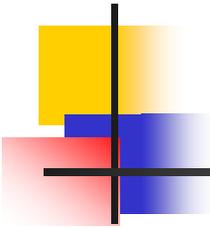


# Informal Design Guidelines

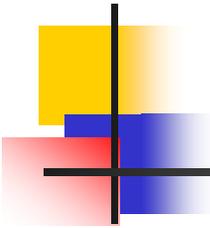
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# Objectives

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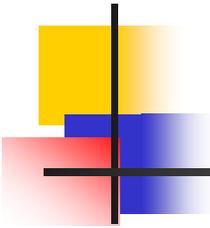
- Measuring the Quality of Relational Database Design +
- Database Design Methodology +
- Informal Design Guidelines for Relational Schema +



## - Measuring the Quality of Relational Database Design

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- At logical level
  - How users interpret relation schemas and the meaning of attributes?
- At the physical level
  - How the tuples in a base relation are stored and updated.



# - Database Design Methodology

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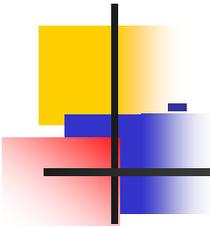
- **A Bottom-Up Method**

- We start by identifying all the attributes then trying to group attributes based on some relationships, to build relations.

- **A Top-Down Method**

- We start by identifying all the grouping of attributes into relations and then analyze these relation to further decompose them to produce better relations.

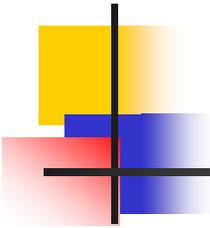
- Note: The theory discussed in this chapter is applicable to both these approaches, but is more practical when applied to top-down approach .



## - Informal Design Guidelines for Relational Schema

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- The four informal Guidelines to measures the quality of relational schema design are:
  - Guideline 1: Semantic of Relation Attributes +
  - Guideline 2: Reducing the Redundant Values in Tuples +
  - Guideline 3: Reducing the Null Values in Tuples +
  - Guideline 4: Disallowing Generating Spurious Tuples +



## -- Guideline 1: Semantic of Relation Attributes

---

- Design a relational schema so that it is easy to explain its meaning.
- Do not combine attributes from multiple entity types and relationship types into a single relation.
- Intuitively, if a relation schema corresponds to one entity type, or one relationship type, the meaning tends to be clear

# --- Example of Good Design ...

## EMPLOYEE

Ename	<u>SSN</u>	Bdate	Address	Dnumber
-------	------------	-------	---------	---------

## DEPT\_LOCATIONS

<u>Dnumber</u>	<u>Dlocation</u>
----------------	------------------

## DEPARTMENT

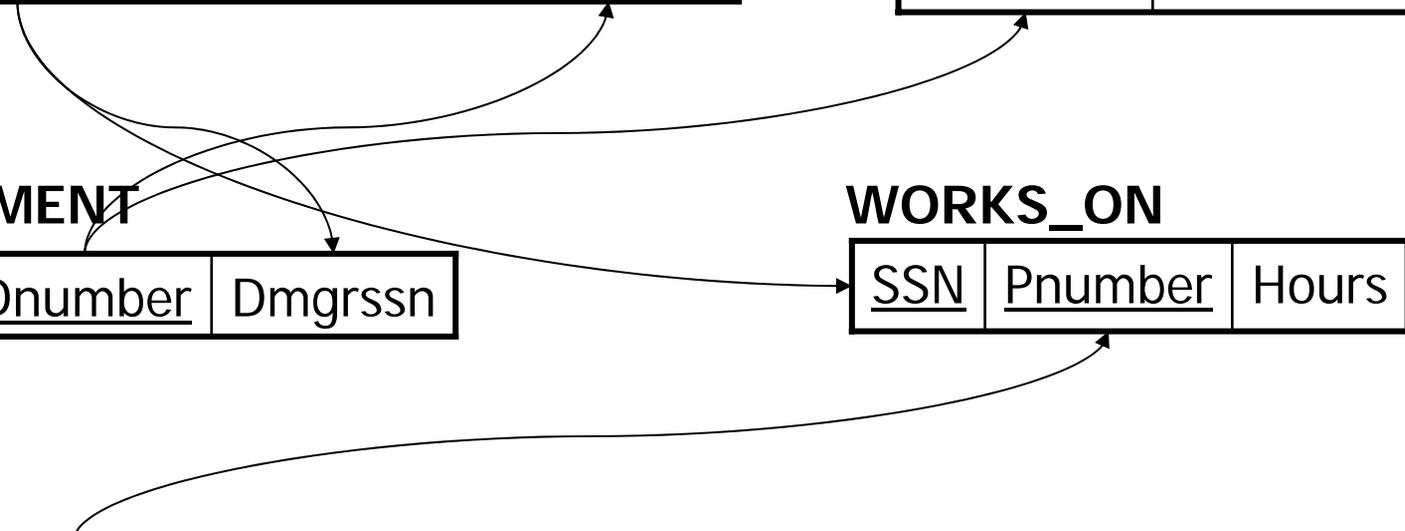
Dname	<u>Dnumber</u>	Dmgrssn
-------	----------------	---------

