Introduction to Database

INT205 Database Management System

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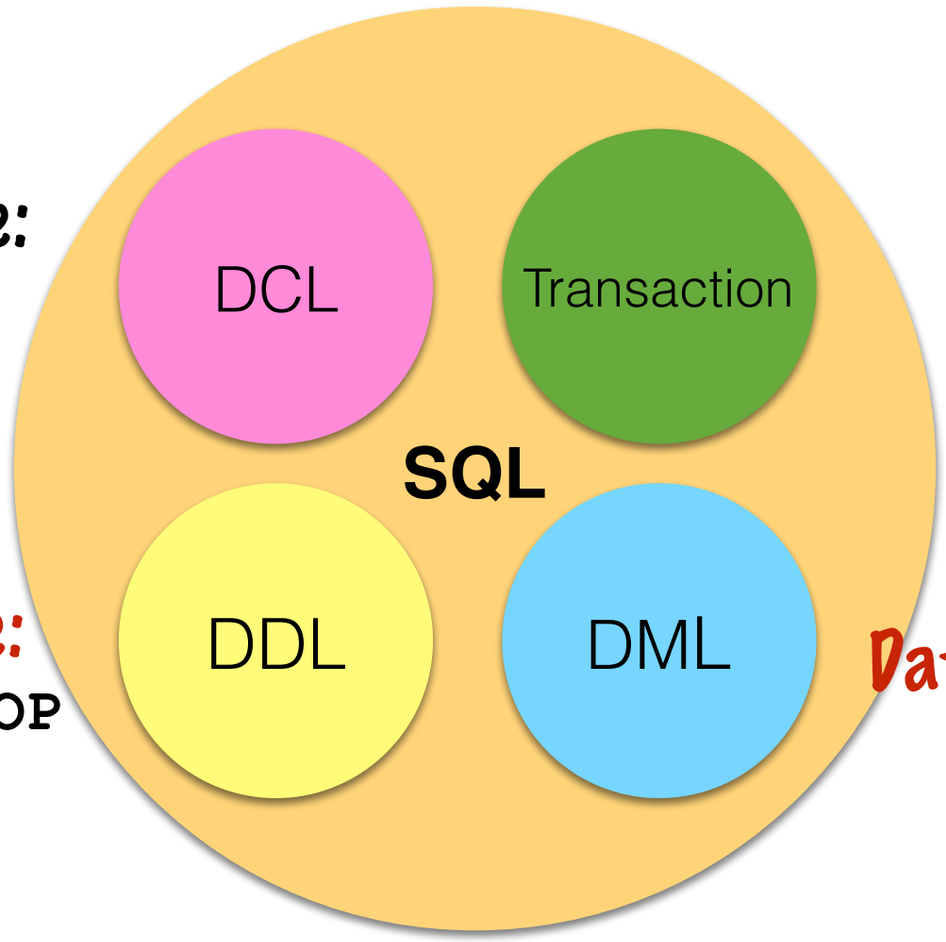
What we will learn

* SQL Review
* Database Concept
* Components in Database System
* DataBase Management System (DBMS)
* Actors in the Database Environment

SQL - Database Language

* Originally: Structured English Query Language (SEQUEL)
* Officially: Structured Query Language (**SQL**)=> Query Language



Data Control Language:

- **GRANT; REVOKE**

Transaction Control:

- **COMMIT; ROLLBACK;**
- **SAVEPOINT;**
- **SET ISOLATION**

Data Definition Language:

- **CREATE; ALTER; DROP**

Data Manipulation Language:

- **SELECT; INSERT;**
- **UPDATE; DELETE;**

DML Statement

```
SELECT [DISTINCT] { * | column | expression [[AS] alias][,…]}
FROM  table1 [,table2, table3,…]
 [WHERE condition(s)]
 [GROUP BY  columnList]
[HAVING aggregate_condition]
[ORDER BY {column|expr|alias} [ASC|DESC][,…]] ;
```

- Aggregate functions are **COUNT, COUNT DISTINCT, MIN, MAX, SUM, AVG, …**
- SET operations: **UNION, UNION ALL, EXCEPT/MINUS, INTERSECT**

DML Statement

```
INSERT INTO  table_name (column1, column2,…, columnN)
VALUES   ( value1, value2,…, valueN);

UPDATE table_name
SET   column1 = value1 [,column2 = value2,…]
[WHERE condition(s)];

DELETE [FROM] table_name
[WHERE condition(s)];

COMMIT; / ROLLBACK;
```

Data vs. Information

Data & Information

data

Data is facts collected together for reference or analysis.

Data can be any set of characters text, numbers, pictures, sound, or video that has been gathered.

