Basic Relational Data Model
Keys & Constraints

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Objectives

- Terminology
- Characteristics of Relations
- Relational Data Model Notations
- Key constraints
- Others Constraints

Terminology

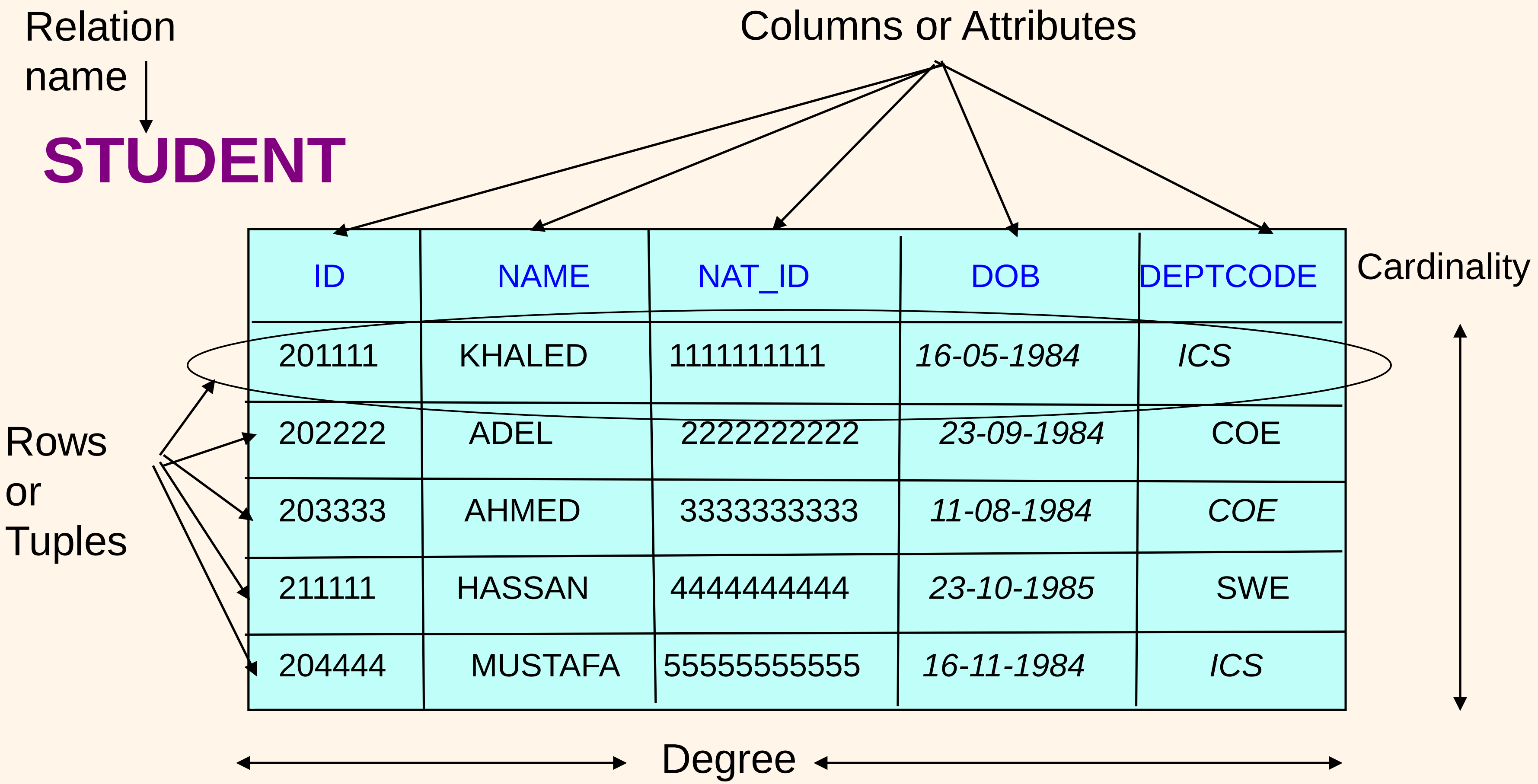
- A relation is a table with columns and rows.
- Attribute is a named column of a relation.
- Domain is a set of allowable values for one or more attributes.
- Tuple is a row of a relation.
- Degree is a number of attributes in a relation.
- Cardinality is a number of tuples in a relation.
- Relationship is a link or dependency between relations.
- Relational Database is a collection of relations.

Terminology

A relation is a table with columns and rows.

A table can be written as

STUDENT(ID, Name, Nat_ID, DOB, DeptCode)



Relation name

Columns or Attributes

STUDENT

ID	NAME	NAT_ID	DOB	DEPTCODE
201111	KHALED	1111111111	*16-05-1984*	*ICS*
202222	ADEL	2222222222	*23-09-1984*	COE
203333	AHMED	3333333333	*11-08-1984*	*COE*
211111	HASSAN	4444444444	*23-10-1985*	SWE
204444	MUSTAFA	55555555555	*16-11-1984*	*ICS*

Cardinality

Rows or Tuples

Degree

Characteristics of Relations

- Each relation in the same relational database schema has a distinct name
- Each value in a tuple is atomic
- Each attribute in a relation has a distinct name.
- Values of an attribute are all from the same domain.
- Each tuple is distinct.
- Order of attributes has no significance.
- Order of tuples has no significance, theoretically.

Relational Data Model Notations

The letters Q, R, S denote the abstract relation names.

R(A_1, A_2, A_3, …., A_n) denotes a relation schema R of degree n.

Example: STUDENT(RollNo, Name, Phone, Address, Mobile, DOB)
COURSE(<u>CourseID</u>, Title, CreditHours)

Both t[A_i] and t.A_i refers to the value v_i in t for attribute A_i

Example: in second tuple, both t[name] and t.name refers to "Adel"

Dom(DEPTCODE) = {'COE','ICS','SWE'}

Relation's Definition

Relation: A *relation* is a subset of Cartesian product of all domains
R(r) $\subseteq$ Dom(A1) x dom(A2) x …… x Dom(An)
Where A1, A2, …., An represent attributes of a relation r.
Evaluation:
Given
A1 = {1, 2}, A2 = {a}, A3 = {x, y}
Then relation
X = {(1, a, y), (2, a, x), (2, a, y)}; 3 tuples of a relation
is a subset of
Y = Dom(A1) x dom(A2) x Dom(A3)
= {(1, a, x), (1, a, y), (2, a, x), (2, a, y)}
Note: Degree of a relation is the number of attributes, in above case degree of relation is 3.
Alternate Definition of Relation
For each tuple ti is a mapping from R to D
Where D = Dom(A1) $\cup$ Dom(A2)$\cup$ … $\cup$ Dom(An)
And t[Ai] $\in$ Dom(Ai)
Then a tuple can be considered as attribute and value.
For example: The following representation shows a tuple definition
t = <(id, 21587), (Name, Muhammad,), (Hphone, Null), (Wphone, 866-1141)>

Data Models

- Object-Based Data Models
  - Entity-Relationship
  - Semantic
  - Functional
  - Object-Oriented
- Record-Based Data Models
  - Relational Data Model
  - Network Data Model
  - Hierarchical Data Model
- Physical Data-Models

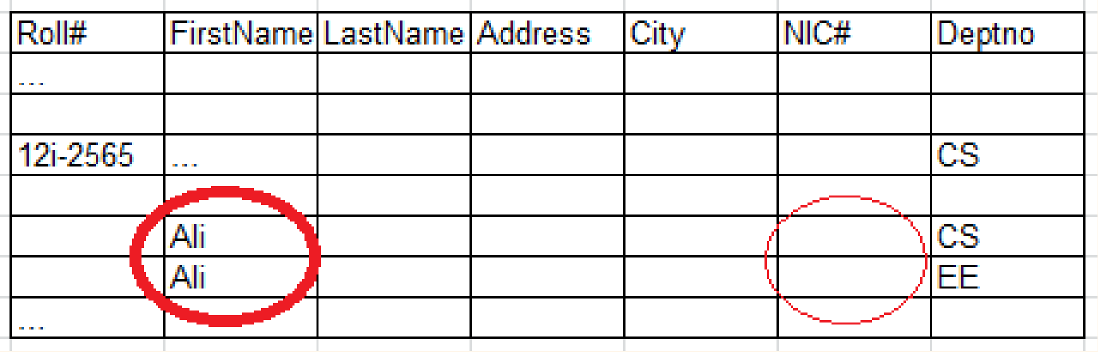
Keys

A **key** is a combination of one or more columns that is used to identify rows in a relation

A **composite key** is a key that consists of two or more columns

Super Key

A super key is a combination of columns that uniquely identifies any row within a relational database management system (RDBMS) table.



Roll#	FirstName	LastName	Address	City	NIC#	Deptno
...						
12i-2565	...					CS
	Ali					CS
	Ali					EE
...						

{Roll#}, {Roll#, NIC#}, {NIC#}
{Roll#, FirstName, LastName, Address, City, NIC#, Deptno}

Example-1

Roll Number	First Name	Last Name
CSU0001	Shabbir	Bhimani
CSU0002	Jain	Rao
CSU0003	Nitin	Uday

Now we have the following as super keys

Roll Number	**First Name**	
Roll Number	**First Name**	**Last Name**

Example-2

Following table consists of four columns EmployeeID, Name, Job, DeptID

- Examples of superkeys in this table would be {employeeID, Name}, {employeeID, Name, job}, and {employeeID, Name, job, departmentID}

In a real database we don't need values for all of those columns to identify a row

We only need, per our example, the set {EmployeeID}.

- This is a minimal superkey
- So, employeeID is a candidate key.
- EmployeeID can also uniquely identify the tuples.

FirstName and FatherName (for NADRA)

Candidate Keys

A **candidate key** is a key that determines all of the other columns in a relation

Candidate key columns help in searching fewer duplicated or unique records.

Examples

In PRODUCT relation

Prod# is a candidate key

Prod_Name is also a candidate key

In ORDER_PROD

(OrderNumber, Prod#) is a candidate key

If BirthDate (or DrivingLicense#) is known then Name, address, telno etc. can be found from fewer searched records.

