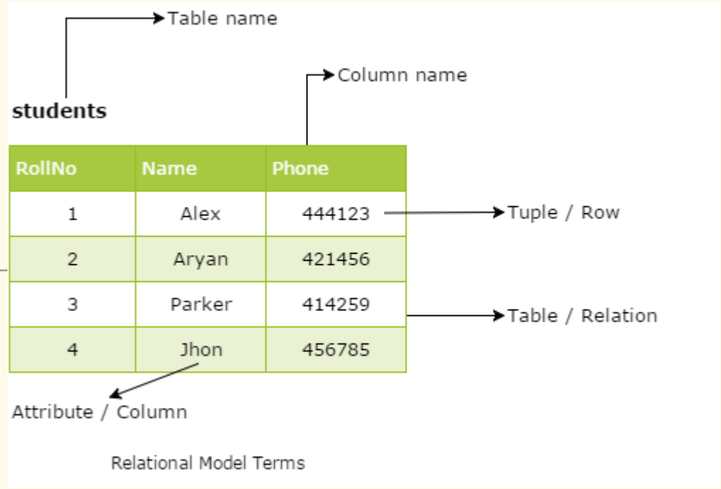
The Relational Model



Topics List

- Relational Model Terminology
- Properties of Relations
- Relational Keys
- Integrity Constraints
- Views