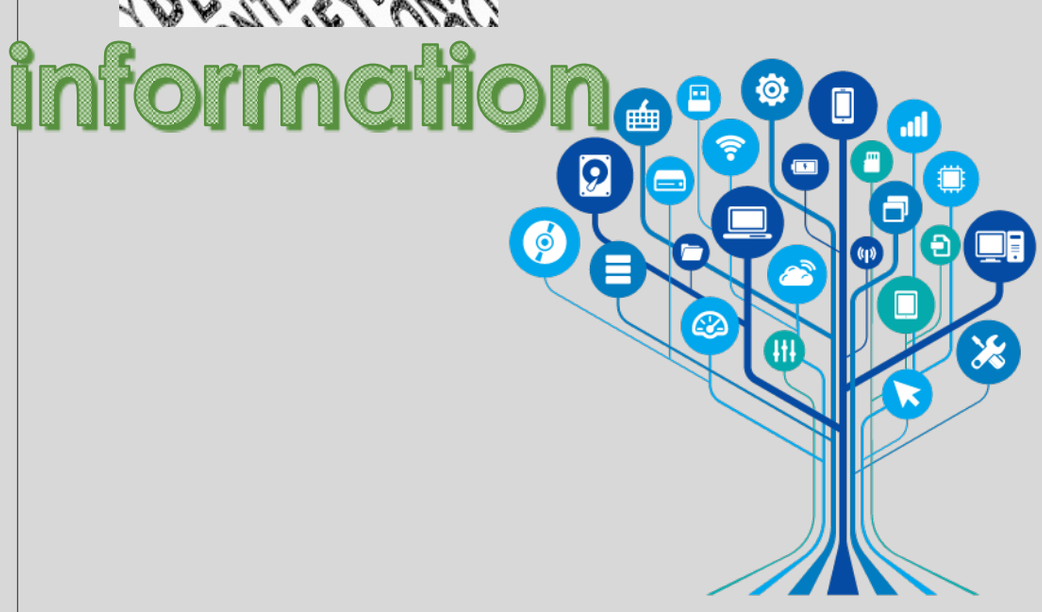
Data is a raw and unorganized fact that required to be processed to make it meaningful.

Data operations are performed by a computer, transmitted in the form of electrical signals, and stored on magnetic, or optical media.

Information Process

IPO Model

Data & Information



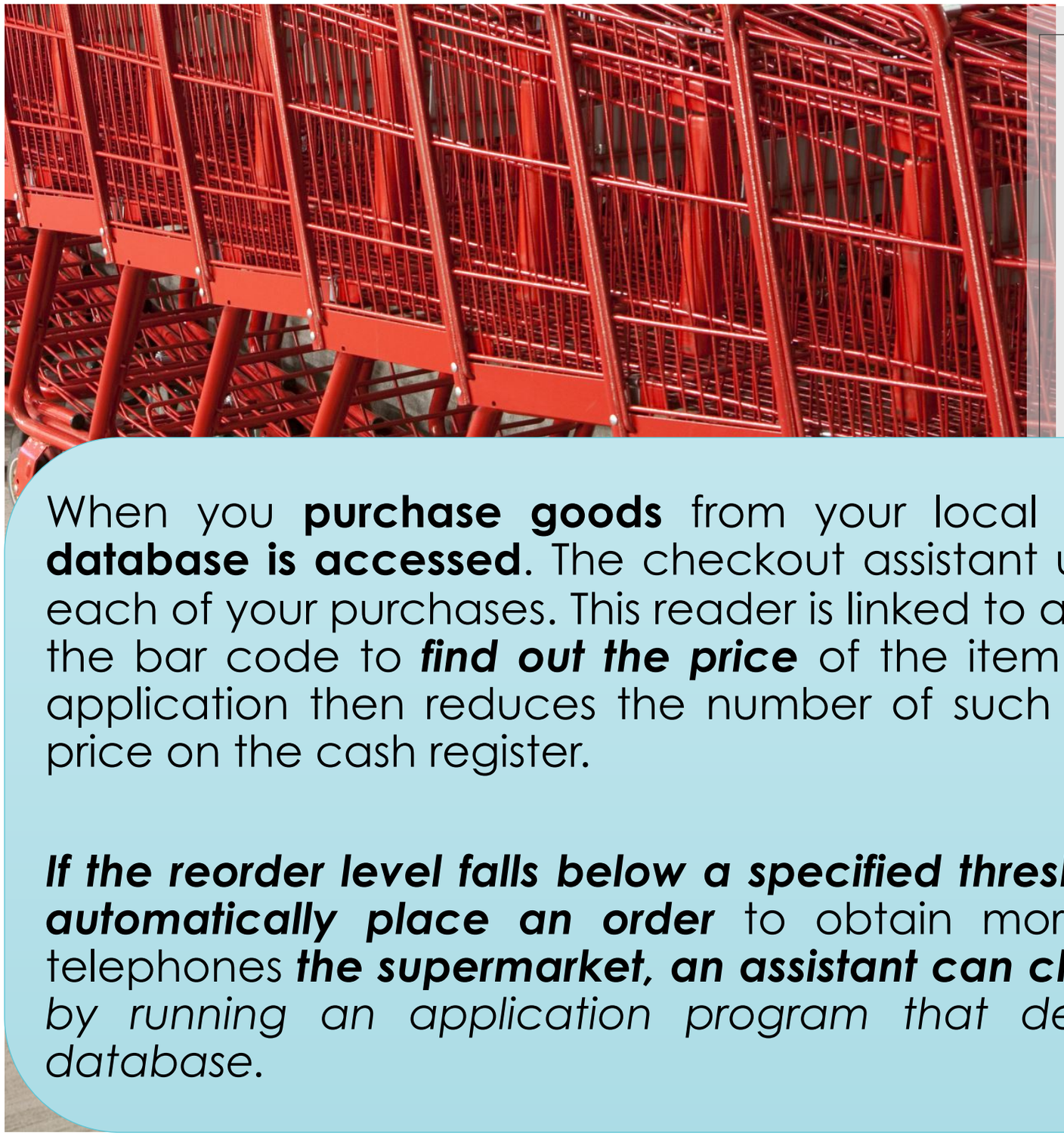
Information is a set of data which is processed in a meaningful way.

