Principles of Database Design

Dr CK Raju

Muthoot Institute of Technology and Science
(Affiliated to KTU)

rajuck@mgmits.ac.in

January 30, 2019

Overview

Objectives

- To impart basic understanding of the theory and applications of database management systems.
- To give basic level understanding of internals of database systems.
- To expose to some of the recent trends in databases.

Syllabus

- Types of data, database and DBMS, Languages and users.
- Software Architecture, E-R and Extended E-R Modelling,
- Relational Model concepts and languages, relational algebra and tuple relational calculus,
- SQL, views, assertions and triggers, HLL interfaces,
- Relational db design, FDs and normal forms,
- Secondary storage organization, indexing and hashing,
- Query optimization, concurrent transaction processing
- Recovery principles, recent topics.

Outcomes: Students would be able to

- define, explain and illustrate the fundamental concepts of databases,
- construct an Entity-Relationship (E-R) model from specifications and to perform the transformation of the conceptual model into corresponding logical data structures,
- model and design a relational database following the design principles,
- develop queries for relational database in the context of practical applications,
- define, explain and illustrate fundamental principles of data organization, query optimization and concurrent transaction processing,
- appreciate the latest trends in databases.

Modules

- Module I - Introduction, Entity-Relationship Model
- Module II - Relational Model, Database Languages
- Module III - SQL, Views-assertions-triggers, Functions-Procedures-HLL-Interfaces
- Module IV - Relational Database Design
- Module V - Physical Data Organisation, Query Optimization
- Module VI - Transaction Processing Concepts, Recent Topics

Introduction

- Data: structured, semi-structured and unstructured
- DBMS: Concept and Overview
- Data Models
- Database Languages
- DB Admin, DB Users
- DBMS: three schema architecture
- DB architectures and classification

Ref: Elmasri - Ch-1 and Ch-2,
Korth - Ch-1

Database Concepts

- Data : Facts that can be stored, processed and also possess some implicit meaning
- Databse : Collection of related data, representing some aspect of real world, univ-of-discourse
- Databases are designed, built and populated with data for some specific purpose
- Manual databases exist in some libraries
- DBMS is a software system used to create and maintain a database
- Meta-data : Database definition or descriptive database catalog information
- DBMSs help in designing, creating, manipulating and sharing of databases

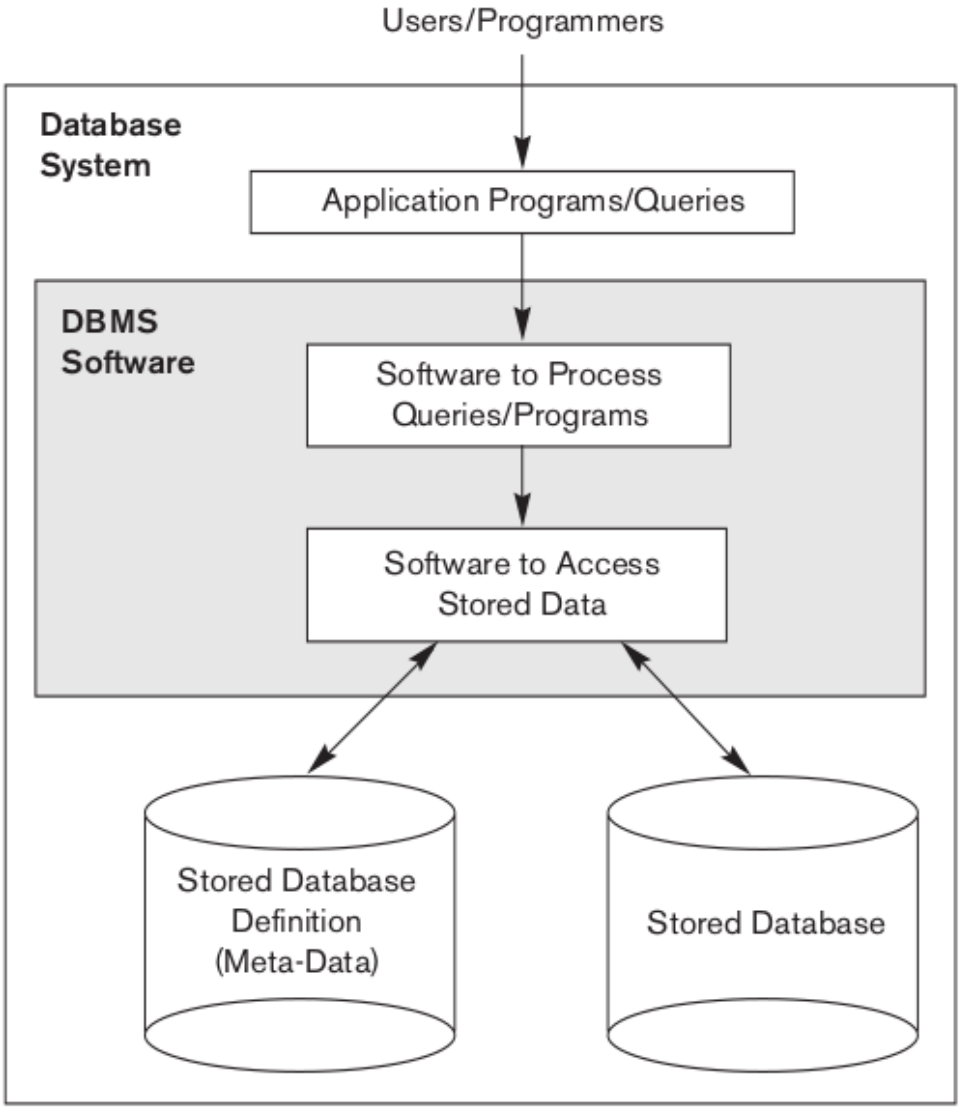
Ref: Elmasri - Ch-1 and Ch-2,
Korth - Ch-1

