Identify Existing Entity and Component Data Items

Exercise 3

For each of the following examples, represent the data model in UNF, and normalize the data model, showing first, second and third normal form. Draw an entity relationship diagram to represent the data model in 3NF.

1. A school administration system: each record contains information about a pupil and the subjects studied.
Pupils are allocated to one set (class) in each subject. Set names are unique throughout the school.
Teacher's take different classes and can teach in different rooms. However, a particular set is always taken by the same teacher in the same room.

Pupil Code	Name	Tutor Group	Year	Year Head	Set	Subject	Teacher	Room
29865	Greg Dike	5PW	5	Mr Niven	5.2.2 5.1.3 5.5.4 5.4.1 5.3.1	English Maths Physics Info Systems Art & Design	Mr Dunn Ms Napier Mrs Newton Mr Codd Miss Emin	4 13 31 11 39
73645	Susan Smith	5CV	5	Mr Niven	5.2.1 5.1.4 5.3.3 5.4.1 5.5.2	English Maths Geography Info Systems Art & Design	Mrs Bacon Mr Fermat Ms Cook Mr Codd Mr Angelo	2 14 28 11 38
42315	Teresa Jewel	5PW	5	Mr Niven	5.2.2 5.1.4 5.5.4 5.3.2 5.5.2	English Maths Physics French Art & Design	Mr Dunn Mr Fermat MrsNewton Miss Kew Mr Angelo	4 14 31 19 38

Identify Existing Entity and Component Data Items

UNF

Pupil and subject

Pupil Code	Name	Tutor Group	Year	Year Head	Set	Subject	Teacher	Room
29865	Greg Dike	5PW	5	Mr Niven	5.2.2 5.1.3 5.5.4 5.4.1 5.3.1	English Maths Physics Info Systems Art & Design	Mr Dunn Ms Napier Mrs Newton Mr Codd Miss Emin	4 13 31 11 39
73645	Susan Smith	5CV	5	Mr Niven	5.2.1 5.1.4 5.3.3 5.4.1 5.5.2	English Maths Geography Info Systems Art & Design	Mrs Bacon Mr Fermat Ms Cook Mr Codd Mr Angelo	2 14 28 11 38
42315	Teresa Jewel	5PW	5	Mr Niven	5.2.2 5.1.4 5.5.4 5.3.2 5.5.2	English Maths Physics French Art & Design	Mr Dunn Mr Fermat MrsNewton Miss Kew Mr Angelo	4 14 31 19 38

Here, do 4 things:

1. Clearly label that this is unnormalised data.
2. Write down an **entity** name (which may or may not be provided) that should be meaningful to the situation given.
3. List the entity **attributes** which should be provided in brackets as shown.
4. Highlight the key (the unique row identifier) by underlining it).

1NF: Remove repeating data to a new entity along with a copy of the key

UNF

pupil and subject (**pupil code**
name
tutor group
year
year head
set
subject
teacher
room)

To identify the repeating group, ask how many rows are displayed in the given table.

Identify Repeating Group

Pupil Code	Name	Tutor Group	Year	Year Head	Set	Subject	Teacher	Room
1	1	1	1	1	M	M	M	M
73645	Susan Smith	5CV	5	Mr Niven	5.2.1 5.1.4 5.3.3 5.4.1 5.5.2	English Maths Geography Info Systems Art & Design	Mrs Bacon Mr Fermat Ms Cook Mr Codd Mr Angelo	2 14 28 11 38
42315	Teresa Jewel	5PW	5	Mr Niven	5.2.2 5.1.4 5.5.4 5.3.2 5.5.2	English Maths Physics French Art & Design	Mr Dunn Mr Fermat MrsNewton Miss Kew Mr Angelo	4 14 31 19 38

To identify the repeating group, ask how many rows are displayed in the given table.

Pupil and subject table displays **three** rows.

