CS3402 Tutorial 4:

1. Examine the table shown below.

**Branch**

|  |  |  |
| --- | --- | --- |
| BranchNo | BranchAddress | TelNo |
| B001 | 8 Jefferson Way, Portland, OR 97201 | 503-555-3618, 503-555-2727, 503-555-6534 |
| B002 | City Center Plaza, Seattle, WA 98122 | 206-555-6756, 206-555-8836 |
| B003 | 14 – 8th Avenue, New York, NY 10012 | 212-371-3000 |
| B004 | 16 – 14th Avenue, Seattle, WA 98128 | 206-555-3131, 206-555-4112 |

1. Why this table is not in 1NF?
2. Describe and illustrate the process of normalizing the data shown in this table to third normal form (3NF).
3. Examine the table shown below.

**StaffBranchAllocation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| StaffNo | BranchNo | BranchAddress | Name | Position | HoursPerWeek |
| S4555 | B002 | City Center Plaza, Seattle, WA 98122 | Ellen Layman | Assistant | 16 |
| S4555 | B004 | 16 – 14th Avenue, Seattle, WA 98128 | Ellen Layman | Assistant | 9 |
| S4612 | B002 | City Center Plaza, Seattle, WA 98122 | Dave Sinclair | Assistant | 14 |
| S4612 | B004 | 16 – 14th Avenue, Seattle, WA 98128 | Dave Sinclair | Assistant | 10 |

<StaffNo, Branch> is the primary key.

<StaffNo> -> <Name, Position>; <BranchNo> -> <BranchAddress>

1. Why this table is not in 2NF?
2. Describe and illustrate the process of normalizing the data shown in this table to third normal form (3NF).
3. Examine the table shown below.

**BranchManager**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| BranchNo | BranchAddress | TelNo | MgrStaffNo | MgrName |
| 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 |

<BranchNo> is the primary key; <MgrStaff> -> <MgrName>

1. Why this table is not in 3NF?
2. Describe and illustrate the process of normalizing the data shown in this table to third normal form (3NF).
3. Examine the table shown below and the set of functional dependency on its attributes：

**CourseRmAlloc** (CourseId, CourseName, Year, Lecturer, Enrollment, RoomId, RoomCapacity, Day, Time)

FD = {*CourseId -> CourseName, CourseName -> CourseId,*

*CourseId, Year -> Lecturer, CourseId, Year -> Enrollment,*

*RoomId -> RoomCapacity, RoomId, Year, Day, Time -> CourseId,*

*CourseId, Year, Day, Time -> RoomId* }

1. Find all candidate keys of this table.
2. Decompose this table into a design into BCNF.

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1. **Answer**:
2. *TelNo* is not an attribute with atomic values, but with multi-values. So, the table is NOT in 1NF.
3. Create another relation specifically for *TelNo* with *BranchNo* as a foreign key

**Branch**

|  |  |
| --- | --- |
| BranchNo | BranchAddress |
| B001 | 8 Jefferson Way, Portland, OR 97201 |
| B002 | City Center Plaza, Seattle, WA 98122 |
| B003 | 14 – 8th Avenue, New York, NY 10012 |
| B004 | 16 – 14th Avenue, Seattle, WA 98128 |

**BranchTel**

|  |  |
| --- | --- |
| BranchNo | TelNo |
| B001 | 503-555-3618 |
| B001 | 503-555-2727 |
| B001 | 503-555-6534 |
| B002 | 206-555-6756 |
| B002 | 206-555-8836 |
| B003 | 212-371-3000 |
| B004 | 206-555-3131 |
| B004 | 206-555-4112 |

1. **Answer**:
2. The primary key of StaffBranchAllocation table is *<Staff No, BranchNo>*. There exist the partial functional dependencies: *StaffNo → Name, Position* and *BranchNo → BranchAddress*. The non-key attributes are not fully dependent on the key. So, the table is NOT in 2NF.
3. Remove *BranchAddress*, *Name*, *Position* from StaffBranchAllocation relation to capture the partial functional dependencies separately.

**Branch**

|  |  |
| --- | --- |
| BranchNo | BranchAddress |
| B002 | City Center Plaza, Seattle, WA 98122 |
| B004 | 16 – 14th Avenue, Seattle, WA 98128 |

**Staff**

|  |  |  |
| --- | --- | --- |
| StaffNo | Name | Position |
| S4555 | Ellen Layman | Assistant |
| S4612 | Dave Sinclair | Assistant |

**StaffBranchAllocation**

|  |  |  |
| --- | --- | --- |
| StaffNo | BranchNo | HoursPerWeek |
| S4555 | B002 | 16 |
| S4555 | B004 | 9 |
| S4612 | B002 | 14 |
| S4612 | B004 | 10 |

1. **Answer**:
2. There exists a non-key attribute transitively dependent on the key, i.e., *MgrName* depends on *MgrStaffNo* and *MgrStaffNo* depends on *BranchNo.*
3. Create another relation which specifically captures the dependency *MgrStaffNo → MgrName*

**Branch**

|  |  |  |  |
| --- | --- | --- | --- |
| 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 |

**ManagerStaff**

|  |  |
| --- | --- |
| MgrStaffNo | MgrName |
| S1500 | Tom Daniels |
| S0010 | Mary Martinez |
| S0145 | Art Peters |
| S2250 | Sally Stern |

1. **Answer:**
2. There are three candidate keys in this table:

(Year, Day, Time, CourseId)

(Year, Day, Time, CourseName)

(Year, Day, Time, RoomId)

1. This table can be decomposed into the following in BCNF (so also in 3NF):

**CourseTeaching** (CourseId, Year, Lecturer, Enrollment)

**Room** (RoomId, RoomCapacity)

**CourseRoomAlloc** (CourseId, Year, Day, Time, RoomId)

**Course** (CourseId, CourseName)