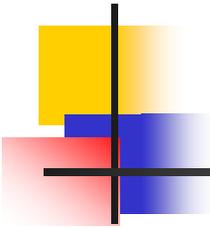
## WORKS\_ON

<u>SSN</u>	<u>Pnumber</u>	Hours
------------	----------------	-------

## PROJECT

Pname	<u>Pnumber</u>	Plocation	Dnum
-------	----------------	-----------	------





## ... --- Example of Good Design...

### EMPLOYEE

Ename	<u>SSN</u>	Ddate	Address	Dnumber
Salah	111	1965-01-09	Khobar	5
Wael	222	1955-12-08	Khobar	5
Zaher	333	1968-07-19	Dammam	4
Walid	444	1941-06-20	Dhahran	4
Nasser	555	1962-09-15	Jubail	5
Essam	666	1972-07-31	Khobar	5
Jabber	777	1969-03-29	Khobar	4
Bader	888	1937-11-10	Khobar	1

### DEPARTMENT

Dname	<u>Dnumber</u>	DMGRManager
Research	5	222
Administration	4	444
Headquarters	1	888

# ... --- Example of Good Design

## PROJECT

<u>Pname</u>	<u>Pnumber</u>	<u>Plocation</u>	<u>Dnum</u>
Product X	1	Dhahran	5
Product Y	2	Jubail	5
Product Z	3	Khobar	5
Computerization	10	Dammam	4
Reorganization	20	Khobare	1
Newbenefit	30	Dammam	4

## DEPT\_LOCATIONS

<u>Dnumber</u>	<u>Plocation</u>
1	Khobar
4	Dammam
5	Dhahran
5	Jubail
5	Khobar

## WORKS\_ON

<u>Ssn</u>	<u>Pnumber</u>	Hours
111	1	32.5
111	2	7.5
555	3	40.0
666	1	20.0
666	2	20.0
222	2	10.0
222	3	10.0
222	10	10.0
222	20	10.0
333	30	30.0
333	10	10.0
777	10	35.0
777	30	5.0
444	30	20.0
444	20	15.0
888	20	null

# --- Example of Bad Design

## EMP\_DEPT

Ename	<u>SSN</u>	Bdate	Address	Dnumber	Dname	DmgrSsn
-------	------------	-------	---------	---------	-------	---------

Employee Related info.

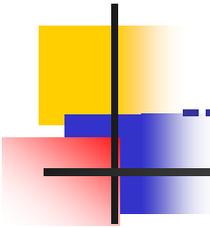
Dept. Specific info.

## EMP\_PROJ

<u>SSN</u>	<u>Pnumber</u>	Hours	Ename	Pname	LOcation
------------	----------------	-------	-------	-------	----------

Employee Related to project

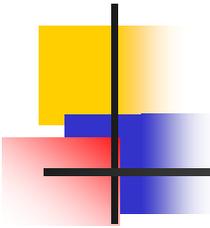
Attributes which violate the guideline



## -- Guideline 2: Reducing The Redundant Values in Tuples

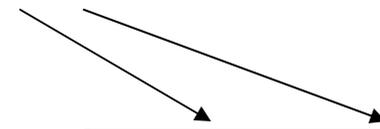
---

- Design the base relation schemas so that no insertion, deletion, or modification anomalies are present in the relation.
- If any anomalies are present, note them clearly and make sure that the programs that update the database will operate correctly.
- Due to improper grouping of attributes into a relation schema, the following problems are encountered.
  - Storage wastage +
  - Insert anomalies +
  - Delete anomalies +
  - Modification anomalies +



## --- Storage Wastage

Redundant data



Ename	SSN	Ddate	Address	Dnumber	Dname	DMGRManager
Salah	111	1965-01-09	Khobar	5	Research	222
Wael	222	1955-12-08	Khobar	5	Research	222
Zaher	333	1968-07-19	Dammam	4	Administration	444
Walid	444	1941-06-20	Dhahran	4	Administration	444
Nasser	555	1962-09-15	Jubail	5	Research	222
Essam	666	1972-07-31	Khobar	5	Research	222
Jabber	777	1969-03-29	Khobar	4	Administration	444
Bader	888	1937-11-10	Khobar	1	Headquarters	888

**EMP\_DEPARTMENT**

Solution

## --- Insert Anomalies

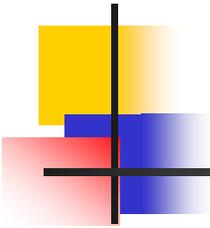
### EMP\_DEPARTMENT

Ename	<u>SSN</u>	Ddate	Address	Dnumber	Dname	DMGRManager
Salah	111	1965-01-09	Khobar	5	Research	222
Wael	222	1955-12-08	Khobar	5	Research	222
Zaher	333	1968-07-19	Dammam	4	Administration	444
Walid	444	1941-06-20	Dhahran	4	Administration	444
Nasser	555	1962-09-15	Jubail	5	Research	222
Essam	666	1972-07-31	Khobar	5	Research	222
Jabber	777	1969-03-29	Khobar	4	Administration	444
Bader	888	1937-11-10	Khobar	1	Headquarters	888
Ali	999	1967-10-15	Dammam			
				6	Accounting	111