Identifying Candidate Keys

For Bank: AccountHolder (or Customer)
ACC#, Fname, Lname, DOB, CNIC#, Addr, City, TelNo, Mobile#, DriveLic#

For PTCL: Customer (single telno holders)
Consumer#, Fname, Lname, DOB, CNIC#, Addr, City, TelNo, Mobile#

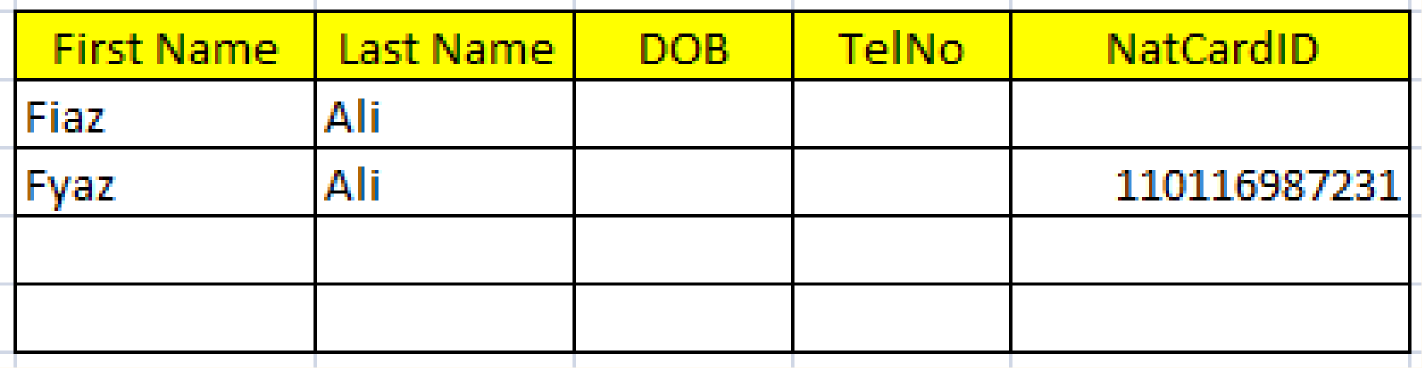
For NADRA: Citizen (CNIC#, Fname, Lname, FatherName, DOB, OldCNIC#, PAddr, PCity, TAddr, TCity, TelNo, Mobile#)

TelNo, Mobile#:
Old value, Null,
fewer duplications,
changeable

Identifying right record using Candidate Key – an Example

Let’s analyze the following set of columns

{FirstName, LastName, DOB, TelNo, NatCardID}



First Name	Last Name	DOB	TelNo	NatCardID
Fiaz	Ali			
Fyaz	Ali			110116987231

Candidate Keys cont….

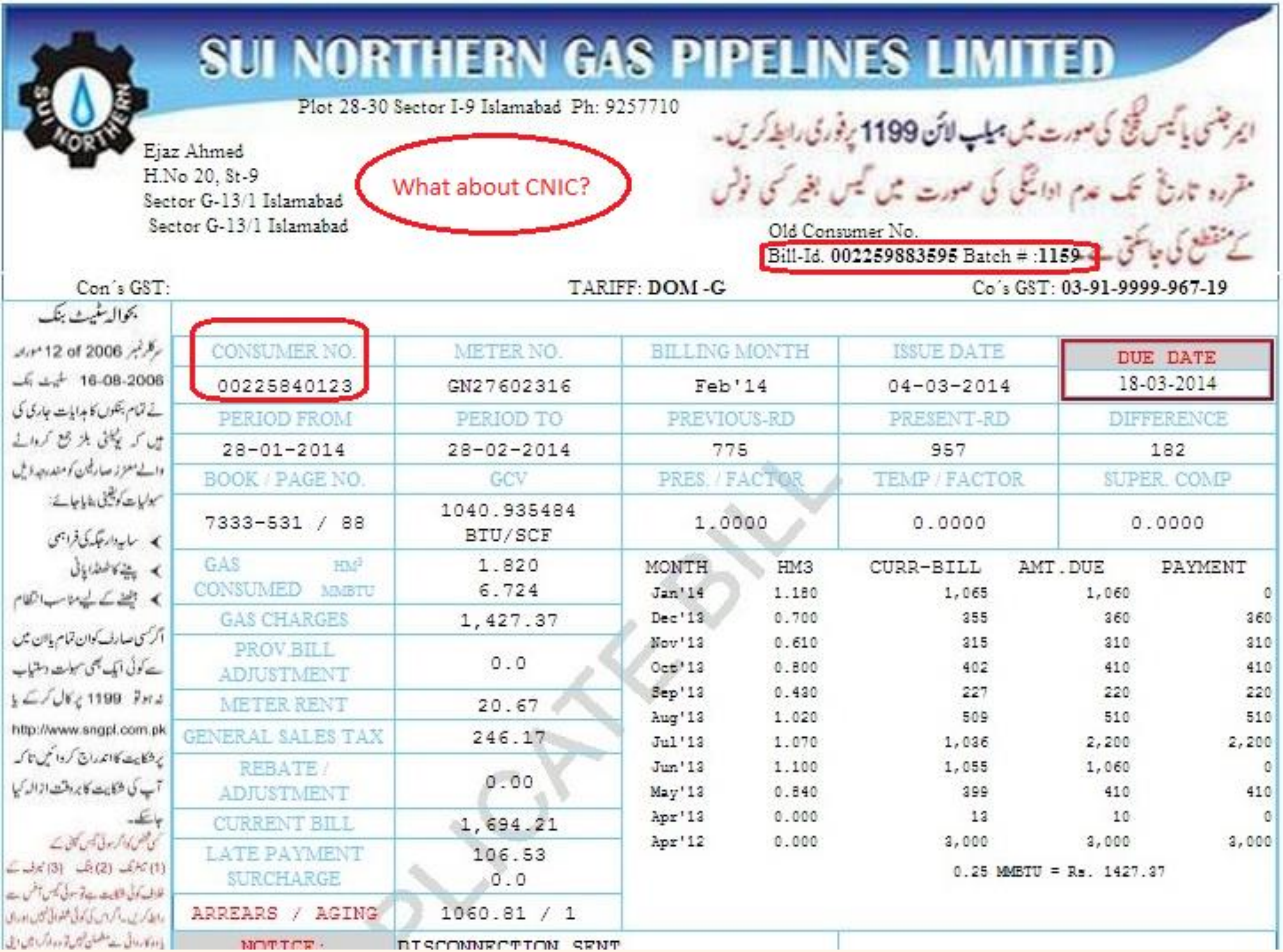
Example-1: Branch (branch-name, assets, branch-city)
Candidate Key: {branch-name}

Example-2: Customer (cname, natid, address, city, telno)
cname, address, city can be duplicated individually and cannot determine a record.

The following combinations distinguish customer records or tuples.
{cname, telno}
{natid}
{natid, cname}
As {natid} $\subseteq$ {natid, cname}, then {natid, cname} is not candidate key and {natid} is a candidate key

Example-3: Employee(empno, name, birth_date, address, city, telno, citizenship_id)
empno, telno, citizenship_id are possible candidate keys ???

Exercise:
Course (cid, cname, deptno)
Semester (sid, syear, startdate)
ClassAllocation (sid, cid, sec#, building#, room#)
Identify candidate keys in each of the above relations



SUI NORTHERN GAS PIPELINES LIMITED

Plot 28-30 Sector I-9 Islamabad Ph: 9257710

Ejaz Ahmed
H.No 20, St-9
Sector G-13/1 Islamabad
Sector G-13/1 Islamabad

What about CNIC?

ایمرجنسی یا گیس لیکج کی صورت میں ہیلپ لائن 1199 پر فوری رابطہ کریں۔
مقررہ تاریخ تک عدم ادائیگی کی صورت میں گیس بغیر کسی نوٹس
کے منقطع کی جا سکتی ہے۔

Old Consumer No.
Bill-Id. 002259883595 Batch # :1159

Con´s GST: TARIFF: DOM -G Co´s GST: 03-91-9999-967-19

بحوالہ سٹیٹ بینک
سرکلر نمبر 12 of 2006 مورخہ 16-08-2006 سٹیٹ بینک نے تمام بینکوں کو ہدایات جاری کی ہیں کہ یوٹیلٹی بلز جمع کروانے والے معزز صارفین کو مندرجہ ذیل سہولیات کو یقینی بنایا جائے:

- سایہ دار جگہ کی فراہمی
- پینے کا ٹھنڈا پانی
- بیٹھنے کے لیے مناسب انتظام

اگر کسی صارف کو ان تمام میں سے کوئی ایک بھی سہولت دستیاب نہ ہو تو 1199 پر کال کر کے یا http://www.sngpl.com.pk پر شکایت کا اندراج کروائیں تاکہ آپ کی شکایت کا بروقت ازالہ کیا جا سکے۔

کسی شخص کو اگر سوئی گیس کنکشن کے (1) کنکشن (2) بلنگ (3) میٹر کے خلاف کوئی شکایت ہے تو سوئی گیس آفس سے رابطہ کریں۔ اگر ان کی کوئی شنوائی نہیں ہوتی اور [illegible]

CONSUMER NO.	METER NO.	BILLING MONTH	ISSUE DATE	DUE DATE
00225840123	GN27602316	Feb'14	04-03-2014	18-03-2014
PERIOD FROM	PERIOD TO	PREVIOUS-RD	PRESENT-RD	DIFFERENCE
28-01-2014	28-02-2014	775	957	182
BOOK / PAGE NO.	GCV	PRES. / FACTOR	TEMP / FACTOR	SUPER. COMP
7333-531 / 88	1040.935484 BTU/SCF	1.0000	0.0000	0.0000

GAS CONSUMED HM³ MMBTU	1.820 6.724
GAS CHARGES	1,427.37
PROV.BILL ADJUSTMENT	0.0
METER RENT	20.67
GENERAL SALES TAX	246.17
REBATE / ADJUSTMENT	0.00
CURRENT BILL	1,694.21
LATE PAYMENT SURCHARGE	106.53 0.0
ARREARS / AGING	1060.81 / 1
NOTICE :	DISCONNECTION SENT

