

It is known a table  $R = (A, B, C, D, E, F, G)$  that satisfy 1-NF, and it is also known the functional dependencies as follows

(1)  $A \rightarrow (B, C)$

(2)  $D \rightarrow E$

(3)  $(A, D) \rightarrow F$

(4)  $F \rightarrow G$

**a – Compute all superkeys (SK) and Candidate Key (CK), and Primary Key (PK)**

Suppose  $\lambda$  is SK(R), then it must be proven that  $\lambda \rightarrow (A, B, C, D, E, F, G)$  (Based on the theorem of Functional Dependency or FD)

**I – Suppose  $\lambda$  consist of 1 attribute, therefore the possible values of  $\lambda$  are:**

{A, B, C, D, E, F, G}

I-1- Suppose  $\lambda = A$ , it must be proven that  $A \rightarrow (A, B, C, D, E, F, G)$

Proof:

$A \rightarrow (B, C)$  (1) known

$A \rightarrow A$  (5) reflexivity

$A \rightarrow (A, B, C)$  (6) union

We cannot continue.

A is not a SK(R)

I-2- Suppose  $\lambda = B$ , it must be proven that  $B \rightarrow (A, B, C, D, E, F, G)$

Proof:

We cannot continue.

B is not a SK(R)

I-3- Suppose  $\lambda = C$ , it must be proven that  $C \rightarrow (A, B, C, D, E, F, G)$

Proof:

We cannot continue.

C is not a SK(R)

I-4- Suppose  $\lambda = D$ , it must be proven that  $D \rightarrow (A, B, C, D, E, F, G)$

Proof:

$D \rightarrow E$  (2) known

$D \rightarrow D$  (7) reflexivity

$D \rightarrow (D, E)$  (8) union

We cannot continue.

D is not a SK(R)

I-5- Suppose  $\lambda = E$ , it must be proven that  $E \rightarrow (A, B, C, D, E, F, G)$

Proof:

We cannot continue.

E is not a SK(R)

I-6- Suppose  $\lambda = F$ , it must be proven that  $F \rightarrow (A, B, C, D, E, F, G)$

Proof:

$F \rightarrow G$  (4) known

$F \rightarrow F$  (9) reflexivity

$F \rightarrow (F, G)$  (10) union

We cannot continue.

F is not a SK(R)

I-7- Suppose  $\lambda = G$ , it must be proven that  $G \rightarrow (A, B, C, D, E, F, G)$

Proof:

We cannot continue.

G is not a SK(R)

**II – Suppose  $\lambda$  consist of 2 attributes, then the possible values of  $\lambda$  are:**

{(A, B), (A, C), (A, D), (A, E), (A, F), (A, G), (B, C), (B, D), (B, E), (B, F), (B, G), (C, D), (C, E), (C, F), (C, G), (D, E), (D, F), (D, G), (E, F), (E, G), (F, G)}

II-1- Suppose  $\lambda = (A, B)$ , it must be proven that  $(A, B) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$A \rightarrow (A, B, C)$  (6) proven

$(A, B) \rightarrow (A, B, C)$  (11) augmentation

We cannot continue.

(A, B) is not a SK(R)

II-2- Suppose  $\lambda = (A, C)$ , it must be proven that  $(A, C) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$A \rightarrow (A, B, C)$  (6) proven

$(A, C) \rightarrow (A, B, C)$  (12) augmentation

We cannot continue.

(A, C) is not a SK(R)

II-3- Suppose  $\lambda = (A, D)$ , it must be proven that  $(A, D) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$A \rightarrow (A, B, C)$  (6) proven

$(A, D) \rightarrow (A, B, C, D)$  (13) augmentation

$D \rightarrow (D, E)$  (8) proven

$(A, D) \rightarrow (A, D, E)$  (14) augmentation

$D \rightarrow E$  (2) known  
 $(A, D) \rightarrow (A, E)$  (15) augmentation  
 $(A, D) \rightarrow F$  (3) known  
 $F \rightarrow G$  (4) known  
 Based on (3) and (4)  
 $(A, D) \rightarrow G$  (16) transitivity  
 Based on (13), (14), (15), (16)  
 $(A, D) \rightarrow (A, B, C, D, E, F, G)$  (17) union

**(A, D) is a SK(R)**

II-4- Suppose  $\lambda = (A, E)$ , it must be proven that  $(A, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$A \rightarrow (A, B, C)$  (6) proven  
 $(A, E) \rightarrow (A, B, C, E)$  (18) augmentation  
 We cannot continue.  
 $(A, E)$  is not a SK(R)

II-5- Suppose  $\lambda = (A, F)$ , it must be proven that  $(A, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$A \rightarrow (A, B, C)$  (6) proven  
 $F \rightarrow (F, G)$  (10) proven  
 $(A, F) \rightarrow (A, B, C, F)$  (19) augmentation  
 $(A, F) \rightarrow (A, F, G)$  (20) augmentation  
 $(A, F) \rightarrow (A, B, C, F, G)$  (21) union  
 We cannot continue.  
 $(A, F)$  is not a SK(R)

II-6- Suppose  $\lambda = (A, G)$ , it must be proven that  $(A, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$A \rightarrow (A, B, C)$  (6) proven  
 $(A, G) \rightarrow (A, B, C, G)$  (22) augmentation  
 We cannot continue.  
 $(A, G)$  is not a SK(R)

II-7- Suppose  $\lambda = (B, C)$ , it must be proven that  $(B, C) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$B \rightarrow B$  (23) reflexivity  
 $C \rightarrow C$  (24) reflexivity  
 $(B, C) \rightarrow (B, C)$  (25) augmentation  
 We cannot continue.  
 $(B, C)$  is not a SK(R)

II-8- Suppose  $\lambda = (B, D)$ , it must be proven that  $(B, D) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$B \rightarrow B$  (23) proven  
 $D \rightarrow (D, E)$  (8) proven  
 $(B, D) \rightarrow (B, D, E)$  (26) augmentation

We cannot continue.

