**Normalisation Workbook**

**First Normal Form (1NF)**

The rules for 1NF:

* Each data item cannot be broken down any further i.e. it is ‘atomic’
* Each row/record is unique and has a primary key
* There are no records with repeating data
* Each field should be unique

1. **Atomic data**

**Rule 1:** Each data item cannot be broken down any further i.e. it is ‘atomic’

State whether the following examples are atomic or non atomic

|  |  |
| --- | --- |
| **Data** | **Atomic or non atomic** |
| Miss Jane Green | Non-atomic |
| 9 Oak Crescent, Warwick | Non-atomic |
| Teacher | Non-atomic |
| 01926 123456 | Non-atomic |
| King George IV School London | Non-atomic |
| CV11 9NB | Atomic (arguably Non-atomic) |
| Keyboard | Atomic |
| Star Trek 12A | Non-atomic |
| Jaguar XJS | Non-atomic |
| Buckingham Palace | Atomic |
| Supersize cheeseburger | Non-atomic |

Change the following examples of non atomic data into atomic data

|  |  |
| --- | --- |
| **Non Atomic** | **Atomic** |
| Name: Sally Chadwick | First name: Sally  Surname: Chadwick |
| Address: 9 Oak Crescent, Snitterfield, CV11 9NB | Street Number:9  Street: Oak Crescent  Town: Snitterfield  Postcode: CV11 9NB |
| King George IV School London | Name: King George IV  Organisation: School  Region: London |
| Star Trek 12A | Program: Star Trek  Classifcation: 12A |
| Jaguar XJS | Make: Jaguar  Model: XJS |

1. **Rule 2:** Each row/record is unique and has a primary key

The records below have no primary key. Choose a suitable primary key and complete the table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PersonID** | **Title** | **First Name** | **Surname** | **Dob** |
| 1 | Mr | James | Smith | 14/05/57 |
| 2 | Miss | Emma | White | 21/11/78 |

The records below have no primary key. Choose a suitable primary key and complete the table.

|  |  |  |  |
| --- | --- | --- | --- |
| **FilmID** | **FilmTitle** | **Rating** | **Genre** |
| 1 | Star Trek | 12A | Sci Fi |
| 2 | The Little Mermaid | U | Children |

1. **Rule 3:** There are no records with repeating data

Look at the tables below and answer the questions:

Table 1:

|  |  |  |  |
| --- | --- | --- | --- |
| **ID\*** | **Title** | **Surname** | **Telephone no** |
| 001 | Miss | Smith | 01234 567890 |
| 002 | Miss | White | 01234 890123 |
| 003 | Miss | James | 01234 798453 |
| 004 | Miss | Green | 01234 578345 |

Is this table in 1NF? Yes No

Reason: Area code of telephone numbers repeat (although likelihood is that other area codes will be listed and therefore the above is in 1NF)

Table 2:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID\*** | **Title** | **Surname** | **Full Name** | **Telephone no** |
| 001 | Mrs | Field | Mrs Field | 01234 523645 |
| 002 | Miss | White | Miss White | 01234 890123 |
| 003 | Mr | Hancock | Mr Hancock | 01234 989654 |
| 004 | Miss | Green | Miss Green | 01234 578345 |

Is this table in 1NF? Yes No

Reason: Full name is not atomic, and repeats Title and Srurname attributes

Table 3:

|  |  |  |  |
| --- | --- | --- | --- |
| **ID\*** | **Title** | **Surname** | **Email** |
| 001 | Mrs | Field | field.m@yahoo.com |
| 002 | Miss | White | White123@hotmail.com [white\_a@btinternet.com](mailto:white_a@btinternet.com) |
| 003 | Mr | Hancock | Hancock1982@aol.com |
| 004 | Miss | Green | alisongreen@btinternet.com [greenam@yahoo.com](mailto:greenam@yahoo.com) |

Is this table in 1NF? Yes No

Reason: Repeated attributes/data (email address)