Now pick one particular row and ask yourself how many values each attribute could possible have in that row.

Attributes set, subject, teacher and room have many values for any particular row and are repeating data.

Identify Repeating Group

UNF

pupil and subject **(pupil code**
name
tutor group
year
year head
set
subject
teacher
room)

Repeating Group

To identify the repeating group, ask how many rows are displayed in the given table.
Pupil and subject table displays **three** rows.
Now pick one particular row and ask yourself how many values each attribute could possible have in that row.
Attributes set, subject, teacher and room have many values for any particular row and are repeating data.

1NF: Remove repeating data to a new entity along with a copy of the key

pupil (pupil code
name
tutor group
year
year head)

set (set
subject
teacher
room
pupil code)

Attributes set, subject, teacher and room are removed to a new entity.
The original key of pupil code is also copied over to relate the 2 tables at a later stage.
Possibly the hardest part of normalisation is identifying a key for the new 1NF entity.
Considering some sample data will usually make life easier.

1NF

pupil (pupil code
name
tutor group
year
year head)

set (set
subject
teacher
room
pupil code)

Set	Subject	Teacher	Room	Pupil Code
5.2.2	English	Mr Dunn	4	29865
5.1.3	Maths	Ms Napier	13	29865
5.2.2	English	Mr Dunn	4	42315

It can be seen that set and pupil code are not unique in the context of this table.
However, set and pupil code together are unique as a pupil is listed in one particular set one time only.
Remember to identify all foreign keys.

Pupil

Code	Name	Tutor group	Year	Year Head
29865	Greg Dike	5PW	5	Mr Niven
73645	Susan Smith	5CV	5	Mr Niven
42315	Teresa Jewel	5PW	5	Mr Niven
65748	Mark Hall	3PV	3	Miss Dent
42736	Ann Rees	2PW	2	Mr Peel

Set

Set	Subject	Teacher	Room	Pupil Code
5.2.2	English	Mr Dunn	4	29865
5.1.3	Maths	Ms Napier	13	29865
5.2.2	English	Mr Dunn	4	42315
5.5.2	Art & Design	Mr Angelo	38	42315
3.2.2	English	Mr Dunn	5	74563
5.2.2	English	Mr Dunn	4	45673
5.1.5	Maths	Mr Wright	26	46654

In 2NF partial dependancies are to be removed.
This can only happen in the set table as the pupil table has a single attribute key.
(Consider set 5.2.2 in the table).
Knowing the set will automatically tell you the subject, teacher and room
These are the partial dependancies to be removed.

For 2NF

pupil (pupil code
name
tutor group
year
year head)

set (set
subject
teacher
room
pupil code*)

2NF

pupil (pupil code
name
tutor group
year
year head)

enrolment (set*
pupil code*)

set (set
subject
teacher
room)

Pupil

Code	Name	Tutor group	Year	Year Head
29865	Greg Dike	5PW	5	Mr Niven
73645	Susan Smith	5CV	5	Mr Niven
42315	Teresa Jewel	5PW	5	Mr Niven
65748	Mark Hall	3PV	3	Miss Dent
42736	Ann Rees	2PW	2	Mr Peel

Set

Set	Subject	Teacher	Room
5.2.2	English	Mr Dunn	4
5.1.3	Maths	Ms Napier	13
5.5.2	Art & Design	Mr Angelo	38
3.2.2	English	Mr Dunn	5
5.1.5	Maths	Mr Wright	26

Enrolment

Set	Pupil Code
5.2.2	29865
5.1.3	29865
5.2.2	42315
5.5.2	42315
3.2.2	74563
5.2.2	45673
5.1.5	46654

2NF

3NF Hint: Only look at attributes that are NOT underlined

In 3NF non key dependancies are to be removed.
Consider the pupil table.
Knowing the tutor group will automatically give the year and year head.
These are the dependancies to remove.