Database Concepts

- DB Query : S/w program that queries database for some information.
- DB Transaction : An activity that reads or manipulates data in a database.
- Protection : System protection and security protection
- System protection - against h/w, s/w malfunction; Security - against unauthorised access

Ref: Elmasri - Ch-1 and Ch-2,
Korth - Ch-1

A typical Database environment



A student database having course information

STUDENT

Name	Student_number	Class	Major
Smith	17	1	CS
Brown	8	2	CS

COURSE

Course_name	Course_number	Credit_hours	Department
Intro to Computer Science	CS1310	4	CS
Data Structures	CS3320	4	CS
Discrete Mathematics	MATH2410	3	MATH
Database	CS3380	3	CS

SECTION

Section_identifier	Course_number	Semester	Year	Instructor
85	MATH2410	Fall	07	King
92	CS1310	Fall	07	Anderson
102	CS3320	Spring	08	Knuth
112	MATH2410	Fall	08	Chang
119	CS1310	Fall	08	Anderson
135	CS3380	Fall	08	Stone

GRADE_REPORT

Student_number	Section_identifier	Grade
17	112	B
17	119	C
8	85	A
8	92	A
8	102	B
8	135	A

PREREQUISITE

Course_number	Prerequisite_number
CS3380	CS3320
CS3380	MATH2410
CS3320	CS1310

Ref: Elmasri - Ch-1 and Ch-2,
Korth - Ch-1

Database Approach

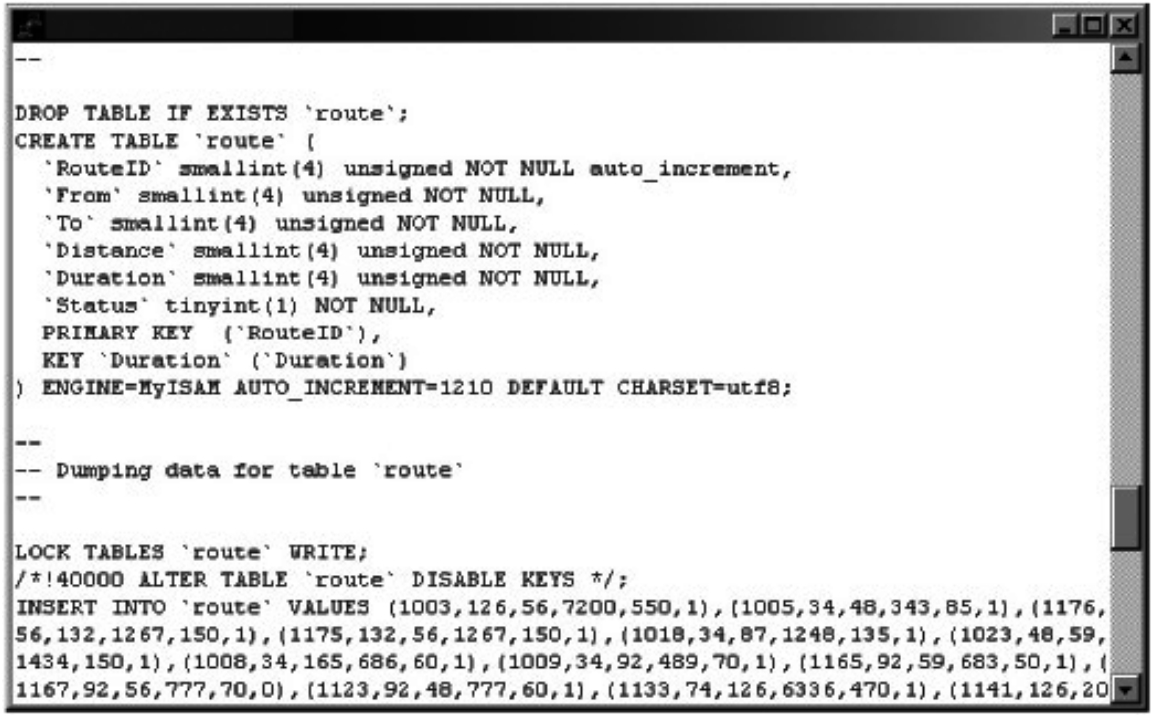
Special Features

- Self-describing notion of database system - meta-data
- Insulation between programs, data and data abstraction
- Support of multiple **views** of data
- Sharing of data and multiuser transaction processing

Ref: Elmasri - Ch-1 and Ch-2,
Korth - Ch-1

Database Approach

- Self-describing notion of database system - meta-data



```
--

DROP TABLE IF EXISTS `route`;
CREATE TABLE `route` (
  `RouteID` smallint(4) unsigned NOT NULL auto_increment,
  `From` smallint(4) unsigned NOT NULL,
  `To` smallint(4) unsigned NOT NULL,
  `Distance` smallint(4) unsigned NOT NULL,
  `Duration` smallint(4) unsigned NOT NULL,
  `Status` tinyint(1) NOT NULL,
  PRIMARY KEY  (`RouteID`),
  KEY `Duration` (`Duration`)
) ENGINE=MyISAM AUTO_INCREMENT=1210 DEFAULT CHARSET=utf8;

