





# Normalization:

---

## 1. Supplier

Supplier{Supplier\_ID, Supplier\_Name, Supplier\_Type, Email\_ID, Contact\_no, Country, State, City}

### Minimal FD set

Supplier\_ID  $\rightarrow$  { Supplier\_Name, Supplier\_Type, Email\_ID, Contact\_no, Country, State, City}

{Supplier\_ID}<sup>+</sup> = Supplier(Supplier\_ID, Supplier\_Name, Supplier\_Type, Email\_ID, Contact\_no, Country, State, City)

Hence, Supplier\_ID is the key.

### BCNF

For every minimal FD that holds on relation Supplier, Supplier\_ID is its key.

**Therefore, Supplier is in BCNF.**

## 2. Parts

Parts{Part\_ID, Part\_Name, Unit\_price}

### Minimal FD set

Part\_ID  $\rightarrow$  {Part\_Name, Unit\_price}

{Part\_ID}<sup>+</sup> = Parts(Part\_ID, Part\_Name, Unit\_price)

Hence, Part\_ID is the key.

### BCNF

For every minimal FD that holds on relation Parts, Part\_ID is its key.

**Therefore, Parts is in BCNF.**

## 3. Supplies\_parts

Supplies\_Parts{Supplier\_ID, Part\_ID, Quantity\_Stock}

**Minimal FD set**

$\{\text{Supplier\_ID}, \text{Part\_ID}\} \rightarrow \{\text{Quantity\_Stock}\}$

$\{\text{Supplier\_ID}, \text{Part\_ID}\}^+ = \text{Supplies\_Parts}(\text{Supplier\_ID}, \text{Part\_ID}, \text{Quantity\_Stock})$

Hence,  $\{\text{Supplier\_ID}, \text{Part\_ID}\}$  is the key.

**BCNF**

For every minimal FD that holds on relation Parts,  $\{\text{Supplier\_ID}, \text{Part\_ID}\}$  is its key.  
**Therefore, Supplies\_Parts is in BCNF.**

**4. Orders\_of\_supplier**

Orders\_of\_supplier{Ordering\_supplier, Providing\_supplier, Ordered\_part\_ID,  
Supplier\_order\_no, Qty, Amount}

**Minimal FD set**

$\{\text{Ordering\_supplier}, \text{Providing\_supplier}, \text{Ordered\_part\_ID}, \text{Supplier\_order\_no}\} \rightarrow \{\text{Qty}, \text{Amount}\}$

$\{\text{Ordering\_supplier}, \text{Providing\_supplier}, \text{Ordered\_part\_ID}, \text{Supplier\_order\_no}\}^+ = \text{Orders\_of\_supplier}(\text{Ordering\_supplier}, \text{Providing\_supplier}, \text{Ordered\_part\_ID}, \text{Supplier\_order\_no}, \text{Qty}, \text{Amount})$

Hence,  $\{\text{Ordering\_supplier}, \text{Providing\_supplier}, \text{Ordered\_part\_ID}, \text{Supplier\_order\_no}\}$  is the key.

**BCNF**

For every minimal FD that holds on relation Orders\_of\_supplier,  $\{\text{Ordering\_supplier}, \text{Providing\_supplier}, \text{Ordered\_part\_ID}, \text{Supplier\_order\_no}\}$  is its key.  
**Therefore, Orders\_of\_supplier is in BCNF.**

**5. Manufacturer**

Manufacturer{M\_ID, M\_Name, Email\_ID, Contact\_no, Country, State, City}

**Minimal FD set**

$M\_ID \rightarrow \{M\_Name, Email\_ID, Contact\_no, Country, State, City\}$

$\{M\_ID\}^+ = \text{Manufacturer}(M\_ID, M\_Name, Email\_ID, Contact\_no, Country, State, City)$

Hence,  $M\_ID$  is the key.

**BCNF**

For every minimal FD that holds on relation Manufacturer,  $M\_ID$  is its key.

