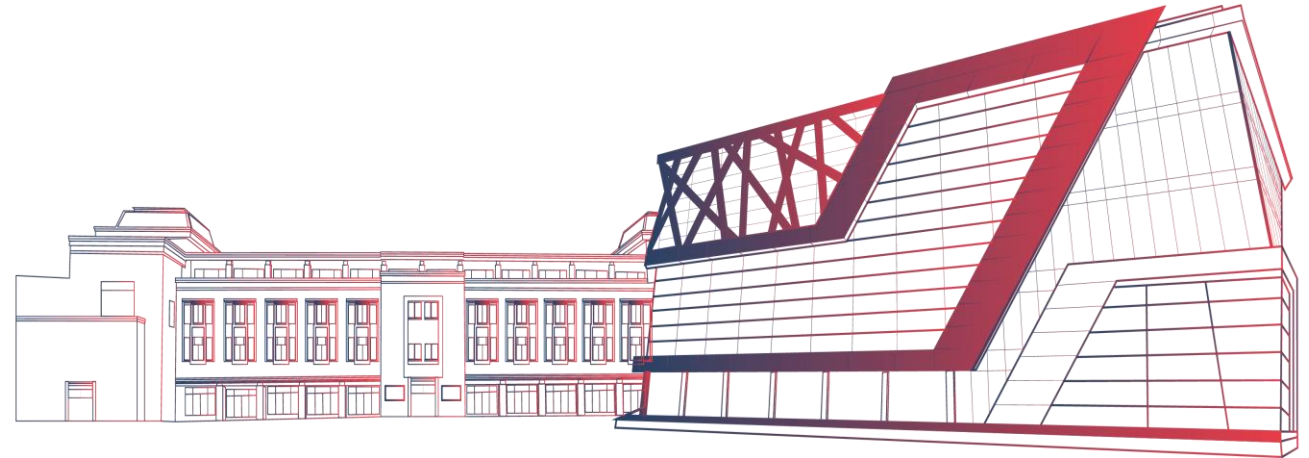


# Lecture-3

## Relational Model



# Relational Model

## The Three Levels of Happiness

Jessie Christensen 12.8.2014



Relatives:  
CONTENTMENT



Relationships:  
JOY



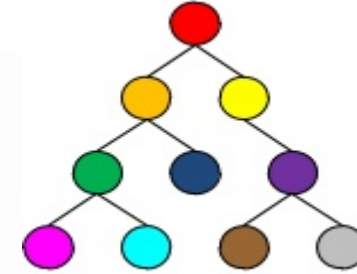
Relational:  
PURE BLISS



# Types of Database Model

## Hierarchical Database Model

- Represented by a group of records that relates to each others by a pointer



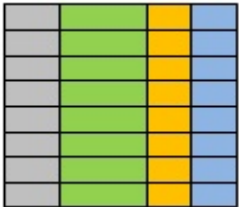
## Network Database Model

- Based on set theory, a set consists a collection of records



## Relational Database Model

- Based on the mathematical concept of relational



## Object-Oriented Model

- Based on object oriented concepts



# Populated Database State for COMPANY

## EMPLOYEE

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

## DEPARTMENT

Dname	<u>Dnumber</u>	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

## DEPT\_LOCATIONS

<u>Dnumber</u>	<u>Dlocation</u>
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

# Populated Database State for COMPANY

**WORKS\_ON**

<u>Essn</u>	<u>Pno</u>	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

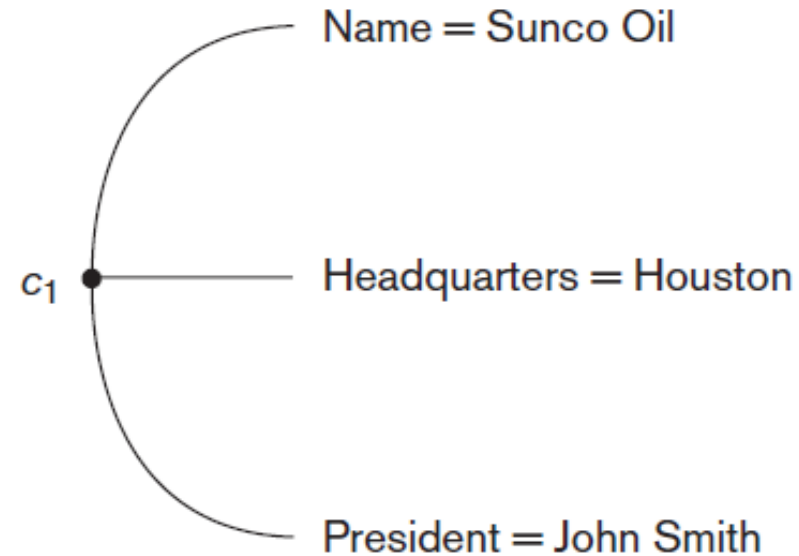
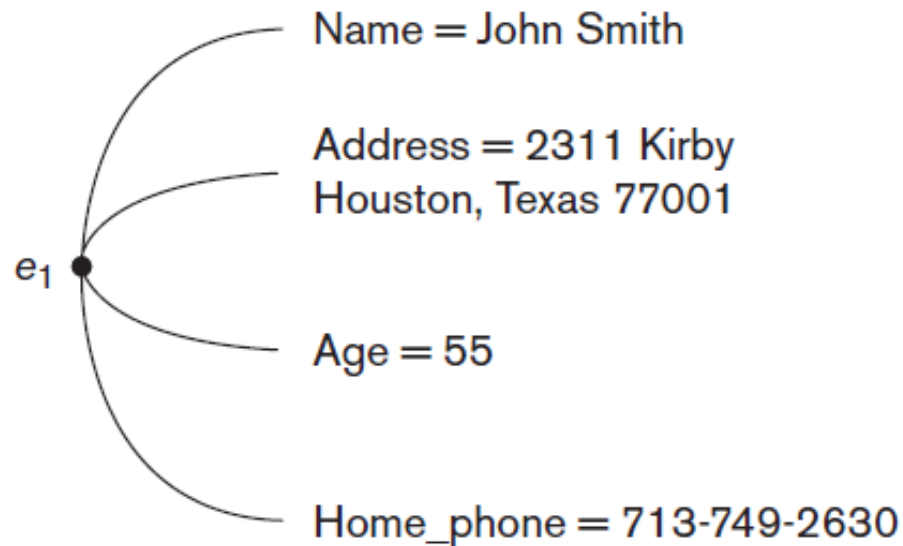
**PROJECT**