Information is processed, structured, or presented in a given context to make it meaningful and useful.

Information depend on data and requirements to carried the new meaning.

Information is widely used for decision making.

https://www.pexels.com/photo/items-organized-on-shelves-3687999/



Purchases from the supermarket

When you **purchase goods** from your local supermarket, it is likely that a **database is accessed**. The checkout assistant uses a ***bar code reader to scan*** each of your purchases. This reader is linked to a database application that uses the bar code to ***find out the price*** of the item from a product database. The application then reduces the number of such items in stock and displays the price on the cash register.

If the reorder level falls below a specified threshold, the database system may ***automatically place an order*** to obtain more of that item. If a customer telephones ***the supermarket, an assistant can check whether an item is in stock*** *by running an application program that determines availability from the database.*

A Database

* What is a database?
* Why do we need the database?
* How does the database system work?

Database Definition

"A **shared** collection of logically **related data** (and a description of this data), designed to meet the information needs of an organization."

"A collection of information that is organized so that it can **easily be accessed, managed and updated**."

"A collection of **persistent** data that can be **shared and interrelated**."

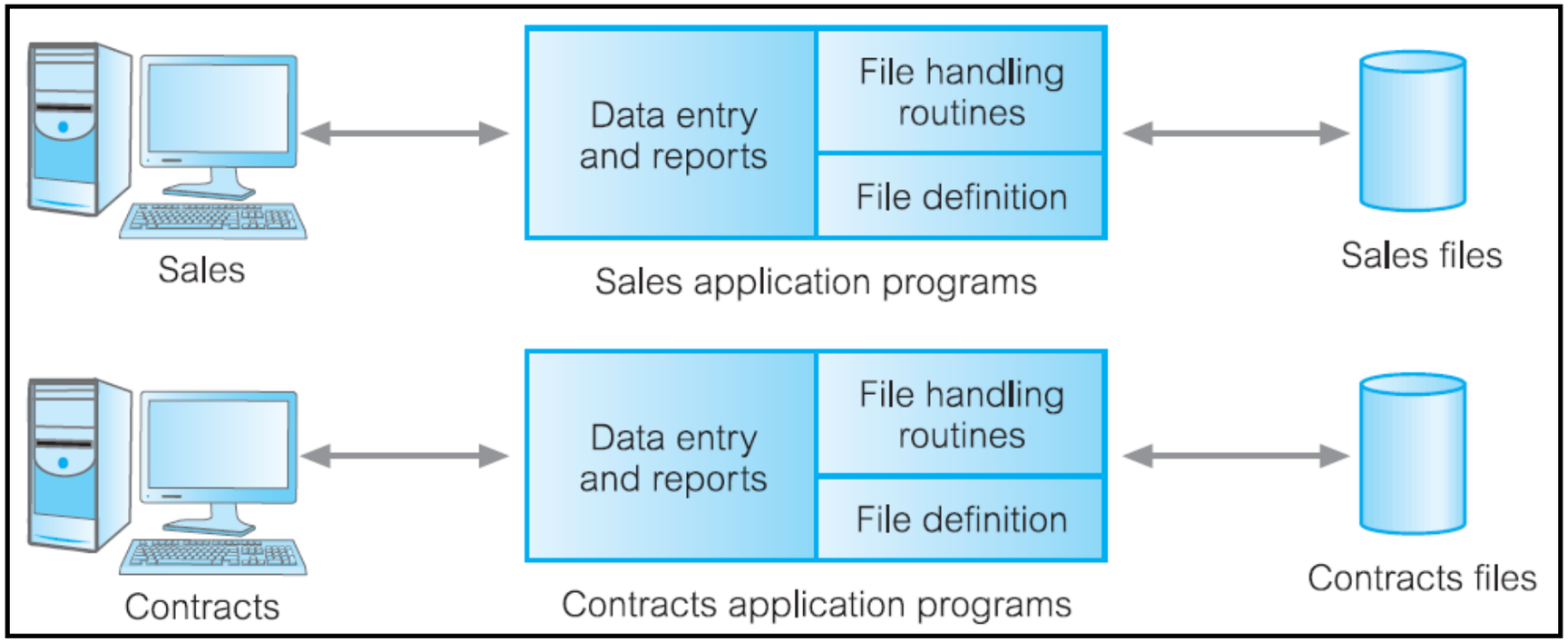
Why do we need the database?

Traditional File-Based Systems

- A collection of application programs that perform services for the end-users, such as the production of reports. **Each program defines and manages its own data.**

- A **decentralized approach** was taken, where each department, where each department stores and controls its own data.

Traditional File-Based Systems



* Each department **accesses its own files** through application programs written especially for them.
* Each set of departmental application programs handles data entry, file maintenance, and the generation of **a fixed set of specific reports.**
* The physical structure and storage of the data files are defined and **record in the application code.**

Limitations of File-Based Approach

Separation and isolation of data

- Each program maintains its own set of data.
- Users of one program may be unaware of potentially useful data held by other programs.

