UNIT 1: Introduction to DBMS

DB

- coll. of interrelated data _ performed particular task on them
- Implicit prop.:
    - represent ascepts of real world
    - logicallt coherent coll. of data with some inherent meaning (no random stuff)
    - designed, built and populated for specific purpose.

DBMS

- coll. of prog. _ enable users to create & maintain a db.
- general purpose S/W _ facilitates proc. of defining, building, and manipulating db for various app.
    - defining: specifying datatype, strcuture & contraints for data to be stored in db.
    - building/constructing: storing data on some storage medium.
    - manipulating: funcs. as query db, retrieve specific data, updating data & making rerports from data.

Characteristics of db

1. Self describing nature of db
2. Insulation of data & program (Data Abstraction)
3. Support multiple views of data
4. Sharing of data / multiuser env.

- Self describing nature of db:

    - not only contains data but aso complete desc. of db struct & constraints.
    - all these definitions stored in data dictionary _ updated automatically & contains info of each file - datatype & contraints of each data item

- Insulation of data & program (Data Abstraction):

    - no need to know how data stored.
    - achieved via data models _ provides conceptual representation
    - models: heirarchical, network, relational, and Object oriented.

- Support multiple views of data:

    - db has many users, each of whom may require diff. view of db.
    - so depedning on what type of user using db, his ops. change.

- Sharing of data / multiuser env.

    - many users simultaneously can access and manipulate data.
    - ensure data consistency and prevent conflicts.
    - how? locking mechanism.
    - ensure changes by 1 user not lost due to actions of another user.

Problems of File System

1. Data Redundancy & inconsistency
2. Difficulty in acessing data
3. Data Isolation
4. Integrity problem
5. Atomicity problems
6. Concurrent access anomalies
7. Security problem

- Data Redundancy & inconsistency:
    - Diff. files for diff. apps. _ duplicated data
    - wastage of storage
- Difficulty in acessing data:
    - data in many diff. locations.
    - not convinient and efficient
- Data Isolation:
    - same as above.
    - one modification in data structure cause problems in apps.
- Integrity Problems:
    - programmers code some stuff to check for correctness
- Atomicity Porblems:
    - if failure occurs, restore data prior to failure.
    - here, we write data simlutaneouslt to file, so kinda hard.
- Concurrent aceess anomalies:
    - multi user support for accessing, writing and modifying
- security problems:
    - unauthorized acces often

Advantages of DB (Basically eliminate Cons of FS)

- Control Reduncancy
- Provide persistent storage for data & prog.
- multiuser interface
- backup & recovery mechanism
- Integrity Contraints
- Restrcit unauthorized access

Users of DB

1. Database Administrators (DBA)
2. Database Designers
3. System Analysts
4. Application Programmers / Back-End Developers
5. Naive Users / Parametric Users
6. Sophisticated Users
7. Casual Users / Temporary Users

- DBA:
    - in db env, primary res. is db and secondary DBMS.
    - DBA manaage these.
    - Responsible for:
        - authorizing access
        - managing its usage
        - orgranising S/W & H/W res.
        - security
        - periodic back & recovery.

- DB designers
    - responsible for:
        - identifying data to be stored
        - choosing proper structure to represent & store data
        - communicate with users (understand req.) & design it

- End Users:
    - people who actually do stuff on the db (query, update and generate reports)

    1. Casual Endusers:
        - occassionally access db, but may need diff. data everytime
        - Ex. Mid lvl managers & occassional browsers.
    2. Naive / parametric users:
        - Majority
        - constantly query & update db using standard types of query called canned transactions.
        - Ex. fontdesk workers, data entry ops, clerks, & clients.
    3. Spohisticated Users:
        - Familiar with DBMS & know how to do stuff
        - Ex. Engineers, scientists, data analysts.
    4. Standalone Users:
        - maintain personal db _ using readymade prog, packages, menu based / GUI

- System Analyst
    - determines req. of end users
    - provides coordination b/w end users, application programmers & DB designers

- Application Programmers:
    - develop fontend prog, test them, debug them & provide functionalities to use db.