<u>Pname</u>	<u>Pnumber</u>	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

**DEPENDENT**

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
333445555	Alice	F	1986-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1967-05-05	Spouse

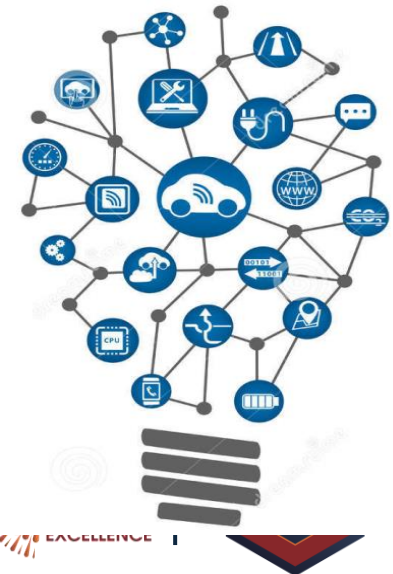
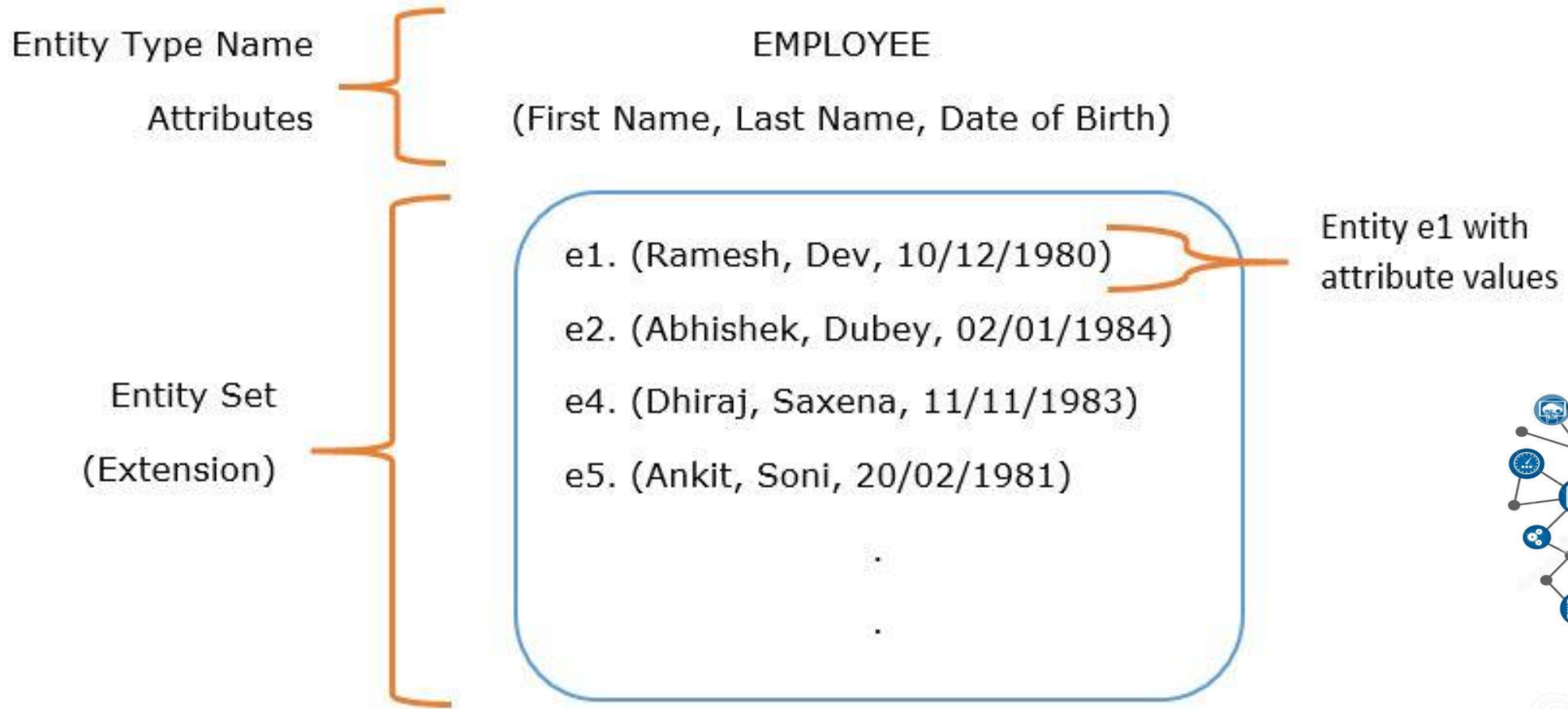
# Entities and Attributes



