→ Database Approach

↳ Data : بيانات

- Facts that can be recorded and that have implicit meaning

(مجموعة من الحقائق التي يمكن تخزينها عن الأشياء. و البيانات لها معنى ضمني يدعى الـ metadata)

- There are different types of data :
  - → Structured: numbers, text, dates, time ...
  - → Unstructured: images, video, documents, audio ...

↳ Data versus Information

- → Data itself has no meaning without meta data wich describes data.
- → Information: is the data you process (تعالجها) in a manner that makes it meaningful.

(المعلومات هي البيانات من بعد ما عالجناها و استخرجنا منها شيء مفيد)

Data is what you store in database
Information is what you retrieve frome database

↳ Database

- A large and an organized collection of logically related data and a description of this data, (meta data), designed to meet the information need of an organization.
- A Database may be of any size and complexity

Exemples of Database: Amazon, University records

↳ Metadata (systeme catalog / data dictionary)

The description of the data, used to enable program-data independence

(إستعمل لبة الـ data عن الـ program وفي التالي لو صار تغيير في البيانات سوف يتم التغيير في الـ metadata ما يسمح لـ program بأن يأخذ آخر تحديث للبيانات من الـ data dictionary وينعامل معه)

→ Example :

Data :

name	city	birth
Khaled	Beirut	01/01/70
Sara	Hart-Hreik	01/03/01

Metadata : name - string, length < 10
city - string, length < 15
birth - Date, format DD/MM/YY

↳ Content of Database :

→ Entity : a distinct object in the organization (person, place, thing, event)
ex: Students, courses

→ Attribute : Characteristic that describes some aspect of the entity that we wish to record
ex : Student id, course credit

→ Relationship : an association between entities
ex : Sami (Student) is studying (Relationship) database (Course)

→ Example of a Database

. Mini-world: Some part of the real world about wich data is stored in a database (ex: Part of a University environment)

. Some mini-word entities: Students - Courses - Sections - Grade report...

Entity

STUDENT

Attributes

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

COURSE

Course_name	Course_number	Credit_hours	Department
Intro to CS	CS1310	4	CS
Data Structure	CS 3320	4	CS
Discreat Math	MATH2410	3	MATH
Database	CS3380	3	CS

SECTION

Section_id	Course_nb	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_nb	Section_id	Grade
17	112	B
17	119	C
8	85	A
8	92	A
8	102	B
8	135	A

PREREQUISITE

Course_nb	Prerequisite_nb
CS3380	CS3320
CS3380	MATH2410
CS3320	CS1310

. Some mini-world relationships:
Sections are of specific Course
Students take Sections
Courses have prerequisite courses
Instructors teach Sections
Courses are offered by Departments
Students major in Departments

→ Example of Database Requests
. Based on the previous database
- Retrieve the transcript - a list of all courses and grades - of "Smith"
- List the names of students who took the section of the "Database" course offered in fall 2008 and their grades in that section
- List the prerequisites of the "Database"

→ Database Management Systemes (DBMS)

. A software systeme that enable users to creat (خلق), maintain (تعديلات), and query (استفسار) the database

. Most DBMSs now have facilities (تسهيلات) that make data access fast, reliable (موثوق), secure (آمن) and easy.

. Example DBMS :
. Microsoft Access
. Microsoft SQL Server
. Oracle
. My SQL

→ Application Programs

. Database Application : is a collection of data and the programs that interact with the database by issuing an appropriate request (typically an SQL statement) to the DBMS

Database application هو برنامج يتعامل مع البيانات الموجودة في الـ Database وذلك من خلال إرسال أوامر لـ DBMS وهذه الأوامر تكتب بلغة SQL.