**Therefore, Manufacturer is in BCNF.**

**6. Order\_of\_manufacturer**

$\text{Order\_of\_manufacturer}\{\underline{\text{Order\_no}}, M\_ID, \text{Placing\_Date}, \text{Receiving\_Date}\}$

**Minimal FD set**

$\text{Order\_no} \rightarrow \{M\_ID, \text{Placing\_Date}, \text{Receiving\_Date}\}$

$\{\text{Order\_no}\}^+ = \text{Order\_of\_manufacturer}(\underline{\text{Order\_no}}, M\_ID, \text{Placing\_Date}, \text{Receiving\_Date})$

Hence,  $\text{Order\_no}$  is the key.

**BCNF**

For every minimal FD that holds on relation Order\_of\_Manufacturer,  $\text{Order\_no}$  is its key.

**Therefore, Order\_of\_manufacturer is in BCNF.**

**7. Order\_for\_parts**

$\text{Order\_for\_parts}\{\underline{\text{Part\_ID}}, \underline{\text{Order\_no}}, \text{Quantity}\}$

**Minimal FD set**

$\{\text{Part\_ID}, \text{Order\_no}\} \rightarrow \{\text{Quantity}\}$

$\{\text{Part\_ID}, \text{Order\_no}\}^+ = \text{Order\_for\_parts}(\text{Part\_ID}, \text{Order\_no}, \text{Quantity})$

Hence, {Part\_ID, Order\_no} is the key.

### **BCNF**

For every minimal FD that holds on relation Order\_for\_parts, {Part\_ID, Order\_no} is its key.

**Therefore, Order\_for\_parts is in BCNF.**

## **8. Order\_transactions**

Order\_transactions {Transaction\_ID, Order\_no, Ordered\_amount, Tax\_name, Tax\_in\_percentage, Total\_amount}

### **Minimal FD set**

Transaction\_ID  $\rightarrow$  {Order\_no, Ordered\_amount, Tax\_name, Tax\_in\_percentage, Total\_amount}

{Transaction\_ID}<sup>+</sup> = Order\_transactions(Transaction\_ID, Order\_no, Ordered\_amount, Tax\_name, Tax\_in\_percentage, Total\_amount)

Hence, Transaction\_ID is the key.

### **BCNF**

For every minimal FD that holds on relation Order\_transactions, Transaction\_ID is its key.

**Therefore, Order\_transactions is in BCNF.**

## **9. Car\_model**

Car\_model {Car\_model\_ID, Model\_Name, Mileage\_in\_kmpl, Color, Base\_price, Warranty\_duration\_in\_months}

### **Minimal FD set**

Car\_model\_ID  $\rightarrow$  {Model\_Name, Mileage\_in\_kmpl, Color, Base\_price, Warranty\_duration\_in\_months}

{Car\_model\_ID}<sup>+</sup> = Car\_model(Car\_model\_ID, Model\_Name, Mileage\_in\_kmpl, Color, Base\_price, Warranty\_duration\_in\_months)

Hence, Car\_model\_ID is the key.

**BCNF**

For every minimal FD that holds on relation Car\_model, Car\_model\_ID is its key.

**Therefore, Car\_model is in BCNF.**

**10. Orders\_based\_on**

Orders\_based\_on{Order\_no, Car\_Model\_ID}

**Minimal FD set**

No minimal FDs.

**BCNF**

Orders\_based\_on is an all attribute key relation. Therefore, according to the normal form theorem, Orders\_based\_on is in BCNF.

**11. Assembly\_plant**

Assembly\_plant{Plant\_no, M\_ID, Country, State, City}

**Minimal FD set**

$\text{Plant\_no} \rightarrow \{\text{M\_ID}, \text{Country}, \text{State}, \text{City}\}$

$\{\text{Plant\_no}\}^+ = \text{Assembly\_plant}(\text{Plant\_no}, \text{M\_ID}, \text{Country}, \text{State}, \text{City})$

Hence, Plant\_no is the key.

**BCNF**

For every minimal FD that holds on relation Assembly\_plant, Plant\_no is its key.

**Therefore, Assembly\_plant is in BCNF.**

**12. Plant\_head**

Plant\_head{Phead\_ID, H\_Name, Plant\_no, Contact\_no}

**Minimal FD set**

$\text{Phead\_ID} \rightarrow \{\text{H\_Name}, \text{Plant\_no}, \text{Contact\_no}\}$

$\{\text{Phead\_ID}\}^+ = \text{Plant\_head}(\text{Phead\_ID}, \text{H\_Name}, \text{Plant\_no}, \text{Contact\_no})$

Hence, Phead\_ID is the key.