1. **Rule 4:** Each field name should be unique

Look at the tables below and answer the questions:

Table 1:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ID\*** | **Title** | **Surname** | **Telephone no** | **Telephone no** | **Telephone no** |
| 001 | Mr | Smith | 01234 567890 | 01234 789123 | 01234 345678 |
| 002 | Miss | White | 01234 890123 | 01234 456789 | 01234 213456 |

Is this table in 1NF? Yes No

Reason: **Telephone no** attribute/field is not unique

Table 2:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ID\*** | **FirstName** | **Surname** | **Course** | **Module** | **Module** |
| 00123 | Tamsin | Wall | Business Studies | Accounts | Economics |
| 00245 | Steven | Weeks | Business Studies | Operations Management | Business Law |

Is this table in 1NF? Yes No

Reason: **Module** attribute/field is not unique

1. **Identifying tables in First Normal Form (1NF)**

Remembering all of the rules of First Normal Form, identify which of the following tables are in 1NF. Explain your reason

Example 1:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Title** | **FirstName** | **Surname** | **Address** | **City** | **Postcode** |
| Mr | Tom | Smith | 42 Mill Street | London | SE31 1WE |

Is this table in 1NF? Yes No

Reason: No primary key

Example 2:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ID\*** | **Username** | **Last accessed** | **Activity** | **Result** | **AccountActive** |
| 1003 | Smithj08 | 2009 06 21: 14:03 | Save file | Success | Y |

Is this table in 1NF? Yes No

Reason: Ignoring the dodgy date format, Activity and Account are different entities and so should be in their own tables.

Example 3:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **ItemID\*** | **Product** | **Description** | **Size** | **Colour** | **Colour** | **Colour** |
| 234 | Shoe | High Heel | 6 | Red | Blue | Green |

Is this table in 1NF? Yes No

Reason: **Colour** attribute is repeated so field is not unique

Example 4:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **StudentID\*** | **FirstName** | **Surname** | **SchoolID** | **ClassID** |
| 354 | Tom | James | 016 | 5F |

Is this table in 1NF? Yes No

Reason: All rules are observed. Has primary key, no repeated attributes, and attributes are atomic (but what would be in these rows if we added more classes for this student?)

**Second Normal Form (2NF)**

The rules for 2NF:

* The table must be in 1NF
* Non-key attributes must depend on every part of the primary key

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Venue\*** | **Artist\*** | **Date\*** | **Attendance** | **Profit** | **Style** |
| Wembley | Girls Aloud | 14/05/09 | 23000 | 12334 | Girl band |
| NEC | Leona Lewis | 18/05/09 | 15000 | 43025 | Female soloist |

Identify the key attributes in this table:

Venue, Artist and Date

Identify the non-key attributes in this table:

Attendance, Profit and Style

Does every non-key attribute depend on every key attribute?

No, Style only depends on the Artist part of the composite key

If your answer above was no, is this table in 2NF?

No

If it is not in 2NF, identify which non-key attribute does not depend on one of the key attributes.

Answer: Style does not depend on Venue or Date

Redesign this database so that it is in 2NF

CONCERT:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Venue\*** | **ArtistID\*** | **Date\*** | **Attendance** | **Profit** |
| Wembley | 1 | 14/05/09 | 23000 | 12334 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NEC | 2 | 18/05/09 | 15000 | 43025 |

ARTIST:

|  |  |  |
| --- | --- | --- |
| ArtistID\* | **StyleID** | **Artist** |
| 1 | 1 | Girls Aloud |

|  |  |  |
| --- | --- | --- |
| 2 | 2 | Leona Lewis |

STYLE:

|  |  |
| --- | --- |
| StyleID\* | **Style** |
| 1 | Girl band |

|  |  |
| --- | --- |
| 2 | Female soloist |

1. **2NF another example**

COURSES:

|  |  |  |  |
| --- | --- | --- | --- |
| **CourseID\*** | **Term\*** | **PlacesAvailable** | **CourseTitle** |
| 001 | Autumn | 50 | Computing |
| 001 | Spring | 40 | Computing |
| 001 | Summer | 45 | Computing |
| 002 | Autumn | 100 | ICT |
| 002 | Spring | 90 | ICT |
| 003 | Summer | 100 | Robotics |