--
-- Dumping data for table `route`
--

LOCK TABLES `route` WRITE;
/*!40000 ALTER TABLE `route` DISABLE KEYS */;
INSERT INTO `route` VALUES (1003,126,56,7200,550,1),(1005,34,48,343,85,1),(1176,
56,132,1267,150,1),(1175,132,56,1267,150,1),(1018,34,87,1248,135,1),(1023,48,59,
1434,150,1),(1008,34,165,686,60,1),(1009,34,92,489,70,1),(1165,92,59,683,50,1),(
1167,92,56,777,70,0),(1123,92,48,777,60,1),(1133,74,126,6336,470,1),(1141,126,20
```

- Insulation between programs, data and data abstraction
- Support of multiple **views** of data
- Sharing of data and multiuser transaction processing

Ref: Elmasri - Ch-1 and Ch-2,
Korth - Ch-1

Database Approach

- Self-describing notion of database system - meta-data
- Insulation between programs, data and data abstraction
  1. Program-data independence - independence of data from programs
  2. Program-operation independence
  3. Characteristic of data abstraction - program-data and program-operation independence
- Support of multiple **views** of data
- Sharing of data and multiuser transaction processing

Ref: Elmasri - Ch-1 and Ch-2,
Korth - Ch-1

Database Approach

- Self-describing notion of database system - meta-data
- Insulation between programs, data and data abstraction
- Support of multiple **views** of data
  1. Special perspective of database
  2. Might contain subset of database in conjunction with other information
- Sharing of data and multiuser transaction processing

Ref: Elmasri - Ch-1 and Ch-2,
Korth - Ch-1

Database Approach

- Self-describing notion of database system - meta-data
- Insulation between programs, data and data abstraction
- Support of multiple **views** of data
- Sharing of data and multiuser transaction processing
  1. Multi-user DBMS involves **concurrency control**
  2. Special **online transaction processing** applications
  3. Process **isolation** amongst different processes
  4. Ensure **atomicity** property of transaction - either whole or none

Ref: Elmasri - Ch-1 and Ch-2,
Korth - Ch-1