**BCNF**

For every minimal FD that holds on relation Plant\_head, Phead\_ID is its key.

**Therefore, Plant\_head is in BCNF.**

**13. Manufactured\_parts\_by\_own**

Manufactured\_parts\_by\_own{Component\_ID, Component\_Name, Car\_model\_ID, M\_ID, Unit\_price, Quality\_factors}

**Minimal FD set**

$\text{Component\_ID} \rightarrow \{\text{Component\_Name}, \text{Car\_model\_ID}, \text{M\_ID}, \text{Unit\_price}, \text{Quality\_factors}\}$

$\{\text{Component\_ID}\}^+ = \text{Manufactured\_parts\_by\_own}\{\text{Component\_ID}, \text{Component\_Name}, \text{Car\_model\_ID}, \text{M\_ID}, \text{Unit\_price}, \text{Quality\_factors}\}$

Hence, Component\_ID is the key.

**BCNF**

For every minimal FD that holds on relation Manufactured\_parts\_by\_own, Component\_ID is its key.

**Therefore, Manufactured\_parts\_by\_own is in BCNF.**

**14. PlantProduces**

PlantProduces{Plant\_no, Car\_model\_ID, Start\_date, End\_date}

**Minimal FD set**

$\{\text{Plant\_no}, \text{Car\_model\_ID}\} \rightarrow \{\text{Start\_date}, \text{End\_date}\}$

$\{\text{Plant\_no}, \text{Car\_model\_ID}\}^+ = \text{Plant\_produces}\{\text{Plant\_no}, \text{Car\_model\_ID}, \text{Start\_date}, \text{End\_date}\}$



End\_date}

Hence, {Plant\_no, Car\_model\_ID} is the key.

### **BCNF**

For every minimal FD that holds on relation Plant\_produces, {Plant\_no, Car\_model\_ID} is its key.

**Therefore, Plant\_produces is in BCNF.**

## 15. Dealer

Dealer{Dealer\_ID, Dealer\_Name, Deals\_with\_M\_ID, Email\_ID, Contact\_no, Country, State, City}

### **Minimal FD set**

Dealer\_ID  $\rightarrow$  {Dealer\_Name, Deals\_with\_M\_ID, Email\_ID, Contact\_no, Country, State, City}

{Dealer\_ID}<sup>+</sup> = Dealer{Dealer\_ID, Dealer\_Name, Deals\_with\_M\_ID, Email\_ID, Contact\_no, Country, State, City}

Hence, Dealer\_ID is the key.

### **BCNF**

For every minimal FD that holds on relation Dealer, Dealer\_ID is its key.

**Therefore, Dealer is in BCNF.**

## 16. Dealer\_order\_for

Dealer\_order\_for{Dealer\_ID, Car\_model\_ID, Ordering\_date, Receiving\_date, Tax\_name, Tax\_in\_Percentage, Total\_Amount}

### **Minimal FD set**

{Dealer\_ID, Car\_model\_ID}  $\rightarrow$  {Ordering\_date, Receiving\_date, Tax\_name, Tax\_in\_Percentage, Total\_Amount}

{Dealer\_ID, Car\_model\_ID}<sup>+</sup> = Dealer\_order\_for{Dealer\_ID, Car\_model\_ID, Ordering\_date, Receiving\_date, Tax\_name, Tax\_in\_Percentage, Total\_Amount}

Hence, {Dealer\_ID, Car\_model\_ID} is the key.

### **BCNF**

For every minimal FD that holds on relation Dealer\_order\_for, {Dealer\_ID, Car\_model\_ID} is its key.

**Therefore, Dealer\_order\_for is in BCNF.**

## 17. Test

Test{Test\_name}

### **Minimal FD set**

No minimal FDs.

### **BCNF**

Test is an all attribute key relation. Therefore, according to the normal form theorem, Test is in BCNF.

## 18. Car\_test

Car\_test{Test\_name, Car\_model\_ID, Result}

### **Minimal FD set**

{Test\_name, Car\_model\_ID}  $\rightarrow$  {Result}

{Test\_name, Car\_model\_ID}<sup>+</sup> = Car\_test{Test\_name, Car\_model\_ID, Result}

Hence, {Test\_name, Car\_model\_ID} is the key.