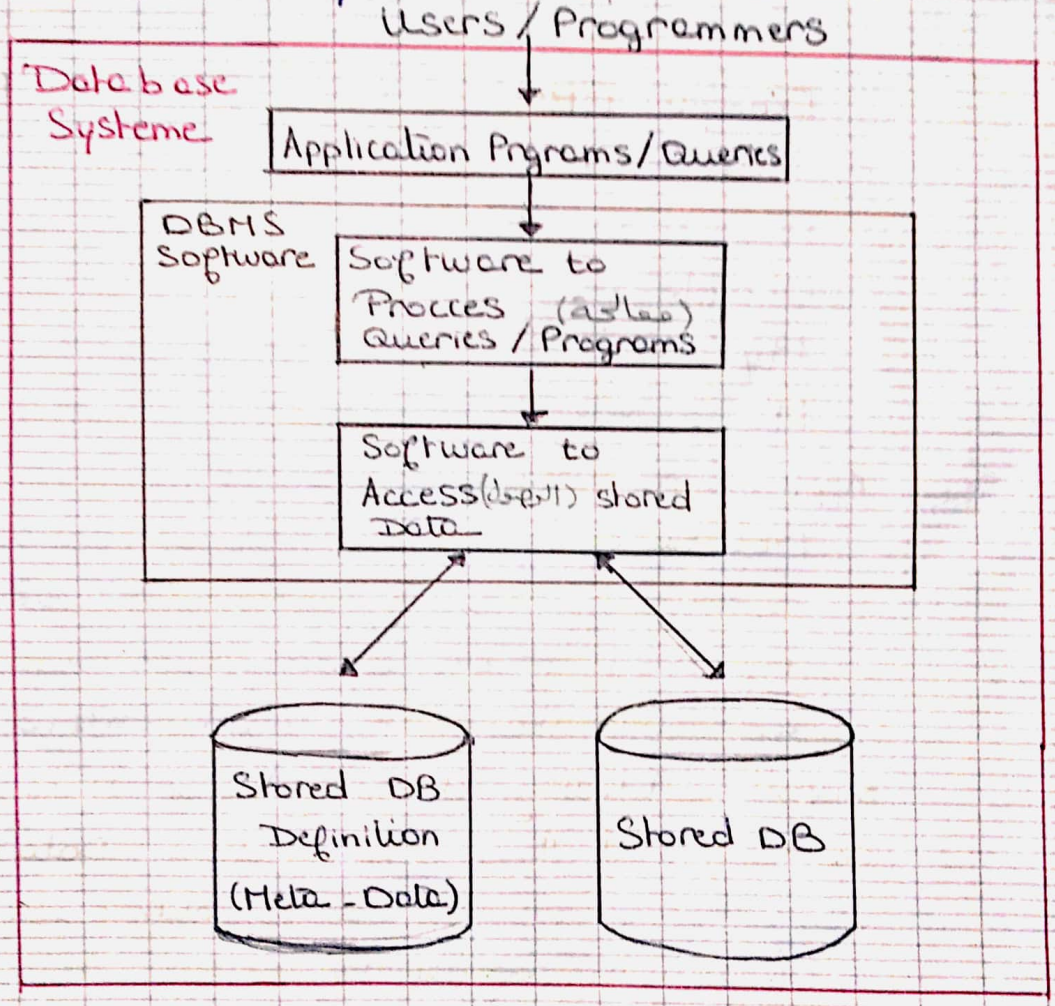
. Buid on top of DBMS
. To satisfy end users special requirements and preferences.

. Examples of Databases applications :
. App of a supermarket . Airline Reservation
. Purchases using Credit Card . Using Internet

→ Database Systems

. Database systems = DB + DBMS + Application progs

. To manage large amounts of data
  → Efficiently بكفاءة
  → Reliably بثقة
  → Securely بأمان
  → Conveniently بشكل سهل



→ Main Characteristics of the Database Approach

1↳ Self-describing nature of a database systeme
A DBMS catalog stores the description of the database. The description is called (meta-data)
This allow the DBMS software to work with different databases
المبرمج ليس بحاجة إلى وضع الـdescription للبيانات بنفسه عند كتابة DB application، عوضاً عن ذلك الـ DBMS يحتفظ بالـ Description لكل DB في الـ DB catalog

2↳ Insulation between programs and data
Called program-data independance. Allows changing data storage structures and operations without having to change the DBMS access programs (application program).
فصل ما بين البرنامج و الـ DB و في التالي لو تم تعديل الـ DB ليس بالضرورة إعادة كتابة البرنامج أو التعديل عليه.

