

COMPUTER SCIENCE



Database Management System

FD's & Normalization

Lecture_04



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An orange diamond-shaped sign with a black border and the text 'TOPICS TO BE COVERED' in black capital letters.

**TOPICS
TO BE
COVERED**

A red diamond-shaped sign with a white border and the number '01' in white.

01

Attribute Closure

A red diamond-shaped sign with a white border and the number '02' in white.

02

Finding Candidate keys



- RDBMS Concept
- FD Concept & its type.
- PQ & Question
- Attribute closure.
- Key Concept
 - ↳ Super key.

Keys Concept

Super key

minimal

Assume
[4 C.K.]
Candidate key (C.K.)

$$\underline{C.K = [P.K + A.K]}$$

1 Selector → Primary key (1)

(3)
Remaining C.K. Alternative/
except P.K Secondary key

Keys Concept

Super key: If All Attribute of Relation R is determined by Attribute (Attribute set) closure of X $[X]^+$ then X is a Super key.

- Every key (c.k. (pk + A.k)) are Super key.
- Every Super set of Super key is also Super key.

Keys Concept

Candidate key: Minimal of Super key.

If Any Proper subset of Super key is also Super key
then that Proper Subset is Called Candidate key (& so on)

SUPER key = $\begin{matrix} + \\ & \& \end{matrix}$ Candidate key
Candidate key + All other Attribute Combination.

Iterative.

- Every Candidate key is a Super key also But
Every Super key is Not a Candidate key.
- Because Candidate key is Minimal of Super key.

Q1 R(ABCDE) [AB → C, C → D, B → EA]

Soln $[AB]^+ = [ABCDE]$

AB is Super key

ABC is Super key



Proper subset
 ϕ X
 AB X

$[A]^+ = [A]$

$[B]^+ = [BEACD]$

key/prime attribute = [B]
 Non key / Non Prime attribute = [A, C, D, E]

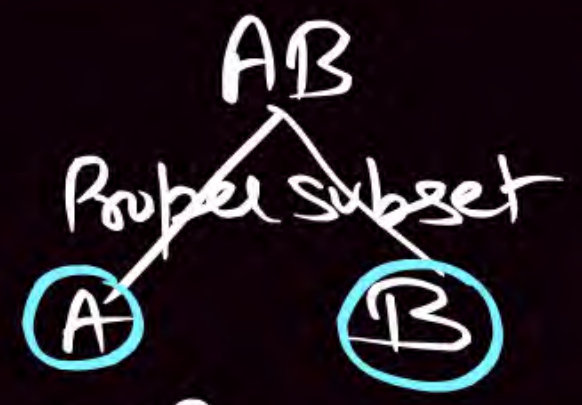
B is Candidate key

Q2 R(ABCDE) [AB → C, C → D, B → E]

$[AB]^+ = [ABCDE]$

AB is Super key

key/prime attribute = [A, B]
 Non key / Non Prime attribute = [C, D, E]