### **BCNF**

For every minimal FD that holds on relation Car\_test, {Test\_name, Car\_model\_ID} is its key.

**Therefore, Car\_test is in BCNF.**

## 19. Customer

Customer{Customer\_ID, Customer\_Name, Email\_ID, Contact\_no, Country, State, City}

**Minimal FD set**

Customer\_ID  $\rightarrow$  {Customer\_Name, Email\_ID, Contact\_no, Country, State, City}

{Customer\_ID}<sup>+</sup> = Customer {Customer\_ID, Customer\_Name, Email\_ID, Contact\_no, Country, State, City}

Hence, Customer\_ID is the key.

**BCNF**

For every minimal FD that holds on relation Customer, Customer\_ID is its key.

**Therefore, Customer is in BCNF.**

**20. RTO**

RTO {Registration\_no, Engine\_no, Registration\_date, VIN, Total\_reg\_amount, Road\_tax\_amount}

**Minimal FD set**

Registration\_no  $\rightarrow$  {Engine\_no, Registration\_date, VIN, Total\_reg\_amount, Road\_tax\_amount}

{Registration\_no}<sup>+</sup> = RTO {Registration\_no, Engine\_no, Registration\_date, VIN, Total\_reg\_amount, Road\_tax\_amount}

Hence, Registration\_no is the key.

**BCNF**

For every minimal FD that holds on relation RTO, Registration\_no is its key.

**Therefore, RTO is in BCNF.**

**21. Sells\_to**

Sells\_to {Dealer\_ID, Customer\_ID, Car\_model\_ID, Registration\_no, Selling\_date, Car\_amount, Tax\_name, Tax\_in\_percentage, Discount\_amount}

**Minimal FD set**

$\{\text{Dealer\_ID}, \text{Customer\_ID}, \text{Car\_model\_ID}\} \rightarrow \{\text{Registration\_no}, \text{Selling\_date}, \text{Car\_amount}, \text{Tax\_name}, \text{Tax\_in\_percentage}, \text{Discount\_amount}\}$
$\{\text{Dealer\_ID}, \text{Customer\_ID}, \text{Car\_model\_ID}\}^+ = \text{Sells\_to}\{\underline{\text{Dealer\_ID}}, \underline{\text{Customer\_ID}}, \underline{\text{Car\_model\_ID}}, \text{Registration\_no}, \text{Selling\_date}, \text{Car\_amount}, \text{Tax\_name}, \text{Tax\_in\_percentage}, \text{Discount\_amount}\}$
<p>Hence, <math>\{\text{Dealer\_ID}, \text{Customer\_ID}, \text{Car\_model\_ID}\}</math> is the key.</p>
<p><b>BCNF</b>  For every minimal FD that holds on relation Sells_to, <math>\{\text{Dealer\_ID}, \text{Customer\_ID}, \text{Car\_model\_ID}\}</math> is its key.  <b>Therefore, Sells_to is in BCNF.</b></p>

## 22. Insurance

Insurance  $\{\text{In\_policy\_no}, \text{Company\_name}, \text{Dealer\_ID}, \text{Customer\_ID}, \text{Car\_model\_ID}, \text{Start\_date}, \text{End\_date}, \text{Coverage\_amount}, \text{Insurance\_amount}\}$

<p><b>Minimal FD set</b>  <math>\text{In\_policy\_no} \rightarrow \{\text{Company\_name}, \text{Dealer\_ID}, \text{Customer\_ID}, \text{Car\_model\_ID}, \text{Start\_date}, \text{End\_date}, \text{Coverage\_amount}, \text{Insurance\_amount}\}</math></p>
$\{\text{In\_policy\_no}\}^+ = \text{Insurance}\{\text{In\_policy\_no}, \text{Company\_name}, \text{Dealer\_ID}, \text{Customer\_ID}, \text{Car\_model\_ID}, \text{Start\_date}, \text{End\_date}, \text{Coverage\_amount}, \text{Insurance\_amount}\}$
<p>Hence, In_policy_no is the key.</p>
<p><b>BCNF</b>  For every minimal FD that holds on relation Insurance, In_policy_no is its key.  <b>Therefore, Insurance is in BCNF.</b></p>