# Database Exercises – Normalization (SOLVED)

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| **Exercise** | Norm.1 |
| **Table** | **Character**   |  |  |  |  | | --- | --- | --- | --- | | **Id** | **Name** | **Class** | **WeaponsOwnedIds** | | 1 | Jax | Warrior | 12 | | 2 | Mjolnir | Hunter | 11, 17, 3 | | 6 | Caran | Warrior | 6, 8, 11 | | 9 | Zinuura | Mage | 6, 8 |   The primary key is (I**d**).  **WeaponsOwnedIds r**epresents the **Id**s of the weapons owned by each character (we assume that a **Weapon** table exists) |
| **Purpose** | Convert a table to first normal form (**1NF**). |
| **Description** | The given table **Character** is not on **1NF**. |
| **Steps** | 1. Why is the table **Character** not on **1NF**? 2. Redesign the table in order to bring it to **1NF**. This may involve creating additional tables. |

**SOLUTION:**

Why is the table **Character** not on **1NF**?

*Because* ***WeaponsOwnedIds*** *contains multiple values.*

**New table design:**

**Character (*Id* is primary key)**

|  |  |  |
| --- | --- | --- |
| **Id** | **Name** | **Class** |
| 1 | Jax | Warrior |
| 2 | Mjolnir | Hunter |
| 6 | Caran | Warrior |
| 9 | Zinuura | Mage |

**WeaponsOwned (*CharacterId* + *WeaponId* is primary key)**

|  |  |
| --- | --- |
| **CharacterId** | **WeaponId** |
| 1 | 12 |
| 2 | 11 |
| 2 | 17 |
| 2 | 3 |
| 6 | 6 |
| 6 | 8 |
| 6 | 11 |
| 9 | 6 |
| 9 | 8 |

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| **Exercise** | Norm.2 |
| **Table** | **WeaponsOwned**   |  |  |  |  | | --- | --- | --- | --- | | **CId** | **WId** | **MinDamage** | **MaxDamage** | | 1 | 12 | 10 | 25 | | 2 | 3 | 20 | 45 | | 2 | 11 | 40 | 110 | | 2 | 17 | 18 | 35 | | 6 | 6 | 30 | 60 | | 6 | 8 | 25 | 55 | | 6 | 11 | 40 | 110 | | 9 | 6 | 30 | 60 | | 9 | 8 | 25 | 55 |   **CId**: Represents a **Character** id, and is thus a foreign key.  **WId**: Represents a **Weapon** id, and is thus a foreign key.  The primary key is (**CId**, **WId**). |
| **Purpose** | Convert a table to second normal form (**2NF**). |
| **Description** | The given table **WeaponsOwned** is not on **2NF.** |
| **Steps** | 1. Why is the table **WeaponsOwned** not on **2NF**? 2. Redesign the table in order to bring it to **2NF**. This may involve creating additional tables. |

**SOLUTION:**

Why is the table **WeaponsOwned** not on **2NF**?

*Because* ***MinDamage*** *and* ***MaxDamage*** *only depend on the weapon (i.e. Wid), not the character (i.e Cid).*

**New table design:**

**WeaponsOwned**

|  |  |
| --- | --- |
| **CId** | **WId** |
| 1 | 12 |
| 2 | 3 |
| 2 | 11 |
| 2 | 17 |
| 6 | 6 |
| 6 | 8 |
| 6 | 11 |
| 9 | 6 |
| 9 | 8 |

**Weapon (*Id* is primary key)**

|  |  |  |
| --- | --- | --- |
| **Id** | **MinDamage** | **MaxDamage** |
| 12 | 10 | 25 |
| 3 | 20 | 45 |
| 11 | 40 | 110 |
| 17 | 18 | 35 |
| 6 | 30 | 60 |
| 8 | 25 | 55 |

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| **Exercise** | Norm.3 |
| **Table** | **JewelsInSocket**   |  |  |  |  | | --- | --- | --- | --- | | **WId** | **JId** | **MatchFactor** | **AddedDamage** | | 3 | 22 | 1.2 | 25 | | 6 | 22 | 0.9 | 25 | | 6 | 8 | 1.4 | 20 | | 8 | 49 | 1.0 | 60 | | 8 | 16 | 1.2 | 40 | | 8 | 22 | 0.85 | 25 | | 17 | 16 | 1.15 | 40 |   **WId**: Represents a **Weapon** id, and is thus a foreign key.  **JId**: Represents a **Jewel** id, and is thus a foreign key.  The primary key is (**WId**, **JId**)  The **MatchFactor** represents a factor by which the specific jewel and the specific weapon match. The **AddedDamage** – which applies to a specific jewel, but does not depend on specific weapons – can then be multiplied with this factor.  Example: A jewel with **AddedDamage** = 25 is added to a specific weapon for which **MatchFactor** is 1.2 for this specific jewel. The total added damage is then 25 x 1.2 = 30. |
| **Purpose** | Convert a table to second normal form (**2NF**). |
| **Description** | The given table **JewelsInSocket** is not on **2NF**. |
| **Steps** | 1. Why is the table **JewelsInSocket** not on **2NF**? 2. Redesign the table in order to bring it to **2NF**. This may involve creating additional tables. |

**SOLUTION:**

Why is the table **JewelsInSocket** not on **2NF**?