$[A]^+ = [A]$

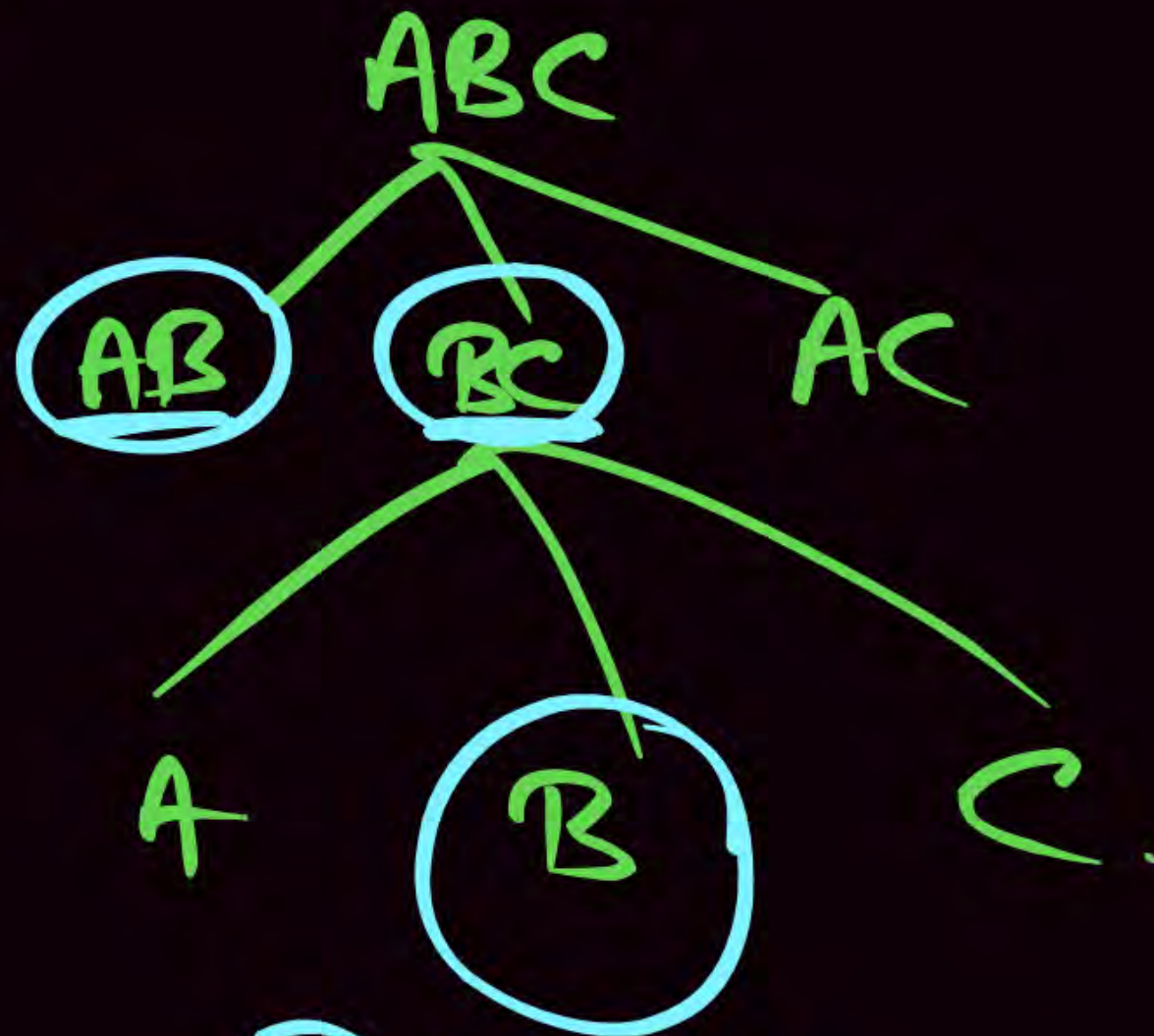
$[B]^+ = [BE]$

In Q2 AB is SK
 So AB is First Super key

AB + All attribute combination is also SK

AB is Candidate key

(23) If we start $(ABC)^+ = (ABCDE)$
ABC is super key.



B is C.K

Iterative

Super key

Q1 B is Candidate key so B is First Super key

B \oplus ALL other ^{Attribute} Combination is also S.K.

Super key =

B
B A
B AC
B ACD

⋮

⋮

⋮

B ACDE

Super key

AB is Candidate key.

A
X

B
X

②

ABC is C.K.

~~AB~~

~~BC~~

~~AC~~

A

B

C

Keys Concept

Key / Prime Attribute : Set of Attribute which belongs / Present in Any Candidate key called Key / Prime Attribute.

Non key / Non Prime Attribute : Set of Attribute which Not belongs / Not Present in Any Candidate key is Called Non key / Non Prime Attribute.

