**Normalization Tasks and Solutions – 01**

11 Nov 2020 / Dr. Mahammad Sharifov

**TASK-1:** Normalize below given table to proper schema (up to 2NF)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **staffNo** | **name** | **position** | **salary** | **branchNo** | **branchAddress** | **telNo** |
| *S1500* | *Tom Daniels* | *manager* | *46000* | *B001* | *8 Jefferson, Portland, OR 97201* | *503-555-3618* |
| *S0003* | *Sally Adams* | *assistant* | *30000* | *B001* | *8 Jefferson, Portland, OR 97201* | *503-555-3618* |
| *S0010* | *Mary Martinez* | *manager* | *50000* | *B002* | *City Center, Seattle, WA 98122* | *206-555-6756* |
| *S3250* | *Robert Chin* | *supervisor* | *32000* | *B002* | *City Center, Seattle, WA 98122* | *206-555-6756* |
| *S2250* | *Sally Stern* | *manager* | *48000* | *B004* | *16th Avenue, Seattle, WA 98128* | *205-555-3131* |
| *S0415* | *Art Peters* | *manager* | *41000* | *B003* | *14th Avenue, New York, NY 1001* | *212-371-3000* |

**Problem:**

**StaffBranch** table has redundant data; **the details of a branch** are repeated for every member of staff for example row 1 and 2, row 3 and 4 on *branchNo*, *branchAddress* and *telNo*.

**Solution:**

The branch information appears only once for each branch in the **Branch** table and only the branch number (*branchNo*) is repeated in the **Staff** table, to represent where each member of staff is located.

***Staff Table***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **staffNo** | **name** | **position** | **salary** | **branchNo** |
| *S1500* | *Tom Daniels* | *manager* | *46000* | *B001* |
| *S0003* | *Sally Adams* | *assistant* | *30000* | *B001* |
| *S0010* | *Mary Martinez* | *manager* | *50000* | *B002* |
| *S3250* | *Robert Chin* | *supervisor* | *32000* | *B002* |
| *S2250* | *Sally Stern* | *manager* | *48000* | *B004* |
| *S0415* | *Art Peters* | *manager* | *41000* | *B003* |

***Branch Table***

|  |  |  |
| --- | --- | --- |
| **branchNo** | **branchAddress** | **telNo** |
| *B001* | *8 Jefferson, Portland, OR 97201* | *503-555-3618* |
| *B002* | *City Center, Seattle, WA 98122* | *206-555-6756* |
| *B004* | *16th Avenue, Seattle, WA 98128* | *205-555-3131* |
| *B003* | *14th Avenue, New York, NY 1001* | *212-371-3000* |

**TASK-2:** Normalize below given table to proper schema

|  |  |  |
| --- | --- | --- |
| **branchNo** | **branchAddress** | **telNos** |
| *B001* | *8 Jefferson, Portland, OR 97201* | *503-555-3618, 505-555-2727, 303-555-3333* |
| *B002* | *City Center, Seattle, WA 98122* | *206-555-6756, 202-222-3344* |
| *B004* | *16th Avenue, Seattle, WA 98128* | *205-555-3131* |
| *B003* | *14th Avenue, New York, NY 1001* | *212-371-3000, 404-222-3435* |

**Problem:**

Records in *telNos* columns are not single, they are multi. So, it is violating 1NF rules.

**Solution:**

Remove *telNos* column and create new column called *telNo* in the new table.

***Branch (1NF)***

|  |  |
| --- | --- |
| **branchNo** | **branchAddress** |
| *B001* | *8 Jefferson, Portland, OR 97201* |
| *B002* | *City Center, Seattle, WA 98122* |
| *B004* | *16th Avenue, Seattle, WA 98128* |
| *B003* | *14th Avenue, New York, NY 1001* |

***BranchTelephone (1NF)***

|  |  |
| --- | --- |
| **branchNo** | **telNo** |
| *B001* | *503-555-3618* |
| *B001* | *505-555-2727* |
| *B001* | *303-555-3333* |
| *B002* | *206-555-6756* |
| *B002* | *202-222-3344* |
| *B003* | *205-555-3131* |
| *B004* | *212-371-3000* |
| *B004* | *404-222-3435* |

**TASK-3:**

1. Why is this table not in 2NF?

2. Describe and illustrate the process of normalizing the data shown in this table to third normal form (3NF).

3. Identify the primary, (alternate) and foreign keys in your 3NF relations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **staffNo** | **branchNo** | **branchAddress** | **name** | **position** | **hoursPerWeek** |
| *S4555* | *B002* | *8 Jefferson, Portland, OR 97201* | *Ellen Layman* | *assistant* | *16* |
| *S4555* | *B004* | *City Center, Seattle, WA 98122* | *Ellen Layman* | *assistant* | *9* |
| *S4612* | *B002* | *8 Jefferson, Portland, OR 97201* | *Dave Sinclair* | *assistant* | *14* |
| *S4612* | *B004* | *City Center, Seattle, WA 98122* | *Dave Sinclair* | *assistant* | *10* |

**Problem:**

* *staffNo* and *branchNo* columns together forms composite primary key.
* Values in *branchAddress* column can be worked out from only *branchNo*, so table not in 2NF
* Values in *name* and *position* columns can be worked out from only *staffNo*, so table not in 2NF
* Values in *hoursPerWeek* column can only be worked out from *staffNo* and *branchNo*

**Solution:**

***Branch table (2NF)***

|  |  |
| --- | --- |
| **branchNo** | **branchAddress** |
| *B002* | *8 Jefferson, Portland, OR 97201* |
| *B004* | *City Center, Seattle, WA 98122* |

