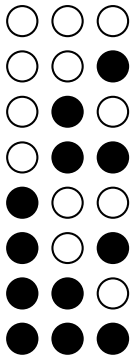
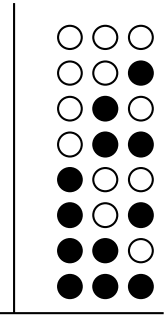
Introduction

Unit 18 Database Design

Extended Diploma in ICT

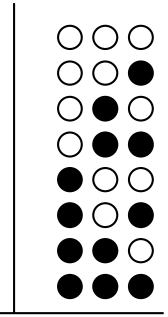


Unit outcomes



- Understand the features of relational databases
- Be able to design, create and populate a relational database
- Be able to test a relational database

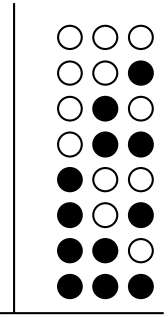
Criteria



- 7 passes
- 4 merits
- 2 distinctions

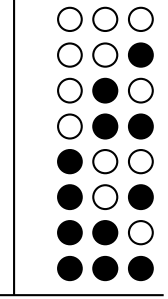
- 4 assignments

Resources



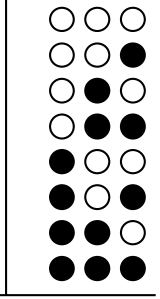
- Microsoft Access 2016
  - VBA – visual basic for applications
- Visual Paradigm 13.1

Steps



- Why do we use relational databases?
- Designing a relational database
- Implementing a relational database
- Testing a relational database

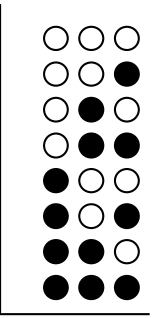
Typical spreadsheet



- Typically users will confuse database and spreadsheet
- Let's look at a typical spreadsheet

Owner ID	Initial	Surname	Title	Address	Postcode	Dog Name	Gender	DOB	Breed
1	A	Smith	Mrs	4 High Street Hereford	HR1 1ZX	Ant	M	21/08/02	Alsatian
1	A	Smith	Mrs	4 High Street Hereford	HR1 1ZX	Dec	M	21/08/02	Alsatian
1	A	Smith	Mrs	4 High Street Hereford	HR1 1ZX		F	08/08/04	Terrier
1	A	Smith	Ms	4 High Street Hereford	HR1 1ZX	Rooney	M	23/10/05	Poodle
2	C	Miles	Mr	72 Castle Road, Ledbury	HR7 AA	Fang	M	14/03/07	
3	D	Jones	Mr	9, Back Street, Ludlow, Shropshire	SY21 BB	Sammy	M	18/03/06	
3	D	Jones	Mr	9, Back Street, Ludlow, Shropshire	SY21 BB	Billy	M	14/11/05	Spaniel
4	R	Dean	Dr	14 Bryngwyn, Monmouth	NP7 AS	Suzy	F	09/03/03	Bloodhound
5	F	Read	Miss	18 Low Terrace, Orcop	HR2 6DZ	Judy	F	22/10/04	Foxhound
5	F	Read	Miss	18 Low Terrace, Orcop	HR2 6DZ	Trudy	F	25/11/05	Foxhound
5	F	Read	Miss	18 Low Terrace, Orcop	HR2 6DZ	Billy	M	14/11/05	Spaniel
5	F	Read	Miss	18 Low Terrace, Orcop	HR2 6D2	Jamie	M	08/09/06	Dachshund
5	F	Read	Miss	18 Low Terrace, Orcop	HR2 6DZ	Tammy	M	26/01/07	Dachshund

Naming conventions



Column or field

Attribute or property

Owner ID	Initial	Surname	Title	Address	Postcode	Dog Name	Gender	DOB	Breed
1	A	Smith	Mrs	4 High Street Hereford	HR1 1ZX	Ant	M	21/08/02	Alsatian
1	A	Smith	Mrs	4 High Street Hereford	HR1 1ZX	Dec	M	21/08/02	Alsatian
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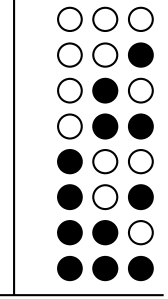
5	F	Read	Miss	18 Low Terrace, Orcop	HR2 6D2	Jamie	M	08/09/06	Dachshund
5	F	Read	Miss	18 Low Terrace, Orcop	HR2 6DZ	Tammy	M	26/01/07	Dachshund

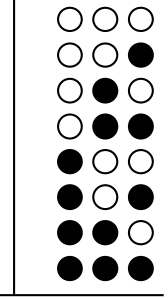
Record or row

Tables



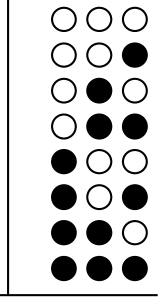
- The whole sheet is a table
- A sheet is a one table database, sometimes known as a flat file database
- There are problems with using just one table

Problems?



