The Paradigm of DBMS

A New Approach to Data Management

by

Kudang B. Seminar

Information System (IS) Model
Data vs Information

Data: *raw facts or observations*

Information: *data that have been transformed into a meaningful and useful context for specific end users*

Data

- Sales person
- Sales Values
- Sales Units

Information

- Data Processing
- Sales Analysis

Data vs Information

Data: raw facts or observations

Information: data that have been transformed into a meaningful and useful context for specific end users

Sample Tabular View of Sales

<table>
<thead>
<tr>
<th>Last Name</th>
<th>Buchanan</th>
<th>Callahan</th>
<th>Darlington</th>
<th>Dodsworth</th>
<th>Fuller</th>
<th>King</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Sales</td>
<td>Total Sales</td>
<td>Total Sales</td>
<td>Total Sales</td>
<td>Total Sales</td>
<td>Total Sales</td>
<td>Total Sales</td>
</tr>
<tr>
<td>1996</td>
<td>$3,059.02</td>
<td>$11,040.00</td>
<td>$18,892.45</td>
<td>$4,304.30</td>
<td>$1,413.00</td>
<td>$33,165.20</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>$3,237.12</td>
<td>$19,992.23</td>
<td>$17,865.82</td>
<td>$986.80</td>
<td>$11,434.38</td>
<td>$15,108.34</td>
<td>$68,682.60</td>
</tr>
<tr>
<td>1998</td>
<td>$6,047.07</td>
<td>$6,066.72</td>
<td>$15,925.06</td>
<td>$5,092.20</td>
<td>$22,136.67</td>
<td>$16,437.92</td>
<td>$75,526.02</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$12,975.80</td>
<td>$8,169.99</td>
<td>$32,384.91</td>
<td>$16,385.05</td>
<td>$38,439.80</td>
<td>$53,752.92</td>
<td>$143,171.28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Years</th>
<th>Quarters</th>
<th>Total Sales</th>
<th>Total Sales</th>
<th>Total Sales</th>
<th>Total Sales</th>
<th>Total Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>Q1</td>
<td>$31,433.16</td>
<td>$66,954.02</td>
<td>$86,860.36</td>
<td>$24,412.89</td>
<td>$71,188.14</td>
</tr>
<tr>
<td>1997</td>
<td>Q2</td>
<td>$18,491.89</td>
<td>$27,030.65</td>
<td>$26,361.00</td>
<td>$31,513.21</td>
<td>$38,822.58</td>
</tr>
<tr>
<td>1998</td>
<td>Q3</td>
<td>$21,000.00</td>
<td>$20,897.10</td>
<td>$34,214.23</td>
<td>$10,529.43</td>
<td>$39,507.82</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>$68,792.58</td>
<td>$131,932.67</td>
<td>$167,277.35</td>
<td>$76,450.04</td>
<td>$162,769.78</td>
</tr>
</tbody>
</table>
Varieties of Information Products
Extracted from Spatial Database
Basis Data (Database)

Integrated collection of inter-related data designed for the need of an enterprise.

Information Extraction from Database

Tim Pengembangan Master Plan

Database A

Database B

Database C

Database D

Laporan Periodik

Laporan Adhoc

Analisis, Audit, Monitoring, Evaluasi

Informasi Strategik Eksekutif

Ekstrak Transform Input

Query (Eksporasi Informasi)
Database Management Systems (DBMS)

Integrated collection of computer tools (software tools) designed for accessing and maintaining database

Database

Application Programs on Top of DBMS

Application programs
Advantages of DBMS

- Data become shareable resources for variety of users or application programs
- Method of data access and maintenance becomes uniform and consistent
- Redundancy data and heterogenity of data structures are minimized
- Data independence
- Logical relationship among data are well maintained

Conventional Data Management

- Data belong to a specific application program
- Lifetime of data is limited by the lifetime of application program
- Difficult data sharing
- Data redundancy and inconsistency is introduced
- Methods of data access are not uniform
- Data structures are likely to be incompatible
Examples of software tools in DBMS

