# Normalization Examples

Example #1

Posted 2/24/2012

# Beer-Drinking Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

A bar keeps a list of the types of beer that customers drink at the bar. This includes maintaining a list of all types of beer that have been ordered by a customer (and the corresponding manufacturer of the beers), as well as recording the drinker's favorite beer.

To distinguish between customers (who only go on a first name basis), their address is also kept. One can assume that there are not two people with the same name at a given address.

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

Argue for why (name, address, brandConsumed) is an appropriate primary key, but none of these simpler sets (name, address), (name, brandConsumed), (address,brandConsumed) is.

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

*Argue for why (name, address, brandConsumed) is an appropriate primary key, but none of these simpler sets (name, address), (name, brandConsumed), (address,brandConsumed) is.*

(name,address) identifies a drinker – there are multiple rows for each drinker if they drink more than one type of beer. (name,brandConsumed) could show up multiple times if there are two people with the same name who drink the same type of beer.
(address, brandConsumed) could point to multiple rows if multiple people from the same household drink at the same bar and drink the same beer).

Given a name and an address, we are down to one person, and then a brand consumed takes us to one specific row for that person – so the three together seem appropriate as a PK.

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

Given (name, address, brandConsumed) as the PK, what functional dependencies does that imply (i.e. what FDs are required for something to be a PK)?

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

*Given (name, address, brandConsumed) as the PK, what functional dependencies does that imply?*

name,address,brandConsumed → manufacturer
name,address,brandConsumed → favorite

All non-primary-key attributes should be functionally dependent on the primary key.

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

Given your understanding of the domain, what are the functional dependencies in the domain? Some may be simpler than what you got from the primary keys.

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

*Given your understanding of the domain, what is a set of minimal (using as few attributes as possible) functional dependencies in the domain? Some may be simpler than what you got from the primary keys.*

In addition to the ones from the primary key, these exist:
brandConsumed → brandManufacturer
name,address → favorite (this requires less than the primary key)

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

Are there any other candidate keys other than the primary key (name,address,brandConsumed) we already came up with?

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

*Are there any other candidate keys other than the primary key (name,address,brandConsumed) we already came up with?*

No, there are not. No other minimal set of attributes (sets without superflous attributes) exist.

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

Is the table in 2NF (that is, are all non-candidate are fully functionally dependent on the a candidate key)?

That is asking for this domain whether:

a) manufacturer is fully functionally dependent on (name,address,brandConsumed)

b) favorite is fully functionally dependent on (name,address,brandConsumed)

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

*Is the table in 2NF (all non-candidate keys are fully functionally dependent on the a candidate key)?*

*That is asking for this domain whether:*
*a) manufacturer is fully functionally dependent on (name,address,brandConsumed)*
*b) favorite is fully functionally dependent on (name,address,brandConsumed)*

Neither of the above statements hold: manufacturer only depends on brandConsumed and favorite only depends on name,address, so this isn't in 2NF

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

Convert to 2NF if needed

# Relation

| name | address | brandConsumed | manufacturer | favorite |
|---|---|---|---|---|
| William | Manchester 240 | Bud Light | Budweiser | Salem Gold |
| William | Manchester 240 | Salem Gold | Foothills Brewing | Salem Gold |
| Errin | Manchester 239 | Stella Artois | Anheiser-Busch | Stella Artois |

*Note this breaks down into information about **drinkers** (name, address, personal favorite), **beers** (brand,manufacturer), and which **beers drinkers drink**. In an ER diagram –this is two entities and one relationship!*

Convert to 2NF if needed:

*Take (brandConsumed, manufacturer) into own table, and separately (name, address, favorite) into own table*

| name | address | brandConsumed |
|---|---|---|
| William | Manchester 240 | Bud Light |
| William | Manchester 240 | Salem Gold |
| Errin | Manchester 239 | Stella Artois |

| brandConsumed | manufacturer |
|---|---|
| Bud Light | Budweiser |
| Salem Gold | Foothills Brewing |
| Stella Artois | Anheiser-Busch |

| name | address | favorite |
|---|---|---|
| William | Manchester 240 | Salem Gold |
| Errin | Manchester 239 | Stella Artois |

# Relation

Convert these tables to 3NF if needed (each table needs to be looked at Independently)

| name | address | brandConsumed |
|---|---|---|
| William | Manchester 240 | Bud Light |
| William | Manchester 240 | Salem Gold |
| Errin | Manchester 239 | Stella Artois |

| brandConsumed | manufacturer |
|---|---|
| Bud Light | Budweiser |
| Salem Gold | Foothills Brewing |
| Stella Artois | Anheiser-Busch |

| name | address | favorite |
|---|---|---|
| William | Manchester 240 | Salem Gold |
| Errin | Manchester 239 | Stella Artois |

# Relation

They are all already  in 3NF! There are no transitive dependencies in these three tables.

| name | address | brandConsumed |
|---|---|---|
| William | Manchester 240 | Bud Light |
| William | Manchester 240 | Salem Gold |
| Errin | Manchester 239 | Stella Artois |

| brandConsumed | manufacturer |
|---|---|
| Bud Light | Budweiser |
| Salem Gold | Foothills Brewing |
| Stella Artois | Anheiser-Busch |

| name | address | favorite |
|---|---|---|
| William | Manchester 240 | Salem Gold |
| Errin | Manchester 239 | Stella Artois |

# Relation

Convert to BCNF if needed
(each table needs to be looked at independently).

Looking for: Is every left hand side of a functional dependency a candidate key?
*Shortcut to answer some: If only one candidate key for a table exists or there are multiple candidate keys but they are only single-attribute, there can't exist BCNF violations.*

| name | address | brandConsumed |
|---|---|---|
| William | Manchester 240 | Bud Light |
| William | Manchester 240 | Salem Gold |
| Errin | Manchester 239 | Stella Artois |

| brandConsumed | manufacturer |
|---|---|
| Bud Light | Budweiser |
| Salem Gold | Foothills Brewing |
| Stella Artois | Anheiser-Busch |

| name | address | favorite |
|---|---|---|
| William | Manchester 240 | Salem Gold |
| Errin | Manchester 239 | Stella Artois |

# Relation

Convert the 3NF to BCNF if needed (each table needs to be looked at independently). Looking for: Is every left hand side of a functional dependency a candidate key?

*Shortcut to answer some: If only one candidate key or there multiple candidate keys but they are only single-attribute, there can't exist BCNF violations.*

Only one candidate key (name,address,brandConsumed) So BCNF

| name | address | brandConsumed |
|---|---|---|
| William | Manchester 240 | Bud Light |
| William | Manchester 240 | Salem Gold |
| Errin | Manchester 239 | Stella Artois |

Only one candidate key (brandConsumed), so BCNF

| brandConsumed | manufacturer |
|---|---|
| Bud Light | Budweiser |
| Salem Gold | Foothills Brewing |
| Stella Artois | Anheiser-Busch |

Only one candidate key (name,address), so in BCNF (make sure you understand why (name, favorite) and (address, favorite) are not candidate keys

| name | address | favorite |
|---|---|---|
| William | Manchester 240 | Salem Gold |
| Errin | Manchester 239 | Stella Artois |