**Advanced Database Management System Assignment**

**Topic: Justify the normalization of the tables in your database.**

**Domain:** Agriculture

**Tables:**

|  |
| --- |
| crop |
| employee |
| equipment |
| farm |
| Farmer |
| Livestock |
| Product |
| Purchase |
| Sale |
| Supplier |

1. **Table Farm**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **FarmerID** | **FirstName** | **LastName** | **Phone** | **Address** | **Gender** |
| 1 | Aarav | Sharma | 1234567890 | 1, MG Road, Bangalore, Karnataka, 560001 | M |
| 2 | Isha | Patel | 2345678901 | 2, Park Street, Kolkata, West Bengal, 700016 | F |
| 3 | Vihaan | Gupta | 3456789012 | 3, Connaught Place, New Delhi, Delhi, 110001 | M |
| 4 | Ananya | Reddy | 4567890123 | 4, Marine Drive, Mumbai, Maharashtra, 400002 | F |
| 5 | Krishna | Mehta | 5678901234 | 5, MG Marg, Agra, Uttar Pradesh, 282001 | M |
| 6 | Sneha | Desai | 6789012345 | 6, Brigade Road, Bangalore, Karnataka, 560025 | F |
| 7 | Rohan | Verma | 7890123456 | 7, Janpath, New Delhi, Delhi, 110001 | M |
| 8 | Priya | Nair | 8901234567 | 8, Banjara Hills, Hyderabad, Telangana, 500034 | F |
| 9 | Aditya | Singh | 9012345678 | 9, Nungambakkam, Chennai, Tamil Nadu, 600034 | M |
| 10 | Nisha | Choudhary | 123456789 | 10, Ratan Tata Road, Mumbai, Maharashtra, 400020 | F |
| 11 | Karan | Joshi | 9876543210 | 11, Park Avenue, Pune, Maharashtra, 411001 | M |
| 12 | Deepika | Bansal | 8765432109 | 12, Ameerpet, Hyderabad, Telangana, 500016 | F |

The Farm table is in **3NF**.

* **1NF**: All values (FarmName, Location, Size) are atomic, and there are no repeating groups. The primary key is FarmID, and each non-key attribute is dependent on this key.
* **2NF**: There is no partial dependency because all non-key attributes depend solely on the primary key (FarmID).
* **3NF**: There are no transitive dependencies. The non-key attributes (FarmName, Location, Size) are independent of one another, and no non-key attribute depends on another non-key attribute. The foreign key FarmerID is correctly used to establish relationships without introducing dependencies between non-key attributes.

1. **Table Farm**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **FarmID** | **FarmName** | **Location** | **Size** | **FarmerID** |
| 111 | Green Valley Farms | Bangalore, Karnataka | 15.5 | 1 |
| 112 | Sunrise Agriculture | Mumbai, Maharashtra | 22 | 2 |
| 113 | Golden Harvest | Chennai, Tamil Nadu | 18.75 | 3 |
| 114 | Blue Sky Plantation | Hyderabad, Telangana | 35.25 | 4 |
| 115 | EcoLand Farms | Kolkata, West Bengal | 42.6 | 5 |
| 116 | Fresh Fields | Pune, Maharashtra | 12.8 | 6 |
| 117 | AgriNova | Delhi, Delhi | 25.3 | 7 |
| 118 | Riverbend Farms | Lucknow, Uttar Pradesh | 55.2 | 8 |
| 119 | Sunny Hill Farms | Ahmedabad, Gujarat | 33.4 | 9 |
| 120 | Orchard Acres | Jaipur, Rajasthan | 20.1 | 10 |
| 121 | Vibrant Fields | Indore, Madhya Pradesh | 45.5 | 11 |
| 122 | Silver Creek Farms | Coimbatore, Tamil Nadu | 37.75 | 12 |

The Farmer table is in **3NF** because it meets all the requirements of the normal forms.

* **1NF**: The table has atomic values with no repeating groups, and each record is uniquely identified by the primary key (FarmerID).
* **2NF**: There is no partial dependency as each non-key attribute (FirstName, LastName, Phone, Address) depends entirely on the primary key (FarmerID).
* **3NF**: There are no transitive dependencies between non-key attributes. For example, characteristics like Phone and Address do not depend on each other or attributes like FirstName or LastName, ensuring that the table is properly normalized.