3↳ Data Abstraction
A data model is used to hide storage details and present the users with a conceptual view of the database
تجريد البيانات مما يسمح لنا برؤية ما نحتاجه فقط - بدون وجود الكثير من التفاصيل - بشكل مبسط و مفهوم

4↳ Support of mutiple views of the data
Each user may see a different view of the database, wich describes only the data of interest to that user.
كل مستخدم له view خاص به يتضمن البيانات التي تهمه فقط و لا يحق له الوصول إلى بيانات أخرى.
يحدد الـ administrator الـ view الخاصة بكل مستخدم في الـ Organization

Views

- Allows each user to have his own view of the database
- A view is essentialy some subset of the DB
- Benefits:
  - → Reduce complexity يخفف التعقيد
  - → Provide a level of security يوفر الحماية
  - → Present a consistent, unchanging picture of the structure of the database, even if the underlying database is changed

5 ↳ Sharing of data and multiuser transaction processing:

- allowing a set of concurrent users to retrieve and to update the database

السماح لأكثر من مستخدم بالدخول إلى DB لاسترجاع أو تحديث البيانات في الوقت نفسه.

→ Transaction: executing program or process that includes one or more database accesses such as reading or updating of DB records

عملية تتكون من عدة خطوات (DB accesses) قد تكون قراءة أو تعديل في الـ DB

→ Concurrency control: within the DBMS guarantees that each transactions is correctly executed or completly aborted

الأسلوب الذي من خلاله الـDBMS يدير تنفيذ الـtransactions المختلفة بحيث أنها تنفذ بشكل سليم ولو حصل مشكلة في الـtransaction ستلغى بشكل كامل.

→ Components of DBMS Environment.

1. Hardware
   . Can range from a PC to a network of computers

2. Software
   . DBMS , operating systeme , network software (if necessary) and also the application programs

3. Data

4. Procedures
   Instructions and rules that should be applied to the design and use of the DB and DBMS
القواعد التي علينا تطبيقها والإلتزام بها عند دمج الـ Design لـ DB .

5. People

→ Roles in the DB environment *

↳ Systeme Analyst :
Determine the user requirement and develop the systeme specifications
يحدد متطلبات المستخدمين ومن خلالها يحدد الخطط الأساسية في الـ DB systeme