Data Models

- Hierarchical model:
    - tree
    - single parent for each record.
    - Each record - multi childs, but each child only 1 parent
    - GOod for one-to-many relationship, but not flexible and shit for many-to-many.
- Network Model:
    - allows more complex relationships b/w data entities.
    - graph like structure.
    - multi parents and childs.
    - more flexible than heirar. but diffi. to manage and maintain.
- Relational Model:
    - Most widely used.
    - data organised into tables
    - each table represent an entity and each record repre. a record.
    - keys used to connect diff. tables.
- Object-relational Model (ORDBMS):
    - combine object-oriented and realtional
    - allow complex data objects in RDBMS
    - Here objects can be represented as tuples in table.
    - each can have attr. and attr, can be of diff. data types (including images, videos, audios, etc).
    - allow user defined data types, operators and functions.

3 schema architecture

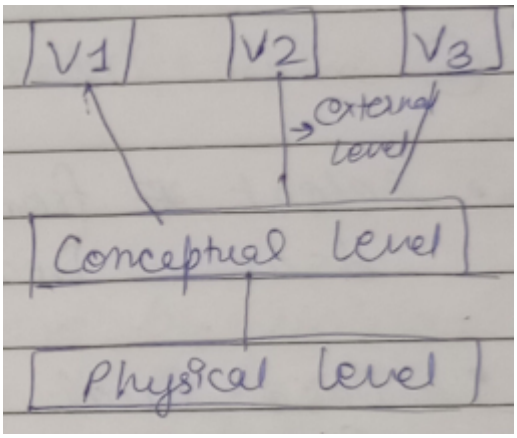
- ANSI/SPARC arch
- framewrok for desgining and developing DBS
- divide db into 3 layers (data abstrac.) each with its own schema.

1. External Schema or View Level:
    - highest level of abstraction and represents user's view of data.
    - includes a set of user views _ define how data is shown to diff. cat. of users.
    - hides complexity of underlying db
2. Conceptual Schema or Logical Level:
    - represents the logical structure of entire db.
    - defines the relationships b/w entities, their attr., and the constraints on data.
    - independent of any specific physical storage device or data access method.
3. Internal Schema or Physical Level:
    - lowest level of abstraction and represents the physical storage structure of database on disk.

- defines how data is physically stored, indexed, and retrieved.
- dependent on the specific technology used for storage and data access.

Mapping

- transforming data from one schema to another.
- data exists in physical/internal lvl.
- transform req. on external into conceptual into internal



Data Independence

- can be explained via 3 schema arch.
- defined as capacity to change chema at 1 lvl of db, without having to change schema at next higher lvl.
- 2 types:

1. Logical Data Independence:

- capacity to change conceptual schema, without having to change external schema or app. prog.
- we may change conceptual sch. to expand db to add/remove constraint OR to enable/disable a constraint.

2. Physical data independence:

- capacity.... internal schema without ... conceptual schema.
- chages to internal sch. may needed to reorganize files OR create additional access struct. like index.
- data independece achieved because when schema changed at some lvl, only mapping b/w 2 lvl changed.

Database Language

DDL (data Definition Lang)

- after db design compl., db schemas expressed by special lang called DDL.
- this. also used to specify prop. of data (constraints).

TO BE CONTINUED

Database Interface

Menu based Interface for browsing

- present user with list of options - menus
- menus eliminate need for memorizing syntax of query lang.
- also called browsing interface - allows user to look through content in exploratory manner.

Form based Interface

- displays form to user _ user can insert data, search relevent data, or delete required data.

Graphical User Interface

- displays a schema to user in diagramatic form.
- most GUIs use pointing device to pick certain part of displayed diag. schema.

Natural language Interface

- accept request written in ENGLISH (or some other lang.)
- useually has its own syntax & a set of reserced words.
- after writing a query, its interpreted, & then interface generates high lvl query & submit to DBMS for further processing.