Two entities, EMPLOYEE e1 and

COMPANY c1 and their attributes

# Entities and Attributes Example



# Attribute

---

**Attribute** Each attribute of a relation has a name

---

Set of allowed values for each attribute is called the domain

---

Attribute values are (normally) required to be atomic

---

The special value null is a member of every domain

---



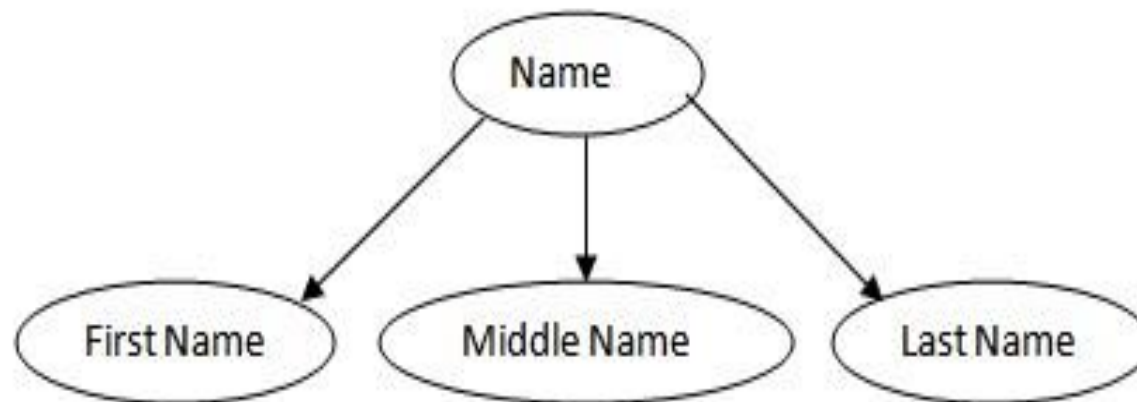


# Simple vs Composite Attribute

- **Simple Attributes** are atomic values, which cannot be divided further.



- **Composite Attributes** are made of more than one simple attribute.



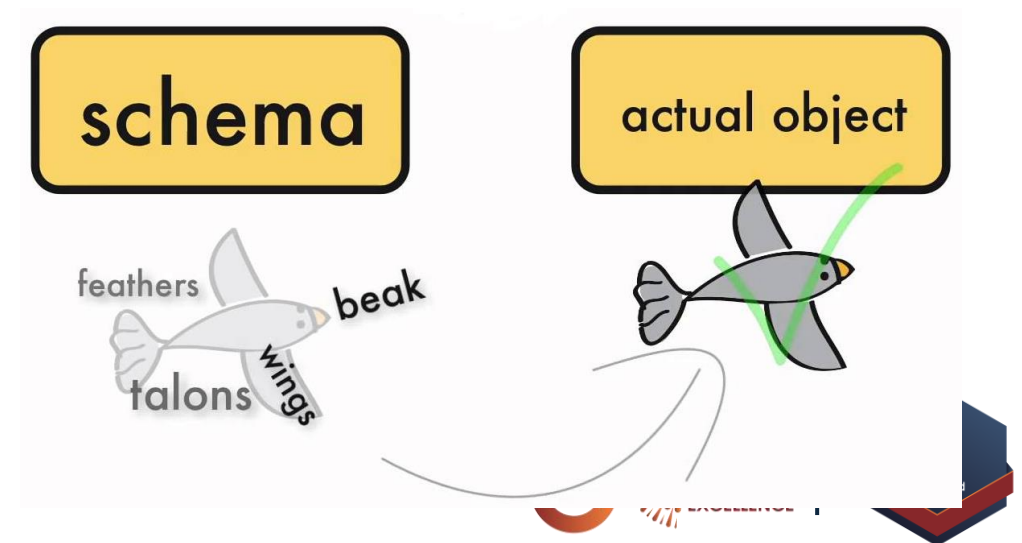
# Relational Schema

## Relation schema $R$

- Denoted by  $R(A_1, A_2, \dots, A_n)$
- Made up of a relation name  $R$  and a list of attributes,  $A_1, A_2, \dots, A_n$

## Schema of a relation consists of

- attribute definitions
  - name
  - type/domain
- integrity constraints



# Relational Schema - COMPANY Database

## EMPLOYEE

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
-------	-------	-------	------------	-------	---------	-----	--------	-----------	-----

## DEPARTMENT

Dname	<u>Dnumber</u>	Mgr_ssn	Mgr_start_date
-------	----------------	---------	----------------

## DEPT\_LOCATIONS

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

## PROJECT

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

## WORKS\_ON

<u>Essn</u>	<u>Pno</u>	Hours
-------------	------------	-------

## DEPENDENT

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
-------------	-----------------------	-----	-------	--------------

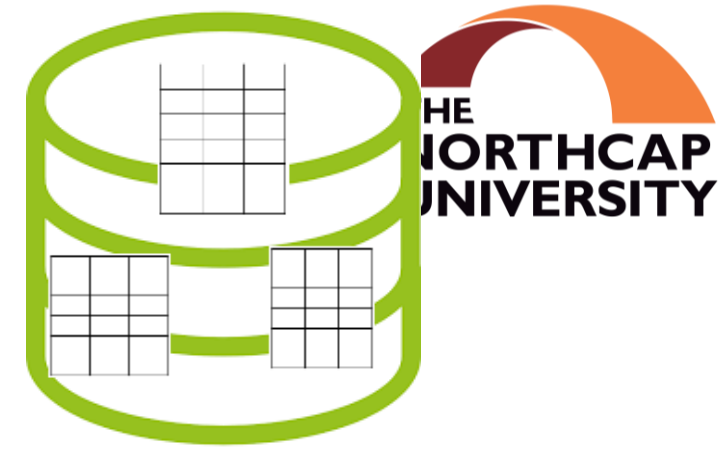
# Relational Instance

- The current values (*relation instance*) of a relation are specified by a table
- An element  $t$  of  $r$  is a *tuple*, represented by a *row* in a table
- Order of tuples is irrelevant (tuples may be stored in an arbitrary order)

**Tuples** →

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

# Database And Relations



- A database consists of multiple relations
- Information about company is broken up into parts, with each relation storing one part of the information
- E.g. **Employee**: information about employee and their department