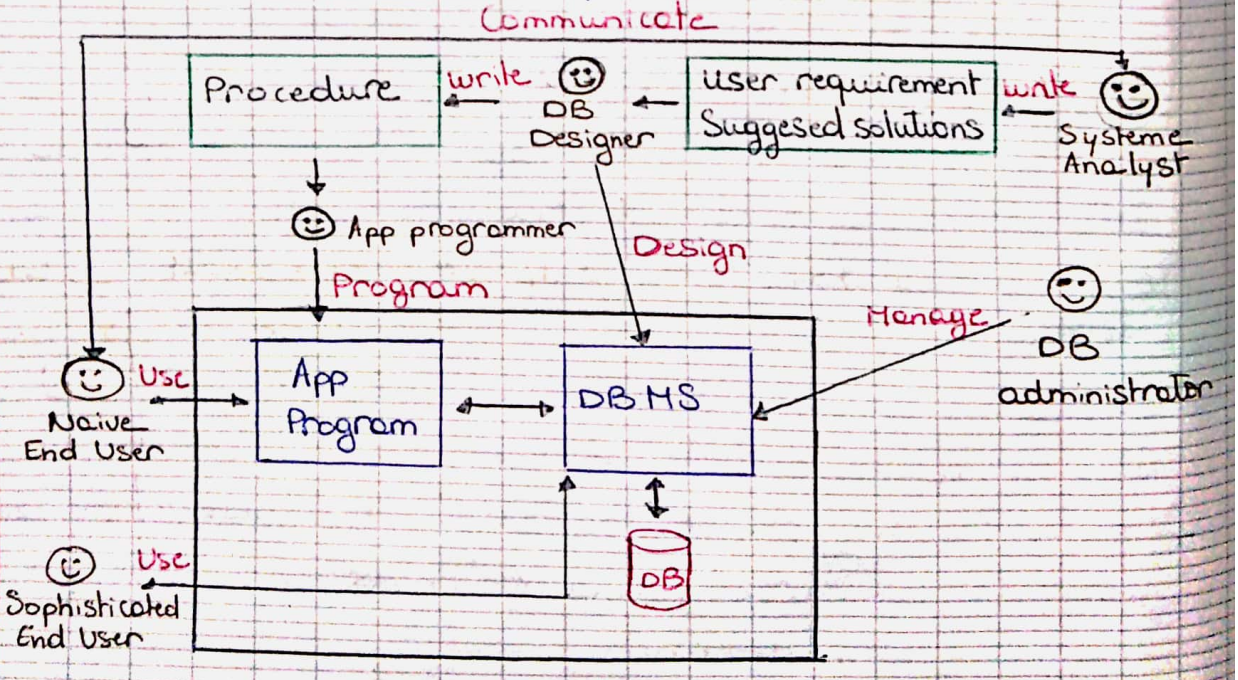
↳ Database Designers
Responsible for defining the content, the structure, the constraints and fonctions or transactions against the database

يحدد محتوى الـ DB (Entities, attributes) ، القيود ، و الوظائف
التي ستطبق على الـ DB .

- Application Programmer
  . Implement programs meet the end users needs
  . Test, debug, document and maintain transaction
  يصمم و يبرمج البرامج الذي يتوافق مع متطلبات المستخدم.

- Database administrators : responsible for :
  1. authorizing access to the DB
     السماح بالدخول إلى الـ DB
  2. Coordinating and monitoring the DB use
     ينسق و يتحكم و يحدد إستخدام الـ DB
  3. acquiring software, and hardware resources
  4. monitoring efficiency of operation
     يراقب كفائة تنفيذ العمليات

- End Users
  They use the data for queries, reports and some of them actually update the database content



→ Operation in DBMS

→ Design (Defining a DB)
- Define structure and constraints of the data to be sorted
- Specify the data Types

→ Construction
- Create data structure of DB, populate DB with data

→ Manipulation of Data
- Creat / Delete table
- Modify table:
  . add records
  . delete records
  . edit records
  . rearrange records
  . Change the table structure
- Retrieve data from a single / multiple table(s)
  . Find and display a record
  . Answer a query: "Wish department pays highest salary"
- Creat reports
  . formatted displays of query results or table contents
  "List monthly salaries of employees, organized by department, with average salary and total sum of salaries for each dept"

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→ Phases for designing and building a DB

→ Requirements specification and analysis
. Requirements gathering by meeting the clients.

→ Requirements modeling
. Conceptual and logical design, as Conceptual data model, ER model

→ Schema design and Implementation
. Relationel Model
. Decide on a set of tables, attributes.
. Create the tables in the DB systeme
. Populate records (insert records / tuples)

→ Write application programs

* → Advantages of using the DBMS Approach.
→ Controlling redundancy : Data normalization and Denormalization. It's necessary to improve queries perfom
→ Restricting unauthorized access: Security and authorization subsysteme / privileged software
→ Providing backup and recovery
→ Providing multiple user interfaces
Graphical user interfaces (GUIs)
→ Flexibility; Data independence
Data accessibility
reduced program maintenance
→ Ease of application development