*Because* ***AddedDamage*** *only depends on the jewel (i.e.* ***Jid****), not the weapon (i.e* ***Wid****).*

**New table design:**

**JewelsInSocket**

|  |  |  |
| --- | --- | --- |
| **WId** | **JId** | **MatchFactor** |
| 3 | 22 | 1.2 |
| 6 | 22 | 0.9 |
| 6 | 8 | 1.4 |
| 8 | 49 | 1.0 |
| 8 | 16 | 1.2 |
| 8 | 22 | 0.85 |
| 17 | 16 | 1.15 |

**Jewel (*Id* is primary key)**

|  |  |
| --- | --- |
| **Id** | **AddedDamage** |
| 22 | 25 |
| 8 | 20 |
| 49 | 60 |
| 16 | 40 |

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| **Exercise** | Norm.4 |
| **Table** | **Mount**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Id** | **Name** | **Type** | **MaxSpeed** | **Seats** | | 1 | Whitey | Goat | 25 | 1 | | 3 | Presto | Horse | 50 | 2 | | 4 | Golden | Goat | 20 | 1 | | 5 | Allerio | Goat | 28 | 1 | | 9 | Vanguardio | Elephant | 10 | 4 | | 13 | Buckey | Horse | 35 | 2 |   The primary key is (I**d**).  A **Mount** is a creature (or machine) a **Character** can use to move around in a game world.  **MaxSpeed** can vary for specific mounts even of the same **Type**, but **Seats** is always the same for mounts of the same **Type**. |
| **Purpose** | Convert a table to third normal form (**3NF**). |
| **Description** | The given table **Mount** is not on 3NF. |
| **Steps** | 1. Why is the table **Mount** not on 3NF? 2. Redesign the table in order to bring it to 3NF. This may involve creating additional tables. |

**SOLUTION:**

Why is the table **Mount** not on **3NF**?

*Because* ***Seats*** *only depends on* ***Type****, which is not part of the primary key.*

**New table design:**

**Mount (*MountTypeId* is a foreign key, referring to *Id* in the MountType table)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Id** | **Name** | **MountTypeId** | **MaxSpeed** |
| 1 | Whitey | 1 | 25 |
| 3 | Presto | 2 | 50 |
| 4 | Golden | 1 | 20 |
| 5 | Allerio | 1 | 28 |
| 9 | Vanguardio | 3 | 10 |
| 13 | Buckey | 2 | 35 |

**MountType (*Id* is primary key)**

|  |  |  |
| --- | --- | --- |
| **Id** | **Description** | **Seats** |
| 1 | Goat | 1 |
| 2 | Horse | 2 |
| 3 | Elephant | 4 |

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| **Exercise** | Norm.5 |
| **Table** | **Subscriber**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Id** | **Name** | **Country** | **Phone** | **PhonePrefix** | | 1 | Alex P. | USA | 5551236576 | +1 | | 2 | Jenny V. | Denmark | 44613407 | +45 | | 3 | Peter G. | Germany | 6973548766 | +49 | | 4 | Bruno M. | USA | 5553104560 | +1 | | 5 | Maria O. | USA | 5559812348 | +1 | | 6 | Hanne H. | Denmark | 55313429 | +45 |   The primary key is (I**d**).  A **Subscriber** is a person which has a subscription for being able to participate in an online game.  The **Phone** number is individual for each subscriber, but the **Phone­Prefix** depends only on the **Country** of the subscriber. |
| **Purpose** | Convert a table to third normal form (**3NF**). |
| **Description** | The given table **Subscriber** is not on 3NF. |
| **Steps** | 1. Why is the table **Subscriber** not on 3NF? 2. Redesign the table in order to bring it to 3NF. This may involve creating additional tables. |

**SOLUTION:**

Why is the table **Subscriber** not on **3NF**?

*Because* ***PhonePrefix*** *only depends on* ***Country****, which is not part of the primary key.*

**New table design:**

**Subscriber (*CountryId* is a foreign key, referring to *Id* in the Country table)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Id** | **Name** | **CountryId** | **Phone** |
| 1 | Alex P. | 1 | 5551236576 |
| 2 | Jenny V. | 2 | 44613407 |
| 3 | Peter G. | 3 | 6973548766 |
| 4 | Bruno M. | 1 | 5553104560 |
| 5 | Maria O. | 1 | 5559812348 |
| 6 | Hanne H. | 2 | 55313429 |

**Country (*Id* is primary key)**

|  |  |  |
| --- | --- | --- |
| **Id** | **Name** | **PhonePrefix** |
| 1 | USA | +1 |
| 2 | Denmark | +45 |
| 3 | Germany | +49 |