.

The agglomerative approach, also called the bottom-up approach, starts with each object forming a separate group. It successively merges the objects or groups that are close to one another, until all of the groups are merged into one (the topmost level of the hierarchy), or until a termination condition holds. The divisive approach, also called the top-down approach, starts with all of the objects in the same cluster. In each successive iteration, a cluster is split up into smaller clusters, until eventually each object is in one cluster, or until a termination condition holds.

**4. What is Bayesian theorem? (May/June 2010)**

Let X be a data tuple. In Bayesian terms, X is considered "evidence." As usual, it is described by measurements made on a set of n attributes. Let H be some hypothesis, such as that the data tuple X belongs to a specified class C. For classification problems, we want to determine P(HjX), the probability that the hypothesis H holds given the "evidence" or observed data tuple X. In other words, we are looking for the probability that tuple X belongs to class C, given that we know the attribute description of X.

**5. What is Association based classification? (Nov/Dec 2010)**

Association-based classification, which classifies documents based on a set of associated, frequently occurring text patterns. Notice that very frequent terms are likely poor discriminators. Thus only those terms that are not very frequent and that have good discriminative power will be used in document classification. Such an association-based classification method proceeds as follows: First, keywords and terms can be extracted by information retrieval and simple association analysis techniques. Second, concept hierarchies of keywords and terms can be obtained using available term classes, such as WordNet, or relying on expert knowledge, or some keyword classification systems.

6. **Compare the advantages of and disadvantages of eager classification (e.g., decision tree) versus lazy classification (k-nearest neighbor) (Nov/Dec 2010**)

Eager learners, when given a set of training tuples, will construct a generalization (i.e., classification) model before receiving new (e.g., test) tuples to classify. We can think of the learned model as being ready and eager to classify previously unseen tuples. Imagine a contrasting lazy approach, in which the learner instead waits until the last minute before doing any model construction in order to classify a given test tuple. That is, when given a training tuple, a lazy learner simply stores it (or does only a little minor processing) and waits until it is given a test tuple.

## 4. FIVE MARKS QUESTION AND ANSWERS

### 1) What is classification?

**Classification:**

- Used for prediction (future analysis) to know the unknown attributes with theirvalues. By using classifier algorithms and decision tree.(in data mining)
- Which constructs some models (like decision trees) then which classifies the attributes.
- Already we know the types of attributes are
  1. Categorical attribute and
  2. Numerical attribute
- These classifications can work on both the above mentioned attributes.

**Prediction:** prediction also used for to know the unknown or missing values.

which also uses some models in order to predict the attributes
models like neural networks, if else rules and other mechanisms

**Classification—A Two-Step Process**

Model construction: describing a set of predetermined classes

– Each tuple/sample is assumed to belong to a predefined class, as determined by the class label attribute

– The set of tuples used for model construction: training set

– The model is represented as classification rules, decision trees, or mathematical formulae