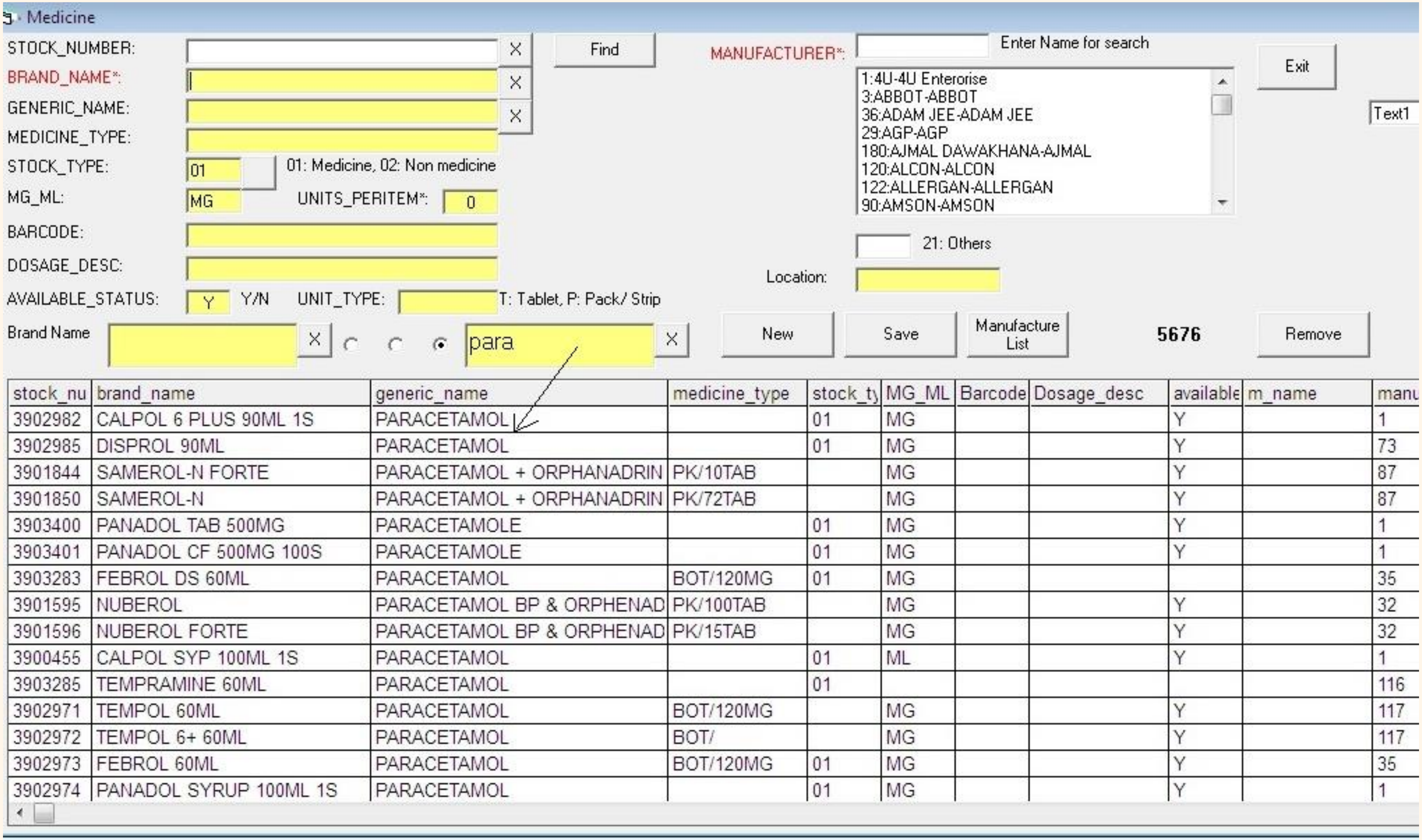
MONTH	HM3	CURR-BILL	AMT.DUE	PAYMENT
Jan'14	1.180	1,065	1,060	0
Dec'13	0.700	355	360	360
Nov'13	0.610	315	310	310
Oct'13	0.800	402	410	410
Sep'13	0.430	227	220	220
Aug'13	1.020	509	510	510
Jul'13	1.070	1,036	2,200	2,200
Jun'13	1.100	1,055	1,060	0
May'13	0.840	399	410	410
Apr'13	0.000	13	10	0
Apr'12	0.000	3,000	3,000	3,000

0.25 MMBTU = Rs. 1427.37

DUPLICATE BILL

Question: With one CNIC, there may be many consumer nos (houses/ shops) , explain?

Candidate Key during search



STOCK_NUMBER:

BRAND_NAME*:

GENERIC_NAME:

MEDICINE_TYPE:

STOCK_TYPE: 01 — 01: Medicine, 02: Non medicine

MG_ML: MG — UNITS_PERITEM*: 0

BARCODE:

DOSAGE_DESC:

AVAILABLE_STATUS: Y Y/N — UNIT_TYPE: T: Tablet, P: Pack/ Strip

Brand Name ○ ○ ● para

MANUFACTURER*: Enter Name for search

1:4U-4U Enterorise
3:ABBOT-ABBOT
36:ADAM JEE-ADAM JEE
29:AGP-AGP
180:AJMAL DAWAKHANA-AJMAL
120:ALCON-ALCON
122:ALLERGAN-ALLERGAN
90:AMSON-AMSON

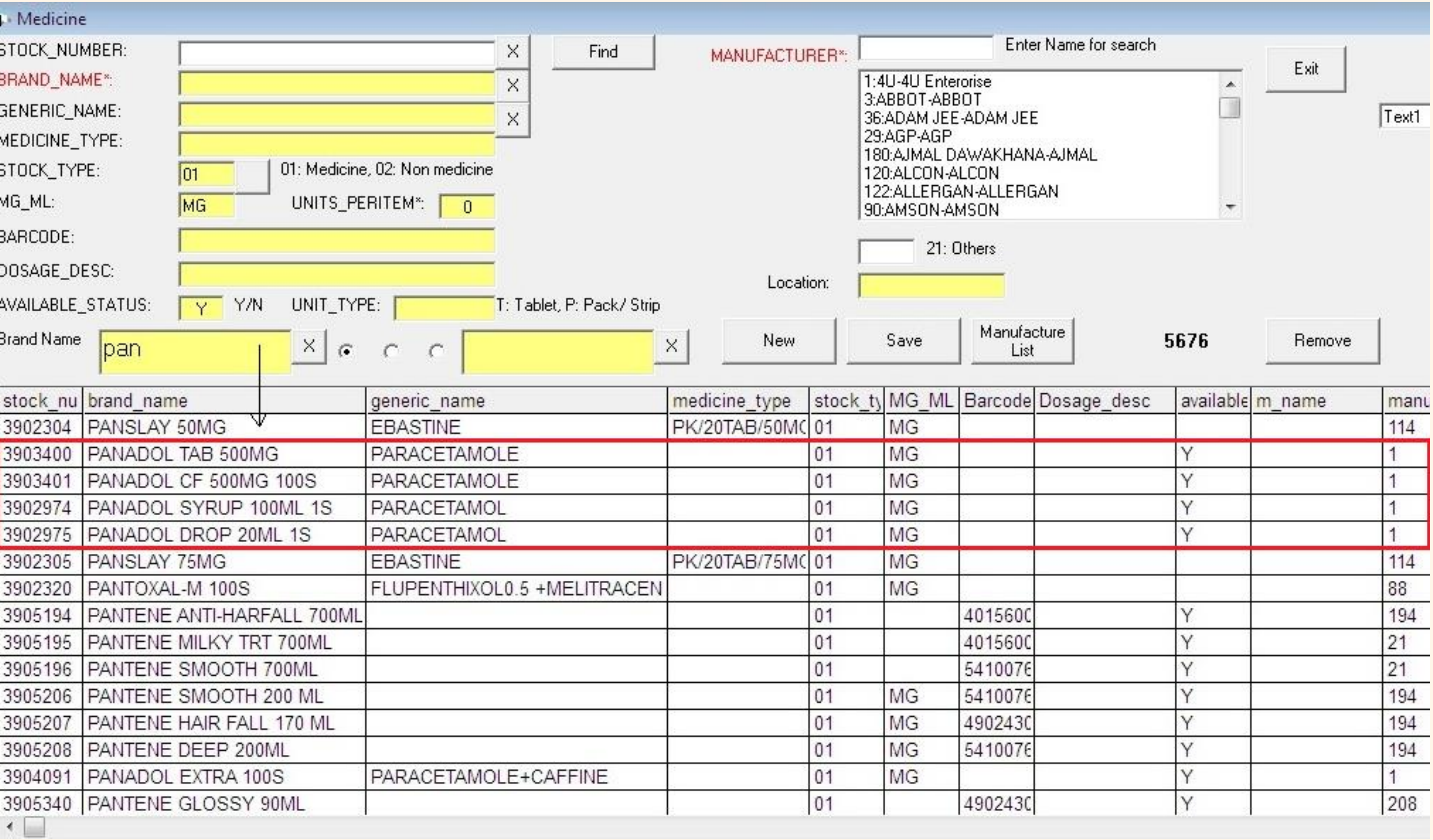
21: Others

Location:

5676

stock_nu	brand_name	generic_name	medicine_type	stock_ty	MG_ML	Barcode	Dosage_desc	available	m_name	manu
3902982	CALPOL 6 PLUS 90ML 1S	PARACETAMOL		01	MG			Y		1
3902985	DISPROL 90ML	PARACETAMOL		01	MG			Y		73
3901844	SAMEROL-N FORTE	PARACETAMOL + ORPHANADRIN	PK/10TAB		MG			Y		87
3901850	SAMEROL-N	PARACETAMOL + ORPHANADRIN	PK/72TAB		MG			Y		87
3903400	PANADOL TAB 500MG	PARACETAMOLE		01	MG			Y		1
3903401	PANADOL CF 500MG 100S	PARACETAMOLE		01	MG			Y		1
3903283	FEBROL DS 60ML	PARACETAMOL	BOT/120MG	01	MG					35
3901595	NUBEROL	PARACETAMOL BP & ORPHENAD	PK/100TAB		MG			Y		32
3901596	NUBEROL FORTE	PARACETAMOL BP & ORPHENAD	PK/15TAB		MG			Y		32
3900455	CALPOL SYP 100ML 1S	PARACETAMOL		01	ML			Y		1
3903285	TEMPRAMINE 60ML	PARACETAMOL		01						116
3902971	TEMPOL 60ML	PARACETAMOL	BOT/120MG		MG			Y		117
3902972	TEMPOL 6+ 60ML	PARACETAMOL	BOT/		MG			Y		117
3902973	FEBROL 60ML	PARACETAMOL	BOT/120MG	01	MG			Y		35
3902974	PANADOL SYRUP 100ML 1S	PARACETAMOL		01	MG			Y		1

Candidate Key during search …



STOCK_NUMBER:

BRAND_NAME*:

GENERIC_NAME:

MEDICINE_TYPE:

STOCK_TYPE: 01 01: Medicine, 02: Non medicine

MG_ML: MG UNITS_PERITEM*: 0

BARCODE:

DOSAGE_DESC:

AVAILABLE_STATUS: Y Y/N UNIT_TYPE: T: Tablet, P: Pack/ Strip

MANUFACTURER*: Enter Name for search

1:4U-4U Enterorise
3:ABBOT-ABBOT
36:ADAM JEE-ADAM JEE
29:AGP-AGP
180:AJMAL DAWAKHANA-AJMAL
120:ALCON-ALCON
122:ALLERGAN-ALLERGAN
90:AMSON-AMSON

21: Others

Location:

Brand Name pan ● ○ ○

5676

stock_nu	brand_name	generic_name	medicine_type	stock_ty	MG_ML	Barcode	Dosage_desc	available	m_name	manu
3902304	PANSLAY 50MG	EBASTINE	PK/20TAB/50M(	01	MG					114
3903400	PANADOL TAB 500MG	PARACETAMOLE		01	MG			Y		1
3903401	PANADOL CF 500MG 100S	PARACETAMOLE		01	MG			Y		1
3902974	PANADOL SYRUP 100ML 1S	PARACETAMOL		01	MG			Y		1
3902975	PANADOL DROP 20ML 1S	PARACETAMOL		01	MG			Y		1
3902305	PANSLAY 75MG	EBASTINE	PK/20TAB/75M(	01	MG					114
3902320	PANTOXAL-M 100S	FLUPENTHIXOL0.5 +MELITRACEN		01	MG					88
3905194	PANTENE ANTI-HARFALL 700ML			01		4015600		Y		194
3905195	PANTENE MILKY TRT 700ML			01		4015600		Y		21
3905196	PANTENE SMOOTH 700ML			01		541007€		Y		21
3905206	PANTENE SMOOTH 200 ML			01	MG	541007€		Y		194
3905207	PANTENE HAIR FALL 170 ML			01	MG	490243(		Y		194
3905208	PANTENE DEEP 200ML			01	MG	541007€		Y		194
3904091	PANADOL EXTRA 100S	PARACETAMOLE+CAFFINE		01	MG			Y		1
3905340	PANTENE GLOSSY 90ML			01		490243(		Y		208

