THE RELATIONAL MODEL

1. Terminology

A. Relation

Relation is a **table** with columns and rows. An RDBMS requires only that the database be perceived by the user as tables.

B. Attribute

An attribute is a named column of a relation. In the relational model, relations are used to hold information about the objects to be represented in the database. A relation is represented as a two-dimensional table in which the rows of the table correspond to individual records and the table columns correspond to attributes. Attributes can appear in any order and the relation will still be the same relation, and therefore will convey the same meaning. For example, the information on branch offices is represented by the Branch relation, with columns for attributes branchNo (the branch number), street, city, and postcode. Similarly, the information on staff is represented by the Staff relation, with columns for attributes staffNo (the staff number), fName, lName, position, sex, DOB (date of birth), salary, and branchNo (the number of the branch the staff member works at). Figure 1 shows instances of the Branch and Staff relations. As you can see from this example, a column contains values of a single attribute; for example, the branchNo columns contain only numbers of existing branch offices.

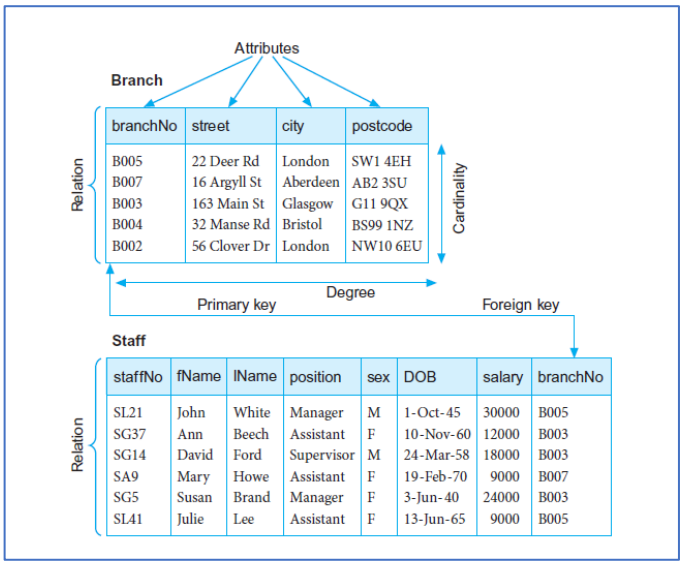

Figure 1: Attributes

C. Domain

A domain is the set of allowable values for one or more attributes. Domains are an extremely powerful feature of the relational model. Every attribute in a relation is defined on a domain. Domains may be distinct for each attribute, or two or more attributes may be defined on the same domain. Figure 2 shows the domains for some of the attributes of the Branch and Staff relations. For example, it is not sensible to compare a street name with a telephone number, even though the domain definitions for both these attributes are **character strings**. On the other hand, the monthly rental on a property and the number of months a property has been leased have different domains (the first a monetary value, the second an integer value), but it is still a legal operation to multiply two values from these 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

Figure 2: Table Domains

D. Tuple

A tuple is a row of a relation. The elements of a relation are the rows or tuples in the table. In the Branch relation, each row contains four values, one for each attribute. Tuples can appear in any order and the relation will still be the same relation, and therefore convey the same meaning. The structure of a relation, together with a specification of the domains and any other restrictions on possible values, is sometimes called its intension, which is usually fixed, unless the meaning of a relation is changed to include additional attributes. The tuples are called the extension (or state) of a relation, which changes over time.

E. Degree

The degree of a relation is the number of attributes it contains. The Branch relation in Figure 1 has four attributes or degree four. This means that each row of the table is a four-tuple, containing four values. A relation with only one attribute would have degree one and be called a **unary** relation or one-tuple. A relation with two attributes is called **binary**, one with three attributes is called **ternary**, and after that the term **n-ary** is usually used. The degree of a relation is a property of the intension of the relation.

F. Cardinality

The cardinality of a relation is the number of tuples it contains. By contrast, the number of tuples is called the cardinality of the relation and this changes as tuples are added or deleted. The cardinality is a property of the extension of the relation and is determined from the particular instance of the relation at any given moment.

G. Alternative terminology

The terminology for the relational model can be quite confusing. We have introduced two sets of terms. In fact, a third set of terms is sometimes used: a relation may be referred to as a file, the tuples as records, and the attributes as fields. This terminology stems from the fact that, physically, the RDBMS may store each relation in a file. Figure 3 summarizes the different terms for the relational model.