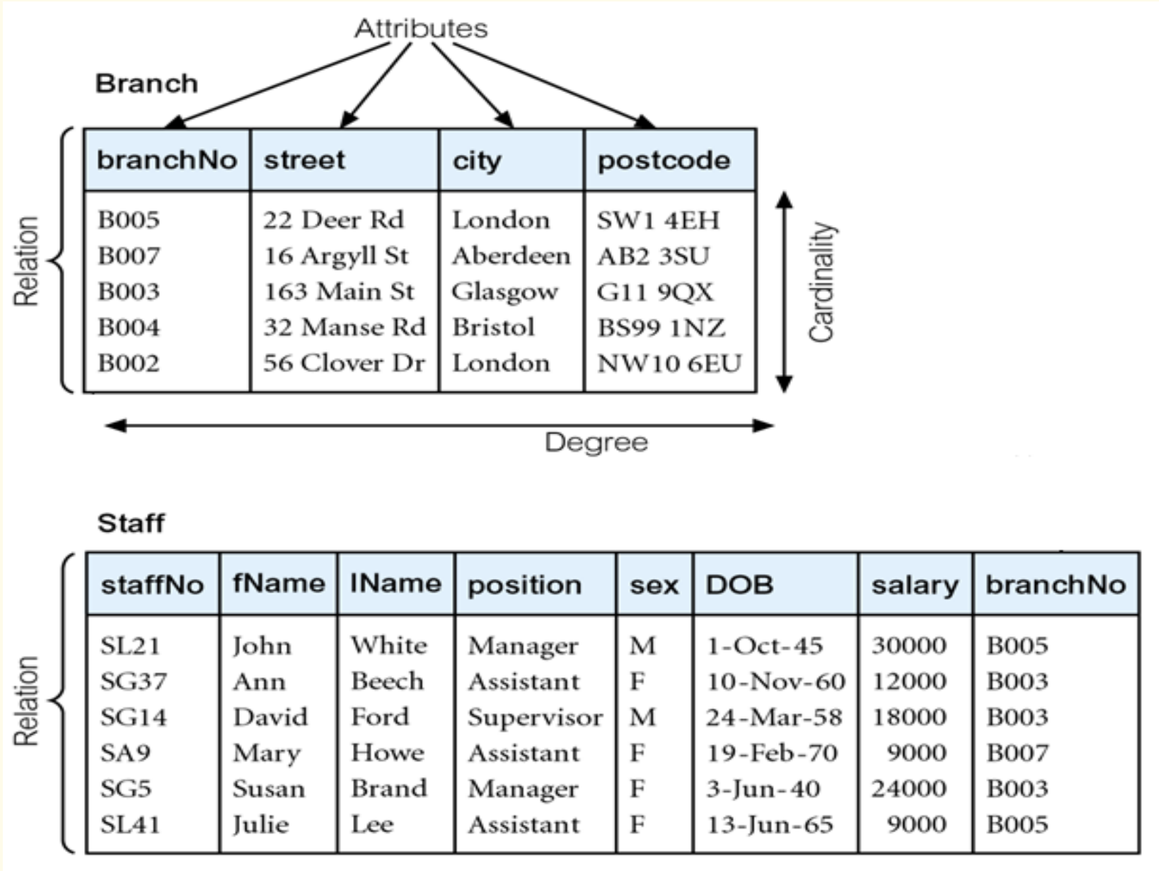
Relational Model Terminology

- **A relation** is a table with columns and rows.
  - Only applies to logical structure of the database, not the physical structure.
- **Attribute** is a named column of a relation**.**
- **Domain** is the set of allowable values for one or more attributes.

Relational Model Terminology

- **Tuple** is a row of a relation.
- **Degree** is the number of attributes in a relation.
- **Cardinality** is the number of tuples in a relation.
- **Relational Database** is a collection of normalised relations with distinct relation names.

Instances of Branch and Staff Relations



Branch

branchNo	street	city	postcode
B005	22 Deer Rd	London	SW1 4EH
B007	16 Argyll St	Aberdeen	AB2 3SU
B003	163 Main St	Glasgow	G11 9QX
B004	32 Manse Rd	Bristol	BS99 1NZ
B002	56 Clover Dr	London	NW10 6EU

Staff

staffNo	fName	lName	position	sex	DOB	salary	branchNo
SL21	John	White	Manager	M	1-Oct-45	30000	B005
SG37	Ann	Beech	Assistant	F	10-Nov-60	12000	B003
SG14	David	Ford	Supervisor	M	24-Mar-58	18000	B003
SA9	Mary	Howe	Assistant	F	19-Feb-70	9000	B007
SG5	Susan	Brand	Manager	F	3-Jun-40	24000	B003
SL41	Julie	Lee	Assistant	F	13-Jun-65	9000	B005

Examples of Attribute Domains

Attribute	Domain Name	Meaning	Domain Definition
branchNo	BranchNumbers	The set of all possible branch numbers	character: size 4, range B001–B999
street	StreetNames	The set of all street names in Britain	character: size 25
city	CityNames	The set of all city names in Britain	character: size 15
postcode	Postcodes	The set of all postcodes in Britain	character: size 8
sex	Sex	The sex of a person	character: size 1, value M or F
DOB	DatesOfBirth	Possible values of staff birth dates	date, range from 1-Jan-20, format dd-mmm-yy
salary	Salaries	Possible values of staff salaries	monetary: 7 digits, range 6000.00–40000.00

Alternative Terminology for Relational Model

Formal terms	Alternative 1	Alternative 2
Relation	Table	File
Tuple	Row	Record
Attribute	Column	Field

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Properties of Relations

- Relation name is distinct from all other relation names in relational schema.
- Each cell of relation contains exactly one atomic (single) value.
- Each attribute has a distinct name.
- Values of an attribute are all from the same domain.

Properties of Relations

- Each tuple is distinct; there are no duplicate tuples.
- Order of attributes has no significance.
- Order of tuples has no significance, theoretically.