1. **Table Crop:**

|  |  |  |  |
| --- | --- | --- | --- |
| **CropID** | **CropName** | **Type** | **FarmID** |
| 221 | Wheat | Cereal | 111 |
| 222 | Rice | Cereal | 112 |
| 223 | Corn | Cereal | 113 |
| 224 | Tomato | Vegetable | 114 |
| 225 | Potato | Vegetable | 115 |
| 226 | Mango | Fruit | 116 |
| 227 | Banana | Fruit | 117 |
| 228 | Cabbage | Vegetable | 118 |
| 229 | Cotton | Fiber | 119 |
| 230 | Soybean | Legume | 120 |
| 231 | Sugarcane | Cash Crop | 121 |
| 232 | Peanut | Legume | 122 |

The Crop table is in **3NF** as it satisfies the criteria for all the normal forms.

* **1NF**: All values are atomic (CropName, Type), and the table has a unique identifier, CropID.
* **2NF**: All non-key attributes depend on the primary key (CropID) entirely.
* **3NF**: There are no transitive dependencies among non-key attributes, meaning that CropName and Type do not depend on each other or any other attributes, ensuring the table is fully normalized.

1. **Table Livestock:**

|  |  |  |  |
| --- | --- | --- | --- |
| **LivestockID** | **AnimalType** | **Count** | **FarmID** |
| 331 | Cattle | 20 | 111 |
| 332 | Sheep | 15 | 112 |
| 333 | Goats | 30 | 113 |
| 334 | Chickens | 100 | 114 |
| 335 | Pigs | 25 | 115 |
| 336 | Ducks | 50 | 116 |
| 337 | Buffaloes | 18 | 117 |
| 338 | Turkeys | 35 | 118 |
| 339 | Horses | 10 | 119 |
| 340 | Rabbits | 40 | 120 |
| 341 | Geese | 60 | 121 |
| 342 | Camels | 8 | 122 |

The Livestock table is also in **3NF**.

* **1NF**: All attributes (AnimalType, Count) are atomic, and the primary key is LivestockID. There are no repeating groups or duplicate records.
* **2NF**: All attributes are fully dependent on the primary key (LivestockID), meaning there are no partial dependencies.
* **3NF**: There are no transitive dependencies between non-key attributes like AnimalType and Count, making the table fully normalized to 3NF.

1. **Table Equipment:**

|  |  |  |  |
| --- | --- | --- | --- |
| **EquipmentID** | **EquipmentName** | **PurchaseDate** | **FarmID** |
| 441 | Tractor | 20-05-2020 | 111 |
| 442 | Plough | 15-07-2019 | 112 |
| 443 | Harvester | 10-03-2021 | 113 |
| 444 | Seeder | 25-11-2018 | 114 |
| 445 | Sprayer | 18-02-2022 | 115 |
| 446 | Water Pump | 08-06-2017 | 116 |
| 447 | Fertilizer Spreader | 30-09-2020 | 117 |
| 448 | Irrigation System | 12-10-2019 | 118 |
| 449 | Cultivator | 19-01-2021 | 119 |
| 450 | Greenhouse Equipment | 25-04-2018 | 120 |
| 451 | Baler | 05-12-2020 | 121 |
| 452 | Combine Harvester | 21-07-2022 | 122 |

The Equipment table adheres to **3NF**.

* **1NF**: All values (EquipmentName, PurchaseDate) are atomic, and the table has a unique primary key (EquipmentID).
* **2NF**: The non-key attributes are fully dependent on the primary key (EquipmentID).
* **3NF**: There are no transitive dependencies among non-key attributes, ensuring that attributes like EquipmentName and PurchaseDate do not depend on each other, confirming that the table is fully normalized.

