**Databases**

**Laboratory work 5**

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**Task 2. Given table in 1NF, convert to 3NF if PK is UnitID and StudentID:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UnitID** | **StudentID** | **Date** | **TutorID** | **Topic** | **Room** | **Grade** | **Book** | **TutEmail** |
| U1 | St1 | 23.02.03 | Tut1 | GMT | 629 | 4.7 | Deumlich | tut1@fhbb.ch |
| U2 | St1 | 18.11.02 | Tut3 | GIn | 631 | 5.1 | Zehnder | tut3@fhbb.ch |
| U1 | St4 | 23.02.03 | Tut1 | GMT | 629 | 4.3 | Deumlich | tut1@fhbb.ch |
| U5 | St2 | 05.05.03 | Tut3 | PhF | 632 | 4.9 | Dümmlers | tut3@fhbb.ch |
| U4 | St2 | 04.07.03 | Tut5 | AVQ | 621 | 5.0 | SwissTopo | tut5@fhbb.ch |

**Solution:**

To convert this table to 3NF, first of all, we should convert it to the 2nd normal form. That is:

1. The table should be in the First Normal Form.
2. There should be no Partial Dependency.

2nd NF of the tables:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UnitID** | **StudentID** | **Date** | **Topic** | **Room** | **Grade** | **Book** | **TutorID** |
| U1 | St1 | 23.02.03 | GMT | 629 | 4.7 | Deumlich | Tut1 |
| U2 | St1 | 18.11.02 | GIn | 631 | 5.1 | Zehnder | Tut3 |
| U1 | St4 | 23.02.03 | GMT | 629 | 4.3 | Deumlich | Tut1 |
| U5 | St2 | 05.05.03 | PhF | 632 | 4.9 | Dümmlers | Tut3 |
| U4 | St2 | 04.07.03 | AVQ | 621 | 5.0 | SwissTopo | Tut5 |

|  |  |
| --- | --- |
| **TutorID** | **TutEmail** |
| Tut1 | tut1@fhbb.ch |
| Tut3 | tut3@fhbb.ch |
| Tut5 | tut5@fhbb.ch |

Then, for a table to be in the third normal form:

1. It should be in the Second Normal form.
2. And it should not have Transitive Dependency.

3nd NF of the tables:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UnitID** | **StudentID** | **Date** | **Room** | **Grade** | **TopicID** | **TutorID** |
| U1 | St1 | 23.02.03 | 629 | 4.7 | Top1 | Tut1 |
| U2 | St1 | 18.11.02 | 631 | 5.1 | Top2 | Tut3 |
| U1 | St4 | 23.02.03 | 629 | 4.3 | Top1 | Tut1 |
| U5 | St2 | 05.05.03 | 632 | 4.9 | Top3 | Tut3 |
| U4 | St2 | 04.07.03 | 621 | 5.0 | Top4 | Tut5 |

|  |  |
| --- | --- |
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| Tut1 | tut1@fhbb.ch |
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| Tut5 | tut5@fhbb.ch |

|  |  |  |
| --- | --- | --- |
| **TopicID** | **Topic** | **Book** |
| Top1 | GMT | Deumlich |
| Top2 | GIn | Zehnder |
| Top3 | PhF | Dümmlers |
| Top4 | AVQ | SwissTopo |

**Task 3. Given table in 1NF, convert to 2NF if PK is {ProjectName, ProjectManager}, use decomposition:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ProjectName** | **ProjectManager** | **Position** | **Budget** | **TeamSize** |
| Project1 | Manager1 | CTO | 1 kk $ | 15 |
| Project2 | Manager2 | CTO2 | 1.5 kk $ | 12 |

**Solution:**

Here, **Position** depends on **ProjectManager** but not **ProjectName**. So, that is a partial dependency. To reduce it we use a decomposition method like shown below.

|  |  |  |  |
| --- | --- | --- | --- |
| **ProjectName** | **ProjectManager** | **Budget** | **TeamSize** |
| Project1 | Manager1 | 1 kk $ | 15 |
| Project2 | Manager2 | 1.5 kk $ | 12 |

|  |  |
| --- | --- |
| **ProjectManager** | **Position** |
| Manager1 | CTO |
| Manager2 | CTO2 |

**Task 4. Given table, convert to 3NF if PK is Group, use decomposition:**

*Faculties have a number of specialties; each specialty consists of a set of particular groups.*

|  |  |  |
| --- | --- | --- |
| **Group** | **Faculty** | **Specialty** |
| g1 | f1 | s1 |
| g2 | f2 | s2 |

**Solution:**

|  |  |
| --- | --- |
| **Group** | **S\_F\_ID** |
| g1 | 1 |
| g2 | 2 |

|  |  |  |
| --- | --- | --- |
| **S\_F\_ID** | **Faculty** | **Specialty** |
| 1 | f1 | s1 |
| 2 | f2 | s2 |

**Task 5. Given table, convert to BCNF if PK is {ProjectID, Department}, use decomposition:**

*Curator depends on* ***ProjectID*** *and related departments,* ***TeamSize*** *directly relates to project and related departments,* ***ProjectGroupsNumber*** *depends on* ***TeamSize****.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ProjectID** | **Department** | **Curator** | **TeamSize** | **ProjectGroupsNumber** |
| p1 | d1 | e1 | 100 | 5 |
| p2 | d2 | e2 | 120 | 6 |

**Solution:**

In this task, first of all, we see a transitive dependency, i.e. **ProjectGroupsNumber** depends on **TeamSize**, that depends on {**ProjectID**, **Department**}. From the definition of Boyce-Codd Normal Form (BCNF), we have:

1. It should be in the Third Normal Form.
2. And, for any dependency A → B, A should be a super key.

Hence, before BCNF, we should convert actual table to 3rd NF, because of transitive dependency. The reduced form looks like:

|  |  |  |  |
| --- | --- | --- | --- |
| **ProjectID** | **Department** | **Curator** | **TeamID** |
| p1 | d1 | e1 | t1 |
| p2 | d2 | e2 | t2 |

|  |  |  |
| --- | --- | --- |
| **TeamID** | **TeamSize** | **ProjectGroupsNumber** |
| t1 | 100 | 5 |
| t2 | 120 | 6 |

Then, if we look at the first table, we can see that,

{**ProjectID**, **Department**} 🡪 **Curator**

**Curator** 🡪 **ProjectID**

So, here we have that **Curator** is not a super key, therefore the first table is not in BCNF. To convert it to BCNF we should decompose it:

|  |  |
| --- | --- |
| **Department** | **Curator** |
| d1 | e1 |
| d2 | e2 |

|  |  |  |
| --- | --- | --- |
| **Curator** | **ProjectID** | **TeamID** |
| e1 | p1 | t1 |
| e2 | p2 | t2 |

|  |  |  |
| --- | --- | --- |
| **TeamID** | **TeamSize** | **ProjectGroupsNumber** |
| t1 | 100 | 5 |
| t2 | 120 | 6 |

That's all of laboratory work 5.