Dependents

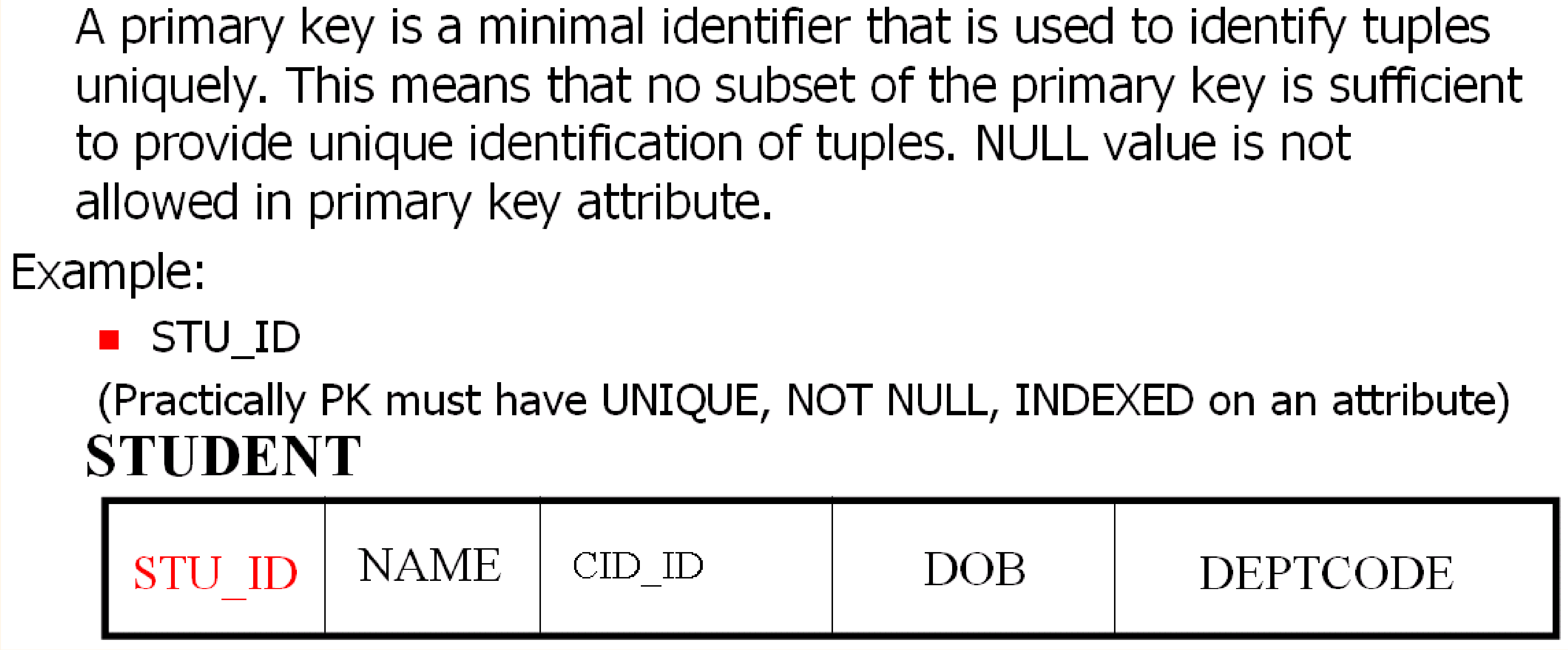
For example: **Dependent** means family members (wife, son, daughter etc.), who depends on father. Father is an employee in some organization

Primary Keys

A **primary key** is a candidate key selected as the primary means of identifying rows in a relation:

- There is one and only one primary key per relation
- The primary key is NOT NULL, UNIQUE
- The ideal primary key is short, numeric(alpha), indexed, fixed length and never changes
- The primary key may be a composite key

Primary Keys cont….



A primary key is a minimal identifier that is used to identify tuples uniquely. This means that no subset of the primary key is sufficient to provide unique identification of tuples. NULL value is not allowed in primary key attribute.

Example:

- STU_ID

(Practically PK must have UNIQUE, NOT NULL, INDEXED on an attribute)

STUDENT

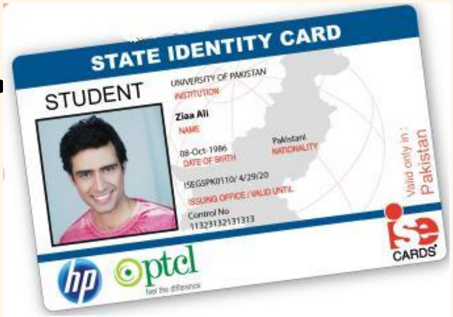
STU_ID	NAME	CID_ID	DOB	DEPTCODE

Although, candidate keys are STU_ID, CIT_ID. Organization ITSELF issues its own identifier PK. PK is a property of an organization. Driving license# is a property of Ministry of Motors/ transportation, it must not be used PK in university or other organizations. It is a candidate key for other organization for search purposes.

Note: It is not recommended to create PKs for columns like Quantity, Salary, Price and column that has datatype DATE

Primary Keys cont…

Example-1:
STUDENT(StuID, FirstName, FamilyName, DOB, …)



STATE IDENTITY CARD

STUDENT

UNIVERSITY OF PAKISTAN
INSTITUTION

Ziaa Ali
NAME

08-Oct-1986
DATE OF BIRTH

Pakistani
NATIONALITY

ISEGSPK0110/ 4/29/20
ISSUING OFFICE / VALID UNTIL

Control No
11323132131313

Valid only in : Pakistan

Example-2: Building (B#, BName, Location, Region),
B# is a primary key. Although, BName is unique, not null but it is not short.

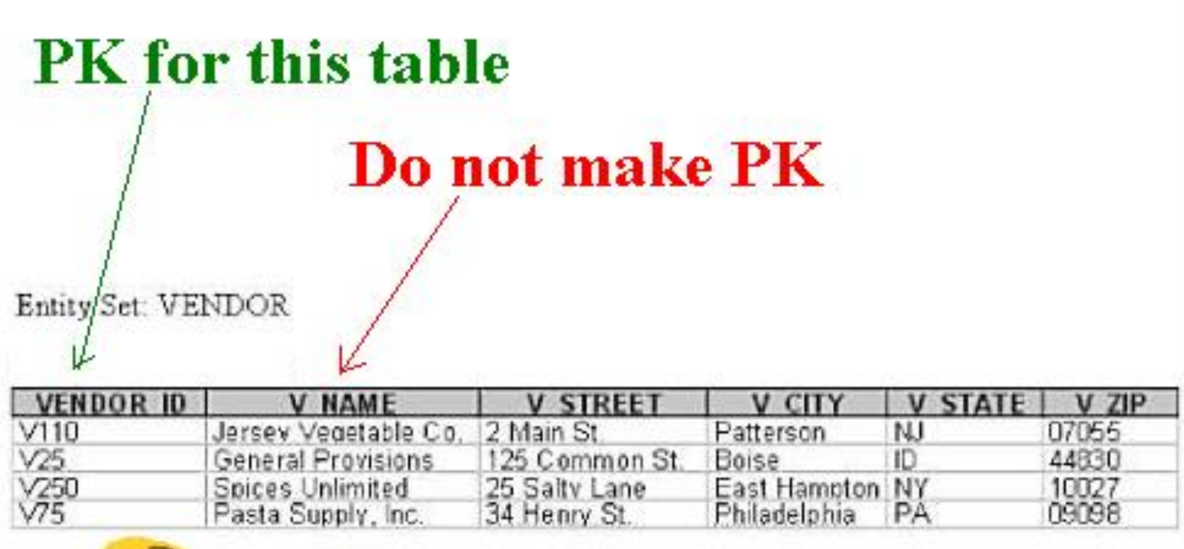
Example-3: Customer (cname, citizenid, address, city, telno)
This relation indicates the information about personal details. There is a chance that cname is duplicated, some may have citizenid and telno as null. This forces us to introduce new a attribute such as cust# that would be a primary key.

Customer (cust#, cname, citizenid, address, city, telno)

Example-4:
BankBranch(Branch-Name, City, TotalAsset)

What will be a PK that you will suggest?
What is a candidate key?
Which attribute is unique
There may be many branches in one city then finalize this relation with possible constraints

Primary Keys cont…

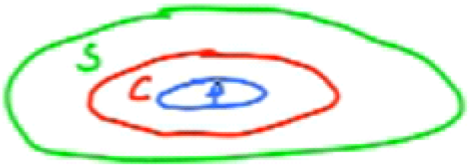


PK for this table

Do not make PK

Entity Set: VENDOR

VENDOR ID	V NAME	V STREET	V CITY	V STATE	V ZIP
V110	Jersey Vegetable Co.	2 Main St	Patterson	NJ	07055
V25	General Provisions	125 Common St.	Boise	ID	44830
V250	Spices Unlimited	25 Salty Lane	East Hampton	NY	10027
V75	Pasta Supply, Inc.	34 Henry St.	Philadelphia	PA	09098