- Look for any problems you can see with the spreadsheet

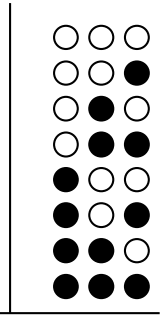
Problems with a flat file design



- The same identifier (Owner ID) can appears in multiple rows. You cannot retrieve a unique owner record with the identifier
- Entities may not have an ID (what is the unique identifier for a dog?).
- Details are repeated – DATA REDUNDANCY, wasting space and time.
- Data can be INCONSISTENT as it is stored more than once
- Multiple records have to be updated. This is an AMENDMENT ANOMALY
- Multiple records have to be deleted. This is a DELETION ANOMALY
- More than one record may need to be added. This is an ADDITION ANOMALY
- Data may not be **ATOMIC**.

  Atomic data is the lowest level of detail. Atomic data provides the base data for all data transformations.

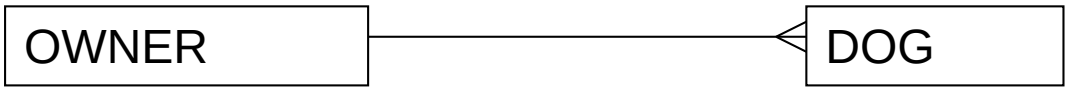
Improving flat files



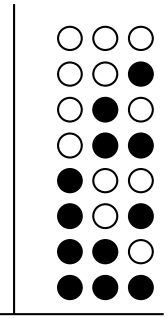
- Split into smaller tables with a defined relationship between them
- At the design stage we can use an Entity Relationship Diagram (ER Diagram)

E-R Diagram

- The relationship is that:
  - A dog can only have one owner
  - One owner can have many dogs
  - This is a “one to many” relationship



Result of E-R diagram

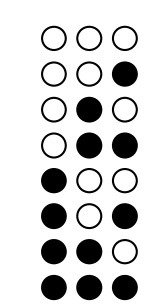


Owner ID	Initial	Surname	Title	Address	Postcode	Dog Name	Gender	DOB	Breed
1	A	Smith	Mrs	4 High St, Hereford	HR1 1ZX	Ant	M	21/08/02	Alsatian
1	A	Smith	Mrs	4 High St, Hereford	HR1 1ZX	Dec	M	21/08/02	Alsatian
1	A	Smith	Mrs	4 High St, Hereford	HR1 1ZX	Jordan	F	08/08/04	Terrier
1	A	Smith	Ms	4 High St, Hereford	HR1 1ZX	Rooney	M	23/10/05	Poodle
2	C	Miles	Mr	72 Castle Road, Ledbury	HR7 AA	Fang	M	14/03/07	Chihuahua

Owner ID	Initial	Surname	Title	Address	Postcode
1	A	Smith	Mrs	4 High St, Hereford	HR1 1ZX
2	C	Miles	Mr	72 Castle Road, Ledbury	HR7 AA

Dog ID	Dog Name	Gender	DOB	Breed	Owner ID
1	Ant	M	21/08/02	Alsatian	1
2	Dec	M	21/08/02	Alsatian	1
3	Jordan	F	08/08/04	Terrier	1
4	Rooney	M	23/10/05	Poodle	1
5	Fang	M	14/03/07	Chihuahua	2

Keys



Primary Key

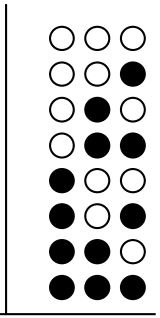
Owner ID	Initial	Surname	Title	Address	Postcode
1	A	Smith	Mrs	4 High St, Hereford	HR1 1ZX
2	C	Miles	Mr	72 Castle Road, Ledbury	HR7 AA

Primary Key

Foreign Key

DogID	Dog Name	Gender	DOB	Breed	Owner ID
1	Ant	M	21/08/02	Alsatian	1
2	Dec	M	21/08/02	Alsatian	1
3	Jordan	F	08/08/04	Terrier	1
4	Rooney	M	23/10/05	Poodle	1
5	Fang	M	14/03/07	Chihuahua	2

Why is this better?