Identify the key attributes in this table:

CourseID, Term

Identify the non-key attributes in this table:

PlacesAvailable, CourseTitle

Does every non-key attribute depend on every key attribute? Explain your answer

No, CourseTitle only depends on CourseID and does not depend on Term

Redesign this database so that it is in 2NF

COURSES AVAILABLE:

|  |  |  |
| --- | --- | --- |
| **CourseID\*** | **Term\*** | **PlacesAvailable** |
| 001 | Autumn | 50 |

|  |  |  |
| --- | --- | --- |
| 001 | Spring | 40 |
| 001 | Summer | 45 |
| 002 | Autumn | 100 |
| 002 | Spring | 90 |
| 003 | Summer | 100 |

COURSE:

|  |  |
| --- | --- |
| **CourseID\*** | **CourseTitle** |
| 001 | Computing |

|  |  |
| --- | --- |
| 002 | ICT |
| 003 | Robotics |

10.

**Third Normal Form (3NF)**

The rules for 3NF:

* The table must be in 2NF
* There are no non-key attributes that depend on another non-key attribute
* Every non-key attribute is non-transitively dependent on the primary key

**Example 1: Concert table**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Venue\*** | **Artist\*** | **Date\*** | **Attendance** | **Profit** | **City** | **Country** |
| Wembley | Girls Aloud | 14/05/09 | 23000 | 12334 | London | UK |
| NEC | Leona Lewis | 18/05/09 | 15000 | 43025 | Birmingham | UK |
| Carnegie Hall | Girls Aloud | 20/05/09 | 13453 | 16785 | New York | USA |

Key attributes: Venue, Artist, Date

Non-key attributes: Attendance, Profit, City, Country

The table is in not in 2NF as ‘City’ only depends on the ‘Venue’ part of the key and it is not in 3NF because ‘Country’ could be derived from ‘City’

Country could be stored in another table e.g.

|  |  |
| --- | --- |
| **City\*** | **Country** |
| London | UK |
| Birmingham | UK |
| New York | USA |

The new table called ‘countries’ has City as the primary key and ‘country’ as an attribute.

The concert table has ‘city’ as a foreign key. Now there is no redundant data.

**3NF – an example**

COURSES AVAILABLE:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CourseID\*** | **Term\*** | **PlacesAvailable** | **TeacherID** | **Teacher** |
| 001 | Autumn | 50 | 024 | Mrs White |
| 001 | Spring | 40 | 024 | Mrs White |
| 001 | Summer | 45 | 019 | Mr Brown |
| 002 | Autumn | 100 | 024 | Mrs White |
| 002 | Spring | 90 | 031 | Miss Green |
| 003 | Summer | 100 | 026 | Mr Black |

Is this table in 3NF?

No

If you answered ‘no’, explain your reason.

Non-key attribute Teacher depends on the non-key attribute TeacherID.

Redesign this database so that it is in 3NF

COURSES AVAILABLE

|  |  |  |  |
| --- | --- | --- | --- |
| **CourseID\*** | **Term\*** | **PlacesAvailable** | **TeacherID** |
| 001 | Autumn | 50 | 024 |

|  |  |  |  |
| --- | --- | --- | --- |
| 001 | Spring | 40 | 024 |
| 001 | Summer | 45 | 019 |
| 002 | Autumn | 100 | 024 |
| 002 | Spring | 90 | 031 |
| 003 | Summer | 100 | 026 |

TEACHER

|  |  |
| --- | --- |
| **TeacherID** | **Teacher** |
| 024 | Mrs White |

|  |  |
| --- | --- |
| 019 | Mr Brown |
| 031 | Miss Green |
| 026 | Mr Black |