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Relational Keys

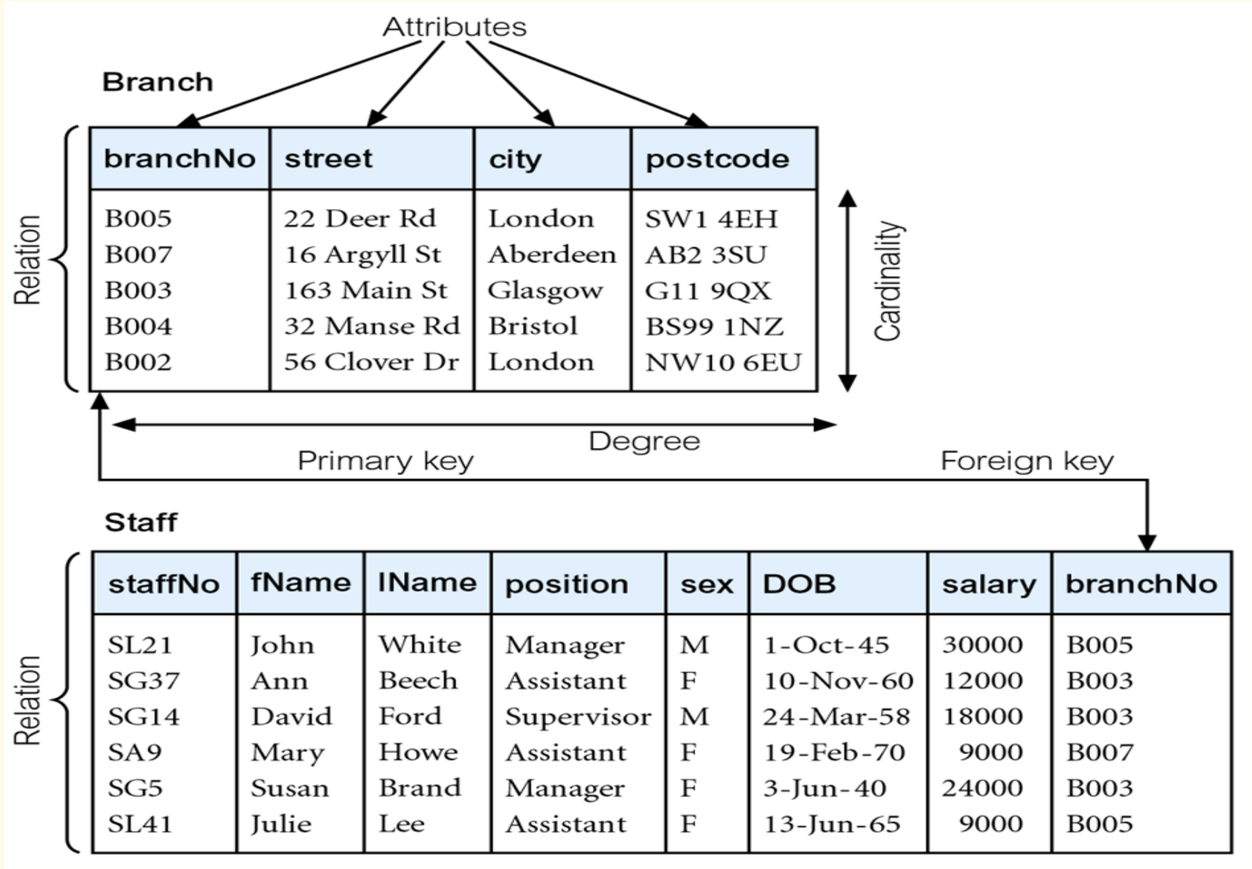
- Keys are a very important part of Relational database model. They are used to establish and identify relationships between tables and also to uniquely identify any record or row of data inside a table.

- A Key can be a single attribute or a group of attributes, where the combination may act as a key.

Relational Keys

- **Candidate Key**
  - Candidate keys are defined as the minimal set of fields which can uniquely identify each record in a table. There can be more than one candidate key.
- **Primary Key**
  - Candidate key selected to identify tuples uniquely within a relation.
- **Alternate Keys**
  - Candidate keys that are not selected to be primary key.
- **Foreign Key**
  - Attribute, or set of attributes, within one relation that matches the primary key of another relation.

Instances of Branch and Staff Relations



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Integrity Constraints

- **Null**
  - Represents value for an attribute that is currently unknown or not applicable for this tuple.
  - Deals with incomplete or exceptional data.
  - Represents the absence of a value and is not the same as zero or spaces, which are values.