**Department**: information about department

**Dept\_locations**: information about department locations.



# Why Split Information Across Relations?

- ❑ Storing all information as a single relation such as

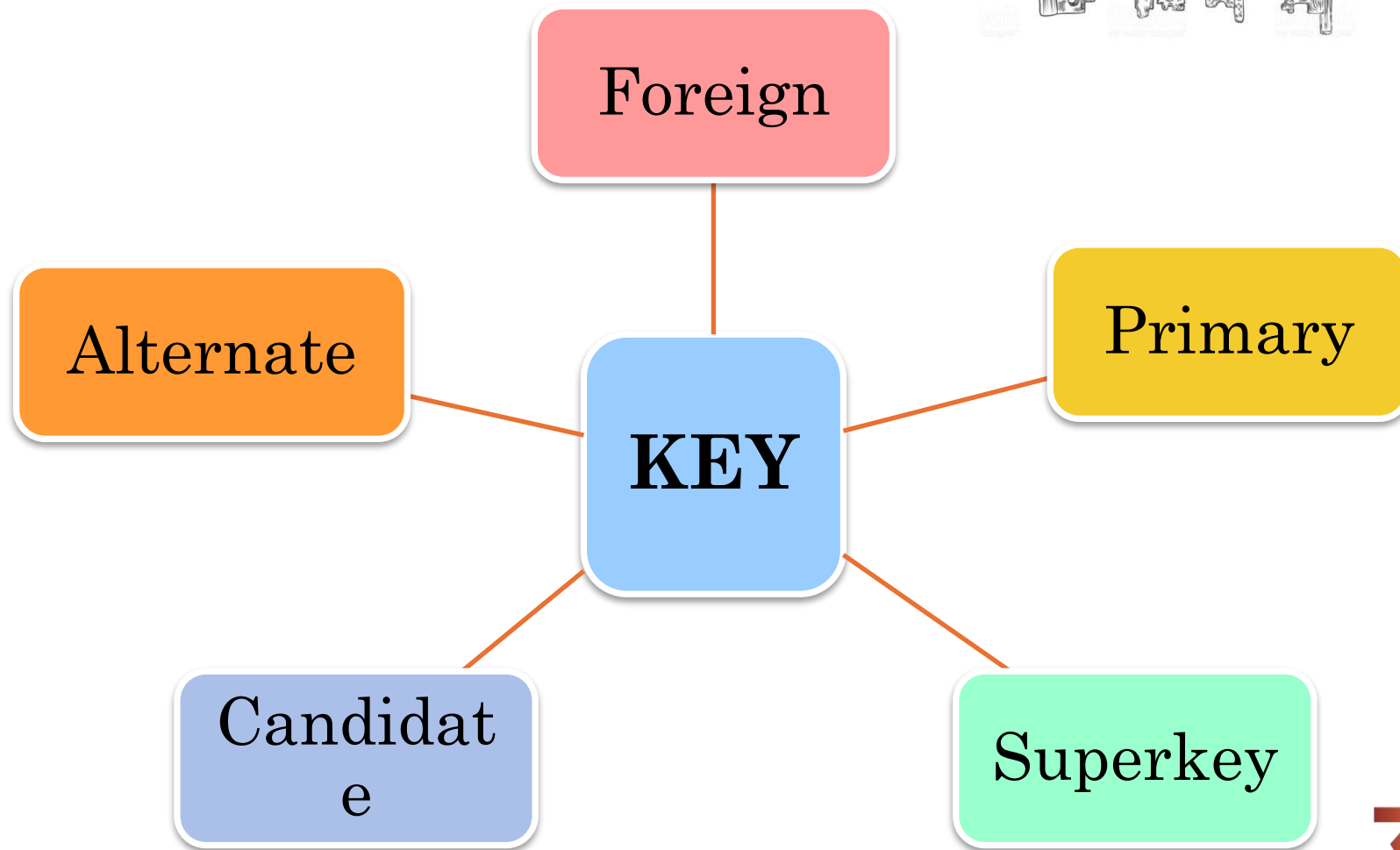
*Company(Employee, Department, Department\_Loc, ..)*

results in

- repetition of information
  - the need for null values
- ❑ Normalization deals with the designing of relational schemas.



# Keys



# Candidate Key

- ❑ It must contain unique values
- ❑ Candidate key may have multiple attributes
- ❑ It should contain **minimum fields** to ensure uniqueness
- ❑ **Uniquely identify each record in a table**
- ❑ Eg. **Ssn : Candidate Key**

**Ssn, Ename: Not Candidate Key**



# Candidate Key Example

**SSN and Dname** can be considered as candidate keys

Employee

<u>SSN</u>	FName	MI	LName	Sex	Address	BDate	Salary
------------	-------	----	-------	-----	---------	-------	--------

Department

<u>DName</u>	<u>DNumber</u>	{Locations}
--------------	----------------	-------------

Problem:

attribute values are  
not ATOMIC....

Project

<u>PName</u>	<u>PNumber</u>	Location
--------------	----------------	----------

Dependent

FName	Sex	BDate	Relationship
-------	-----	-------	--------------

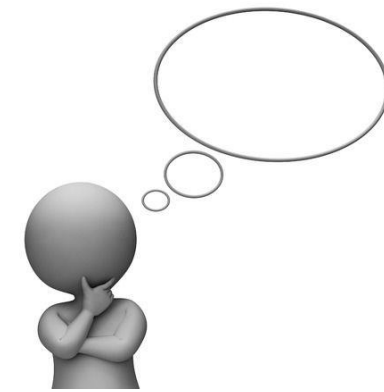
Problem:

Relation does not have a KEY

== = primary key

— = candidate key

# Candidate Key Drill

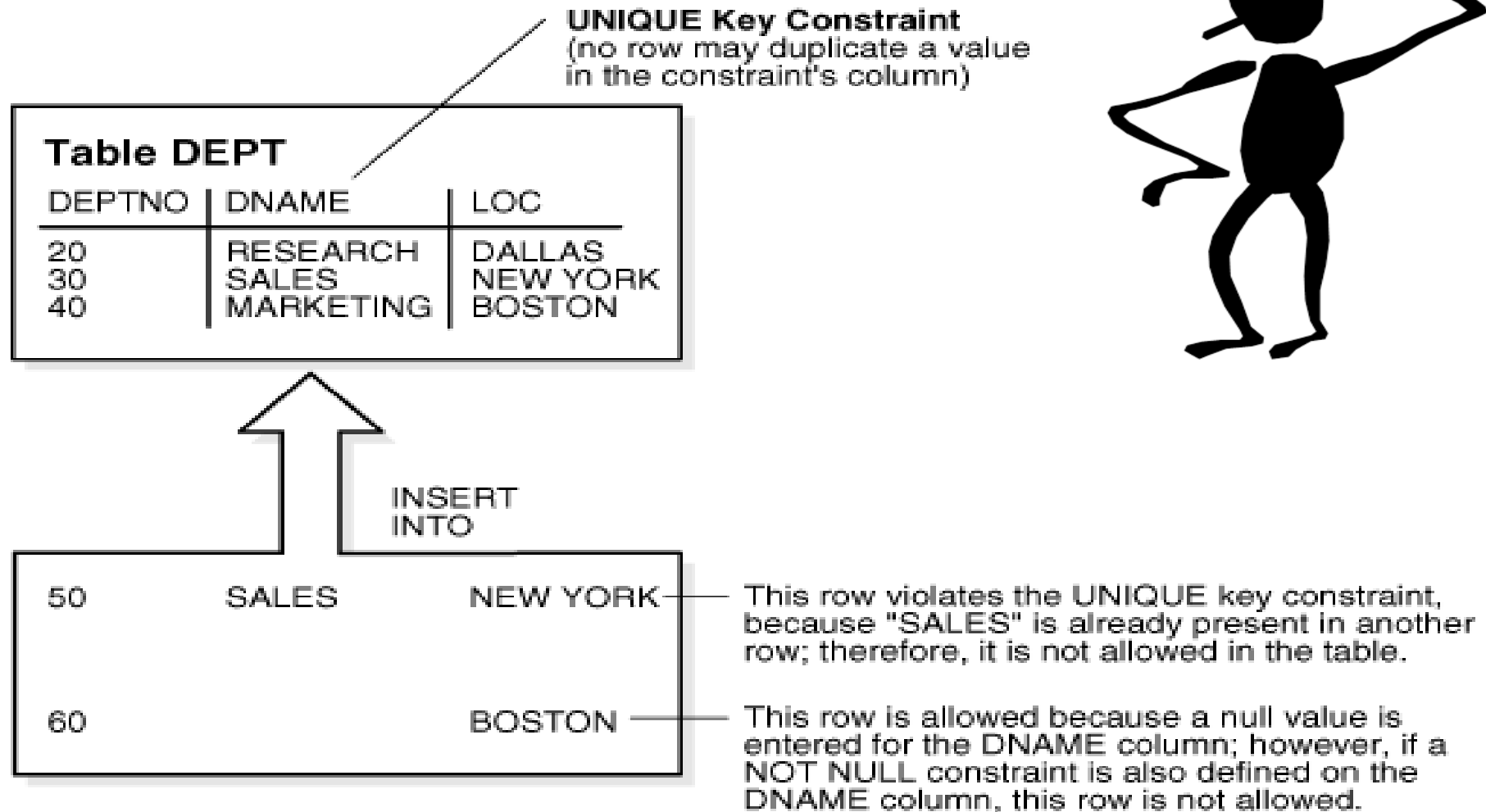


- In the given table which columns can be considered as candidate keys which help us to uniquely identify the student record in the table?

StudID	Roll No	FirstName	LastName	Email
1	11	Tom	Price	<a href="mailto:abc@gmail.com">abc@gmail.com</a>
2	12	Nick	Wright	<a href="mailto:xyz@gmail.com">xyz@gmail.com</a>
3	13	Dana	Natan	<a href="mailto:mno@yahoo.com">mno@yahoo.com</a>



