## Normalisation Example

**EXAMPLE::1**

### Student Example

The following table depicts the set of attribute found in a University database:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Student-No** | **Student-Name** | **Course-Code** | **Course-Length** (yrs) | **Unit-Code** | **Unit-Name** | **Lecturer** |
| 001 | Smith | A203 | 3 | U45 U87 | Databases II  Programming | Brown Green |
| 003 | Soap | A104 | 4 | U86 U45 U25 | Algorithms  Databases II  Business I | Purple Brown Red |
| 007 | Who | A203 | 3 | U12 U46 | Business II  Databases I | Pink Orange |
| 010 | Lemon | A323 | 2 | U12 U86 | Business II  Algorithms | Pink Purple |

**Notes**: A student attends one course and can take any units during the course. A unit may be presented as part of any course and is always given by one particular lecturer.

You are required to show the first, second and third normal forms. Explain the normalisation process used.

## Answer

### First Normal Form

"Remove repeating groups"

1. The attribute chosen as the primary key is student-no.
2. The set of attributes which repeat for each value of student-no are unit-code, unit-name, and lecturer.
3. Removing these attributes from the full attribute set produces the relation:

(student-no, student-name, course-code, course-length)

1. The primary key is student-no.

(student-no, student-name, course-code, course-length)

1. The primary key for the repeating group is unit-code. This is because for each student\_no the unit-code uniquely identifies the unit-name and lecturer attributes. For example, for student 001, unit U45 is always 'Databases II' and the lecturer is always 'Brown'.
2. The new relation is:

(student-no, unit-code, unit-name, lecturer)

1. The attribute unit-code is not unique in this relation and so the key of this relation is (student-no, unit-code).

(student-no, unit-code, unit-name, lecturer)

1. There are no more repeating groups.

The first normal form relations are:

student1(student-no, student-name, course-code, course-length)

takes1(student-no, unit-code, unit-name, lecturer)

### Second Normal Form

"Remove partial dependencies"

The student1 relation does not have a composite primary key and, therefore, cannot contain partial dependencies. The takes1 relation has the following dependencies:

|  |  |
| --- | --- |
| student-no, unit-code -> unit-name, lecturer | The primary key determines all attributes. |
| unit-code ->unit-name | Each unit has a name. |
| unit-code -> lecturer | Each unit is taught by the same lecturer. |

Therefore, a partial dependency exists between unit-code and unit-name and lecturer. Removing the partial dependencies from takes1 (but not changing the key of takes1) produces the relations:

takes2(student-no, unit-code)

unit2(unit-code, unit-name, lecturer)

The second normal form relations are:

student2(student-no, student-name, course-code, course-length)

takes2(student-no, unit-code)

unit2(unit-code, unit-name, lecturer)

### Third Normal Form

"Remove transitive dependencies"

The student2 relation has the following functional dependencies:

|  |  |
| --- | --- |
| student-no -> student-name, course-code, course-length | The primary key determines all attributes. |
| course-code -> course-length | The course length is determined by the course. |

Therefore, the following transitive dependency exists:

student-no -> course-code -> course-length

Removing this transitive dependency from student2 produces the following relations:

student3(student-no, student-name, course-code)

course3(course-code, course-length)

The takes2 relation contains no non-key attributes and so contains no transitive dependencies. The unit2 relation contains the following dependencies:

|  |  |
| --- | --- |
| unit-code -> unit-name, lecturer | The primary key determines all attributes. |

Therefore, there are no transitive dependencies in unit2. The set of third normal form relations are:

student3(student-no, student-name, course-code)

course3(course-code, course-length)

takes3(student-no, unit-code)

unit3(unit-code, unit-name, lecturer)