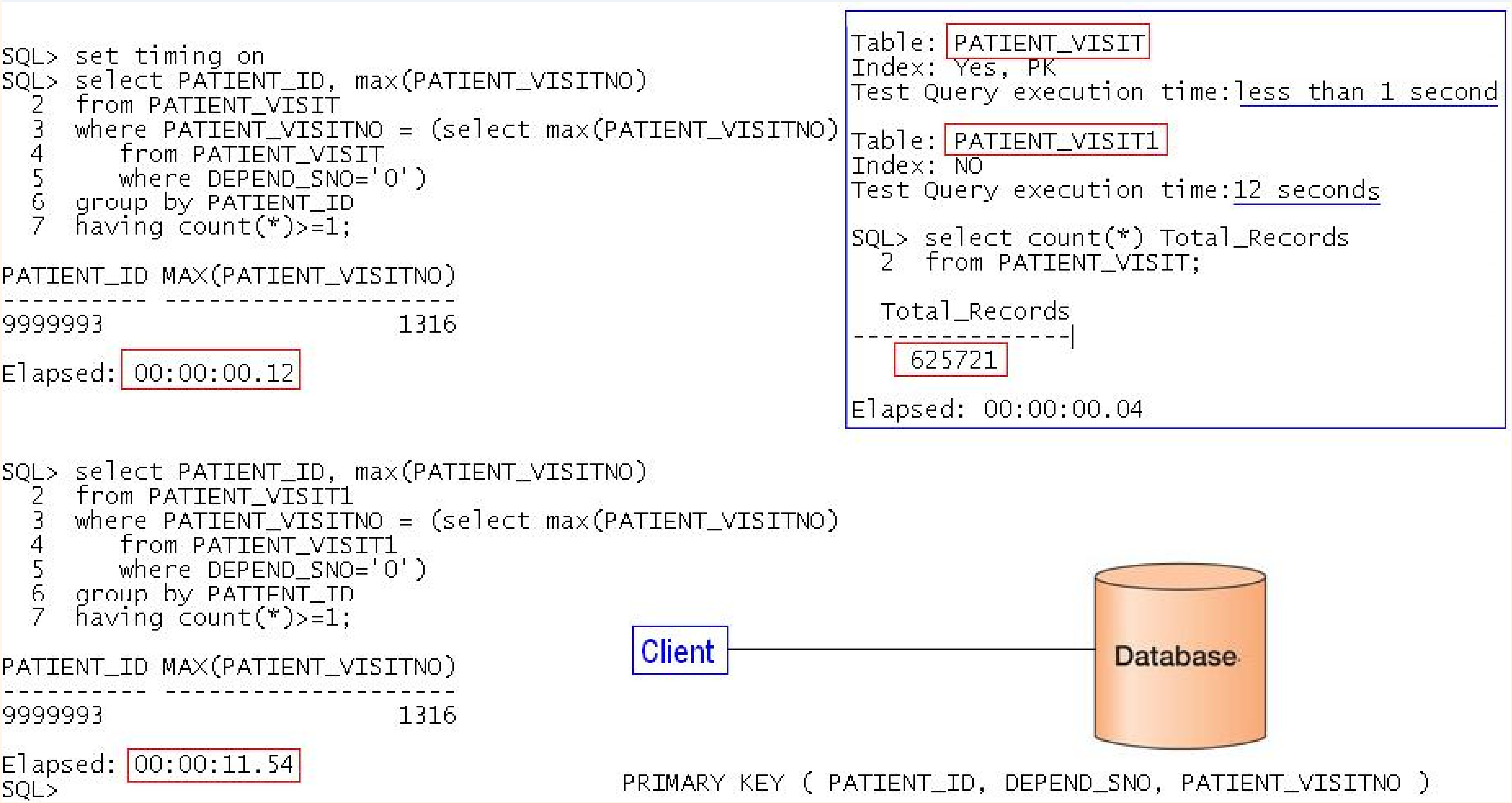


Primar Key is a Candidate Key
Candidate is a Super Key

Primary Key Instances - Samples

512235665 610112654	Social Security Number (By Birth Asian, Europian, HomeLand)
2003389	Student ID (With Registration year)
DMM051 JUB004	Product ID (with Manufacturing Loc, branches)
312668852369	Bank Account# (followed by Branch Code)
100211 300411	SKU# (By Category) or a barcode
Serial#	Serial# starts with 1 and incremented by 1
005384 007004	Company has many branches with code 005, 007 etc., invoices issued from branches are recognized with branch codes

Use of PK or Indexing



```
SQL> set timing on
SQL> select PATIENT_ID, max(PATIENT_VISITNO)
  2  from PATIENT_VISIT
  3  where PATIENT_VISITNO = (select max(PATIENT_VISITNO)
  4     from PATIENT_VISIT
  5     where DEPEND_SNO='0')
  6  group by PATIENT_ID
  7  having count(*)>=1;

PATIENT_ID MAX(PATIENT_VISITNO)
---------- --------------------
9999993                    1316

Elapsed: 00:00:00.12
```

```
Table: PATIENT_VISIT
Index: Yes, PK
Test Query execution time:less than 1 second

Table: PATIENT_VISIT1
Index: NO
Test Query execution time:12 seconds

SQL> select count(*) Total_Records
  2  from PATIENT_VISIT;

  Total_Records
---------------
    625721

Elapsed: 00:00:00.04
```

```
SQL> select PATIENT_ID, max(PATIENT_VISITNO)
  2  from PATIENT_VISIT1
  3  where PATIENT_VISITNO = (select max(PATIENT_VISITNO)
  4     from PATIENT_VISIT1
  5     where DEPEND_SNO='0')
  6  group by PATIENT_ID
  7  having count(*)>=1;

PATIENT_ID MAX(PATIENT_VISITNO)
---------- --------------------
9999993                    1316

Elapsed: 00:00:11.54
SQL>
```

```
PRIMARY KEY ( PATIENT_ID, DEPEND_SNO, PATIENT_VISITNO )
```

Surrogate Keys

A **surrogate key** as an artificial column added to a relation to serve as a primary key:

- DBMS supplied
- Short, numeric and never changes – an ideal primary key!
- Has artificial values that are meaningless to users
- Normally hidden in forms and reports

Surrogate Keys cont….

RENTAL_PROPERTY without surrogate key:

RENTAL_PROPERTY (Street, City, State/Province, Zip/PostalCode, Country, Rental_Rate)

RENTAL_PROPERTY with surrogate key:

RENTAL_PROPERTY (PropertyID, Street, City,State/Province, Zip/PostalCode, Country, Rental_Rate)

Other examples include Invoice#, ComplaintRef#
ATMTransaction (Card#, Serial#, Amount, DrawDate)

Surrogate Keys cont….

Other examples include

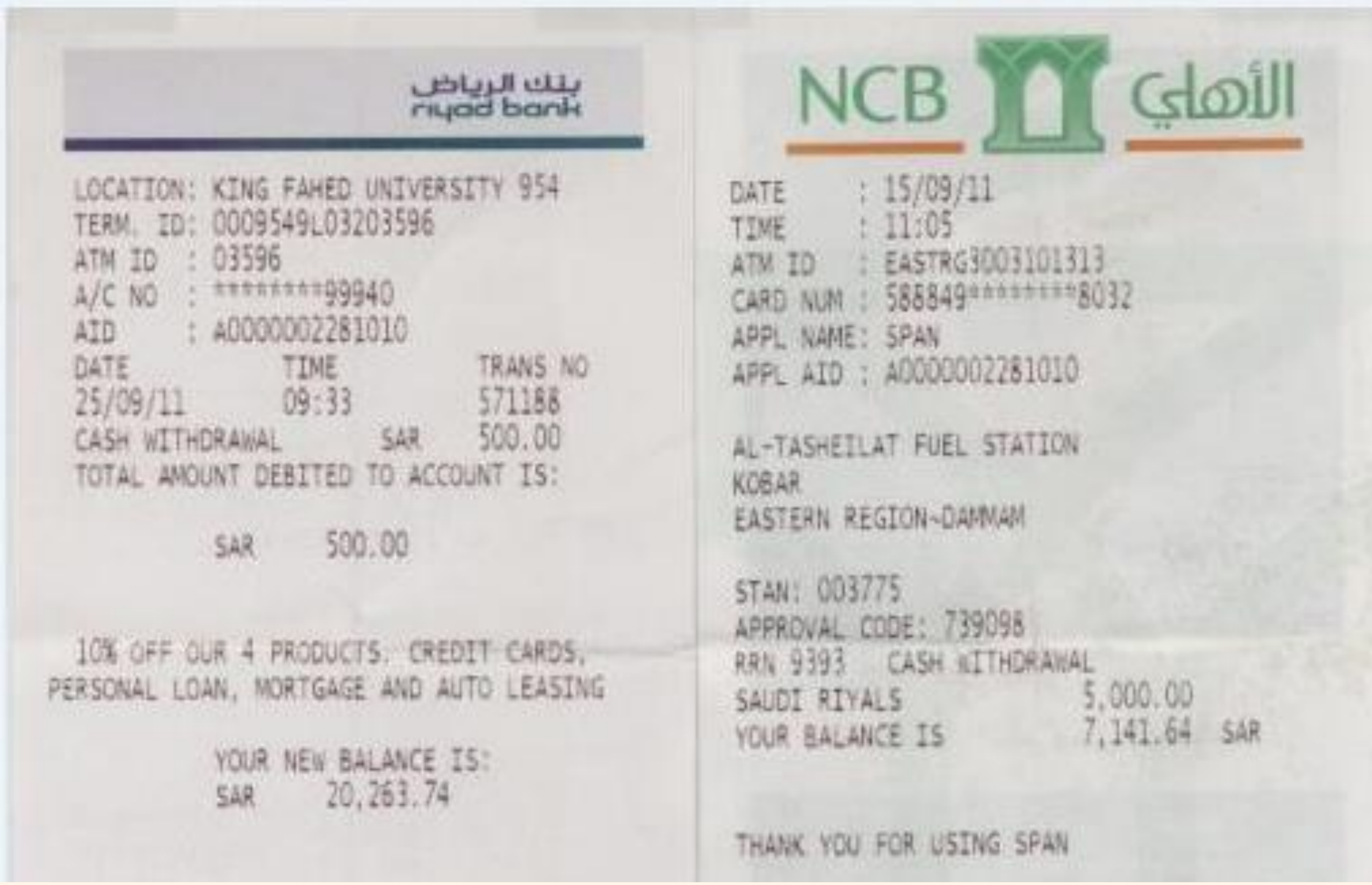
Invoice#

ComplaintRef#

ATMTransaction (Card#, Serial#, Amount, TransDate, TransType)

InsurancePaid(Policy#, PaidYear, PaidDate, VehicleReg#, Amount)

ATM Transaction Sample



بنك الرياض
riyad bank

```
LOCATION: KING FAHED UNIVERSITY 954
TERM. ID: 0009549L03203596
ATM ID   : 03596
A/C NO   : ********99940
AID      : A0000002281010
DATE            TIME            TRANS NO
25/09/11        09:33           571188
CASH WITHDRAWAL          SAR    500.00
TOTAL AMOUNT DEBITED TO ACCOUNT IS:

          SAR      500.00


 10% OFF OUR 4 PRODUCTS. CREDIT CARDS,
PERSONAL LOAN, MORTGAGE AND AUTO LEASING

          YOUR NEW BALANCE IS:
          SAR      20,263.74
```