# Key Constraints



# Simple Vs Composite Candidate Key

EMPLOYEE

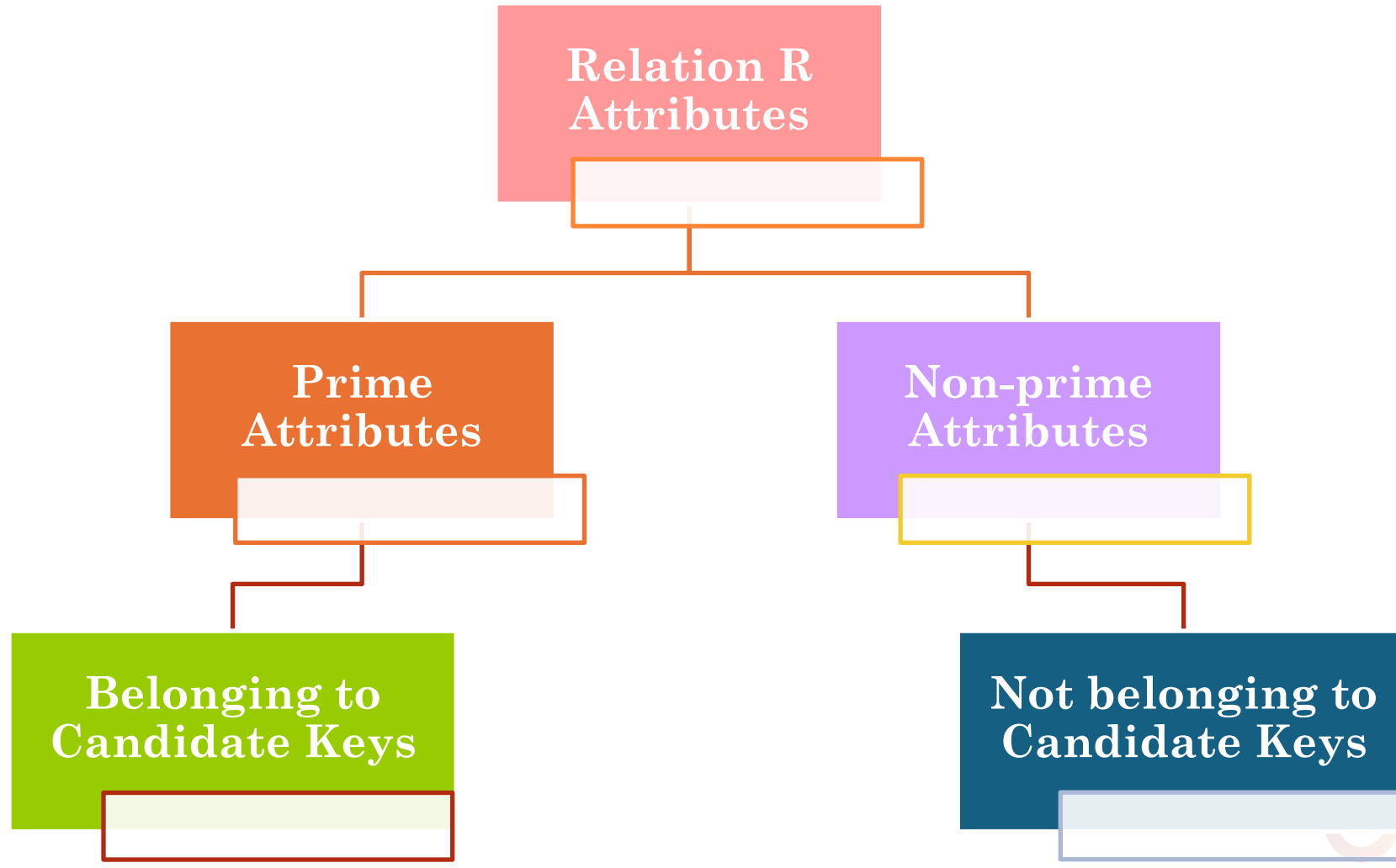
Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

**Ssn: Simple Key**

**Fname, Minit, Lname: Composite Key**

**Fname, Address ????**

# Prime vs Non-prime Attribute



# Primary Key



- Two rows can't have the same primary key value
- The primary key field cannot be null.
- The value in a primary key column can never be modified or updated if any foreign key refers to that primary key.
- Atmost one primary key for any relation.

**i.e. any candidate key whose values are always NOT NULL.**

- **Eg. Ssn: Primary Key (no null value allowed)**

# Primary Key Drill

EMPLOYEE

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

DEPARTMENT

Dname	<u>Dnumber</u>	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT\_LOCATIONS

<u>Dnumber</u>	<u>Dlocation</u>
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

Identify Primary Key??



# Alternate Key

- All candidate keys except primary keys.
- Allows NULL value
- More than 1 alternate key possible
- **Eg. { Ename, Address, Bdate }**



# Alternate Key Example

Dnumber and Dname are qualified to become a primary key in DEPARTMENT relation.

But since Dnumber are the primary key, DName becomes the alternate key.

**EMPLOYEE**

Ename	<u>Ssn</u>	Bdate	Address	Dnumber
Smith, John B.	123456789	1965-01-09	731 Fondren, Houston, TX	5
Wong, Franklin T.	333445555	1955-12-08	638 Voss, Houston, TX	5
Zelaya, Alicia J.	999887777	1968-07-19	3321 Castle, Spring, TX	4
Wallace, Jennifer S.	987654321	1941-06-20	291 Berry, Bellaire, TX	4
Narayan, Ramesh K.	666884444	1962-09-15	975 Fire Oak, Humble, TX	5
English, Joyce A.	453453453	1972-07-31	5631 Rice, Houston, TX	5
Jabbar, Ahmad V.	987987987	1969-03-29	980 Dallas, Houston, TX	4
Borg, James E.	888665555	1937-11-10	450 Stone, Houston, TX	1

**DEPARTMENT**

Dname	<u>Dnumber</u>	Dmgr_ssn
Research	5	333445555
Administration	4	987654321
Headquarters	1	888665555

**DEPT\_LOCATIONS**

<u>Dnumber</u>	<u>Dlocation</u>
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