Model usage: for classifying future or unknown objects

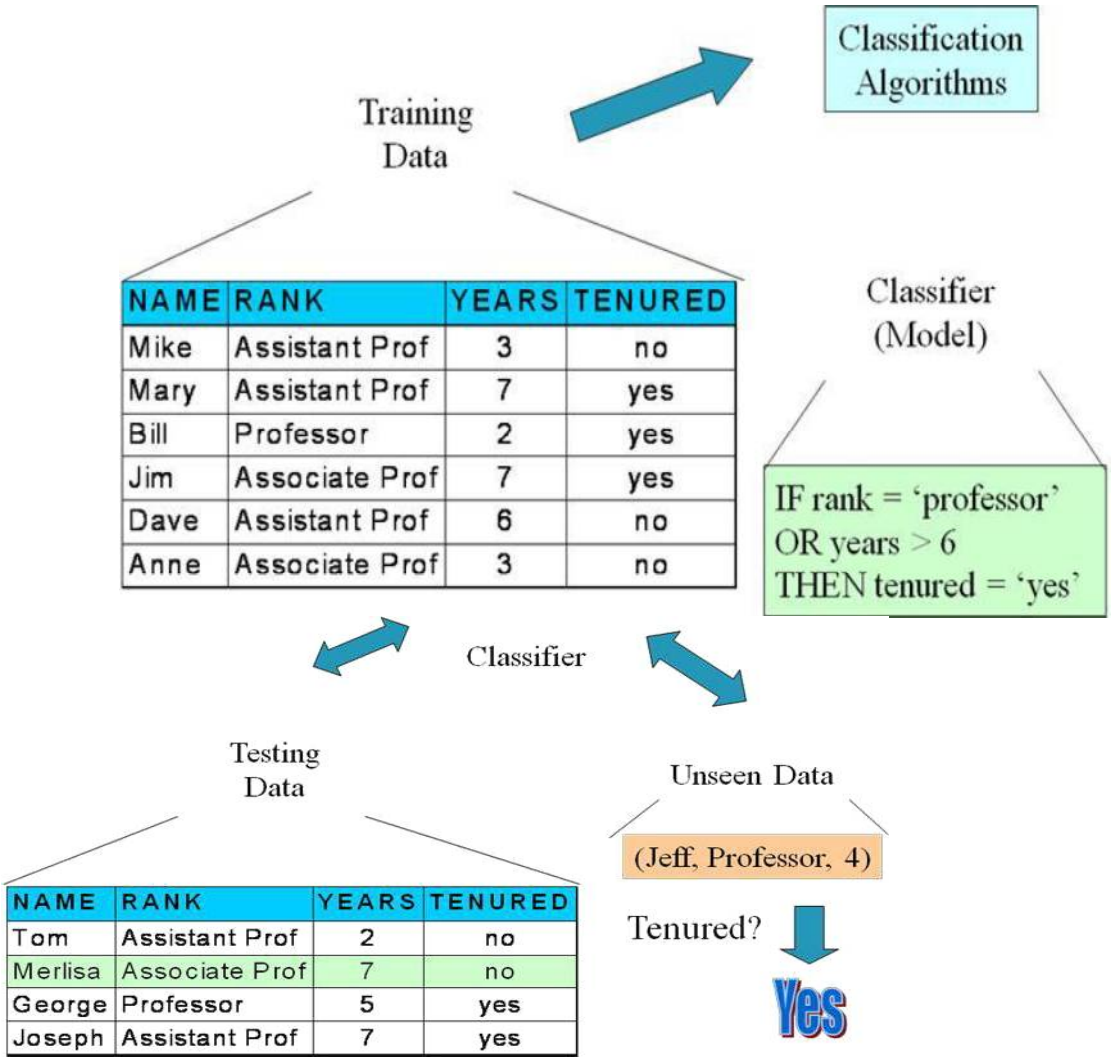
– Estimate accuracy of the mode

The known label of test sample is compared with the classified result from the model

Accuracy rate is the percentage of test set samples that are correctly classified by the model

Test set is independent of training set, otherwise over-fitting will occur

**Process (1): Model Construction**




**Process (2): Using the Model in Prediction**

**Supervised vs. Unsupervised Learning**

Supervised learning (classification)

Supervision: The training data (observations, measurements, etc.) are accompanied by labels indicating the class of the observations.

New data is classified based on the training set

Unsupervised learning (clustering)

The class labels of training data is unknown

Given a set of measurements, observations, etc. with the aim of establishing the existence of classes or clusters in the data

2) What are the Issues regarding in classification?

There are two issues regarding classification and prediction they are Issues (1):
Data Preparation

Issues (2): Evaluating Classification Methods

**Issues (1): Data Preparation:** Issues of data preparation includes the following1) Data cleaning

Preprocess data in order to reduce noise and handle missing values (refer preprocessing techniques i.e. data cleaning notes)

2) Relevance analysis (feature selection)

Remove the irrelevant or redundant attributes (refer unit-iv AOI Relevance analysis)Data transformation (refer preprocessing techniques i.e data cleaning notes) Generalize and/or normalize data

**Issues (2): Evaluating Classification Methods:** considering classification methodsshould satisfy the following properties