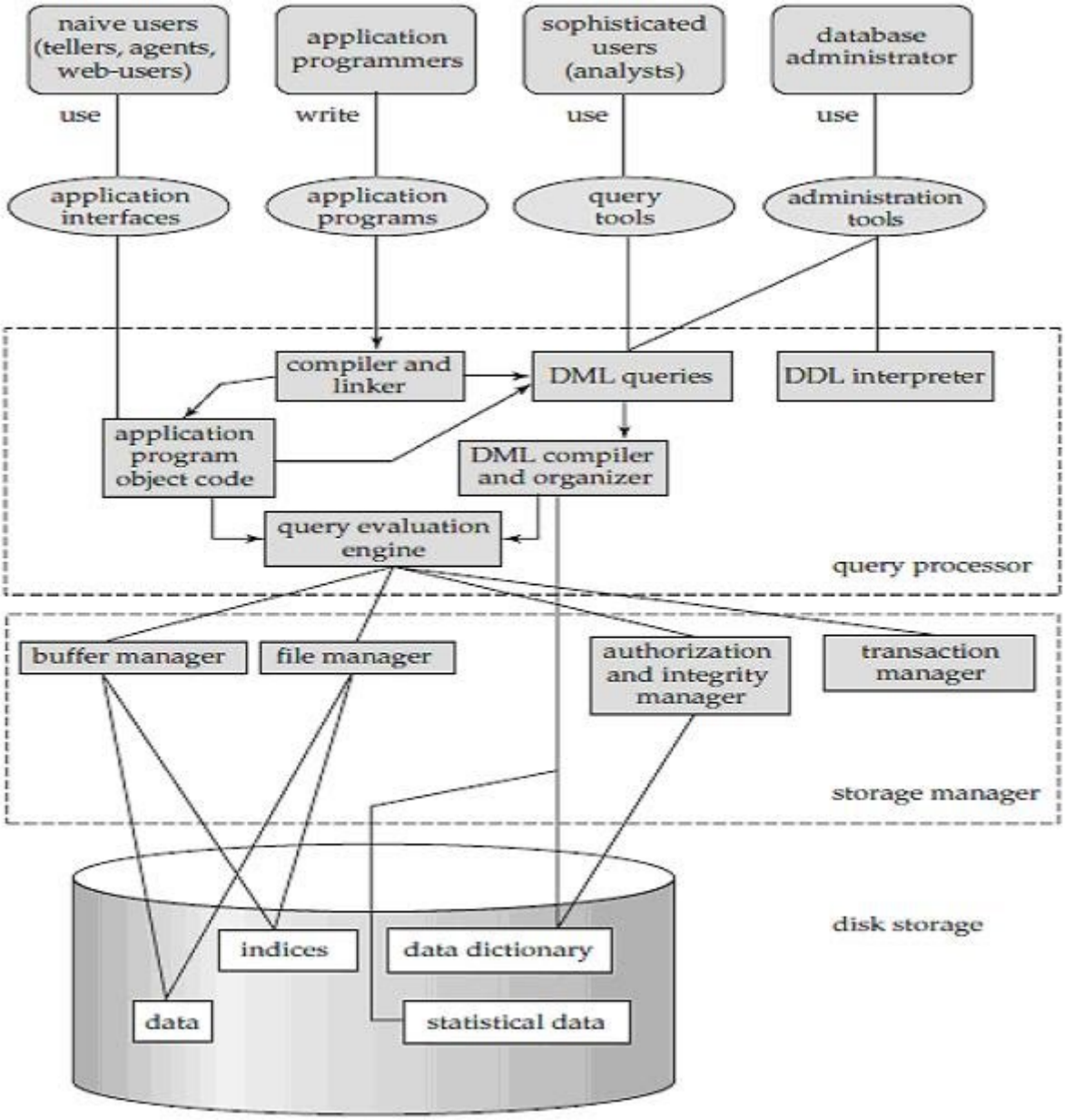
Interface for Naive Users

- naive users such as front desk workers, often have small set of op. they perform repeatedly.
- interface made to minimize keystrokes required for each request.

Interface for DBA

- THIS include commands for creating accounts, setting system params, giving authorization & reorgranizing storage strcuture of DB.

DBMS Structure Components



- DBMS partitioned into modules _ deals with each responsibilites of overall system.
- functional compo. divided in 2 parts: Query Processor AND Storage Manager.

1. Query Processor

- belps db sytem to simplify & provide easier access to data.
- includes:

1. DDL Interpretor:
    - interpretes DDL statements
    - record definitions in data dictionary
2. DML Compiler:
    - translates DML statements -> eval. plan having low lvl instruct.
    - A Query can usually be translated into >1 alt. eval. plan which give same results.
    - all the eval. plan passed to eval. engine.
3. Query Evaluation Engine:

- do query optimization
- i.e, picks up eval plan with lowest cost and execute query.

2. Storage Manager

- program _ provides interface b/w low lvl data stored in DB AND query submitted to system.
- includes

1. File Manager:
    - manages allocation of space on disk & ds used to represent info on disk
2. Buffer Manager:
    - responsible for fetching data from disk -> main mem, & deciding which data to cache.
3. Authorization & Integrity Manager:
    - test for satisfaction of integrity constraint & check authority of user trying to access data.
4. Transaction Manager:
    - resposonsible to ensure DB system remains in consistent state regardless of failure.