FORMAL TERMS	ALTERNATIVE 1	ALTERNATIVE 2
Relation	Table	File
Tuple	Row	Record
Attribute	Column	Field

Figure 3: Alternative terminology

2. Relational Keys

We need to be able to identify one or more attributes (called relational keys) that **uniquely identifies** each tuple in a relation. In this section, we explain the terminology used for relational keys.

A. Superkey

An attribute, or set of attributes, that uniquely identifies a tuple within a relation. A superkey uniquely identifies each tuple within a relation. However, a superkey may contain additional attributes that are not necessary for unique identification, and we are interested in identifying superkeys that contain only the minimum number of attributes necessary for unique identification.

B. Candidate key

There may be several candidate keys for a relation. When a key consists of more than one attribute, we call it a **composite key**. Consider the Branch relation shown in Figure 1. Given a value of city, we can determine several branch offices (for example, London has two branch offices). This attribute **cannot be a candidate key**. On the other hand, because *DreamHome* allocates each branch office a unique branch number, given a branch number value, branchNo, we can determine at most one tuple, so that branchNo is a candidate key. Similarly, postcode is also a candidate key for this relation

C. Primary key

The candidate key that is selected to identify tuples uniquely within the relation. Because a relation has no duplicate tuples, it is always possible to identify each row uniquely. This means that a relation always has a primary key. The candidate keys that are not selected to be the primary key are called **alternate keys**. For the Branch relation, if we choose branchNo as the primary key, postcode would then be an alternate key.

D. Foreign key

An attribute, or set of attributes, within one relation that matches the candidate key of some (possibly the same) relation. When an attribute appears in more than one relation (table), its appearance usually represents a relationship between tuples of the two relations. For example, the inclusion of branchNo in both the Branch and Staff relations is quite deliberate and links each branch to the details of staff working at that branch. In the Branch relation, branchNo is the primary key. However, in the Staff relation, the branchNo attribute exists to match staff to the branch office they work in. In the Staff relation, branchNo is **a foreign key**. We say that the attribute branchNo in the Staff relation targets the primary key attribute branchNo in the home relation, Branch. These common attributes play an important role in performing data manipulation.

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

PropertyForRent

propertyNo	street	city	postcode	type	rooms	rent	ownerNo	staffNo	branchNo
PA14	16 Holhead	Aberdeen	AB7 5SU	House	6	650	CO46	SA9	B007
PL94	6 Argyll St	London	NW2	Flat	4	400	CO87	SL41	B005
PG4	6 Lawrence St	Glasgow	G11 9QX	Flat	3	350	CO40		B003
PG36	2 Manor Rd	Glasgow	G32 4QX	Flat	3	375	CO93	SG37	B003
PG21	18 Dale Rd	Glasgow	G12	House	5	600	CO87	SG37	B003
PG16	5 Novar Dr	Glasgow	G12 9AX	Flat	4	450	CO93	SG14	B003

Client

clientNo	fName	lName	telNo	prefType	maxRent	eMail
CR76	John	Kay	0207-774-5632	Flat	425	john.kay@gmail.com
CR56	Aline	Stewart	0141-848-1825	Flat	350	astewart@hotmail.com
CR74	Mike	Ritchie	01475-392178	House	750	mritchie01@yahoo.co.uk
CR62	Mary	Tregear	01224-196720	Flat	600	maryt@hotmail.co.uk

PrivateOwner

ownerNo	fName	lName	address	telNo	eMail	password
CO46	Joe	Keogh	2 Fergus Dr, Aberdeen AB2 7SX	01224-861212	jkeogh@lhh.com	********
CO87	Carol	Farrel	6 Achray St, Glasgow G32 9DX	0141-357-7419	cfarrel@gmail.com	********
CO40	Tina	Murphy	63 Well St, Glasgow G42	0141-943-1728	tinam@hotmail.com	********
CO93	Tony	Shaw	12 Park Pl, Glasgow G4 0QR	0141-225-7025	tony.shaw@ark.com	********

Viewing

clientNo	propertyNo	viewDate	comment
CR56	PA14	24-May-13	too small
CR76	PG4	20-Apr-13	too remote
CR56	PG4	26-May-13	
CR62	PA14	14-May-13	no dining room
CR56	PG36	28-Apr-13	

Registration

clientNo	branchNo	staffNo	dateJoined
CR76	B005	SL41	2-Jan-13
CR56	B003	SG37	11-Apr-12
CR74	B003	SG37	16-Nov-11
CR62	B007	SA9	7-Mar-12

Figure 4: Sample of DereamHome Relations