Database Management System (DBMS)

A New Approach to Data Management

by
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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

Data Processing
Sales Analysis

Sample Tabular View of Sales

<table>
<thead>
<tr>
<th>Last Name:</th>
<th>Buchanan</th>
<th>Callahan</th>
<th>Dario</th>
<th>Dodsworth</th>
<th>Fuller</th>
<th>King</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years</td>
<td>Quarters</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1996</td>
<td>Qtr 1</td>
<td>$3,050.02</td>
<td>$1,060.00</td>
<td>$4,092.48</td>
<td>$4,304.30</td>
<td>$1,936.00</td>
<td>$33,165.20</td>
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<tr>
<td></td>
<td>Qtr 2</td>
<td>$14,088.36</td>
<td>$8,120.70</td>
<td>$21,962.28</td>
<td>$5,530.21</td>
<td>$13,567.86</td>
<td>$77,447.39</td>
</tr>
<tr>
<td></td>
<td>Qtr 3</td>
<td>$17,647.20</td>
<td>$19,150.70</td>
<td>$30,081.76</td>
<td>$9,694.51</td>
<td>$17,211.45</td>
<td>$110,622.79</td>
</tr>
<tr>
<td></td>
<td>Qtr 4</td>
<td>$3,237.12</td>
<td>$19,992.23</td>
<td>$17,885.82</td>
<td>$986.80</td>
<td>$11,438.38</td>
<td>$15,108.34</td>
</tr>
<tr>
<td>1997</td>
<td>Qtr 1</td>
<td>$6,047.67</td>
<td>$8,065.72</td>
<td>$16,325.60</td>
<td>$5,922.20</td>
<td>$22,136.67</td>
<td>$16,487.92</td>
</tr>
<tr>
<td></td>
<td>Qtr 2</td>
<td>$12,975.80</td>
<td>$9,049.99</td>
<td>$32,384.91</td>
<td>$6,255.05</td>
<td>$16,188.80</td>
<td>$20,263.93</td>
</tr>
<tr>
<td></td>
<td>Qtr 3</td>
<td>$6,572.57</td>
<td>$16,625.08</td>
<td>$29,644.07</td>
<td>$12,499.76</td>
<td>$21,446.29</td>
<td>$8,047.00</td>
</tr>
<tr>
<td></td>
<td>Qtr 4</td>
<td>$31,433.16</td>
<td>$66,954.02</td>
<td>$99,803.36</td>
<td>$24,412.89</td>
<td>$71,168.14</td>
<td>$59,927.19</td>
</tr>
<tr>
<td>1998</td>
<td>Qtr 1</td>
<td>$19,481.88</td>
<td>$27,030.65</td>
<td>$36,281.50</td>
<td>$31,513.21</td>
<td>$36,822.56</td>
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<tr>
<td></td>
<td>Qtr 2</td>
<td>$21,000.00</td>
<td>$30,897.10</td>
<td>$34,214.23</td>
<td>$10,629.43</td>
<td>$39,307.62</td>
<td>$24,802.41</td>
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<td>$19,691.88</td>
<td>$47,727.95</td>
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<td>$42,142.64</td>
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<td>$76,450.04</td>
<td>$162,769.78</td>
<td>$119,519.24</td>
</tr>
</tbody>
</table>

[Show Raw Data]
Sample Pivot Chart for Sale Analysis

Akusisi Data Geografis
Varieties of Information Products
Extracted from Spatial Database
**Database**

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

**Database Management Systems (DBMS)**

Integrated collection of computer tools (software tools) designed for accessing and maintaining database.
Application Programs on Top of DBMS

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 heterogeneity 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

View 1  View 2  ...  View n

Conceptual schema

Internal schema

Database

External Level
Conceptual Level
Internal Level
Physical Level
Data Abstraction (cont.)

- **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

Record-Based Model
- Relational
- Hierarchical
- Network

Object-Based Model
- Functional
- Object Oriented

Relational Data Model
Representation of data as an integrated collections of inter-related tables
Samples of Relational Data

<table>
<thead>
<tr>
<th>CourseCode</th>
<th>CourseName</th>
<th>Credit</th>
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</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>

Student - Take

<table>
<thead>
<tr>
<th>ID</th>
<th>StudentName</th>
<th>ID</th>
<th>CourseCode</th>
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</thead>
<tbody>
<tr>
<td>MMA.101</td>
<td>Rudi Wibowo</td>
<td>MMA.101</td>
<td>SIM105</td>
</tr>
<tr>
<td>MMA.102</td>
<td>Melinda</td>
<td>MMA.101</td>
<td>AKO104</td>
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<tr>
<td></td>
<td></td>
<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

- Country
  - Province
    - City
  - Province
    - City
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
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)`
- `Is-bird (?x) -> Has-wings (?x)`
- `Greater-Than(Body-Temperature-Of (?x)), 37) \& Is-human (?x)`
- `Has-wings (?y) -> Can-fly (?y)`
- `Can-fly (pigeon)`
- `Has-wings (pigeon)`

**Conclusion:**
- `Is-Sick (?x)`

**Derived Facts:**
- `Has-wings (pigeon)`

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

**Animal**
- IS-A Creature
- Less Intelligent

**Student**
- IS-A Human
- Enrolled in University

**Herbivor**
- IS-A Animal
- Eats plants

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

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