For 3NF

pupil (pupil code
name
tutor group
year
year head)

enrolment (set*
pupil code*)

set (set
subject
teacher
room)

3NF

pupil (pupil code
name
tutor group*)

tutor group (tutor group
year
year head)

enrolment (set*
pupil code*)

set (set
subject
teacher
room)

3NF

Pupil

Code	Name	Tutor group
29865	Greg Dike	5PW
73645	Susan Smith	5CV
42315	Teresa Jewel	5PW
65748	Mark Hall	3PV
42736	Ann Rees	2PW

Enrolment

Set	Pupil Code
5.2.2	29865
5.1.3	29865
5.2.2	42315
5.5.2	42315
3.2.2	74563
5.2.2	45673
5.1.5	46654

Set

Set	Subject	Teacher	Room
5.2.2	English	Mr Dunn	4
5.1.3	Maths	Ms Napier	13
5.5.2	Art & Design	Mr Angelo	38
3.2.2	English	Mr Dunn	5
5.1.5	Maths	Mr Wright	26

Tutor Group

Tutor group	Year	Year Head
5PW	5	Mr Niven
5CV	5	Mr Niven
3PV	3	Miss Dent
2PW	2	Mr Peel

Although 3NF has been applied there is still a further non-key dependancy.
Consider the tutor table.
Knowing the year will give the year head.
This should be removed. (Look at the duplication of year and year head info).

3NF

pupil (pupil code
name
tutor group*)

tutor group (tutor group
year
year head)

enrolment (set*
pupil code*)

set (set
subject
teacher
room)

3NF

pupil (pupil code
name
tutor group*)

tutor group (tutor group
year)

year (year
year head)

enrolment (set*
pupil code*)

set (set
subject
teacher
room)

3NF

Pupil

Code	Name	Tutor group*
29865	Greg Dike	5PW
73645	Susan Smith	5CV
42315	Teresa Jewel	5PW
65748	Mark Hall	3PV
42736	Ann Rees	2PW

Enrolment

Set*	Pupil Code*
5.2.2	29865
5.1.3	29865
5.2.2	42315
5.5.2	42315
3.2.2	74563
5.2.2	45673
5.1.5	46654