Integrity Constraints

- **Entity Integrity**
  - In a base relation, no attribute of a primary key can be null. Primary key must also be unique.

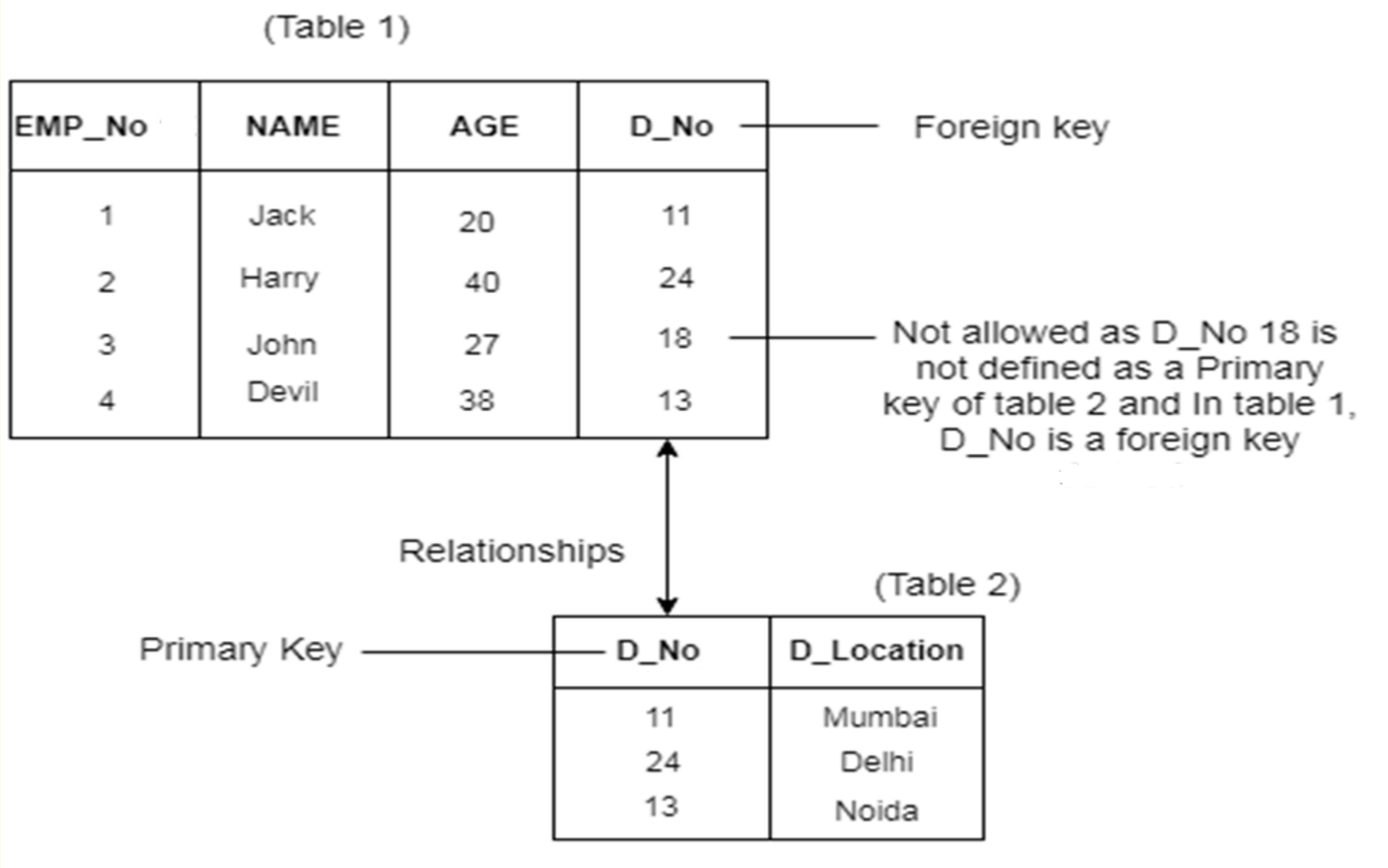
- **Referential Integrity**
  - If foreign key exists in a relation, either foreign key value must match the primary (or alternate) key value of some tuple in its home relation or foreign key value must be wholly null.