Keys Concept

(I) How to Find Candidate Key:

- First find Super key [Any Super key] then check minimal of that Super key. [oath]

$R(AB\bar{C}\bar{D}\bar{E})$ ($AB \rightarrow C, C \rightarrow D, D \rightarrow E$)

$(AB)^+ = [ABCDE]$ AB: super key.
 $(A)^+ = [A]$
 $(B)^+ = [B]$ AB is candidate key

- Those attribute Not Present in Right Hand Side [R.H.S] that Attribute must be Part/Present in Candidate key

Keys Concept

② How to Find Multiple Candidate key:

First Find Any Candidate key, & that Attributes (C.K Attribute)
is Prime/Key Attribute

v.v.v.v.v.v.v.v Imp.

If $X_{\text{Attribute}} \rightarrow [\text{Prime/Key Attribute}]$

then Multiple
Candidate keys are
possible.

Q.1

R(ABCDEF) $\{A \rightarrow B, B \rightarrow C, D \rightarrow CEF\}$

Find candidate keys for the relation R?

oath 8:58 AM



$$[A]^+ = [ABC]$$

$$[D]^+ = [DCEF]$$

$$[AD]^+ = [ABCDEF]$$

AD is Candidate key. — ①

OR

$$[AD]^+ = [ABCDEF]$$

$$[A]^+ = [ABC]$$

$$[D]^+ = [DCEF]$$

AD is Candidate key.

key / Prime Attribute = {A, D}

Check: $\nexists X_{\text{Attribute}} \rightarrow [\text{Prime Attribute}]$

Only 1 CK [AD].

No multiple C.K. Ans

Q.2

$R(ABCDE) \{AB \rightarrow C, C \rightarrow D, D \rightarrow E, \overline{B \rightarrow A}, \underline{C \rightarrow B}\}$

Find candidate keys for the relation R?

Solⁿ $[AB]^+ = [ABCDE]$

AB is Super key

$\rightarrow [A]^+ = [A]$

$\rightarrow [B]^+ = [BACDE]$

B is Candidate key — (1)

2 Candidate key
 B & C .

Key/Prime Attribute = $[B, C]$

If X Attribute \rightarrow [Prime Attribute]

$C \rightarrow \underline{B}$

$[C]^+ = [CBADE]$

C is Candidate key — (2)



Q.3

$R(ABCD) \{A \rightarrow B, B \rightarrow C, C \rightarrow D, D \rightarrow A\}$

Find candidate keys for the relation R?

$[A]^+ = [ABCD]$

A is Candidate key. — (1)

Prime Attribute = $[A, D, C, B]$

$D \rightarrow A$

$[D]^+ = [DABC]$

D is Candidate key — (2)

$C \rightarrow D$

$[C]^+ = [CDAB]$

C is Candidate key. — (3)

$B \rightarrow C$

$[B]^+ = [BCDA]$

B is Candidate key. — (4)

C.K $\left. \begin{matrix} A \\ B \\ C \\ D \end{matrix} \right\} \text{Ans}$

Q.4

$R(ABCDEF) \{A \rightarrow \underline{BCDE}, \underline{BC} \rightarrow \underline{AD}, D \rightarrow EF\}$

Find candidate keys for the relation R?

$$[A]^+ = [ABCDEF]$$

Key/Prime Attribute = $[A, B, C]$

A is Candidate key.

If $X_{\text{Attribute}} \rightarrow [\text{Prime Attribute}]$

$(A) \rightarrow \underline{BCDE}$
 \downarrow
 already Taken.

$(AC) \times$

$$BC \rightarrow \underline{AD}$$

$$[BC]^+ = [BCADE F]$$

$$[B]^+ = [B]$$

$$[C]^+ = [C]$$

BC is Candidate key.

Candidate key

① A
 ② BC



Q.5

$R(ABCD)$ F: $\{AB \rightarrow C, B \rightarrow D, C \rightarrow B, D \rightarrow B\}$

Find all candidate key of R?