**Predictive accuracy**

**Speed and scalability**

*time to construct the model *time to use the model

**3. Robustness**

Handling noise and missing values

**4. Scalability**

Efficiency in disk-resident databases

**5. Interpretability**:

Understanding and insight provided by the model

**6. Goodness of rules**

Decision tree size

Compactness of classification rules

**3). what is Decision Tree?**

**Decision tree**

– A flow-chart-like tree structure

– Internal node denotes a test on an attribute

– Branch represents an outcome of the test

– Leaf nodes represent class labels or class distribution

**Decision tree generation consists of two phases**

– Tree construction

At start, all the training examples are at the root

Partition examples recursively based on selected attributes

– Tree pruning

Identify and remove branches that reflect noise or outliers

**Use of decision tree:** Classifying an unknown sample

– Test the attribute values of the sample against the decision tree

**Training Dataset**

**This follows an example from Quinlan's ID3**

| Age | income | student | credit_rating |
|---|---|---|---|
| <=30 | high | no | fair |
| <=30 | high | no | excellent |
| 31…40 | high | no | fair |
| >40 | medium | no | fair |
| >40 | low | yes | fair |
| >40 | low | yes | excellent |
| 31…40 | low | yes | excellent |
| <=30 | medium | no | fair |
| <=30 | low | yes | fair |
| >40 | medium | yes | fair |
| <=30 | medium | yes | excellent |
| 31…40 | medium | no | excellent |
| 31…40 | high | yes | fair |
| >40 | medium | no | excellent |

**4) Write the Algorithm for Decision Tree?**

Basic algorithm (a greedy algorithm)

- Tree is constructed in a top-down recursive divide-and-conquer manner
- At start, all the training examples are at the root
- Attributes are categorical (if continuous-valued, they are discretized in advance)
- Examples are partitioned recursively based on selected attributes
  - Test attributes are selected on the basis of a heuristic or statistical measure (e.g., information gain)

**Conditions for stopping partitioning**

- All samples for a given node belong to the same class.
- There are no remaining attributes for further partitioning – majority voting is employed for classifying the leaf.
- There are no samples left.

**5) Write down Tree Mining in Weka and Tree Mining in Clementine?**

**Tree Mining in Weka**

Example:

- Weather problem: build a decision tree to guide the decision about whether or not to play tennis.
- Dataset (weather.nominal.arff)

Validation:

– Using training set as a test set will provide optimal classification accuracy.

– Expected accuracy on a different test set will always be less.

– 10-fold cross validation is more robust than using the training set as a test set.

Divide data into 10 sets with about same proportion of class label values as in original set.
Run classification 10 times independently with the remaining 9/10 of the set as the training set.
Average accuracy.

– Ratio validation: 67% training set / 33% test set.

– Best: having a separate training set and test set.

Results:

– Classification accuracy (correctly classified instances).

– Errors (absolute mean, root squared mean, …)

– Kappa statistic (measures agreement between predicted and observed classification; -100%-100% is the proportion of agreements after chance agreement has been excluded; 0% means complete agreement by chance)

Results:

– TP (True Positive) rate per class label

– FP (False Positive) rate

– Precision = TP rate = TP / (TP + FN)) * 100%

– Recall = TP / (TP + FP)) * 100%

– F-measure = 2* recall * precision / recall + precision

D3 characteristics:

– Requires nominal values

– Improved into C4.5

Dealing with numeric attributes
Dealing with missing values
Dealing with noisy data
Generating rules from trees

**Tree Mining in Clementine**

Methods:

– C5.0: target field must be categorical, predictor fields may be numeric or categorical, provides multiple splits on the field that provides the maximum information gain at each level

– QUEST: target field must be categorical, predictor fields may be numeric ranges or categorical, statistical binary split

– C&RT: target and predictor fields may be numeric ranges or categorical, statistical binary split based on regression

– CHAID: target and predictor fields may be numeric ranges or categorical, statistical binary split based on chi-square

**Extracting Classification Rules from Trees**

- Represent the knowledge in the form of IF-THEN rules
- One rule is created for each path from the root to a leaf
- Each attribute-value pair along a path forms a conjunction

- The leaf node holds the class prediction
- Rules are easier for humans to understand

Example

IF *age* = "<=30" AND *student* = "*no*" THEN *buys_computer* = "*no*"

IF *age* = "<=30" AND *student* = "*yes*" THEN *buys_computer* = "*yes*"

IF *age* = "31…40" THEN *buys_computer* = "*yes*"

IF *age* = ">40" AND *credit rating* = "*excellent*" THEN *buys_computer* = "*yes*"

IF *age* = ">40" AND *credit_rating* = "*fair*" THEN *buys_computer* = "*no*"

**Avoid Overfitting in Classification**

The generated tree may overfit the training data

– Too many branches, some may reflect anomalies due to noise or outliers

– Result is in poor accuracy for unseen samples

Two approaches to avoid over fitting

– Prepruning: Halt tree construction early—do not split a node if this would result in the goodness measure falling below a threshold

Difficult to choose an appropriate threshold

– Post pruning: Remove branches from a "fully grown" tree—get a sequence of progressively pruned trees

Use a set of data different from the training data to decide which is the "best pruned tree"