Tutor Group

Tutor group	Year*
5PW	5
5CV	5
3PV	3
2PW	2

Set

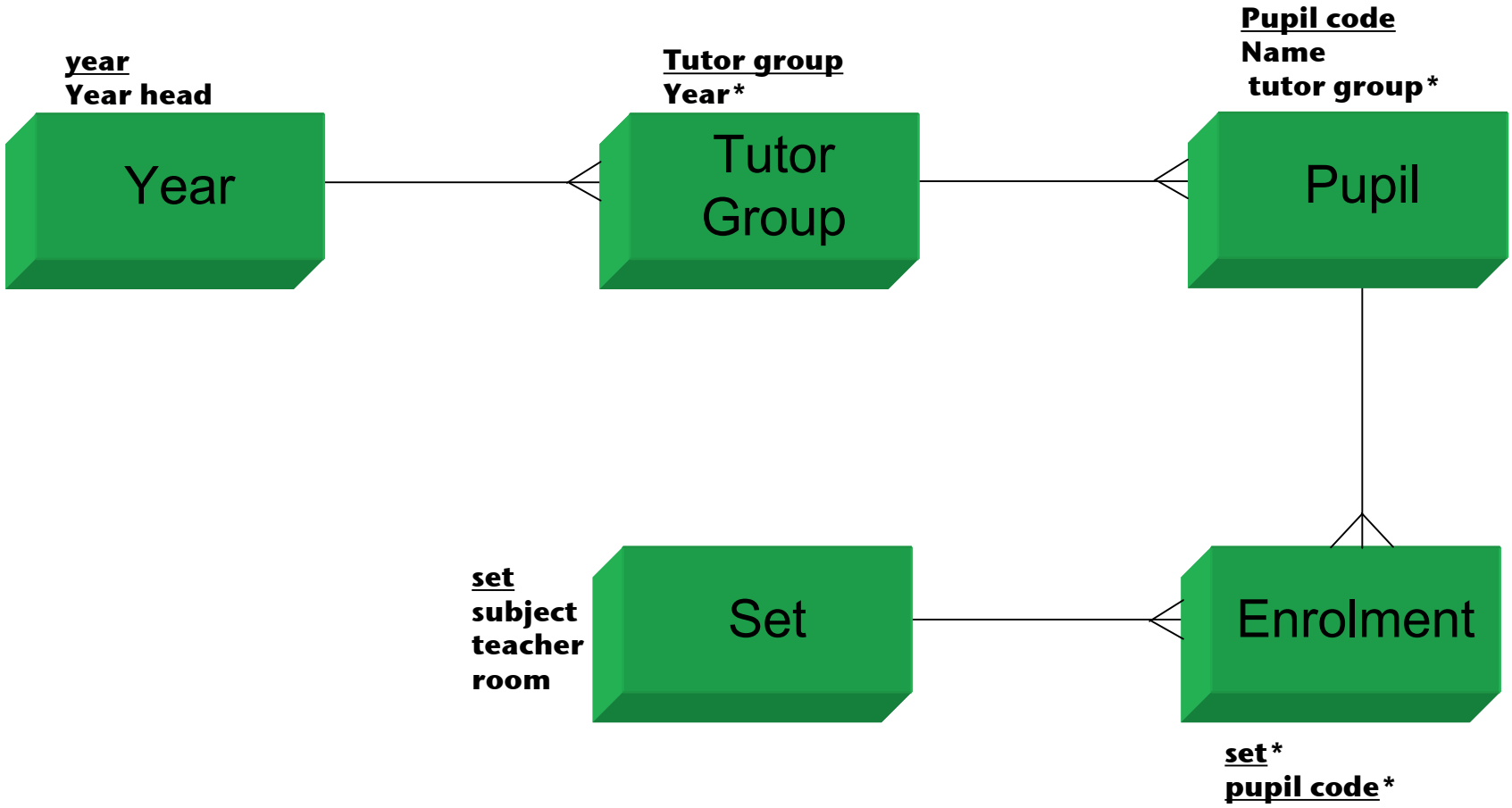
Set	Subject	Teacher	Room
5.2.2	English	Mr Dunn	4
5.1.3	Maths	Ms Napier	13
5.5.2	Art & Design	Mr Angelo	38
3.2.2	English	Mr Dunn	5
5.1.5	Maths	Mr Wright	26

Year

Year	Year Head
5	Mr Niven
3	Miss Dent
2	Mr Peel

For relationships, remember the informal rule: Start in an entity with no foreign keys.
Then match keys to foreign keys.

E/R Diagram



"One year has many tutor groups.
One tutor group comprises many pupils.
One pupil makes many enrolments.
One set contains many enrolments.".

3NF

Pupil

Code	Name	Tutor group*
29865	Greg Dike	5PW
73645	Susan Smith	5CV
42315	Teresa Jewel	5PW
65748	Mark Hall	3PV
42736	Ann Rees	2PW

Enrolment

Set*	Pupil Code*
5.2.2	29865
5.1.3	29865
5.2.2	42315
5.5.2	42315
3.2.2	74563
5.2.2	45673
5.1.5	46654

Tutor Group

Tutor group	Year*
5PW	5
5CV	5
3PV	3
2PW	2

Set

Set	Subject	Teacher	Room
5.2.2	English	Mr Dunn	4
5.1.3	Maths	Ms Napier	13
5.5.2	Art & Design	Mr Angelo	38
3.2.2	English	Mr Dunn	5
5.1.5	Maths	Mr Wright	26

Year

Year	Year Head
5	Mr Niven
3	Miss Dent
2	Mr Peel