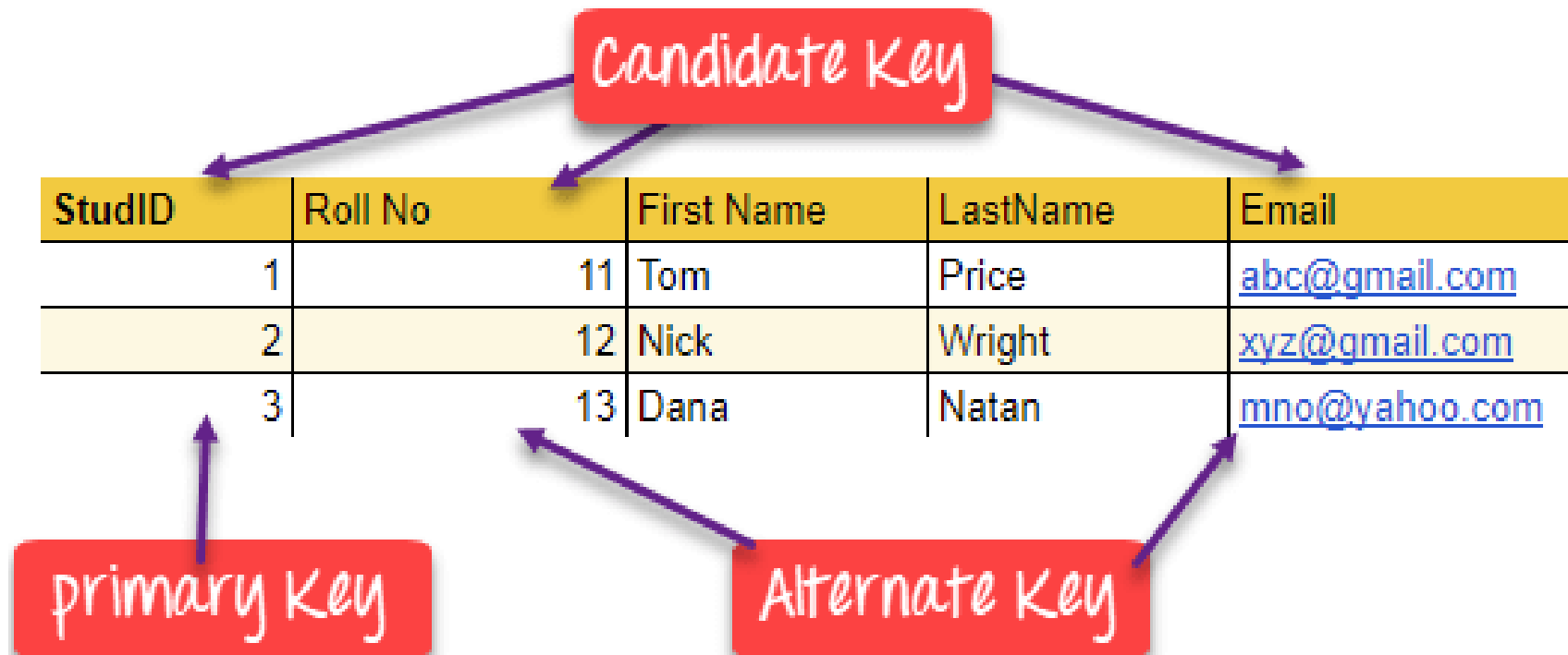
# Alternate Key Drill

Identify the candidate, primary and alternate key in the following SCHOOL Database.

StudID	Roll No	FirstName	LastName	Email
1	11	Tom	Price	<a href="mailto:abc@gmail.com">abc@gmail.com</a>
2	12	Nick	Wright	<a href="mailto:xyz@gmail.com">xyz@gmail.com</a>
3	13	Dana	Natan	<a href="mailto:mno@yahoo.com">mno@yahoo.com</a>



## Solution - Alternate Key Drill



# SuperKey

A superkey is a group of single or multiple keys which identifies rows in a table. A

Super key may have additional attributes that are not needed for unique identification.

EmpSSN	EmpNum	Empname
9812345098	AB05	Shown
9876512345	AB06	Roslyn
199937890	AB07	James



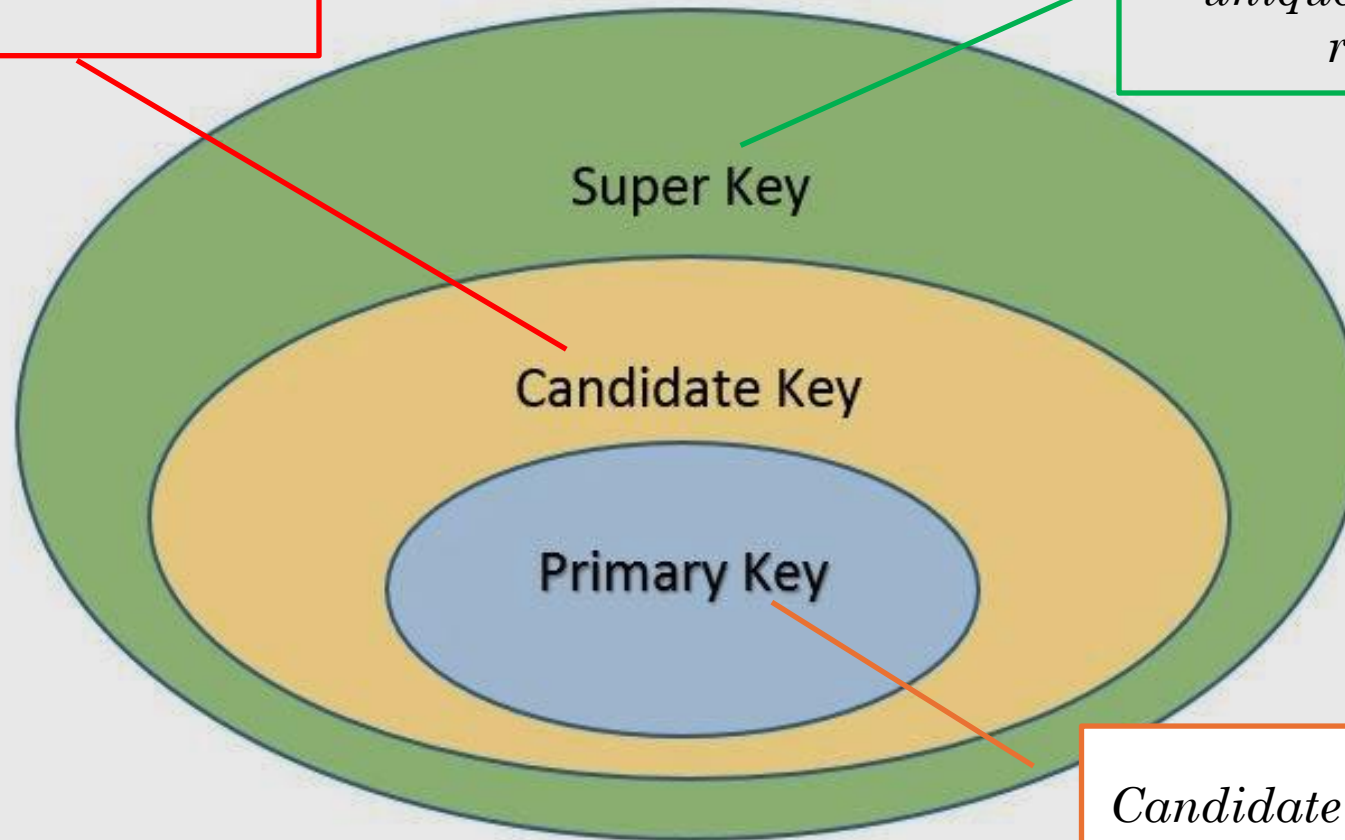
- Eg. (EmpSSN, Empname) and (EmpNum, Empname) are superkeys.