[HOMEWORK]

Q.6



Consider the following relational schema $R(ABCDEF)$ with functional dependency $\{AB \rightarrow C, C \rightarrow D, D \rightarrow E, E \rightarrow F, F \rightarrow B\}$
 The number of candidate keys for relation R?

Key/Prime Attribute = $\{\checkmark A, \checkmark B, \checkmark F, \checkmark E, \checkmark D, \checkmark C\}$

$[AB]^+ = [ABCDEF]$

$[A]^+ = [A]$

$[B]^+ = [B]$

AB is Candidate key - (1)

If $X_{Attribute} \rightarrow [Prime Attribute]$

$\text{A} \rightarrow \text{F} \quad F \rightarrow B$
 $[AF]^+ = [AFBCDE]$

$[F]^+ = [FB]$

AF is Candidate key - (2)

$\text{A} \rightarrow \text{E} \quad E \rightarrow F$
 $[AE]^+ = [AEFBCD]$

$[E]^+ = [EFB]$

AE is Candidate key - (3)

$\text{A} \rightarrow \text{C} \quad C \rightarrow D$
 $[AC]^+ = [ACDEFB]$
 $[C]^+ = [CDEFB]$

AC is Candidate key - (5)

$\text{A} \rightarrow \text{D} \quad D \rightarrow E$
 $[AD]^+ = [ADEFCB]$
 $[D]^+ = [DEFB]$

AD is Candidate key - (4)

5 C.K

- AB
 - AF
 - AE
 - AD
 - AC
- Ans

Q.6

Consider the following relational schema $R(ABCDEF)$ with functional dependency $\{AB \rightarrow C, C \rightarrow D, D \rightarrow E, E \rightarrow F, F \rightarrow B\}$

The number of candidate keys for relation R ?



$$[BE]^+ = [BEF]$$

$$\checkmark \textcircled{(\underline{BE})^+} = [\text{---}]$$

$$\checkmark \textcircled{(\underline{EB})^+} = [\text{---}]$$

Q.7

$R(ABCDE) : \{AB \rightarrow C, BC \rightarrow D\}$

Find Candidate keys for the Relation R?

$$[AB]^+ = [ABCD]$$

Prime Attribute = $\{E, A, B\}$

E is Not Present in FD.

Note Whenever Any Attribute Not Present in FD then Make a Part of (ADD IN) Candidate key

$$\begin{matrix} AB \\ BE \\ AE \end{matrix} \rightarrow [ABE]^+ = [ABCDE]$$

$$[AB]^+ = [ABCD]$$

$$[AE]^+ = [AE]$$

$$[BE]^+ = [BE]$$

ABE is Candidate key.

No Multiple C.K
Ans



Q.8

$R(ABCDEFG) : \{A \rightarrow B, B \rightarrow C, C \rightarrow D, D \rightarrow E, F \rightarrow G\}$

Find Candidate keys for the Relation R?

[HOMEWORK]

Q.9

$R(ABCDEFGH) : \{AB \rightarrow C, AC \rightarrow B, AD \rightarrow E, B \rightarrow D, BC \rightarrow A, E \rightarrow G\}$

Find Candidate keys for the Relation R?



Q.10

$R(ABDCPT), \{B \rightarrow PT, T \rightarrow L, A \rightarrow D\}$

Find candidate keys for the relation R?

Q.11

$R(ABCDEFGHIJ) = \{AB \rightarrow C, A \rightarrow DE, B \rightarrow F, F \rightarrow GH, D \rightarrow IJ\}$

Find candidate keys for the relation R?



Q.12

$R(ABCDEFGG)$

$[A \rightarrow B, B \rightarrow A, C \rightarrow D, D \rightarrow E, E \rightarrow FG]$

Find candidate keys for the relation R?

Q.13

$R(ABCDEFG) \{AB \rightarrow CDEF, C \rightarrow ADE, D \rightarrow EBF, F \rightarrow DA, BE \rightarrow AF\}$

Find candidate keys for the relation R?