Duplication of data

- Same data is held by different programs.
- Wasted space and potentially different values and/or different formats for the same item.

Data dependence

- File structure is defined in the program code.

Incompatible file formats

- Programs are written in different languages, and so cannot easily access each other's files.

Fixed Queries/Proliferation of application programs

- Programs are written to satisfy particular functions.
- Any new requirement needs a new program.

The reasons why we need the database

1. Sharing of data
2. Control of data redundancy
3. Data consistency
4. Improved security
5. Enforcement of standards
6. Increased productivity

Goal of Database System

* To provide a way to store and retrieve database information conveniently and efficiently.
* DBMSs must meet the following requirements:
  * **Data Persistency** : the data must outlast their creators
  * **System Reliability** : recover correctly and promptly, if crash
  * **Scalability** : handle large numbers of data and lots of concurrent clients/users

Goal of Database System

* **Common Characteristics** in Database Systems
  * Self-Describing Nature
  * Integrity Constraint Control
  * Access Authorization
  * Multiple Views (for different levels/groups of users)

Database Concepts

* A Database System (DBS) consists of
  - A Database (DB) and
  - A Database Management System (DBMS)

* A Database is
  - a collection of well-organized and interrelated data

* A Database Management System is
  - a set of programs to manipulate those data

Simplified Database System Environment

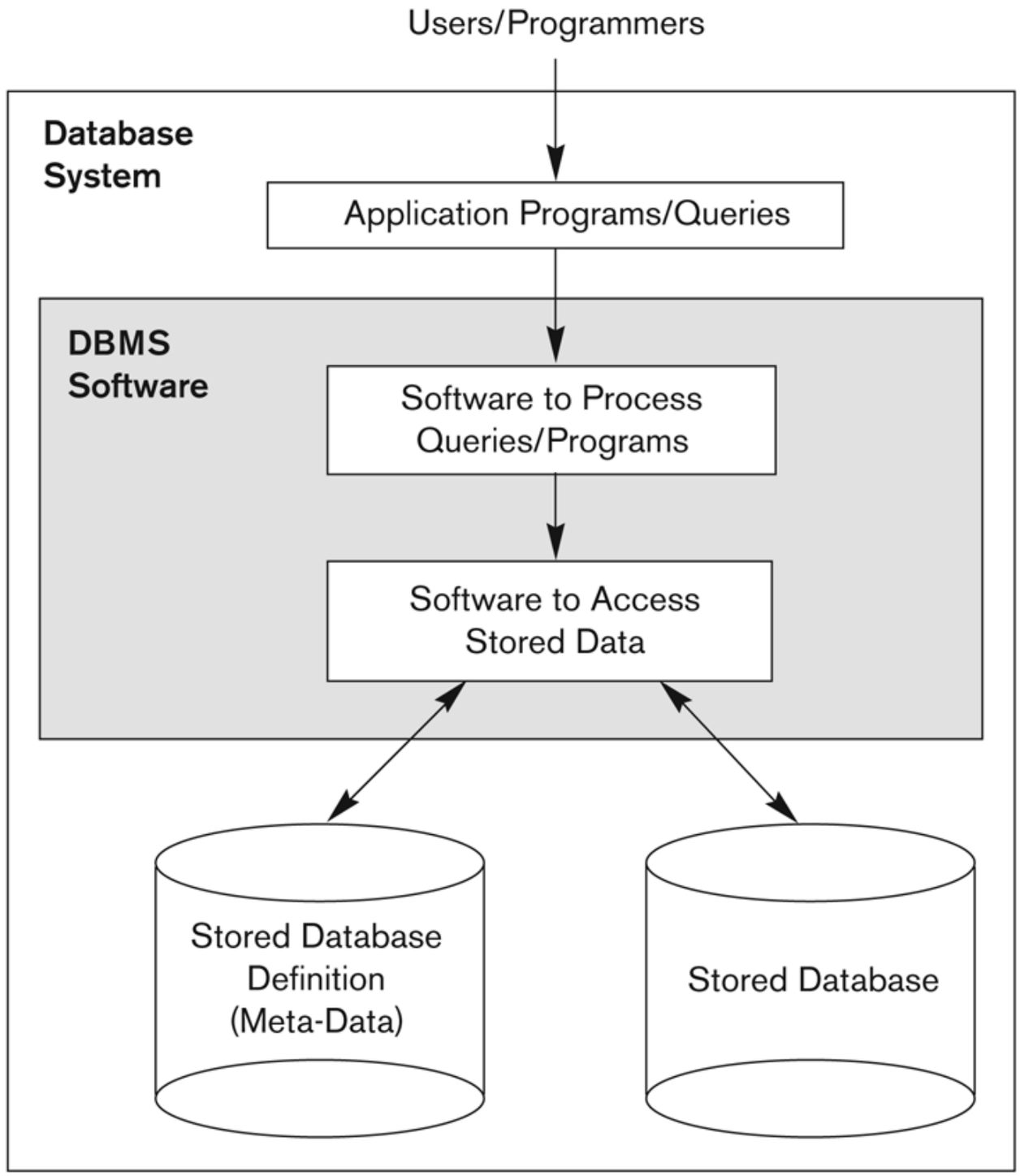
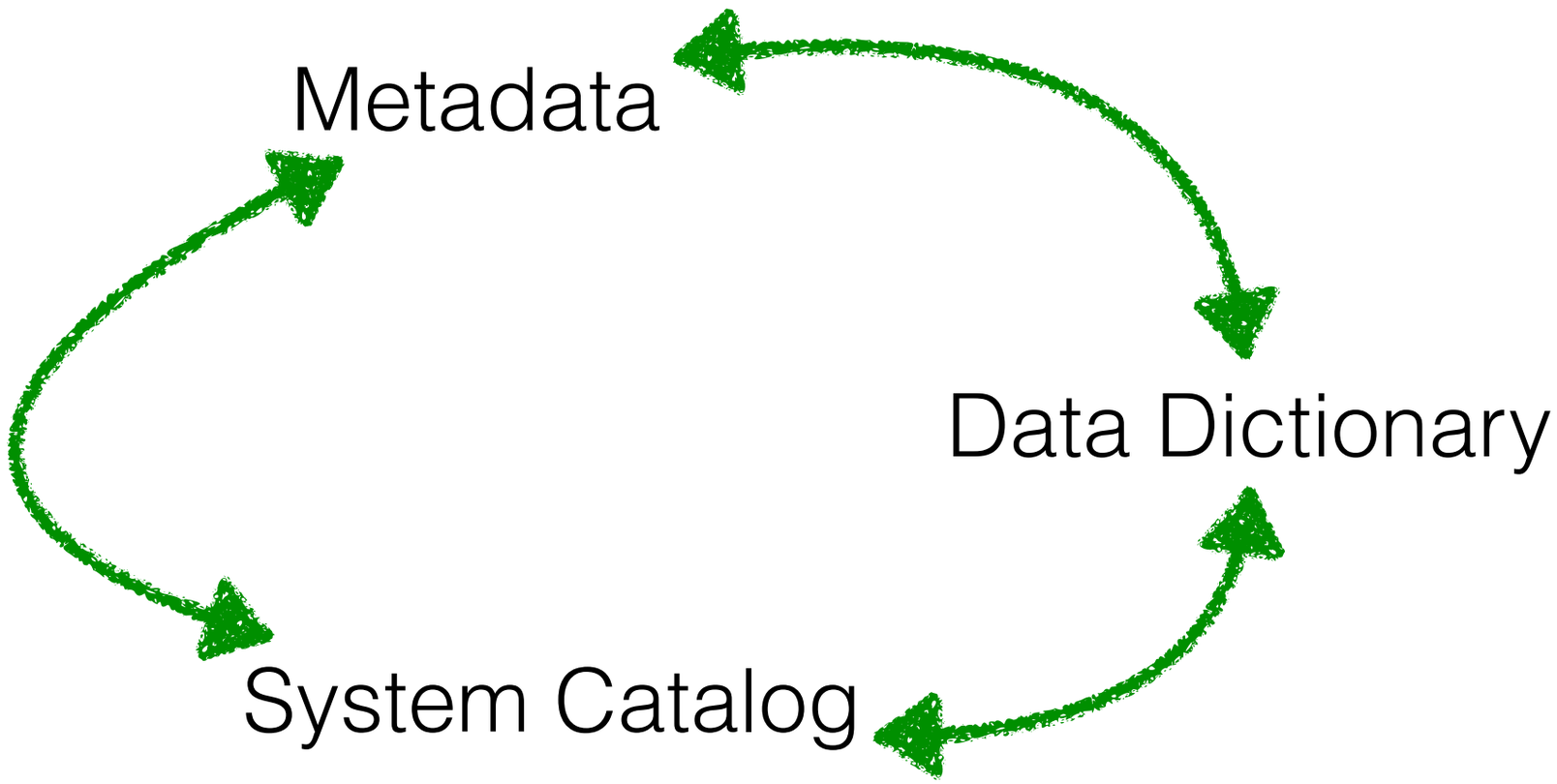


Figure 1.1
A simplified database system environment.

Meta-Data

"The description of the data"



https://dataedo.com/blog/what-is-metadata-examples

Relational Databases

* (Single) DBMS - Database Server
  * A DBMS consist of multiple databases
  * Each Database consists of
    * a set of **metadata** (information about data structures in the database)
  * A set of **tables**, views, users, triggers, indices, etc.
  * Each table consists of multiple **rows**
  * Each row consists of multiple **columns**
  * Usually, one data item is equivalent to one row of data in a table

Tables

"A named, two dimensional arrangement of data that consists of a heading part and a body part"