- **Designing**: ERD (Entity Relationship Diagram), DDL (Data Definition Language)
- **Inputing & Manipulating**: DML (Data Modification Language), QL (Query Language), Multimedia processor
- **Searching & Retrieving**: QL (Query Language): SQL * QBE
- **Converting & Squeezing**: Encoder & Decoder, Data Converter & Squeezer, Multimedia processor
- **Optimizing**: Data Organizer & Analyzer
- **Calculating**: Math & statistical functions
- **Presenting**: Report Generator, Multimedia Processor

Data Modeling: Methods & Tools
Hierarchy of Data Abstractions

- **External Level**: describes only part of database relevant to specific users
- **Conceptual Level**: describes "what" to store (entity & attributes), constraints, semantics, data integrity & security, also relationships among data
- **Internal Data**: describes "how" data is organized & stored (memory allocation, indexing, compressing)
- **Physical Level**: describes file structures comprising database
Data Model

**Definition:** Integrated collection of concepts, theories, axioms, constraints for description, organization, validation, and interpretation of data.

**Usage:** a fundamental set of tools & methods to consistently & uniformly view, organize, and treat database.

Types Data Models

<table>
<thead>
<tr>
<th>Record-Based Model</th>
<th>Object-Based Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relational</td>
<td>Entity-relationship</td>
</tr>
<tr>
<td>Hierarchical</td>
<td>Semantic</td>
</tr>
<tr>
<td>Network</td>
<td>Functional</td>
</tr>
<tr>
<td></td>
<td>Object Oriented</td>
</tr>
</tbody>
</table>
Relational Data Model

Representation of data as an integrated collections of inter-related tables

## Samples of Relational Data

<table>
<thead>
<tr>
<th>Course ID</th>
<th>Course Name</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIM105</td>
<td>MIS</td>
<td>3</td>
</tr>
<tr>
<td>AKO104</td>
<td>DBMS</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Student ID</th>
<th>Student Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMA.101</td>
<td>Rudi Wibowo</td>
</tr>
<tr>
<td>MMA.102</td>
<td>Melinda</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Take ID</th>
<th>Course Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMA.101</td>
<td>SIM105</td>
</tr>
<tr>
<td>MMA.101</td>
<td>AKO104</td>
</tr>
<tr>
<td>MMA.102</td>
<td>SIM105</td>
</tr>
</tbody>
</table>
Terminology

<table>
<thead>
<tr>
<th>In This Document</th>
<th>Formal Terms</th>
<th>Many Database Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relational Table</td>
<td>Relation</td>
<td>Table</td>
</tr>
<tr>
<td>Column</td>
<td>Attribute</td>
<td>Field</td>
</tr>
<tr>
<td>Row</td>
<td>Tuple</td>
<td>Record</td>
</tr>
</tbody>
</table>

Hierarchical Data Model

Representation of data as a tree structure (one-to-many relationships)
Sample of Hierarchical Data

Network Data Model

Representation of data as a network structure (many-to-many relationships)
Sample of Network Model

- Department
- Department
- Employee
- Employee
- Research Work
- Projects
- Fund Source
- Fund Source

Entity Relationship Model

- Representation of data as entity, attribute, & relationship
- Mainly used for conceptual modeling & designing of database

- Student
  - StudentID
  - Grade
  - Year
  - Take

- Instructor
  - ID
  - Teach

- Supervise
  - Code
  - Course
Semantic Model

- Representation of data as entity & semantic relationship
- Mainly used for conceptual modeling & designing of database

Functional Data Model

- Representation of data using logic: predicate logic, proportional logic, & functional logic
- Mainly for expert system & Artificial Intelligence (AI)

Facts:
- Is-bird (pigeon)
- Greater-Than(Body-Temperature-Of (?x)), 37) ∧ Is-human (?x)
- Can-fly (pigeon)

Rules:
- Is-bird (?x) -> Has-wings (?x)
- Has-wings (?y) -> Can-fly (?y)