Q.14

$R(ABCDEFGH) \{A \rightarrow BC, B \rightarrow DEF, DE \rightarrow AGH\}$

Find candidate keys for the relation R?

Q.15

$R(ABCDE) \{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$

Find candidate keys for the relation R ?

Q.16

$R(ABCDEFGH)$

$\{AB \rightarrow CD, D \rightarrow EG, F \rightarrow H, C \rightarrow EF, H \rightarrow A, G \rightarrow B, A \rightarrow B\}$

Find candidate keys for the relation R ?

Q.1

Consider the relation scheme $R(A,B,C)$ with the following functional dependencies

$$AB \rightarrow C$$

$$C \rightarrow A$$

Determine the minimal keys of relations R .

[1995: 2 Marks]

Q.2

Let $R = (A, B, C, D, E, F)$ be a relation scheme with the following dependencies $C \rightarrow F$, $E \rightarrow A$, $EC \rightarrow D$, $A \rightarrow B$. Which of the following is a key for R ?
[1999: 1 Mark]

A

CD

B

EC

C

AE

D

AC

Q.3

The relation scheme student Performance (name course No, rollNo, grade) has the following functional dependencies:



name, courseNo \rightarrow grade

[1999: 1 Mark]

RollNo, courseNo \rightarrow grade

name \rightarrow rollNo

rollNo \rightarrow name

Find candidate keys?

Q.4

Consider a relation scheme $R = (A, B, C, D, E, H)$ on which of the following functional dependencies hold:

$\{A \rightarrow B, BC \rightarrow D, E \rightarrow C, D \rightarrow A\}$

What are the candidate keys of R ? [2005: 2 Marks]

A

AE, BE

B

AE, BE, DE

C

AEH, BEH, BCH

D

AEH, BEH, DEH



Q.5

Let $R(A,B,C,D,E,F,P,G)$ be a relational schema in which of the following functional dependencies are known to hold:



$A \rightarrow BCD$, $DE \rightarrow P$, $C \rightarrow E$, $P \rightarrow C$ and $B \rightarrow G$.

Find candidate key of Relations R?

Q.6

Consider a relation R with five attributes V, W, X, Y, and Z. The following functional dependencies hold : $VY \rightarrow W$, $WX \rightarrow Z$, and $ZY \rightarrow V$. Which of the following is a candidate key for R?



[2006: 2 Marks]

A

VXZ

B

VXY

C

VWXY

D

VWXYZ

Q.7

Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values.



$F = \{CH \rightarrow G, A \rightarrow BC, B \rightarrow CFH, E \rightarrow A, F \rightarrow EG\}$ is a set of functional dependencies (FDs) so that F is exactly the set of FDs that hold for R.

How many candidate keys does the relation R have? [2013: 2 Marks]

A 3

B 4

C 5

D 6

Q.8

Consider the relation scheme $R = (E, F, G, H, I, J, K, L, M, N)$ and the set of functional dependencies $\{ \{EF\} \rightarrow \{G\}, \{F\} \rightarrow \{I, J\}, \{E, H\} \rightarrow \{K, L\}, \{K\} \rightarrow \{M\}, \{L\} \rightarrow \{N\} \}$ on R . What is the key of R ?

- A** $\{E, F\}$
- C** $\{E, F, H, K, L\}$

- B** $\{E, F, H\}$
- D** $\{E\}$

[2014: 1 Mark]

↓
C.K.

~~MSQ~~
MCQ

Q.9

A prime attribute of a relation scheme R is an attribute that appears

[2014: 1 Mark]

- A In all candidate keys of R.
- B In some candidate key of R.
- C In a foreign key of R.
- D Only in the primary key of R.



Q.10

Which of the following is NOT a superkey in a relational schema with attributes V, W, X, Y, Z and primary key VY? [2016: 1 Mark]



A

VXYZ

B

VWXZ

C

VWXY

D

VWXYZ

Any Doubt ?



**THANK
YOU!**