Columns/Attributes/Fields

PropertyForRent

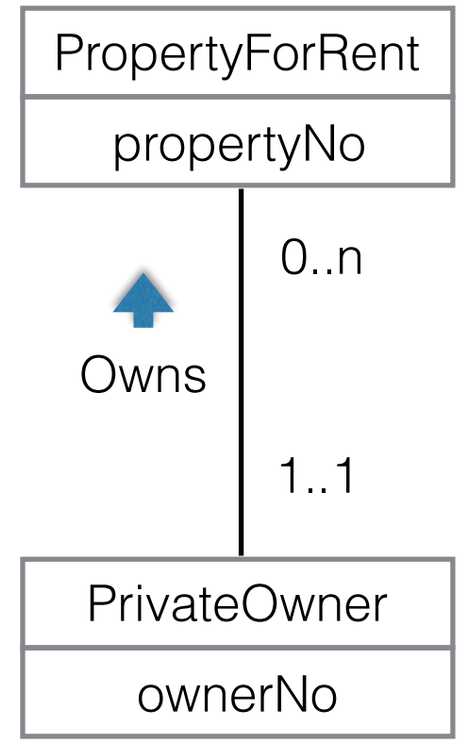
propertyNo	street	city	postcode	type	rooms	rent	ownerNo
PA14	16 Holhead	Aberdeen	AB7 5SU	House	6	650	CO46
PL94	6 Argyll St	London	NW2	Flat	4	400	CO87
PG4	6 Lawrence St	Glasgow	G11 9QX	Flat	3	350	CO40
PG36	2 Manor Rd	Glasgow	G32 4QX	Flat	3	375	CO93
PG21	18 Dale Rd	Glasgow	G12	House	5	600	CO87
PG16	5 Novar Dr	Glasgow	G12 9AX	Flat	4	450	CO93

Rows/Records

Relationship

PrivateOwner

ownerNo	fName	lName	address	telNo
CO46	Joe	Keogh	2 Fergus Dr, Aberdeen AB2 7SX	01224-861212
CO87	Carol	Farrel	6 Achray St, Glasgow G32 9DX	0141-357-7419
CO40	Tina	Murphy	63 Well St, Glasgow G42	0141-943-1728
CO93	Tony	Shaw	12 Park Pl, Glasgow G4 0QR	0141-225-7025



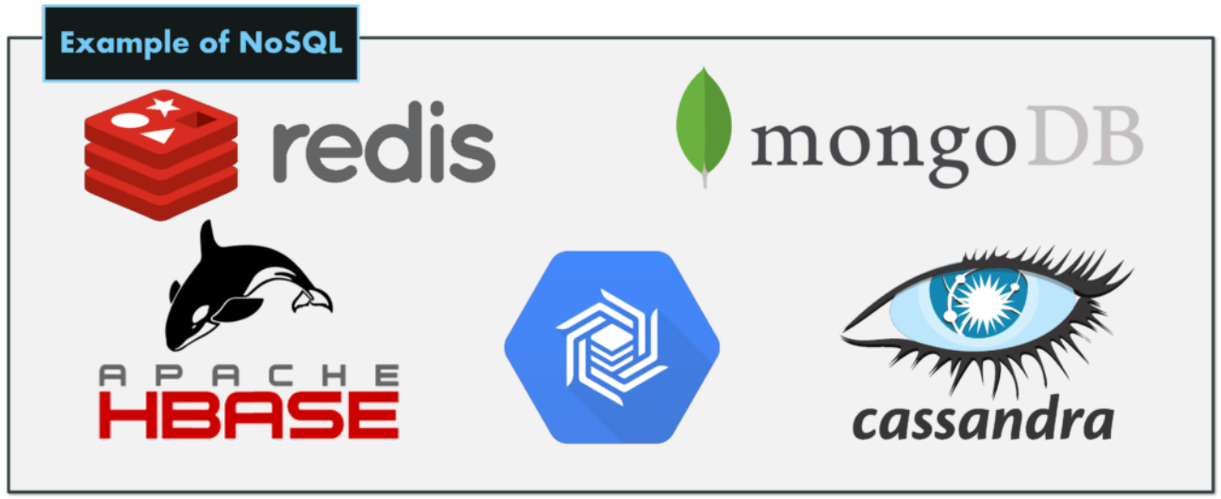
Database Management System (DBMS)

"A software system that enables users to define, create, maintain, and control access to the database"