***Staff table (2NF)***

|  |  |  |
| --- | --- | --- |
| **staffNo** | **name** | **position** |
| *S4555* | *Ellen Layman* | *assistant* |
| *S4612* | *Dave Sinclair* | *assistant* |

***Working table (2NF)***

|  |  |  |
| --- | --- | --- |
| **staffNo** | **branchNo** | **hoursPerWeek** |
| *S4555* | *B002* | *16* |
| *S4555* | *B004* | *9* |
| *S4612* | *B002* | *14* |
| *S4612* | *B004* | *10* |

**TASK-4:**

1. Why is this table not in 3NF?

2. Describe and illustrate the process of normalizing the data shown in this table to third normal form (3NF).

3. Identify the primary, (alternate) and foreign keys in your 3NF relations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **branchNo** | **branchAddress** | **telNo** | **mgrStaffNo** | **name** |
| *B001* | *8 Jefferson Way, Portland, OR 97201* | *503-555-3618* | *S1500* | *Tom Daniels* |
| *B002* | *City Center Plaza, Seattle, WA 98122* | *206-555-6756* | *S0010* | *Mary Martinez* |
| *B003* | *14 – 8th Avenue, New York, NY 10012* | *212-371-3000* | *S0145* | *Art Peters* |
| *B004* | *16 – 14th Avenue, Seattle, WA 98128* | *206-555-3131* | *S2250* | *Sally Stern* |

**Problem:**

* Values in *branchAddress*, *telNo*, *mgrStaffNo*, and name columns can be worked out from *branchNo* *(primary key)*
* Values in *name* column can also be worked out from *mgrStaffNo* *(non-primary-key column)*, so table not in 3NF

**Solution:**

***Branch table (3NF)***

|  |  |  |  |
| --- | --- | --- | --- |
| **branchNo** | **branchAddress** | **telNo** | **mgrStaffNo** |
| *B001* | *8 Jefferson Way, Portland, OR 97201* | *503-555-3618* | *S1500* |
| *B002* | *City Center Plaza, Seattle, WA 98122* | *206-555-6756* | *S0010* |
| *B003* | *14 – 8th Avenue, New York, NY 10012* | *212-371-3000* | *S0145* |
| *B004* | *16 – 14th Avenue, Seattle, WA 98128* | *206-555-3131* | *S2250* |

***Manager table (3NF)***

|  |  |
| --- | --- |
| **mgrStaffNo** | **name** |
| *S1500* | *Tom Daniels* |
| *S0010* | *Mary Martinez* |
| *S0145* | *Art Peters* |
| *S2250* | *Sally Stern* |

TASK – 5:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***StudentID*** | ***CourseID*** | ***CourseName*** | ***CreditHours*** | ***PassingGrade*** | ***StdMark*** |
| *S01234* | *ITSE1100* | *Multimedia* | *6* | *D* | *60* |
| *S01234* | *ITNT1103* | *Hardware* | *5* | *C* | *70* |
| *S01234* | *ITDB1102* | *Database* | *5* | *C* | *50* |
| *S01235* | *ITSE1100* | *Multimedia* | *6* | *D* | *70* |
| *S01235* | *ITNT1103* | *Hardware* | *5* | *C* | *80* |

**Solution:**

StudentCourse { StudID, CourseID, StudMark }

Course { CourseID, CourseName, CreditHours, PassingGrade }

|  |  |  |  |
| --- | --- | --- | --- |
| ***CourseID*** | ***CourseName*** | ***CreditHours*** | ***PassingGrade*** |
| *ITSE1100* | *Multimedia* | *6* | *D* |
| *ITNT1103* | *Hardware* | *5* | *C* |
| *ITDB1102* | *Database* | *5* | *C* |

|  |  |  |
| --- | --- | --- |
| ***StudentID*** | ***CourseID*** | ***StdMark*** |
| *S01234* | *ITSE1100* | *60* |
| *S01234* | *ITNT1103* | *70* |
| *S01234* | *ITDB1102* | *50* |
| *S01235* | *ITSE1100* | *70* |
| *S01235* | *ITNT1103* | *80* |

TASK – 6:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Stud ID*** | ***Firstname*** | ***Lastname*** | ***Marital Status*** | ***Course Title*** | ***Fee*** | ***Qualfication*** | ***Grade*** |
| *1* | *Kevin* | *Drum* | *Single* | *Computer Science* | *2000* | *Advanced level* | *A* |
| *1* | *Kevin* | *Drum* | *Single* | *Mathematics* | *1500* | *Advanced level* | *B* |
| *1* | *Kevin* | *Drum* | *Single* | *Physics* | *1800* | *Advanced level* | *C* |
| *2* | *Murvin* | *Drake* | *Single* | *Physics* | *1800* | *Advanced level* | *B* |
| *2* | *Murvin* | *Drake* | *Single* | *Chemistry* | *1800* | *Advanced level* | *C* |
| *3* | *John* | *Johnson* | *Single* | *Music* | *1200* | *Diploma* | *C* |
| *4* | *Sally* | *Jones* | *Single* | *Biology* | *1000* | *Certificate* | *A* |
| *4* | *Sally* | *Jones* | *Single* | *Economics* | *1500* | *Diploma* | *B* |
| *5* | *David* | *Smith* | *Married* | *Mathematics* | *2500* | *Advanced level* | *C* |
| *5* | *David* | *Smith* | *Married* | *Physics* | *1800* | *Advanced level* | *D* |