1. **Table Employee:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **EmployeeID** | **FirstName** | **LastName** | **DateOfBirth** | **Gender** | **Address** | **Phone** | **FarmID** | **Salary** |
| 551 | Amit | Sharma | 12-06-1985 | M | 12, MG Road, Delhi | 9876543210 | 111 | 33759 |
| 552 | Neha | Verma | 19-08-1990 | F | 56, MG Road, Delhi | 9876543211 | 112 | 49665 |
| 553 | Ravi | Kumar | 21-03-1987 | M | 24, MG Road, Delhi | 9876543212 | 113 | 37044 |
| 554 | Meena | Singh | 30-11-1992 | F | 10, Sarita Vihar, Delhi | 9876543213 | 111 | 46229 |
| 555 | Vikram | Patel | 10-02-1980 | M | 45, CP, Delhi | 9876543214 | 112 | 30011 |
| 556 | Sunita | Joshi | 25-05-1988 | F | 78, Green Park, Delhi | 9876543215 | 113 | 41368 |
| 557 | Suresh | Mehta | 14-12-1984 | M | 13, Janakpuri, Delhi | 9876543216 | 111 | 46808 |
| 558 | Priya | Desai | 09-03-1995 | F | 34, Malviya Nagar, Delhi | 9876543217 | 112 | 39937 |
| 559 | Rakesh | Chawla | 20-04-1983 | M | 67, Lajpat Nagar, Delhi | 9876543218 | 113 | 49260 |
| 560 | Swati | Kapoor | 15-06-1991 | F | 99, Hauz Khas, Delhi | 9876543219 | 111 | 36487 |
| 561 | Ajay | Malhotra | 27-09-1986 | M | 52, Rohini, Delhi | 9876543220 | 112 | 44656 |
| 562 | Pooja | Kumar | 05-12-1989 | F | 101, Vasant Kunj, Delhi | 9876543221 | 113 | 43818 |

The Employee table is in **3NF**.

* **1NF**: It has atomic attributes (FirstName, LastName, DateOfBirth, etc.) with a unique identifier, EmployeeID.
* **2NF**: There are no partial dependencies as all attributes depend fully on the primary key (EmployeeID).
* **3NF**: There are no transitive dependencies between non-key attributes. For example, attributes like DateOfBirth and Address do not depend on one another, meaning the table satisfies the conditions for 3NF.

1. **Table Supplier:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SupplierID** | **SupplierName** | **ContactPerson** | **Phone** | **Email** |
| 661 | AgroSupplies | Rakesh Singh | 9876543111 | rakesh@agrosupplies.com |
| 662 | FarmingTools | Priya Jain | 9876543222 | priya@farmingtools.com |
| 663 | GrowEquip | Manoj Agarwal | 9876543333 | manoj@growequip.com |
| 664 | AgriStore | Vikash Nair | 9876543444 | vikash@agristore.com |
| 665 | HarvestHub | Rohan Sharma | 9876543555 | rohan@harvesthub.com |
| 666 | SeedMart | Anjali Deshmukh | 9876543666 | anjali@seedmart.com |
| 667 | FertileSoil | Rahul Gupta | 9876543777 | rahul@fertilesoil.com |
| 668 | GreenTools | Pallavi Rao | 9876543888 | pallavi@greentools.com |
| 669 | FarmersAlly | Sandeep Patel | 9876543999 | sandeep@farmersally.com |
| 670 | AgriConnect | Bhavna Reddy | 9876544000 | bhavna@agriconnect.com |
| 671 | TractorPoint | Mohan Joshi | 9876544111 | mohan@tractorpoint.com |
| 672 | CropGears | Meghna Bansal | 9876544222 | meghna@cropgears.com |

The Supplier table is normalized to **3NF**.

* **1NF**: All attributes (SupplierName, ContactPerson, Phone, Email) are atomic, and the table has a primary key (SupplierID).
* **2NF**: The non-key attributes are dependent on the primary key (SupplierID).
* **3NF**: There are no transitive dependencies, as non-key attributes like ContactPerson and Phone do not depend on each other, ensuring that the table is fully normalized to 3NF.

1. **Table Product:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ProductID** | **ProductName** | **SupplierID** | **Price** | **QuantityInStock** |
| 771 | Tractor | 661 | 500000 | 15 |
| 772 | Harvester | 662 | 250000 | 2 |
| 773 | Irrigation Pump | 663 | 30000 | 10 |
| 774 | Plough | 664 | 15000 | 20 |
| 775 | Fertilizer | 665 | 1000 | 100 |
| 776 | Pesticide | 666 | 2000 | 50 |
| 777 | Shovel | 667 | 500 | 200 |
| 778 | Tiller | 668 | 80000 | 8 |
| 779 | Seed Drill | 669 | 40000 | 15 |
| 780 | Combine Harvester | 670 | 600000 | 3 |
| 781 | Water Tank | 671 | 10000 | 30 |
| 782 | Sprayer | 672 | 7000 | 25 |

The Product table satisfies **3NF**.

