Calculation of Super Keys and Candidate Keys

Sid	Name	Marks	Dept	Course
1	Harsh	88	CE	C1
2	Raj	77	EE	C2
3	Harsh	88	CE	C2
4	Raj	77	EE	C3
5	Kunj	80	IT	C2

Key = Sid

{Dept,Course} is Key? YES

{Name} is Key? No

{Name, Marks} is Key? No

{Sid, Name, Marks, Dept, Course} is Key? YES

For above relation: sid is a super key.

{sid, Name} is super key? YES
{sid, Marks} is super key? YES
{sid,Marks,Name} is super key? YES
{Name, Marks, Dept} is super key? NO
{Marks,Course, Dept} is super key? YES

How many maximum number keys are possible for a above relation?

Here there are five attributes, so maximum number of super keys are,

$5C_1 + 5C_2 + 5C_3 + 5C_4 + 5C_5 = 5 + 10 + 10 + 5 + 1 = 31$

If there are 4 attributes, so maximum number of suoer keys are 15

In general, Maximum number of super keys for given relation with n attributes are 2^n-1

Example: Find Super keys in a given relation

A	B	C	D
1	1	5	1
2	1	7	1
3	1	7	1
4	2	7	1
5	2	5	1
6	2	5	2

Answer:

Super key = A, AB, AC, AD, ABC, ACD, ABD, ABCD

Example : Calculate Candidate Key for the given relation

A	B	C
1	1	1
2	1	2
3	2	1
4	2	2

Answer:

Superkey = A, AB, AC, ABC, BC

Candidate key = Whose proper subset is not super key.

Example 1: S1 = {1,2,3} and S2 = {1,2}

Then S2 $\subseteq$ S1 $\subseteq$ = Subset

and S2 $\subset$ S1 $\subset$ = Proper Subset

IF S2 $\subseteq$ S1 and S1 $\not\subseteq$ S2 THEN S2 $\subset$ S1

Example 2: S1 = {1,2,3} and S2 = {1,2,3}

Then S2 $\subseteq$ S1

and S2 $\not\subset$ S1

	Super Key	Candidate Key
A	✓	✓
AB	✓	X
AC	✓	X
ABC	✓	X
BC	✓	✓

The subset of AB will be {A}, {B}

Hence Candidate keys are A and BC

Key Point: Every Candidate key is a Super key. But the reverse is not always true.

Example:
R(A, B, C) and A is a Candidate Key. Calculate number of super keys in the relation?
Answer:
Super key = A, AB, AC, ABC

Example:
R(A, B, C) and AC is a Candidate Key. Calculate number of super keys in the relation?
Answer:
Super key = AC, ACB

Example:
R(A, B, C, D) and A and D are Candidate Key. Calculate number of super keys in the relation?
Answer:
Super key = AB, AD, BC, CD

Finding number of Candidate keys in a relation:

Example :
R(A, B, C, D, E, F)
F = { AB --> C, C --> DE, E --> F, D --> A, C --> B}
Calculate Candidate Key.
Answer:
Find Super keys:
1) (ABCDEF)+ = {A, B, C, D, E, F}
To find candidate keys, Try to discard attributes from ABCDEF.
Check for first dependency which is AB --> C, we can discard C
Hence, (ABDEF)+ = {A, B, C, D, E, F}
Try to discard attributes from ABDEF, we discard D because AB --> C, C --> D henceAB --> D
Hence (ABEF)+ = {A, B, C, D, E, F}
Try to discard attributes from ABEF, we discard E
Hence (ABF)+ = {A, B, C, D, E, F}
Try to discard attributes from ABF, we discard F
Hence (AB)+ = {A, B, C, D, E, F}
Try to discard attributes from AB. we can't discard anything
Check AB is Candidate key or not?
Proper Subset of AB are {A} and {B}
Find A+ = {A}
B+ = {B}
Here A and B are not Super key. Hence, **AB is a candidate key**
Here prime attributes are A and B

Note: If prime attributes are present on R.H.S. of FD then there are more candidates key.

For above scenario, A and B are prime attributes and they are on RHS of FD hence there are more Candidate keys are there.

Here Candidate key is AB and FD D --> A is there so by psudotransitivity property,
A in AB will be replaced with D. Hence it will become DB. Still DB is not a Candidate key. We need to prove it.
DB is super key, but need to calculate for Candidate key.
Check DB is Candidate key or not?
Proper Subset of DB are {D} and {B}
Find D+ = {DA} DA is not super key.
B+ = {B} B is not super key.
Hence DB is a Candidate key.
Hence prime attributes are {A, B, D}

Here Candidate key is AB and FD C --> B is there so by psudotransitivity property,
B in AB will be replaced with C. Hence it will become AC. Still AC is not a Candidate key. We need to prove it.
Check AC is Candidate key or not?
Proper subset of AC are {A} and {C}
Find A+ = {A}
C+ = {C,D,E,F,A,B} **AC is not a Candidate Key.**

But C is a Super key, Hence C is a Candidate Key.

Hence prime attributes are {A, B, D,C}

Check D is present on RHS of FD.
D in DB is replaced with C. Hence, CB or BC
Check BC is Candidate key or not?
Proper subset of BC are {B} and {C}
B+ = {B}
C+ = {C,D,E,F,A,B} **BC is not a Candidate Key.**
But C is a Super key, Hence C is a Candidate Key.

Check C is present on RHS of FD.
AB --> C hence C will be replaced with AB. And AB is already a CK.

Hence, CK for above relation are, {AB, DB, C}