**4. Objective question with answers**

1. Highly summarized data is _____.

A. compact and easily accessible.

B. compact and expensive.

C. compact and hardly accessible.

D. compact.

2. A directory to help the DSS analyst locate the contents of the data warehouse is seen in _____.

A. Current detail data.

B. Lightly summarized data.

C. Metadata.

D. Older detail data.

3. Metadata contains at least _____.

A. the structure of the data.

B. the algorithms used for summarization.

C. the mapping from the operational environment to the data warehouse.

D. all of the above.

4. Which of the following is not a old detail storage medium?

A. Photo Optical Storage.

B. RAID.

C. Microfiches.

D. Pen drive.

5. The data from the operational environment enter _____ of data warehouse.

A. Current detail data.

B. Older detail data.

C. Lightly summarized data.

D. Highly summarized data.

6. The data in current detail level resides till _____ event occurs.

A. purge.

B. summarization.

C. achieved.

D. all of the above.

7. The dimension tables describe the _____.

A. entities.

B. facts.

C. keys.

D. units of measures.

8. The granularity of the fact is the _____ of detail at which it is recorded.

A. transformation.

B. summarization.

C. level.

D. transformation and summarization.

9. Which of the following is not a primary grain in analytical modeling?

A. Transaction.

B. Periodic snapshot.

C. Accumulating snapshot.

D. All of the above.

10. Granularity is determined by _____.

A. number of parts to a key.

B. granularity of those parts.

C. both A and B.

D. none of the above.

Answer:

| | |
|---|---|
| 1. A | 6. D |
| 2. C | 7. B |
| 3. D | 8. C |
| 4. D | 9. B |
| 5. A | 10. C |

**5. Fill in the blanks questions with answers.**

1. _____ contains information that gives users an easy-to-understand perspective of the information stored in the data warehouse.
2. _____ helps to integrate, maintain and view the contents of the data warehousing system.
3. Discovery of cross-sales opportunities is called _____.
4. Data marts that incorporate data mining tools to extract sets of data are called _____.
5. _____ can generate programs itself, enabling it to carry out new tasks.
6. The power of self-learning system lies in _____.
7. Building the informational database is done with the help of _____.
8. How many components are there in a data warehouse?
9. Which of the following is not a component of a data warehouse?
10. _____ is data that is distilled from the low level of detail found at the current detailed level.

Answer:

| | |
|---|---|
| 1. Business metadata | 6. Accuracy. |
| 2. Information directory | 7. Transformation or propagation tools. |
| 3. association | 8. Five. |
| 4. Dependent data marts. | 9. Component Key. |
| 5. Productivity system | 10. Lightly summarized data |

## UNIT-5

### 1. TWO MARKS QUESTION AND ANSWERS.

1. **What do you go for clustering analysis? (Nov/Dec 2011)**

Clustering can be used to generate a concept hierarchy for A by following either a top down splitting strategy or a bottom- up merging strategy, where each cluster forms a node of the concept hierarchy. In the former, each initial cluster or partition may be further decomposed into several sub clusters, forming a lower level of the hierarchy. In the latter, clusters are formed by repeatedly grouping neighboring clusters in order to form higher- level concepts.

***2. What are the requirements of cluster analysis? (Nov/Dec 2010)***

- Scalability
- Ability to deal with different types of attributes Discovery of clusters with arbitrary shape
- Minimal requirements for domain knowledge to determine input parameters Ability to deal with noisy data
- Incremental clustering and insensitivity to the order of input records High dimensionality
- Constraint-based clustering

***3. What is mean by cluster analysis? (April/May 2008)***

A cluster analysis is the process of analyzing the various clusters to organize the different objects into meaningful and descriptive object.

***4. Define CLARANS.***

CLARANS(Cluster Large Applications based on Randomized Search) to improve the quality of CLARA we go for CLARANS. It Draws sample with some randomness in each step of search. It overcome the problem of scalability that K-Medoids suffers from.

***5. Define BIRCH,ROCK and CURE.***

BIRCH(Balanced Iterative Reducing and Clustering Using Hierarchies): Partitions objects hierarchically using tree structures and then refines the clusters using other clustering methods. It defines a clustering feature and an associated tree structure that summarizes a cluster. The tree is a height balanced tree that stores cluster information. BIRCH doesn't Produce spherical Cluster and may produce unintended cluster.

ROCK(RObust Clustering using links): Merges clusters based on their interconnectivity. Great for categorical data. Ignores information about the looseness of two clusters while emphasizing interconnectivity.