NCB الأهلي

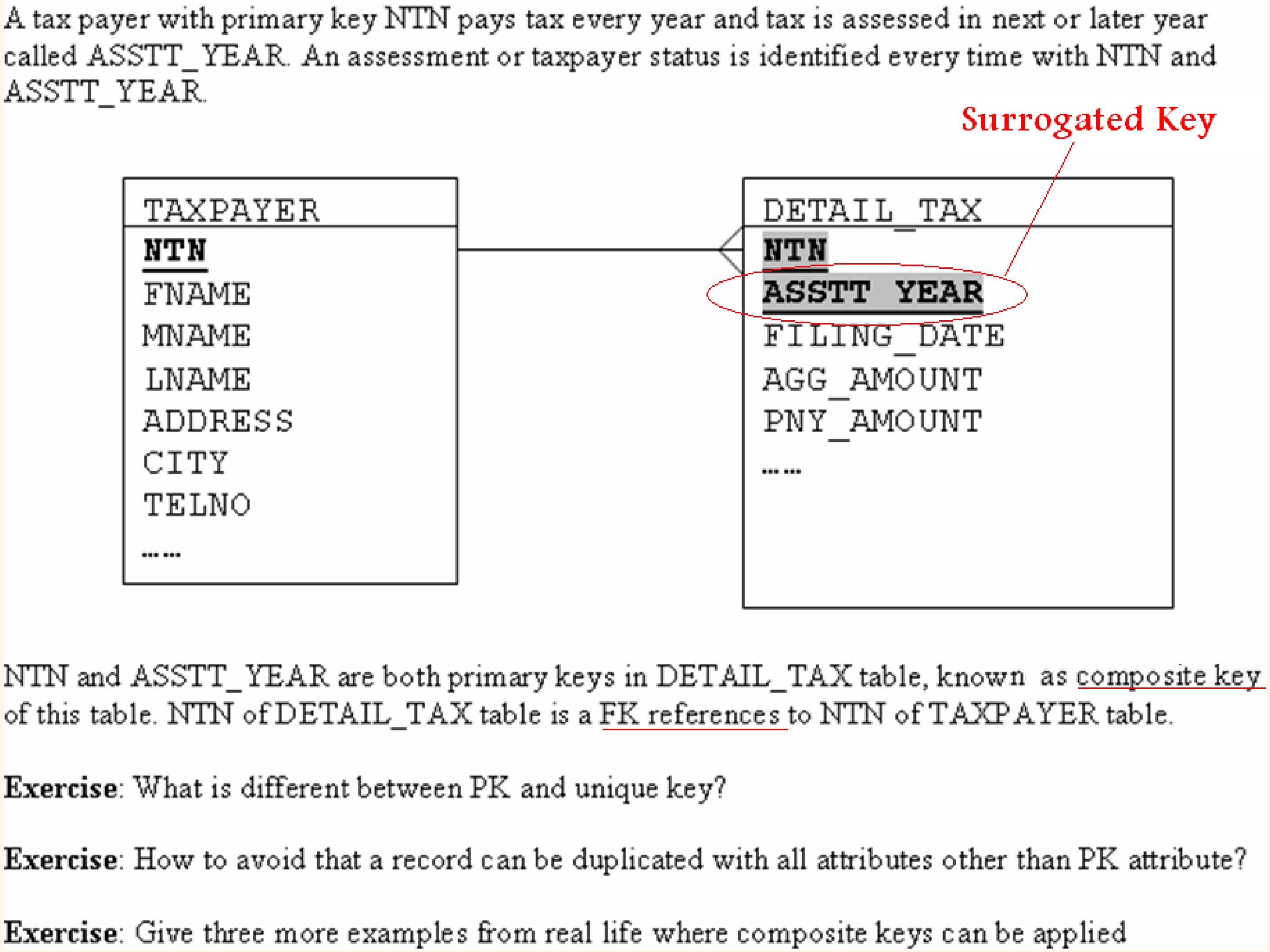
```
DATE      : 15/09/11
TIME      : 11:05
ATM ID    : EASTRG3003101313
CARD NUM  : 588849********8032
APPL NAME: SPAN
APPL AID : A0000002281010

AL-TASHEILAT FUEL STATION
KOBAR
EASTERN REGION-DAMMAM

STAN: 003775
APPROVAL CODE: 739098
RRN 9393   CASH WITHDRAWAL
SAUDI RIYALS                5,000.00
YOUR BALANCE IS             7,141.64   SAR


THANK YOU FOR USING SPAN
```

Surrogate Keys cont….



A tax payer with primary key NTN pays tax every year and tax is assessed in next or later year called ASSTT_YEAR. An assessment or taxpayer status is identified every time with NTN and ASSTT_YEAR.

Surrogated Key

TAXPAYER
NTN
FNAME
MNAME
LNAME
ADDRESS
CITY
TELNO
……

DETAIL_TAX
NTN
ASSTT_YEAR
FILING_DATE
AGG_AMOUNT
PNY_AMOUNT
……

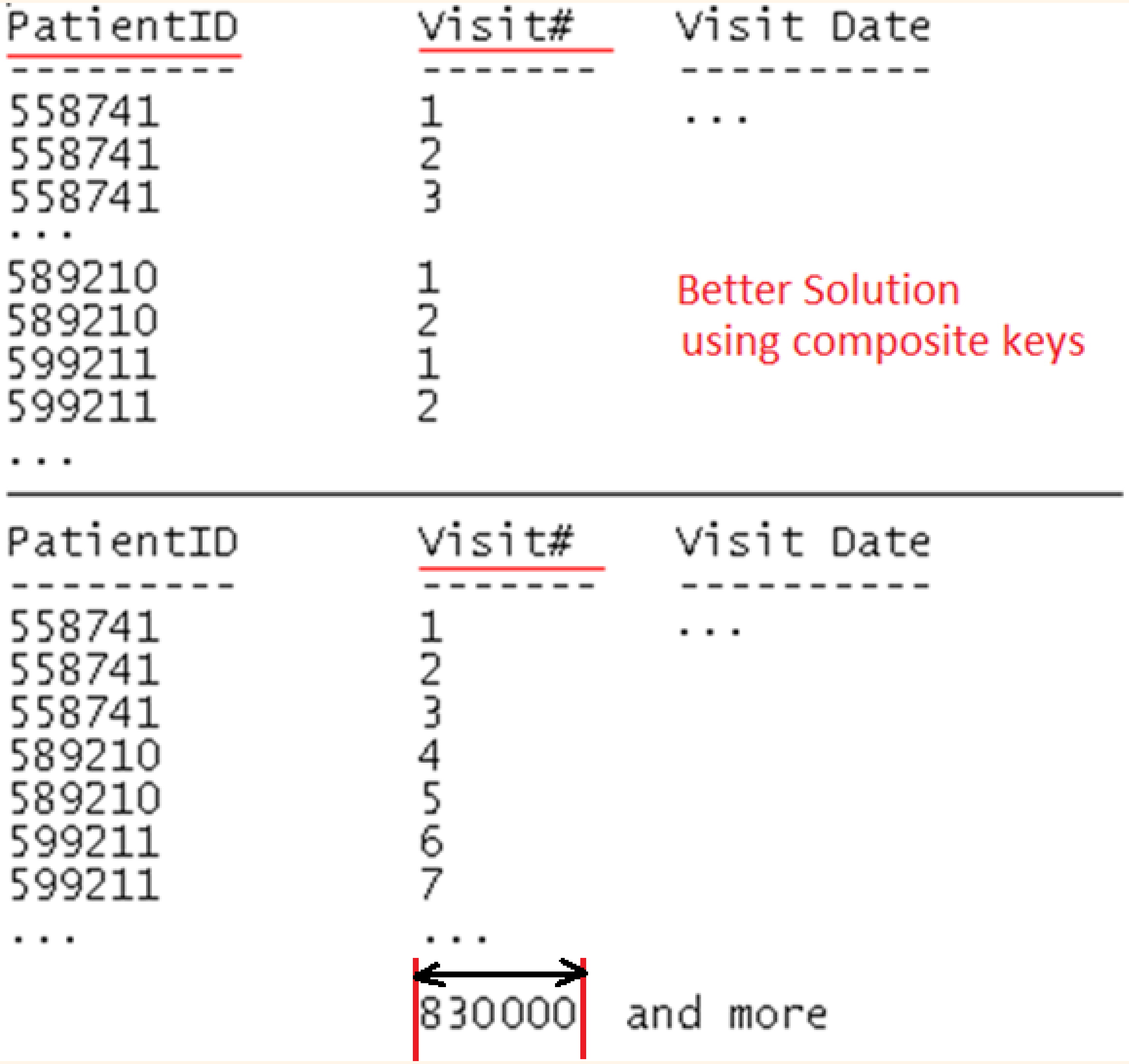
NTN and ASSTT_YEAR are both primary keys in DETAIL_TAX table, known as composite key of this table. NTN of DETAIL_TAX table is a FK references to NTN of TAXPAYER table.

Exercise: What is different between PK and unique key?

Exercise: How to avoid that a record can be duplicated with all attributes other than PK attribute?

Exercise: Give three more examples from real life where composite keys can be applied

Surrogate Keys cont….

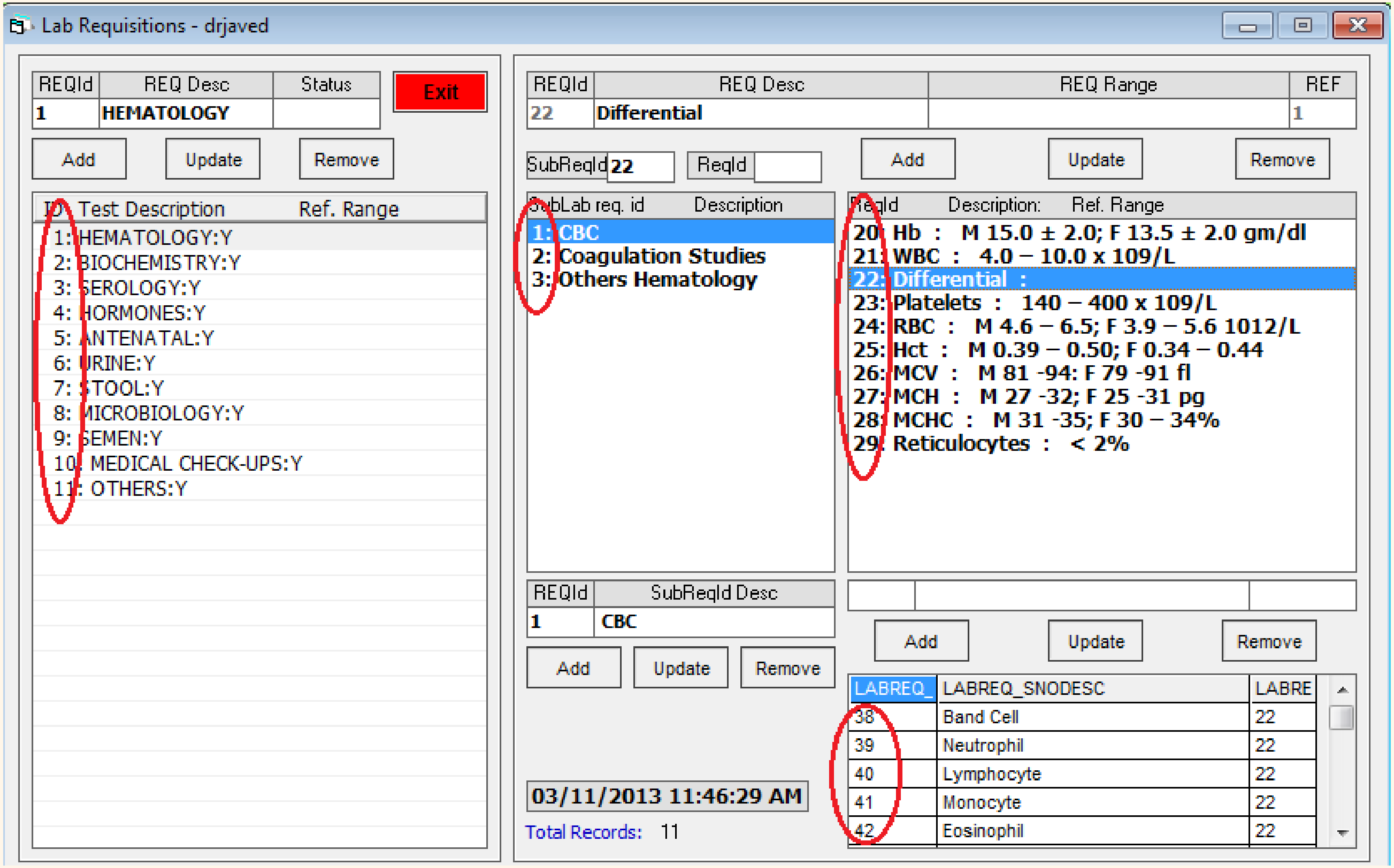


```
PatientID          Visit#      Visit Date
----------         -------     ----------
558741             1           ...
558741             2
558741             3
...
589210             1
589210             2
599211             1
599211             2
...
```