DBMS

Relational DBMS

NoSQL Database

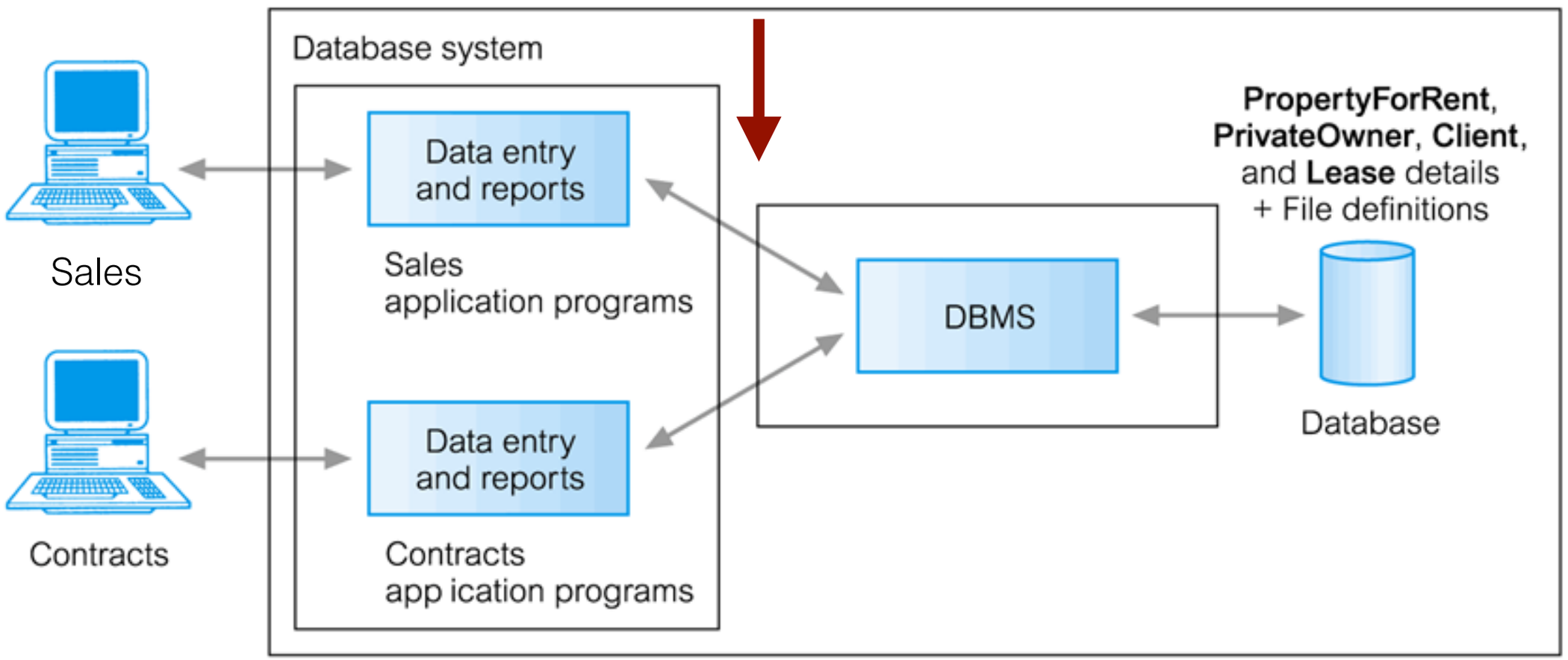


edureka!

https://www.edureka.co/blog/sql-vs-nosql-db/

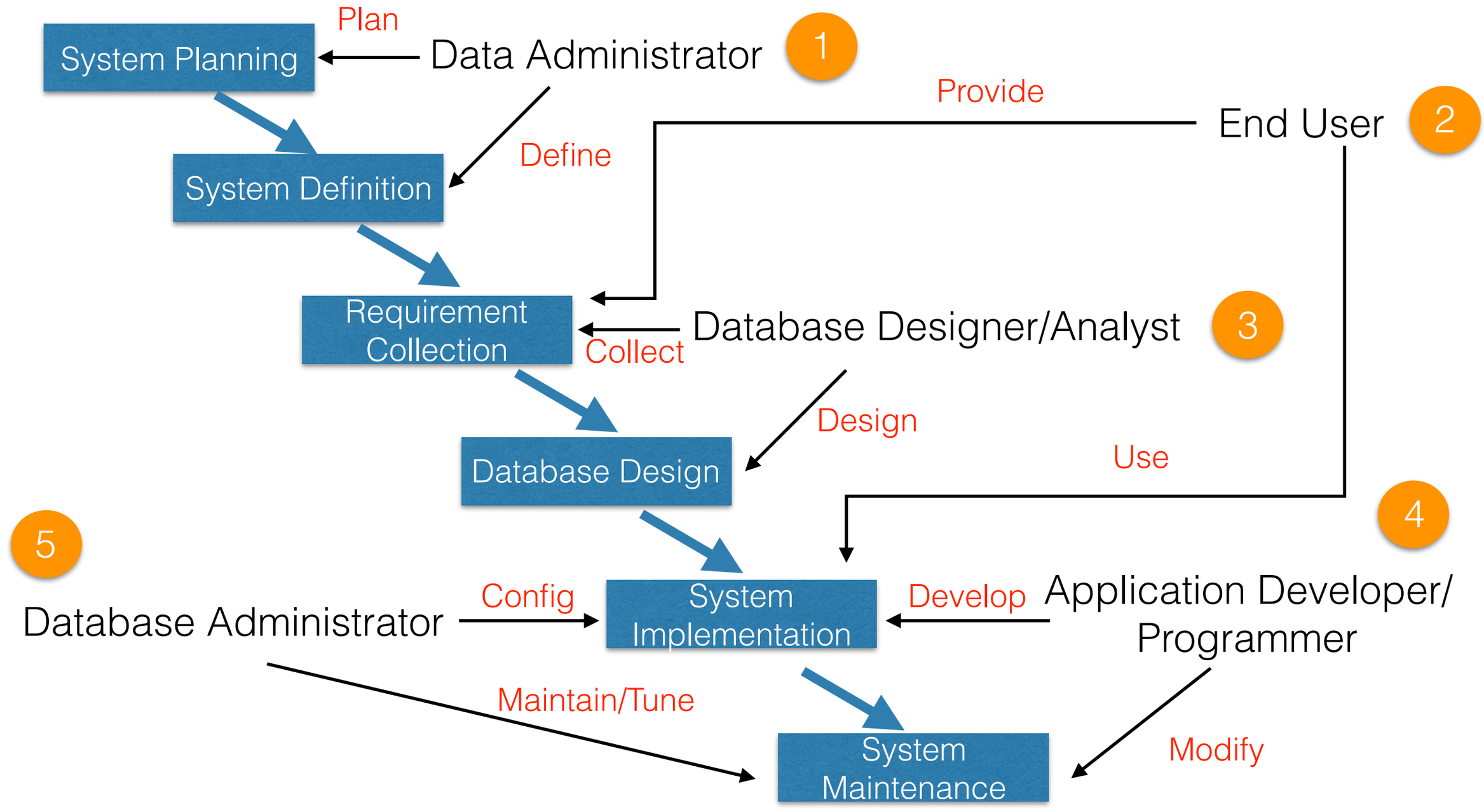
Sample: Database System

```
SELECT  propertyno, type, rooms, rent
FROM    propertyforrent
WHERE propertyno = 'PA14'
```

