Functional dependency

Function dependency

- A function dependency A → B means for all instances of a particular value of A, there is the same value of B.

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b2	c3	d2	e3
a3	b3	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

- A function dependency A → B means for all instances of a particular value of A, there is the same value of B.

A	B	C	D	E
a1	<u>b1</u>	c1	d1	e1
a2	b2	c2	d2	e2
a1	<u>b1</u>	c3	d2	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

1.What about B→A ?????????

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d2	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

1. **What about C→A ????????**
1. **What about C→D ????????**
1. **What about D→A ????????**

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d2	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

1. What about C→A holds
1. What about C→D holds
1. What about D→A does not hold

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d2	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Candidate Key

- Any attribute(attributes) that can uniquely identify a tuple in a relation
- According to **functional dependency**, any attribute (set of attributes) can functionally determine all other attributes in a relation , that attribute(attributes) is called candidate key

Function dependency

1.What about A??

A→B holds

A→C does not hold

A can’t be the candidate key

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d2	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

1.What about B??

B→A does not hold

B can't be the candidate key

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d2	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

1.What about B??

B→A does not hold

B can't be the candidate key

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d3	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

1.What about C??

C→A ???

C→B ???

C→C ???

C→D???

C→E ???

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d3	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

1.What about C??

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d3	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

C→A ??? yes

C→B ??? yes

C→C ??? yes

C→D??? yes

C→E ???yes

C is a candidate key

Function dependency

1.What about D??

D→A ??? NO

D→B ??? NO

D→C ??? NO

D→D??? yes

D→E ??? No

D is a not a candidate key

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d3	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

Any other candidate key possible??????

We can take all two attribute combinations after excluding C& E

Ie:AB??

AD??

BD?

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d3	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

AB?????

AB-→C does not exist

So AB is not a key

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d3	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

AD?????

AD-→A?

AD-→B?

AD-→C?

AD-→D?

AD-→E?

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d2	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

AD?????

AD-→A? YES

AD-→B?YES

AD-→C?YES

AD-→D? YES

AD-→E?YES

AD is a key

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d2	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Function dependency

BD?????

BD-→A? NO

BD-→B?YES

BD-→C?NO

BD-→D? YES

BD-→E?NO

BD IS NOT A KEY

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b2	c2	d2	e2
a1	b1	c3	d2	e3
a3	b1	c4	d2	e4
a4	b4	c5	d4	e5

Prime attributes

- Prime attribute-The constituent attributes of a relation are called **prime attributes**.
- Conversely, an attribute that does not occur in ANY candidate key is called a **non-prime attribute**.
- In the previous relation ,R(A,B,C,D,E) ,Candidate keys are {C,E,AD}
- So prime apptributes are {A,C,D,E}
- Non prime attribtes are {B}

Armstrong's Axioms

- Armstrong's Axioms: Let $\underline{X}$, $\underline{Y}$ be sets of attributes from a relation T.
  - [1] Inclusion rule: If $\underline{Y} \subseteq \underline{X}$, then $\underline{X} \rightarrow \underline{Y}$.
  - [2] Transitivity rule: If $\underline{X} \rightarrow \underline{Y}$, and $\underline{Y} \rightarrow \underline{Z}$, then $\underline{X} \rightarrow \underline{Z}$.
  - [3] Augmentation rule: If $\underline{X} \rightarrow \underline{Y}$, then $\underline{XZ} \rightarrow \underline{YZ}$.
- Other derived rules:
  - [1] Union rule: If $\underline{X} \rightarrow \underline{Y}$ and $\underline{X} \rightarrow \underline{Z}$, then $\underline{X} \rightarrow \underline{YZ}$
  - [2] Decomposition rule: If $\underline{X} \rightarrow \underline{YZ}$, then $\underline{X} \rightarrow \underline{Y}$ and $\underline{X} \rightarrow \underline{Z}$
  - [3] Pseudotransitivity: If $\underline{X} \rightarrow \underline{Y}$ and $\underline{WY} \rightarrow \underline{Z}$, then $\underline{XW} \rightarrow \underline{Z}$