# Primary, Candidate and Super Key

*Minimal SuperKey*

*Set of attributes that  
uniquely identifies  
records*



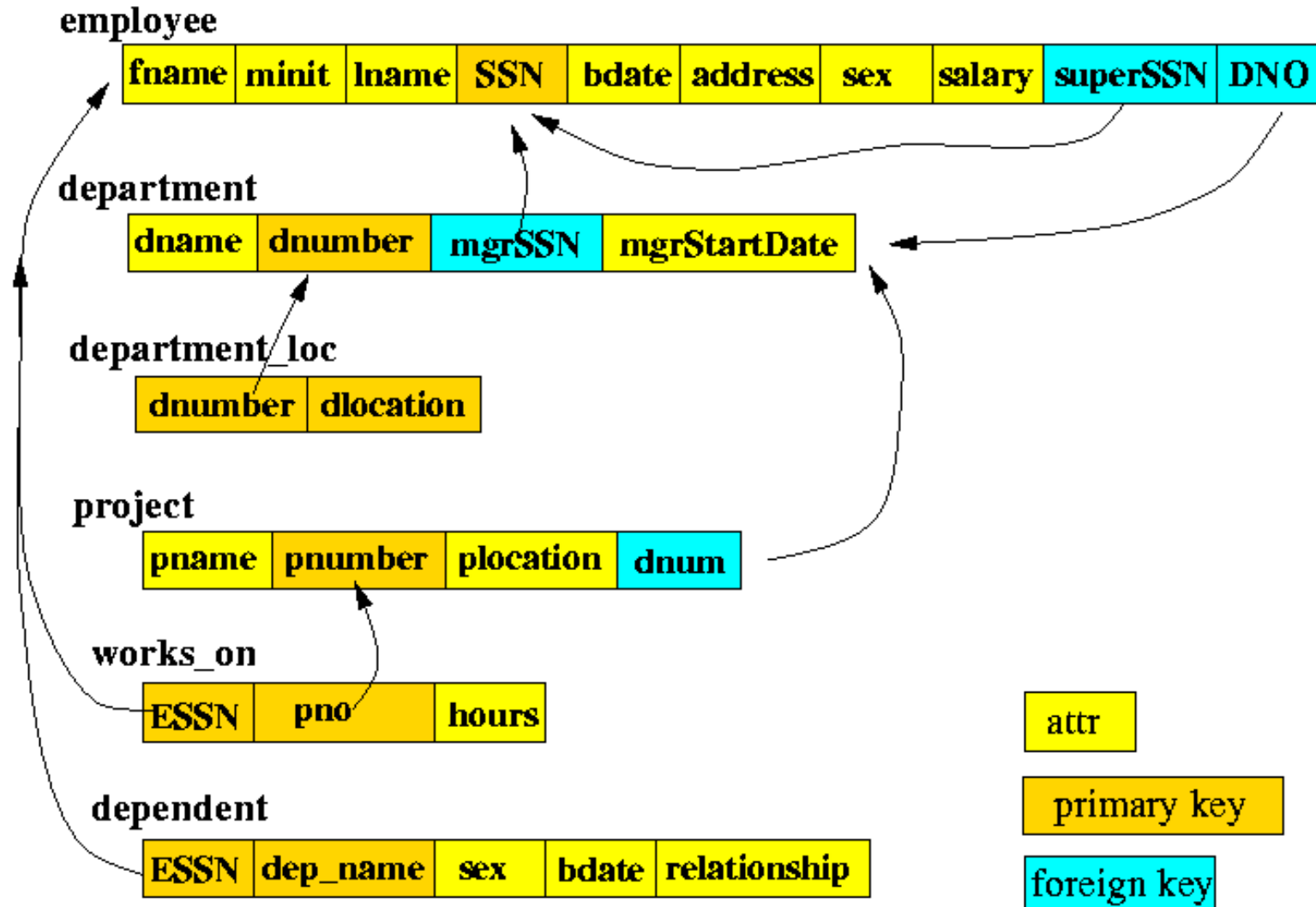
*Candidate key with NO  
NULL values*

# Foreign Key

- A foreign key is a set of attributes **to create a relationship with another relation.**
- Foreign keys help us to maintain data integrity and also allows navigation between two different instances of an entity.



# Foreign Key Example



# Foreign Key Drill

Identify the primary and foreign key in the following SCHOOL database.

DeptCode	DeptName
001	Science
002	English
005	Computer

Teacher ID	Fname	Lname
B002	David	Warner
B017	Sara	Joseph
B009	Mike	Brunton

# Solution - Foreign Key Drill



In this table, adding the foreign key in Deptcode to the Teacher name, creates a relationship between the two tables.

This concept is also known as **Referential Integrity**.

Teacher ID	DeptCode	Fname	Lname
B002	002	David	Warner
B017	002	Sara	Joseph
B009	001	Mike	Brunton

Thanks!!