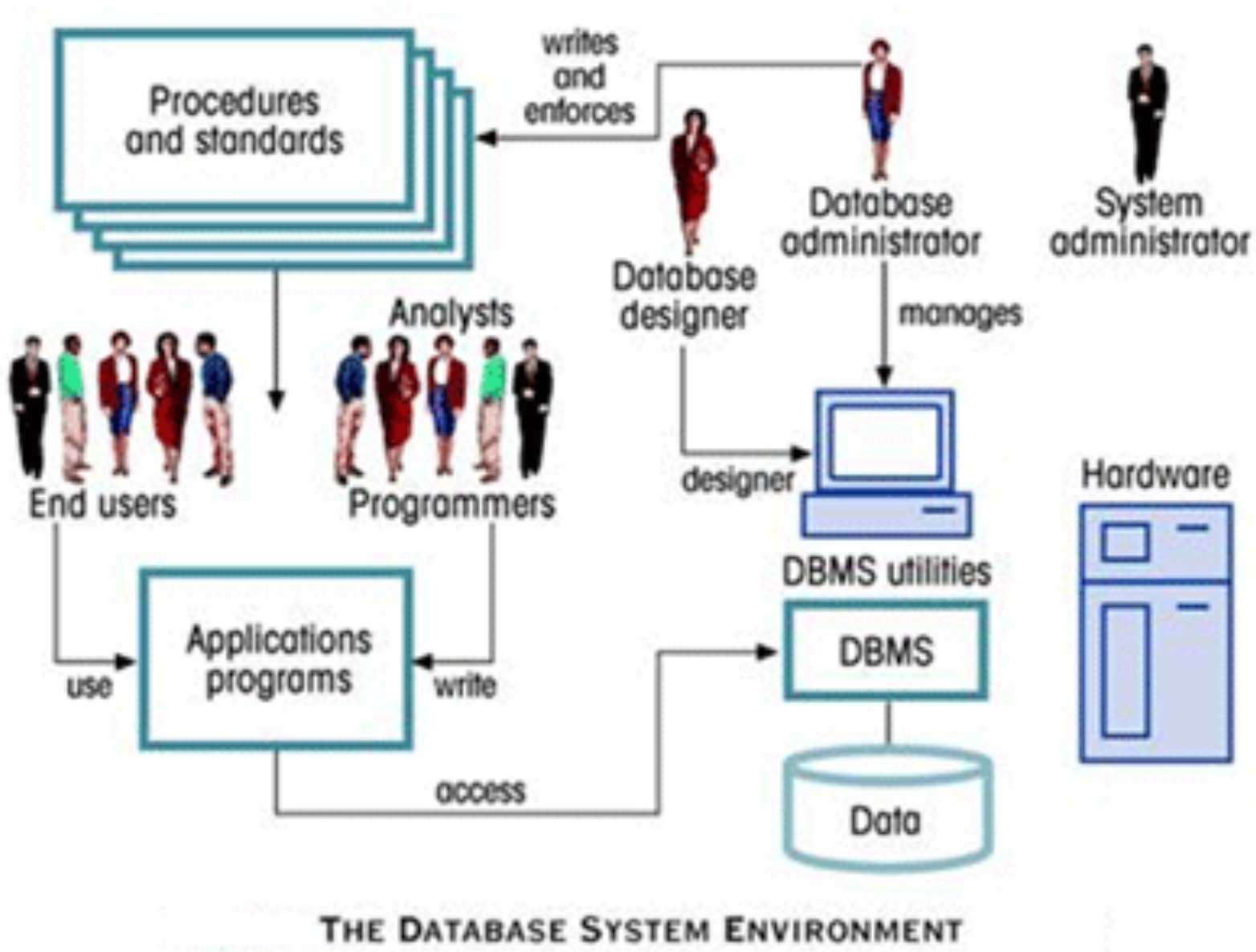


PropertyForRent (propertyNo, street, city, postcode, type, rooms, rent, ownerNo)
PrivateOwner (ownerNo, fName, lName, address, telNo)
Client (clientNo, fName, lName, address, telNo, prefType, maxRent)
Lease (leaseNo, propertyNo, clientNo, paymentMethod, deposit, paid, rentStart, rentF nish)

Actors in the Database Environment



Database System Environment



THE DATABASE SYSTEM ENVIRONMENT

Source: http://dbms-ii.blogspot.com/p/dbms-architecture.html

References

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