* **1NF**: It contains atomic attributes (ProductName, Price, QuantityInStock), and ProductID serves as the primary key.
* **2NF**: All attributes are fully dependent on the primary key.
* **3NF**: There are no transitive dependencies, meaning that Price and QuantityInStock are independent of other non-key attributes like ProductName, making the table properly normalized.

1. **Table Sale:**

|  |  |  |  |
| --- | --- | --- | --- |
| **SaleID** | **SaleDate** | **TotalAmount** | **FarmerID** |
| 881 | 01-01-2024 | 250000 | 1 |
| 882 | 05-01-2024 | 180000 | 2 |
| 883 | 12-02-2024 | 320000 | 3 |
| 884 | 20-02-2024 | 150000 | 4 |
| 885 | 02-03-2024 | 50000 | 5 |
| 886 | 10-03-2024 | 80000 | 6 |
| 887 | 15-03-2024 | 120000 | 7 |
| 888 | 22-03-2024 | 220000 | 8 |
| 889 | 05-04-2024 | 260000 | 9 |
| 890 | 11-04-2024 | 190000 | 10 |
| 891 | 20-04-2024 | 340000 | 11 |
| 892 | 02-05-2024 | 280000 | 12 |

The Sale table is normalized to **3NF**.

* **1NF**: All values (SaleDate, TotalAmount) are atomic, and SaleID is the unique primary key.
* **2NF**: The non-key attributes depend fully on the primary key (SaleID).
* **3NF**: There are no transitive dependencies between non-key attributes, ensuring that attributes like SaleDate and TotalAmount do not depend on one another, which satisfies the criteria for 3NF.

1. **Table Purchase:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PurchaseID** | **PurchaseDate** | **ProductID** | **Quantity** | **TotalCost** | **FarmerID** | **SupplierID** |
| 991 | 05-01-2024 | 771 | 20 | 5000 | 1 | 661 |
| 992 | 15-01-2024 | 772 | 15 | 3500 | 2 | 662 |
| 993 | 10-02-2024 | 773 | 10 | 2000 | 3 | 663 |
| 994 | 20-02-2024 | 774 | 25 | 6250 | 4 | 664 |
| 995 | 05-03-2024 | 775 | 30 | 9000 | 5 | 665 |
| 996 | 15-03-2024 | 776 | 12 | 3000 | 6 | 666 |
| 997 | 01-04-2024 | 777 | 22 | 5500 | 7 | 667 |
| 998 | 10-04-2024 | 778 | 18 | 4500 | 8 | 668 |
| 999 | 20-04-2024 | 779 | 20 | 5000 | 9 | 669 |
| 1000 | 01-05-2024 | 780 | 10 | 2500 | 10 | 670 |
| 1001 | 10-05-2024 | 781 | 28 | 7000 | 11 | 671 |
| 1002 | 20-05-2024 | 782 | 16 | 4000 | 12 | 672 |

* **1NF** : The Purchase table is in 1NF because all attributes contain atomic values, and there are no repeating groups. Each row represents a unique purchase, and fields like PurchaseID, ProductID, SupplierID, PurchaseDate, Quantity, and TotalCost contain singular, non-divisible values.
* **2NF**: The primary key for this table is likely PurchaseID, which uniquely identifies each record. All non-key attributes like ProductID, SupplierID, PurchaseDate, Quantity, and TotalCost depend on this primary key. There are no partial dependencies, meaning every non-key attribute is fully functionally dependent on the entire primary key.
* **3NF**: The Purchase table is in 3NF as well. There are no transitive dependencies, which means non-key attributes do not depend on other non-key attributes. For example, Quantity and TotalCost depend directly on the primary key (PurchaseID) and not on each other or other non-key attributes. Additionally, fields like ProductID and SupplierID reference foreign keys without introducing transitive dependencies.

Conclusion: In conclusion, all the tables in the agriculture domain database have been successfully normalized to the **Third Normal Form (3NF)**. Each table follows the principles of normalization by eliminating redundant data and ensuring data integrity through well-defined relationships.

* **1NF** Is achieved by ensuring that each column contains atomic values, and each record is unique.
* **2NF** It is attained by ensuring that all non-key attributes are fully functionally dependent on the primary key.
* **3NF** It is satisfied by removing transitive dependencies, ensuring that non-key attributes do not depend on other non-key attributes.

As the tables are in 3NF, there is minimal data anomalies like update, insert, and delete anomalies. This results in a well-structured database that is efficient, flexible, and optimized for querying and maintaining integrity over time.

**1MSCSA**

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