Better Solution
using composite keys

```
PatientID          Visit#      Visit Date
----------         -------     ----------
558741             1           ...
558741             2
558741             3
589210             4
589210             5
599211             6
599211             7
...                ...
                   830000   and more
```

Example – End User View



Lab Requisitions - drjaved

REQId	REQ Desc	Status
1	HEMATOLOGY	

```
ID: Test Description        Ref. Range
1: HEMATOLOGY:Y
2: BIOCHEMISTRY:Y
3: SEROLOGY:Y
4: HORMONES:Y
5: ANTENATAL:Y
6: URINE:Y
7: STOOL:Y
8: MICROBIOLOGY:Y
9: SEMEN:Y
10: MEDICAL CHECK-UPS:Y
11: OTHERS:Y
```

REQId	REQ Desc	REQ Range	REF
22	Differential		1

SubReqId 22 ReqId

```
SubLab req. id      Description
1: CBC
2: Coagulation Studies
3: Others Hematology
```

```
ReqId      Description:      Ref. Range
20: Hb  :   M 15.0 ± 2.0; F 13.5 ± 2.0 gm/dl
21: WBC  :   4.0 – 10.0 x 109/L
22: Differential  :
23: Platelets  :   140 – 400 x 109/L
24: RBC  :   M 4.6 – 6.5; F 3.9 – 5.6 1012/L
25: Hct  :   M 0.39 – 0.50; F 0.34 – 0.44
26: MCV  :   M 81 -94: F 79 -91 fl
27: MCH  :   M 27 -32; F 25 -31 pg
28: MCHC  :   M 31 -35; F 30 – 34%
29: Reticulocytes  :   < 2%
```

REQId	SubReqId Desc
1	CBC

03/11/2013 11:46:29 AM

Total Records: 11

LABREQ_	LABREQ_SNODESC	LABRE
38	Band Cell	22
39	Neutrophil	22
40	Lymphocyte	22
41	Monocyte	22
42	Eosinophil	22

Foreign Keys (FK)

A **foreign key** is an attribute that refers to a primary key of same or different relation to form a link (constraint) between the relations:

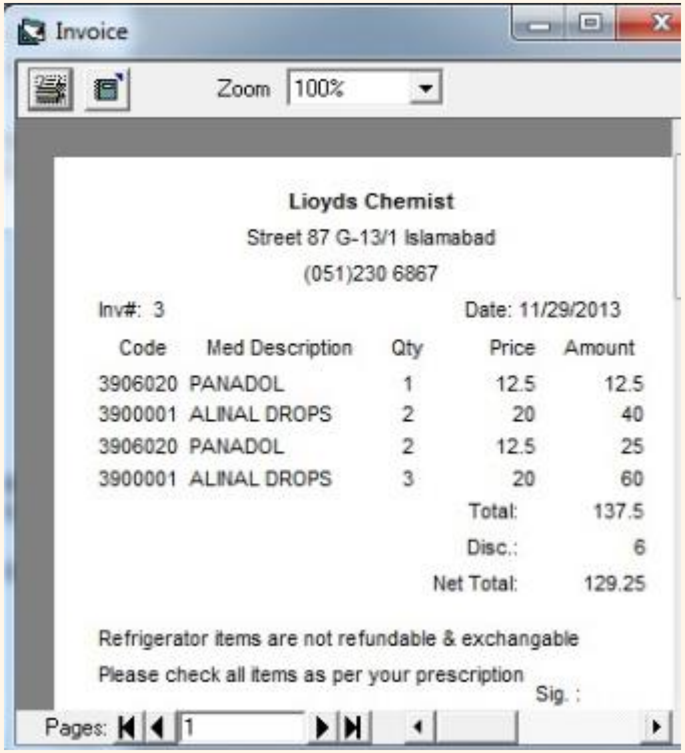
- A foreign key can be a single column or a composite key
- The term refers to the fact that key values are *foreign* to the relation in which they appear as foreign key values
- Ideally Data type, Length/ Size of FK and referring PK must be same

Foreign Keys

NOTE: The primary keys of the relations are underlined and any foreign keys are in *italics* in the relations below:
Name of FK column may be different from the name of referencing PK

Example-1:
DEPARTMENT (DeptID, DepartmentName, BudgetCode, ManagerName)
EMPLOYEE (EmployeeNumber, EmployeeName, *DeptID*)

Customer-Orders



Zoom 100%

Lioyds Chemist
Street 87 G-13/1 Islamabad
(051)230 6867

Inv#: 3 Date: 11/29/2013

Code	Med Description	Qty	Price	Amount
3906020	PANADOL	1	12.5	12.5
3900001	ALINAL DROPS	2	20	40
3906020	PANADOL	2	12.5	25
3900001	ALINAL DROPS	3	20	60
			Total:	137.5
			Disc.:	6
			Net Total:	129.25

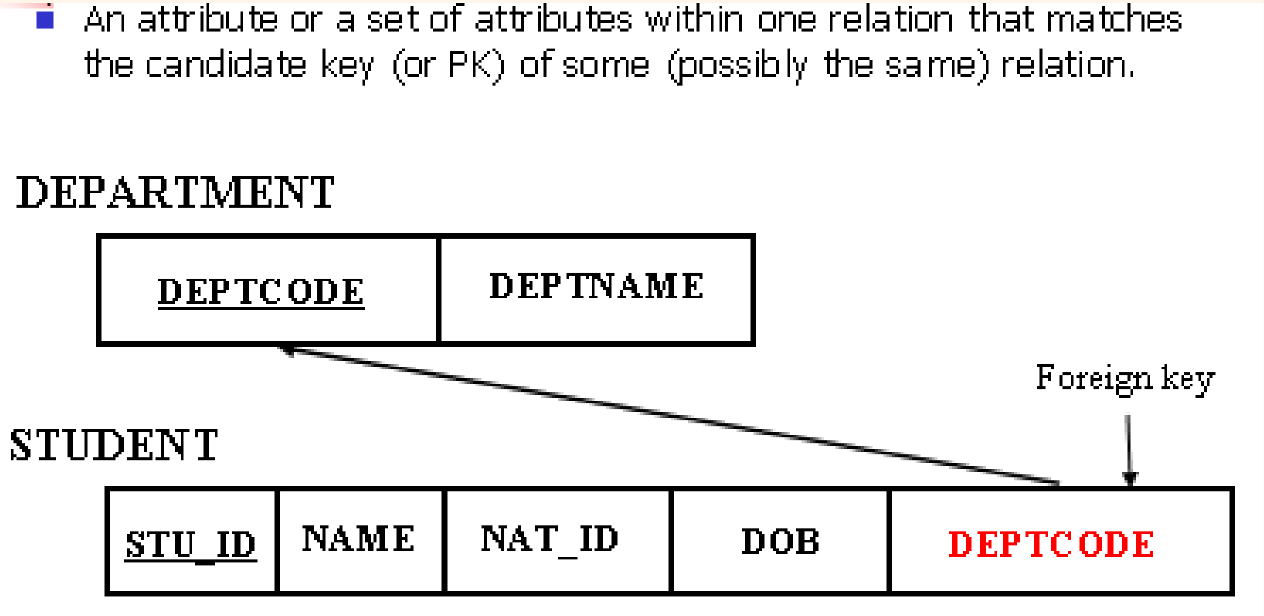
Refrigerator items are not refundable & exchangable
Please check all items as per your prescription
Sig. :

Pages: 1

Example-2:
CUSTOMER(CustId, Name, Address, Telno, Email)
ORDERS(Invoice#, InvType, InvDate, *CustomerId*)

Can we call Invoice# as a Surrogated Key?
Does Invoice# always contain serial numbers?

Foreign Key with a Referential Integrity Constraint



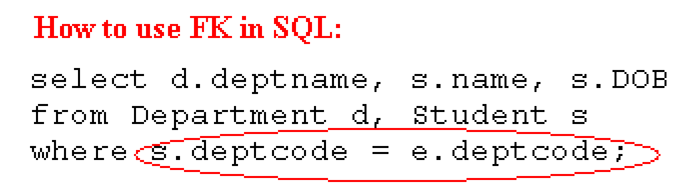
- An attribute or a set of attributes within one relation that matches the candidate key (or PK) of some (possibly the same) relation.

DEPARTMENT

DEPTCODE	DEPTNAME

STUDENT

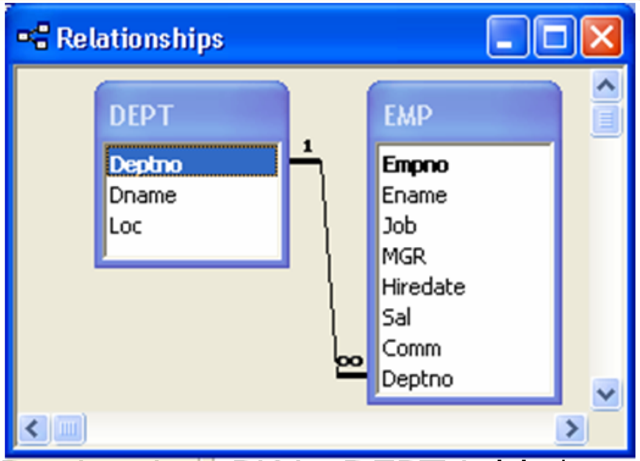
STU_ID	NAME	NAT_ID	DOB	DEPTCODE



How to use FK in SQL:

```
select d.deptname, s.name, s.DOB
from Department d, Student s
where s.deptcode = e.deptcode;
```