Derived Facts:
- •Has-wings (pigeon)

Conclusion: Is-Sick (?x)
Object-Oriented Data Model

Encapsulation of attributes & behaviors

Inheritance of object attributes & behaviors: single or multiple inheritance

Interobject communication by message exchange

Sample of Object-Oriented Model

Creature
- Breathing
- Reproducing
- Eating

Human
- IS-A Creature
- Intelligent

Student
- IS-A Human
- Enrolled in University

Rudi Wibowo
- Instance-of Student
- Nrp: MMA.101

Eli Rosida
- Instance-of Student
- Nrp: MMA.102

Animal
- IS-A Creature
- Less Intelligent

Herbivor
- IS-A Animal
- Eats plants
Basic Analysis of Database & DBMS

- Determine what to store
- Determine what relations exist

- Determine what data services are needed
- Determine what data model is suitable

(Data Requirement Analysis)

- Think and conceptualize business objects and logic
- Identify information needed -> then what data are needed
- Formulate what computer applications are needed?
Kasus Contoh: Data Requirement Analysis

Forward Support Analysis

Sources of Data
- BAAK
- Faculty
- Dept.
- Study Program
- KRS
- Transkrip
- Supervisi
- Research List

Supporting Data
- Academic Progress
- Treated Students
- Student Potentials
- Academic Problem

Supporting Information
- Monitoring Student Progress ...
- Directing Student Research ...
- Planning for Remedial Efforts ...
- Acting on Remedial Plan ...

Management Objectives
- Monitoring
- Directing
- Planning
- Acting

Management Functions
- Monitoring
- Directing
- Planning
- Acting

Backward Requirement Analysis

Data Requirement Analysis

<table>
<thead>
<tr>
<th>Data</th>
<th>Info</th>
<th>Monitoring</th>
<th>Directing</th>
<th>Acting</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRS, Transkrip</td>
<td>IPK Kumulatif</td>
<td>Status Akademik Mhs</td>
<td>Warning 1, 2, 3, rekomendasi</td>
<td>D.O or Extended</td>
</tr>
<tr>
<td>Minat riset &amp; PTA mhs, Data PTA</td>
<td>Profile minat riset &amp; PTA mhs, Beban PTA</td>
<td>Analisis minat riset &amp; PTA mhs</td>
<td>Alokasi PTA utk mhs</td>
<td>Alokasi final PTA utk mhs</td>
</tr>
<tr>
<td>Catatan riset mhs, Trankrip, KRS</td>
<td>Kemajuan riset mhs</td>
<td>Status Akademik Mhs</td>
<td>Rekomendasi perlakuan</td>
<td>Eksekusi perlakuan</td>
</tr>
<tr>
<td>Catatan riset mhs, Trankrip, KRS</td>
<td>Profile kelulusan mhs: lama studi &amp; prestasi akad.</td>
<td>Analisis kelulusan: rerata lama studi, ranking akademik</td>
<td>Rekomendasi program akselerasi studi</td>
<td>Eksekusi akselerasi studi</td>
</tr>
</tbody>
</table>

\[ \Sigma \text{Data} = \bigcup_{1 \leq i \leq n} \text{Data}_{i} \]
\[ \Sigma \text{Info} = \bigcup_{1 \leq j \leq n} \text{Info}_{j} \]
\[ \Sigma \text{Management Functions} = \Sigma \text{Monitoring} \cup \Sigma \text{Directing} \cup \Sigma \text{Acting} \Rightarrow \text{Mencapai Target Academic Excellence?} \]
Utilization Vs Availability of Data

- Exist & Required
- Not-Exist & Required
- Exist & Not Required
- Not-Exist & Not Required

Data Management Life Cycle

- Need of changes
- Observing
- Identifying
- Conceptualizing
- Representing
- Structuring
- Updating
- Monitoring
- Protecting
- Browsing
- Analyzing
- Optimizing
- Coding
- Monitoring
- Browsing
- Coding