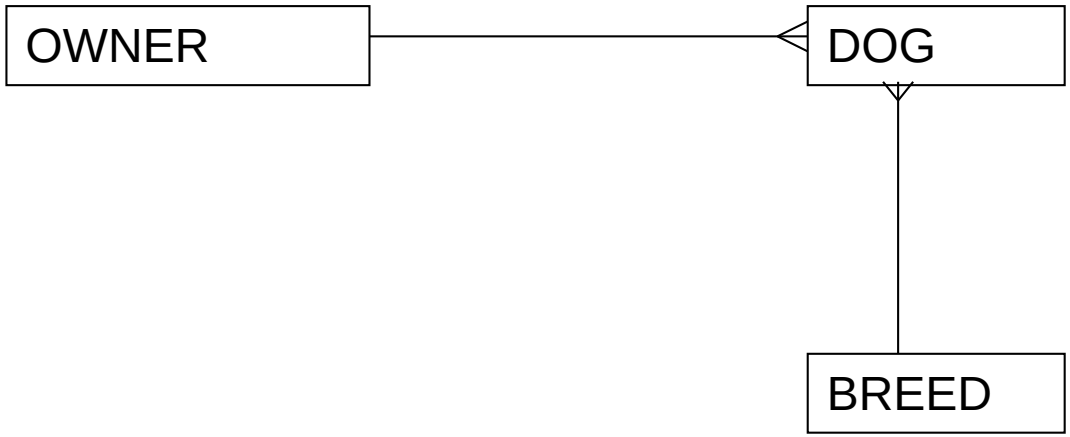


- Member's details are only stored once
- Each dog has a unique ID
- New owners only entered once
- Changes only made in one place
- Details need only be deleted from one record

ID	Initial	Surname	Title	Address	Postcode
1	A	Smith	Mrs	4 High St, Hereford	HR1 1ZX
2	C	Miles	Mr	72 Castle Road, Ledbury	HR7 AA

DogID	Dog Name	Gender	DOB	Breed	ID
1	Ant	M	21/08/02	Alsatian	1
2	Dec	M	21/08/02	Alsatian	1
3	Jordan	F	08/08/04	Terrier	1
4	Rooney	M	23/10/05	Poodle	1
5	Fang	M	14/03/07	Chihuahua	2

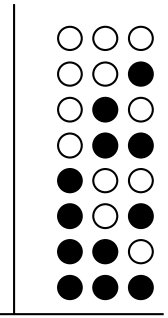
Further improvements



Now many dogs can belong to a breed

A dog can only be of one breed

The tables now look like this



Owners

ID	Initial	Surname	Title	Address	Postcode
1	A	Smith	Mrs	4 High St, Hereford	HR1 1ZX
2	C	Miles	Mr	72 Castle Road, Ledbury	HR7 AA

Dogs

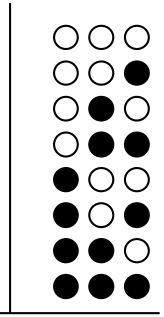
DogID	Dog Name	Gender	DOB	BreedID	ID
1	Ant	M	21/08/02	1	1
2	Dec	M	21/08/02	1	1
3	Jordan	F	08/08/04	2	1
4	Rooney	M	23/10/05	3	1
5	Fang	M	14/03/07	4	2

DogBreeds

Breed ID	Breed	Description
1	Alsatian	Large
2	Terrier	Medium
3	Poodle	Small
4	Chihuahua	Toy

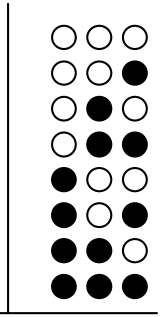
http://www.akc.org/dog-breeds/

The benefits are



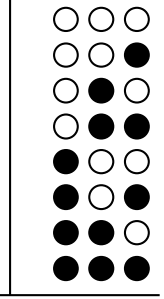
- Member’s details are only stored once
- Each dog has a unique ID
- New owners only entered once
- Changes only made in one place
- Details need only be deleted from one record
- We only need to store the details of each breed once
- A new breed can be added without an owner

Recap



- Features: Three core features – entities (e.g. Customer), relationships and attributes (e.g. Primary key)
  - Attributes – Often called fields and each one needs to be defined according to the type of data held. See Data types.
  - Relationships – Relational databases allows for the use of simple named tables based on entities to store information. These tables are created separately and then linked together.

Exercise



- Explain the main features of relational databases and the benefits they bring to an organisation. You will need to include an explanation of how the structure of relational databases can provide efficiencies in data storage, the elimination of data redundancy and the ease by which information can be extracted from the underlying data. **(P1)**