CURE(Clustering Using Representatives): Creates clusters by sampling the database and shrinks them toward the center of the cluster by a specified fraction. Obviously better in runtime but lacking in precision.

***6. What is meant by web usage mining? (Nov/Dec 2007)(April/May 2008)(Nov/Dec2009) (May/June 2010)***

Web usage mining is the process of extracting useful information from server logs i.e. users history. Web usage mining is the process of finding out what users are looking for on the Internet. Some users might be looking at only textual data, whereas some others might be interested in multimedia data.

## 2. THREE MARKS QUESTION AND ANSWERS.

***1. What is mean by audio data mining? (Nov/Dec 2007)***

Audio data mining uses audio signals to indicate the patterns of data or the features of data mining results. Although visual data mining may disclose interesting patterns using graphical displays, it requires users to concentrate on watching patterns and identifying interesting or novel features within them. This can sometimes be quite tiresome. If patterns can be transformed into sound and music, then instead of watching pictures, we can listen to pitches, rhythms, tune, and melody in order to identify anything interesting or unusual. This may relieve some of the burden of visual concentration and be more relaxing than visual mining. Therefore, audio data mining is an interesting complement to visual mining.

***2. Define visual data mining. (April/May 2008)***

Visual data mining discovers implicit and useful knowledge from large data sets using data and/or knowledge visualization techniques. The human visual system is controlled by the eyes and brain, the latter of which can be thought of as a powerful, highly parallel processing and reasoning engine containing a large knowledge base. Visual data mining essentially combines the power of these components, making it a highly attractive and effective tool for the comprehension of data distributions, patterns, clusters, and outliers in data.

***3. What is mean by the frequency item set property? (Nov/Dec 008)***

A set of items is referred to as an itemset. An itemset that contains k items is a k-itemset. The set

{computer, antivirus software} is a 2-itemset. The occurrence frequency of an itemset is the number of transactions that contain the itemset. This is also known, simply, as the frequency, support count, or count of the itemset.

***4. Mention the advantages of hierarchical clustering. (Nov/Dec 2008)***

Hierarchical clustering (or hierarchic clustering) outputs a hierarchy, a structure that is more informative than the unstructured set of clusters returned by flat clustering. Hierarchical clustering does not require us to prespecify the number of clusters and most hierarchical algorithms that have been used in IR are deterministic. These advantages of hierarchical clustering come at the cost of lower efficiency.

***5. Define time series analysis. (May/June 2009)***

Time series analysis comprises methods for analyzing time series data in order to extract meaningful statistics and other characteristics of the data. Time series forecasting is the use of a model to predict future values based on previously observed values. Time series are very frequently plotted via line charts.

***6. What is mean by web content mining? (May/June 2009)***

Web content mining, also known as text mining, is generally the second step in Web data mining. Content mining is the scanning and mining of text, pictures and graphs of a Web page to determine the relevance of the content to the search query. This scanning is completed after the clustering of web pages through structure mining and provides the results based upon the level of relevance to the suggested query. With the massive amount of information that is available on the World Wide Web, content mining provides the results lists to search engines in order of highest relevance to the keywords in the query.

## 3. FIVE MARKS QUESTION AND ANSWERS

- Partitioning algorithms: Construct various partitions and then evaluate them by some criterion
- Hierarchy algorithms: Create a hierarchical decomposition of the set of data (or objects) using some criterion
- Density-based: based on connectivity and density functions
- Grid-based: based on a multiple-level granularity structure
- Model-based: A model is hypothesized for each of the clusters and the idea is to find the best fit of that model to each other.
- Partitioning approach:
    - Construct various partitions and then evaluate them by some criterion, e.g., minimizing the sum of square errors
    - Typical methods: k-means, k-medoids,CLARANS
- Hierarchical approach:
    - Create a hierarchical decomposition of the set of data (or objects) using some criterion
    - Typical methods: Diana, Agnes, BIRCH, ROCK,CHAMELEON
- Density-based approach:
    - Typical methods: DBSCAN, OPTICS,DenClue
- Grid-based approach:
    - based on a multiple-level granularity structure
    - Typical methods: STING, WaveCluster,CLIQUE
- Model-based:
    - A model is hypothesized for each of the clusters and tries to find the best fit of that model to each other
    - Typical methods: EM, SOM,COBWEB
- Frequent pattern-based:

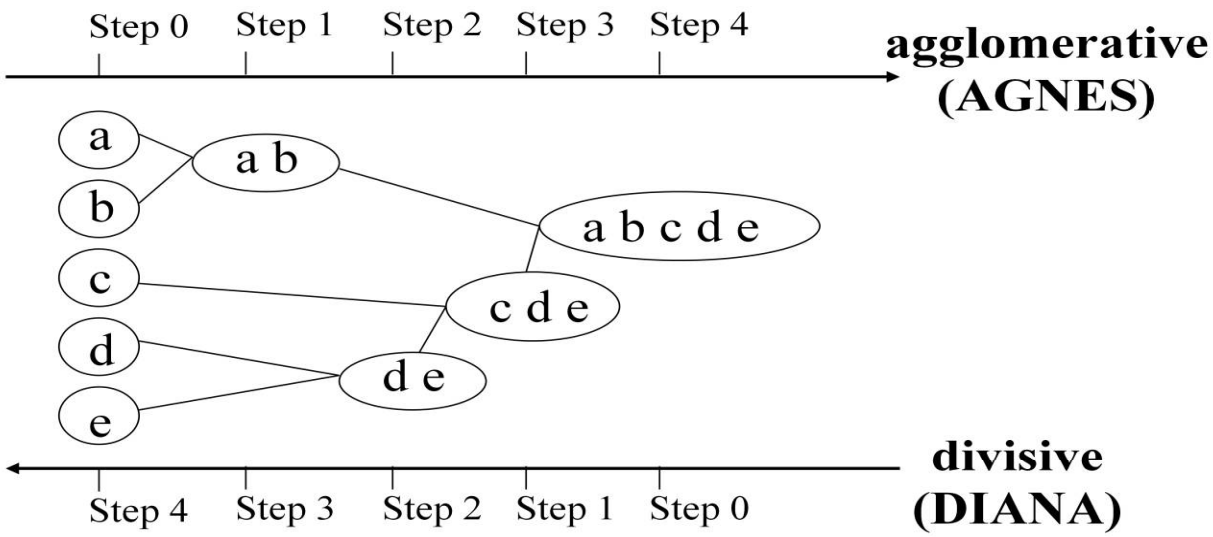
- Based on the analysis of frequent patterns
- Typical methods:pCluster

- User-guided or constraint-based:
  - Clustering by considering user-specified or application-specific constraints

Typical methods: COD (obstacles), constrained clustering

**2. Explain Hierarchical method clustering of classification with example?[Nov/Dec 2014]**

- Use distance matrix. This method does not require the number of clusters *k* as an input, but needs a termination condition




AGNES (Agglomerative Nesting):

- Introduced in Kaufmann and Rousseeuw(1990)
- Implemented in statistical analysis packages, e.g.,Splus
- Use the Single-Link method and the dissimilarity matrix.
- Merge nodes that have the least dissimilarity
- Go on in a non-descending fashion
- Eventually all nodes belong to the same cluster

***Dendrogram:*** **Shows How the Clusters are merged:**

Decompose data objects into a several levels of nested partitioning (tree of clusters), called a

*Dendrogram*.

A clustering of the data objects is obtained by cutting the dendrogram at the desired level, and then each connected component forms a cluster.