Foreign Key with a Referential Integrity Constraint



Deptno is a PK in DEPT table*

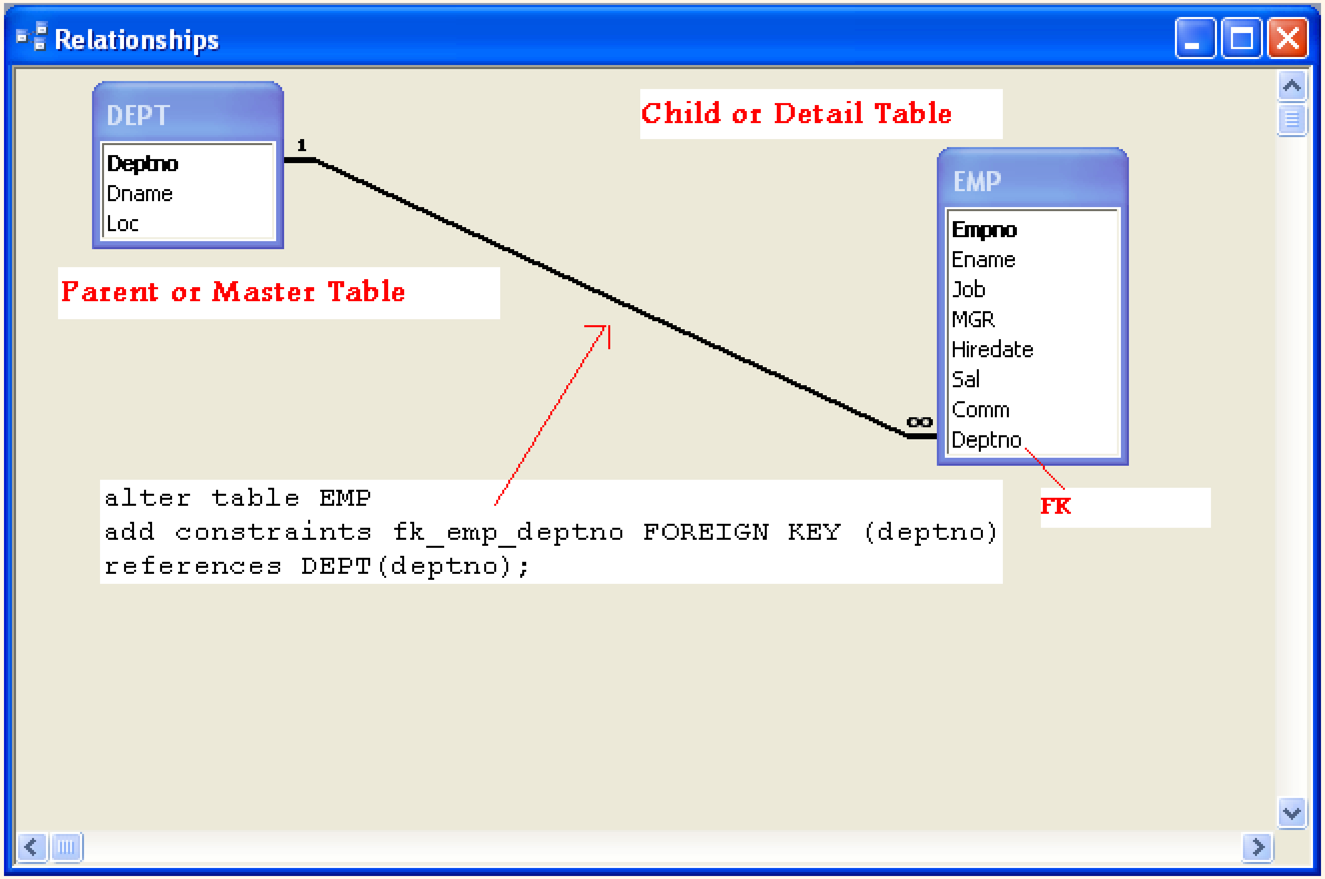
Empno is a PK in EMP table

Deptno is a FK in EMP table*

(it references to an attribute Deptno of DEPT table)

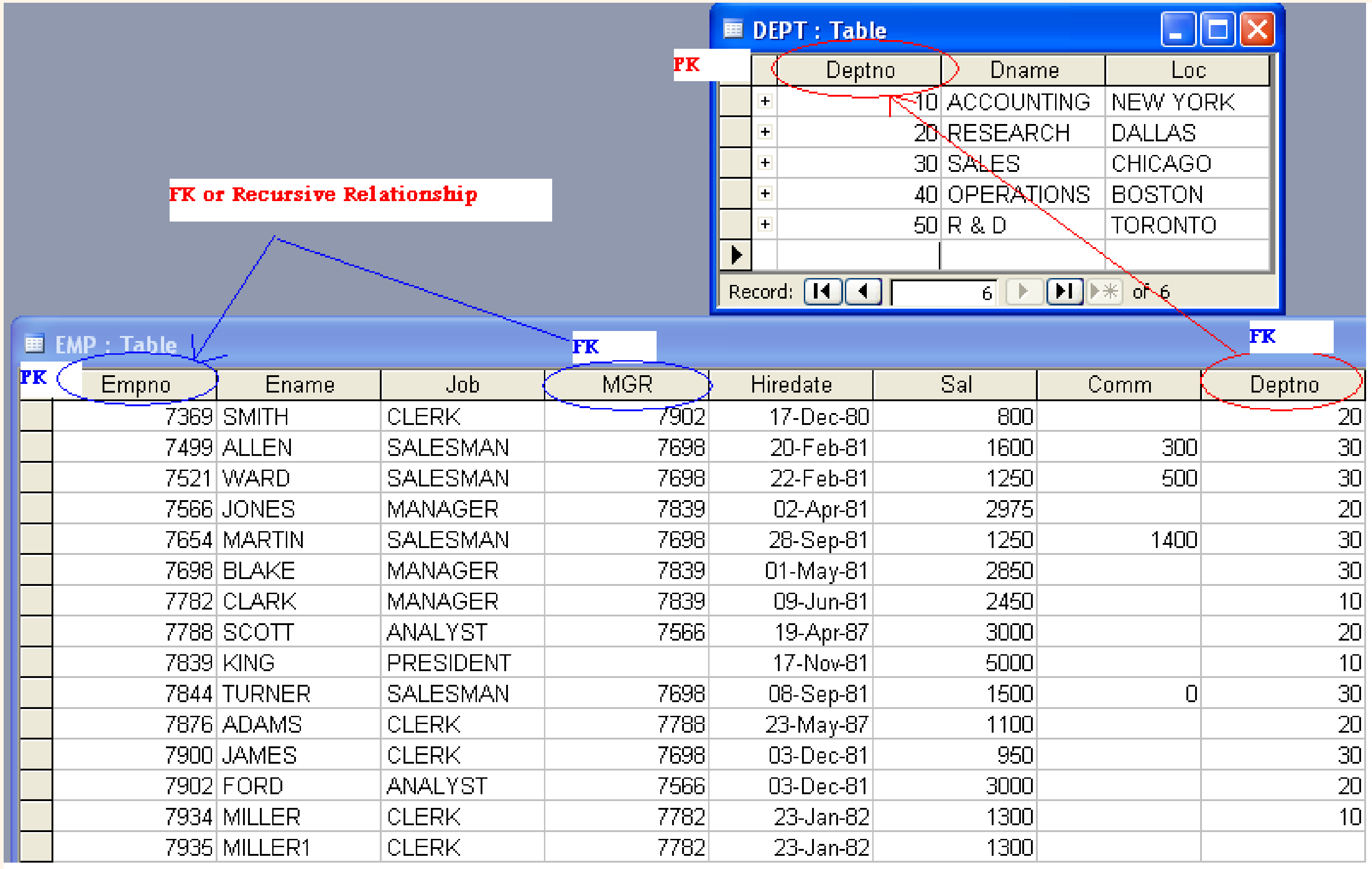
NOTE: An attribute within one relation that matches the key (Primary/same) in the same relation, is called recursive relation

Creating Foreign Key in MS Access & Oracle



```
alter table EMP
add constraints fk_emp_deptno FOREIGN KEY (deptno)
references DEPT(deptno);
```

FK and Recursive Relationship

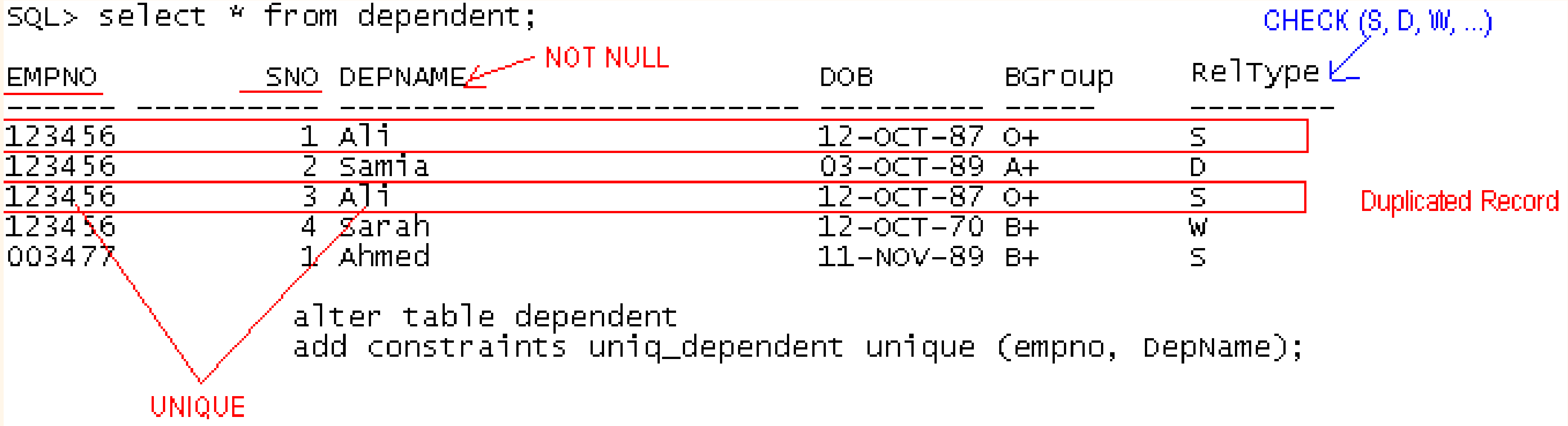


Deptno	Dname	Loc
10	ACCOUNTING	NEW YORK
20	RESEARCH	DALLAS
30	SALES	CHICAGO
40	OPERATIONS	BOSTON
50	R & D	TORONTO

Empno	Ename	Job	MGR	Hiredate	Sal	Comm	Deptno
7369	SMITH	CLERK	7902	17-Dec-80	800		20
7499	ALLEN	SALESMAN	7698	20-Feb-81	1600	300	30
7521	WARD	SALESMAN	7698	22-Feb-81	1250	500	30
7566	JONES	MANAGER	7839	02-Apr-81	2975		20
7654	MARTIN	SALESMAN	7698	28-Sep-81	1250	1400	30
7698	BLAKE	MANAGER	7839	01-May-81	2850		30
7782	CLARK	MANAGER	7839	09-Jun-81	2450		10
7788	SCOTT	ANALYST	7566	19-Apr-87	3000		20
7839	KING	PRESIDENT		17-Nov-81	5000		10
7844	TURNER	SALESMAN	7698	08-Sep-81	1500	0	30
7876	ADAMS	CLERK	7788	23-May-87	1100		20
7900	JAMES	CLERK	7698	03-Dec-81	950		30
7902	FORD	ANALYST	7566	03-Dec-81	3000		20
7934	MILLER	CLERK	7782	23-Jan-82	1300		10
7935	MILLER1	CLERK	7782	23-Jan-82	1300		

Other Constraints Examples

Unique constraint can be applied on single or multiple columns



```
SQL> select * from dependent;

EMPNO         SNO DEPNAME                   DOB        BGroup    RelType
------ ---------- ------------------------- ---------- -----     ---------
123456          1 Ali                       12-OCT-87  O+        S
123456          2 Samia                     03-OCT-89  A+        D
123456          3 Ali                       12-OCT-87  O+        S
123456          4 Sarah                     12-OCT-70  B+        W
003477          1 Ahmed                     11-NOV-89  B+        S

                alter table dependent
                add constraints uniq_dependent unique (empno, DepName);
```

CHECK (Max_Participants>=Enrolled_Participants)

CHECK (Deptno>0)

CHECK (RelType IN ('S', 'D', 'W'))

Default 'Y‘

Database Triggers