A null primary Key

Newly inserted rows

Solution



## --- Delete Anomalies

### EMP\_DEPARTMENT

Ename	SSN	Ddate	Address	Dnumber	Dname	DMGRManager
Salah	111	1965-01-09	Khobar	5	Research	222
Wael	222	1955-12-08	Khobar	5	Research	222
Zaher	333	1968-07-19	Dammam	4	Administration	444
Walid	444	1941-06-20	Dhahran	4	Administration	444
Nasser	555	1962-09-15	Jubail	5	Research	222
Essam	666	1972-07-31	Khobar	5	Research	222
Jabber	777	1969-03-29	Khobar	4	Administration	444
<i>Bader</i>	<i>888</i>	<i>1937-11-10</i>	<i>Khobar</i>	<i>1</i>	<i>Headquarters</i>	<i>888</i>

Deleting Borg. James will delete the only information of department 1 from the database

Solution

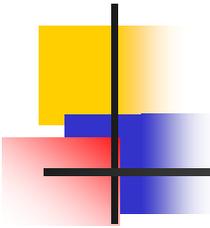
## --- Modification Anomalies

Updating the manager of Smith to 444 will cause inconsistency

Ename	SSN	Ddate	Address	Dnumber	Dname	DMGRManager
Salah	111	1965-01-09	Khobar	5	Research	444
Wael	222	1955-12-08	Khobar	5	Research	222
Zaher	333	1968-07-19	Dammam	4	Administration	444
Walid	444	1941-06-20	Dhahran	4	Administration	444
Nasser	555	1962-09-15	Jubail	5	Research	222
Essam	666	1972-07-31	Khobar	5	Research	222
Jabber	777	1969-03-29	Khobar	4	Administration	444
Bader	888	1937-11-10	Khobar	1	Headquarters	888

### EMP\_DEPARTMENT

Solution



## -- Guideline 3: Reducing Null Values in Tuples

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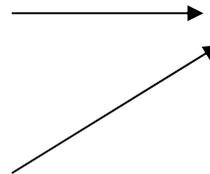
- If possible avoid placing attributes in a base relation whose values may frequently be null. If nulls are unavoidable, make sure they apply in exceptional cases only and not to majority of tuples in a relation.
- Problems with null values:
  - Waste of disk space
  - Problem of understanding the meaning of attributes
  - Problems in specifying JOIN operations
  - Problems in applying some aggregate functions
  - May have multiple interpretations (not applicable, unknown, unavailable)

## -- Guideline 4: Disallowing generating Spurious Tuples ...

- Make sure that the foreign keys refer to unique keys.

Lid	Fname	Lname	Salary
1	Adel	Adam	1000
2	Aggel	Hassan	1100
3	Adel	Khaled	1200

**Lecturers**



SID	Sname	Lname
ICS334	DB	Adel
ICS434	OS	Yahya
ICS202	DS	Adel

**Subjects**

Which Adel is the teacher of DB

## ... -- Guideline 4: Disallowing generating Spurious Tuples

Lid	Fname	Lname	Salary
1	Adel	Adam	1000
2	Ageel	Hassan	1100
3	Adel	Khaled	1200

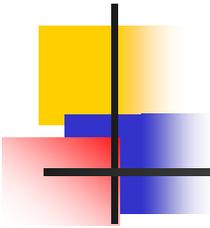
**Lecturers**

SID	Sname	Fname
ICS334	DB	Adel
ICS434	OS	Yahya
ICS202	DS	Adel

**Subjects**

```
SELECT L.LID, L.Fname, S.Sname  
FROM lecturers L, Subjects S  
Where S.Fname = L.Fname
```

LID	Fname	Sname
1	Adel	DB
2	Yahya	OS
3	Adel	DB
1	Adel	DS
2	Adel	DS



## -- Guideline 4: Disallowing generating Spurious Tuples

- Design relational schemas so that they can be joined with equality conditions of attributes that are either primary keys or foreign keys in a way that guarantees that no spurious tuples are generated. Do not have relations that contain matching attributes other than foreign key-primary key combination. If such relations are unavoidable, do not join them on such attributes, because the join may produce spurious tuples

**EMP\_PROJ1**

<u>SSN</u>	<u>Pnumber</u>	Hours	Pname	Plocation
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**EMP\_LOCS**

<u>Ename</u>	<u>Plocation</u>
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**EMP\_PROJ**

<u>SSN</u>	<u>Pnumber</u>	Hours	Ename	Pname	Plocation
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