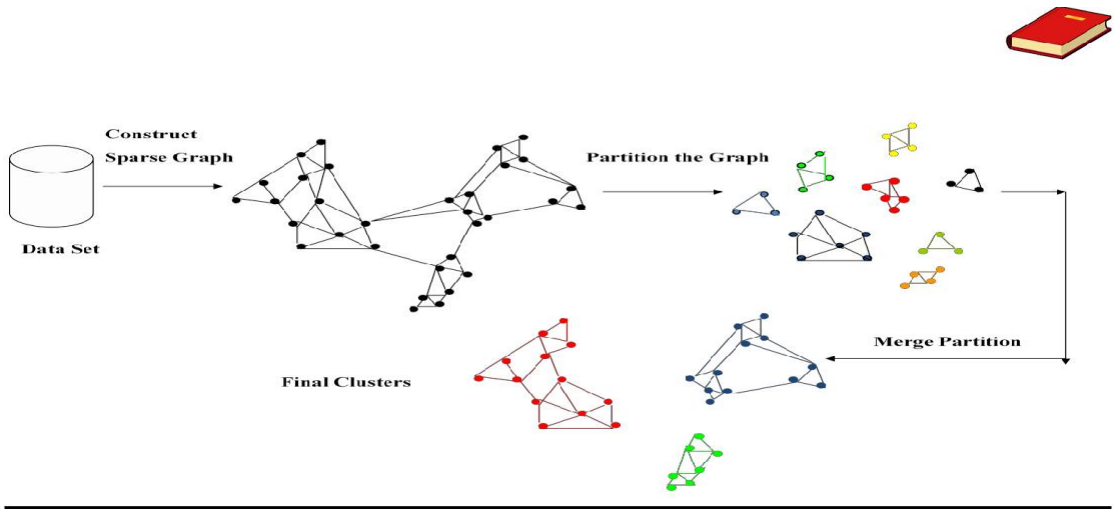
**DIANA (Divisive Analysis):**

- Introduced in Kaufmann and Rousseeuw(1990)
- Implemented in statistical analysis packages, e.g.,Splus
- Inverse order ofAGNES
- Eventually each node forms a cluster on itsown

**3. Explain CHAMELEON: Hierarchical Clustering Using Dynamic modeling?**

- Measures the similarity based on a dynamic model
    - Two clusters are merged only if the *interconnectivity* and *closeness (proximity)* between two clusters are high *relative to* the internal interconnectivity of the clusters and closeness of items within the clusters
    - Cure ignores information about interconnectivity of the objects, Rock ignores information about the closeness of two clusters
- A two-phase algorithm
    - Use a graph partitioning algorithm: cluster objects into a large number of relatively small sub-clusters
    - Use an agglomerative hierarchical clustering algorithm: find the genuine clusters by repeatedly combining these sub-clusters

**Overall Framework of CHAMELEON**




**4. Explain Density-Based Clustering Methods of classification with example?**

- Clustering based on density (local cluster criterion), such as density-connected points
- Major features:
  - Discover clusters of arbitrary shape
  - Handle noise
  - One scan
  - Need density parameters as termination condition
- Several interesting studies:
  - DBSCAN: Ester, et al.(KDD'96)
  - OPTICS: Ankerst, et al(SIGMOD'99).
  - DENCLUE: Hinneburg& D. Keim(KDD'98)
  - CLIQUE: Agrawal, et al. (SIGMOD'98) (moregrid-based)
- DBSCAN: The Algorithm:

- Arbitrary select a point *p*
- Retrieve all points density-reachable from *p* w.r.t. *Eps*and*MinPts*.
- If *p* is a core point, a cluster is formed.
- If *p* is a border point, no points are density-reachable from *p* and DBSCAN visits the next point of the database.
- Continue the process until all of the points have been processed.
- Grid-Based Clustering Method:
- Using multi-resolution grid data structure

- Several interesting methods
    - STING (a Statistical Information Grid approach) by Wang, Yang and Muntz(1997)
    - Wave Cluster by Sheikholeslami, Chatterjee, and Zhang(VLDB'98)
        - A multi-resolution clustering approach using wavelet method
    - CLIQUE: Agrawal, et al.(SIGMOD'98)
        - On high-dimensional data (thus put in the section of clustering high- dimensional data

- STING: A Statistical Information Grid Approach:
- Wang, Yang and Muntz(VLDB'97)
- The spatial area area is divided into rectangular cells
- There are several levels of cells corresponding to different levels of resolution

- The STING Clustering Method:
    - Each cell at a high level is partitioned into a number of smaller cells in the next lower level
    - Statistical info of each cell is calculated and stored beforehand and is used to answer queries
    - Parameters of higher level cells can be easily calculated from parameters of lower level cell
        - *count, mean, s, min,max*

- type of distribution—normal, *uniform*,etc.

- Use a top-down approach to answer spatial data queries
- Start from a pre-selected layer—typically with a small number of cells
- For each cell in the current level

compute the confidence interval Comments on

STING:

- Remove the irrelevant cells from further consideration
- When finish examining the current layer, proceed to the next lower level
- Repeat this process until the bottom layer is reached
- Advantages:
  - Query-independent, easy to parallelize, incremental update
  - *O(K),* where *K* is the number of grid cells at the lowest level
- Disadvantages:
  - All the cluster boundaries are either horizontal or vertical, and no diagonal boundary is detected

- EM (Expectation maximization),Auto Class

***5. Explain Outlier analysis with example?***

- Assume a model underlying distribution that generates data set (e.g. normal distribution)
- Use discordancy tests depending on
  - data distribution
  - distribution parameter (e.g., mean, variance)
  - number of expected outliers
- Drawbacks

- most tests are for single attribute
- In many cases, data distribution may not be known Outlier Discovery: Distance-Based Approach:

- Introduced to counter the main limitations imposed by statistical methods
  - We need multi-dimensional analysis without knowing data distribution
- Distance-based outlier: A DB(p, D)-outlier is an object O in a dataset T such that at least a fraction p of the objects in T lies at a distance greater than D from O
- Algorithms for mining distance-based outliers
  - Index-based algorithm
  - Nested-loop algorithm
  - Cell-based algorithm

**Density-Based Local Outlier Detection:**

- Distance-based outlier detection is based on global distance distribution
- It encounters difficulties to identify outliers if data is not uniformly distributed
- Ex. $C_1$ contains 400 loosely distributed points, $C_2$ has 100 tightly condensed points, 2 outlier points $o_1$,$o_2$
- Distance-based method cannot identify $o_2$ as an outlier
- Need the concept of local outlier

**Outlier Discovery: Deviation-Based Approach:**

- Identifies outliers by examining the main characteristics of objects in a group
- Objects that "deviate" from this description are considered outliers

- Sequential exception technique
    - simulates the way in which humans can distinguish unusual objects from among a series of supposedly like objects
- OLAP data cube technique
    - uses data cubes to identify regions of anomalies in large multidimensional data
- Summary:
- Cluster analysis groups objects based on their similarity and has wide applications
- Measure of similarity can be computed for various types of data
- Clustering algorithms can be categorized into partitioning methods, hierarchical methods, density-based methods, grid-based methods, and model-based methods
- Outlier detection and analysis are very useful for fraud detection, etc. and can be performed by statistical, distance-based or deviation-based approaches
- There are still lots of research issues on cluster analysis

Problems and Challenges:

- **Considerable progress has been made in scalable clustering methods**
    - Partitioning: k-means, k-medoids,CLARANS
    - Hierarchical: BIRCH, ROCK,CHAMELEON
    - Density-based: DBSCAN, OPTICS,DenClue
    - Grid-based: STING, WaveCluster,CLIQUE
    - Model-based: EM, Cobweb,SOM
    - Frequent pattern-based:pCluster
    - Constraint-based: COD, constrained-clustering

- Current clustering techniques do not address all the requirements adequately, still an active area of research

**4. Objective question with answers.**

1. A _____ model identifies patterns or relationships.

A. Descriptive.

B. Predictive.

C. Regression.

D. Time series analysis.

2. A predictive model makes use of _____.

A. current data.

B. historical data.

C. both current and historical data.

D. assumptions.

3. _____ maps data into predefined groups.

A. Regression.

B. Time series analysis

C. Prediction.

D. Classification.

4. _____ is used to map a data item to a real valued prediction variable.

A. Regression.

B. Time series analysis.

C. Prediction.

D. Classification.

5. In _____, the value of an attribute is examined as it varies over time.

A. Regression.

B. Time series analysis.

C. Sequence discovery.

D. Prediction.

6. In _____ the groups are not predefined.

A. Association rules.

B. Summarization.

C. Clustering.

D. Prediction.

7. Link Analysis is otherwise called as _____.

A. affinity analysis.

B. association rules.

C. both A & B.

D. Prediction.

8. _____ is a the input to KDD.

A. Data.

B. Information.

C. Query.

D. Process.

9. The output of KDD is _____.

A. Data.

B. Information.

C. Query.

D. Useful information.

10. The KDD process consists of _____ steps.

A. three.

B. four.

C. five.

D. six.

Answer:

| | |
|---|---|
| 1. A | 6. C |
| 2. B | 7. C |
| 3. D | 8. A |
| 4. B | 9. D |
| 5. B | 10. C |

**5. Fill in the blanks questions with answers**

1. Treating incorrect or missing data is called as _____.
2. Converting data from different sources into a common format for processing is called as _____.
3. Various visualization techniques are used in _____ step of KDD.
4. Extreme values that occur infrequently are called as _____.
5. Box plot and scatter diagram techniques are _____.
6. _____ is used to proceed from very specific knowledge to more general information.
7. Describing some characteristics of a set of data by a general model is viewed as _____
8. _____ helps to uncover hidden information about the data.
9. _____ are needed to identify training data and desired results.
10. Over fitting occurs when a model _____.

ANSWERS:

| | |
|---|---|
| 1. pre-processing | 6. Induction. |
| 2. transformation | 7. Compression. |
| 3. Interpretation. | 8. Approximation. |
| 4. Outliers. | 9. Users. |
| 5. Geometric. | 10. Does not fit in future states. |