

# What is the minimal set of functional dependencies or canonical cover of FD?

A minimal cover of a set of functional dependencies (FD)  $E$  is a minimal set of dependencies  $F$  that is equivalent to  $E$ .

The formal definition is: A set of FD  $F$  to be minimal if it satisfies the following conditions –

- Every dependency in  $F$  has a single attribute for its right-hand side.
- We cannot replace any dependency  $X \rightarrow A$  in  $F$  with a dependency  $Y \rightarrow A$ , where  $Y$  is a proper subset of  $X$ , and still have a set of dependencies that is equivalent to  $F$ .
- We cannot remove any dependency from  $F$  and still have a set of dependencies that are equivalent to  $F$ .

Canonical cover is called minimal cover which is called the minimum set of FDs. A set of FD  $FC$  is called canonical cover of  $F$  if each FD in  $FC$  is a –

- Simple FD.
- Left reduced FD.
- Non-redundant FD.

**Simple FD** –  $X \rightarrow Y$  is a simple FD if  $Y$  is a single attribute.

**Left reduced FD** –  $X \rightarrow Y$  is a left reduced FD if there are no extraneous attributes in  $X$ . {extraneous attributes: Let  $XA \rightarrow Y$  then,  $A$  is a extraneous attribute if  $X \rightarrow Y$ }

**Non-redundant FD** –  $X \rightarrow Y$  is a Non-redundant FD if it cannot be derived from  $F - \{X \rightarrow y\}$ .

## Example

Consider an example to find canonical cover of  $F$ .

The given functional dependencies are as follows –

$A \rightarrow BC$

$B \rightarrow C$

$A \rightarrow B$

$AB \rightarrow C$

- Minimal cover: The minimal cover is the set of FDs which are equivalent to the given FDs.



- Canonical cover: In canonical cover, the LHS (Left Hand Side) must be unique.

First of all, we will find the minimal cover and then the canonical cover.

**First step** – Convert RHS attribute into singleton attribute.

$A \rightarrow B$

$A \rightarrow C$

$B \rightarrow C$

$A \rightarrow B$

$AB \rightarrow C$

**Second step** – Remove the extra LHS attribute

Find the closure of A.

$A^+ = \{A, B, C\}$

So,  $AB \rightarrow C$  can be converted into  $A \rightarrow C$

$A \rightarrow B$

$A \rightarrow C$

$B \rightarrow C$

$A \rightarrow B$

$A \rightarrow C$

**Third step** – Remove the redundant FDs.

$A \rightarrow B$

$B \rightarrow C$

Now, we will convert the above set of FDs into canonical cover.

The canonical cover for the above set of FDs will be as follows –

$A \rightarrow BC$

$B \rightarrow C$