Integrity Constraints

INTEGRITY RULES

ENTITY INTEGRITY	DESCRIPTION
Requirement	All primary key entries are unique, and no part of a primary key may be null.
Purpose	Guarantees that each entity will have a unique identity and ensures that foreign key values can properly reference primary key values.
Example	No invoice can have a duplicate number, nor can it be null. In short, all invoices are uniquely identified by their invoice number.
REFERENTIAL INTEGRITY	**DESCRIPTION**
Requirement	A foreign key may have either a null entry—as long as it is not a part of its table's primary key—or an entry that matches the primary key value in a table to which it is related. (Every non-null foreign key value *must* reference an *existing* primary key value.)
Purpose	Makes it possible for an attribute NOT to have a corresponding value, but it will be impossible to have an invalid entry. The enforcement of the referential integrity rule makes it impossible to delete a row in one table whose primary key has mandatory matching foreign key values in another table.
Example	A customer might not (yet) have an assigned sales representative (number), but it will be impossible to have an invalid sales representative (number).

Integrity Constraints



Integrity Constraints

- **General Constraints**
  - Additional rules specified by users or database administrators that define or constrain some aspect of the enterprise.
  - For Example:
    In the PropertyForRent table, type must be House, Flat or Apartment.

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Views

- **Base Relation**
  - Named relation corresponding to an entity in conceptual schema, whose tuples are physically stored in database.

- **View**
  - Dynamic result of one or more relational operations operating on base relations to produce another relation (like the output of a *SQL Select* statement).

Views

- A virtual relation that does not actually exist in the database but is produced upon request.
- Contents of a view are defined as a query on one or more base relations.
- Views are dynamic, meaning that changes made to base relations that affect view attributes are reflected in the view.

Views

- A view name may be used in exactly the same way as a table name in any SELECT query. Once stored, the view can be used again and again, rather than re-writing the same query many times.

- One of the most important uses of views is in large multi-user systems, where they make it easy to control access to data for different types of users.

Views - Example

- As a very simple example, suppose that you have a table of employee information

Employee(PPS, fName, lName, phone, jobTitle, payRate, managerID)

- Obviously, you can’t let everyone in the company look at all of this information, let alone make changes to it.

- Only a very few trusted people would have SELECT, UPDATE, INSERT, and DELETE privileges on the entire Employee base table; everyone else would have exactly the access that they need, but no more.

Views - Example

- You could create separate views on just the Employee table, and control access to it like this:

```
CREATE VIEW phone_view AS
  (SELECT fName, lName, phone
  FROM Employee);
```

```
GRANT SELECT ON phone_view TO public;
```

Views - Example

```
CREATE VIEW job_view AS
 (SELECT PPS, fName, lName, jobTitle,
 managerID
 FROM Employee);


GRANT SELECT, UPDATE ON job_view TO managers;
```

Views - Example

```
CREATE VIEW pay_view AS
 (SELECT PPS, fName, lName, payRate
 FROM Employee);
```

```
GRANT SELECT, UPDATE ON pay_view TO payroll;
```

Views - Example

```
CREATE VIEW sales_rate AS
 (SELECT PPS, fName, lName, payRate
 FROM Employee
 where jobTitle = ‘Sales’);


GRANT SELECT ON sales_rate TO managers;
```

Purpose of Views

- Provides powerful and flexible security mechanism by hiding parts of database from certain users.
- Permits users to access data in a customized way, so that same data can be seen by different users in different ways, at same time.
- Can simplify complex operations on base relations. For example, rather than writing a query that involves 2 or more tables. Create the view once and then query the view as often as required.

Updating Views

- All updates to a base relation should be immediately reflected in all views that reference that base relation.

- If view is updated, underlying base relation should reflect change.