$(B, D)$  is not a SK(R)

II-9- Suppose  $\lambda = (B, E)$ , it must be proven that  $(B, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$B \rightarrow B$  (23) proven  
 $E \rightarrow E$  (27) reflexivity  
 $(B, E) \rightarrow (B, E)$  (28) augmentation

We cannot continue.

$(B, E)$  is not a SK(R)

II-10- Suppose  $\lambda = (B, F)$ , it must be proven that  $(B, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$B \rightarrow B$  (23) proven  
 $F \rightarrow (F, G)$  (10) proven  
 $(B, F) \rightarrow (B, F, G)$  (29) augmentation

We cannot continue.

$(B, F)$  is not a SK(R)

II-11- Suppose  $\lambda = (B, G)$ , it must be proven that  $(B, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$B \rightarrow B$  (23) proven  
 $G \rightarrow G$  (30) reflexivity  
 $(B, G) \rightarrow (B, G)$  (31) augmentation

We cannot continue.

$(B, G)$  is not a SK(R)

II-12- Suppose  $\lambda = (C, D)$ , it must be proven that  $(C, D) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$C \rightarrow C$  (32) reflexivity  
 $D \rightarrow (D, E)$  (8) proven  
 $(C, D) \rightarrow (C, D, E)$  (33) augmentation

We cannot continue.

$(C, D)$  is not a SK(R)

II-13- Suppose  $\lambda = (C, E)$ , it must be proven that  $(C, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$C \rightarrow C$  (32) proven  
 $E \rightarrow E$  (34) reflexivity  
 $(C, E) \rightarrow (C, E)$  (35) augmentation

We cannot continue.

$(C, E)$  is not a SK(R)

II-14- Suppose  $\lambda = (C, F)$ , it must be proven that  $(C, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$C \rightarrow C$  (32) proven  
 $F \rightarrow (F, G)$  (10) proven  
 $(C, F) \rightarrow (C, F, G)$  (36) augmentation

We cannot continue.

$(C, F)$  is not a SK(R)

II-15- Suppose  $\lambda = (C, G)$ , it must be proven that  $(C, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$C \rightarrow C$  (32) proven  
 $G \rightarrow G$  (30) proven  
 $(C, G) \rightarrow (C, G)$  (37) augmentation

We cannot continue.

$(C, G)$  is not a SK(R)

II-16- Suppose  $\lambda = (D, E)$ , it must be proven that  $(D, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$D \rightarrow (D, E)$  (8) proven  
 $(D, E) \rightarrow (D, E)$  (38) augmentation

We cannot continue.

$(D, E)$  is not a SK(R)

II-17- Suppose  $\lambda = (D, F)$ , it must be proven that  $(D, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$D \rightarrow (D, E)$  (8) proven  
 $F \rightarrow (F, G)$  (10) proven  
 $(D, F) \rightarrow (D, F, G)$  (39) augmentation  
 $(D, F) \rightarrow (D, E, F)$  (40) augmentation  
 $(D, F) \rightarrow (D, E, F, G)$  (41) union

We cannot continue.

$(D, F)$  is not a SK(R)

II-18- Suppose  $\lambda = (D, G)$ , it must be proven that  $(D, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$D \rightarrow (D, E)$  (8) proven  
 $G \rightarrow G$  (30) proven  
 $(D, G) \rightarrow (D, E, G)$  (42) augmentation

We cannot continue.

$(D, G)$  is not a SK(R)

II-19- Suppose  $\lambda = (E, F)$ , it must be proven that  $(E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$E \rightarrow E$  (34) proven  
 $F \rightarrow (F, G)$  (10) proven  
 $(E, F) \rightarrow (E, F, G)$  (43) augmentation

We cannot continue.

$(E, F)$  is not a SK(R)

II-20- Suppose  $\lambda = (E, G)$ , it must be proven that  $(E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$E \rightarrow E$  (34) proven  
 $G \rightarrow G$  (30) proven  
 $(E, G) \rightarrow (E, G)$  (44) augmentation

We cannot continue.

$(E, G)$  is not a SK(R)

II-21- Suppose  $\lambda = (F, G)$ , it must be proven that  $(F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$F \rightarrow (F, G)$  (10) proven  
 $G \rightarrow G$  (30) proven  
 $(F, G) \rightarrow (F, G)$  (45) augmentation

We cannot continue.

$(F, G)$  is not a SK(R)

**III – Suppose  $\lambda$  consist of 3 attributes, then the possible values of  $\lambda$  are:**

{(A, B, C), (A, B, D), (A, B, E), (A, B, F), (A, B, G), (A, C, D), (A, C, E), (A, C, F), (A, C, G), (A, D, E), (A, D, F), (A, D, G), (A, E, F), (A, E, G), (A, F, G), (B, C, D), (B, C, E), (B, C, F), (B, C, G), (B, D, E), (B, D, F), (B, D, G), (B, E, F), (B, E, G), (B, F, G), (C, D, E), (C, D, F), (C, D, G), (C, E, F), (C, E, G), (C, F, G), (D, E, F), (D, E, G), (D, F, G), (E, F, G)}

III-1- Suppose  $\lambda = (A, B, C)$ , it must be proven that  $(A, B, C) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B) \rightarrow (A, B, C)$  (11) proven  
 $(A, B, C) \rightarrow (A, B, C)$  (46) augmentation

We cannot continue.

(A, B, C) is not a SK(R)

III-2- Suppose  $\lambda = (A, B, D)$ , it must be proven that  $(A, B, D) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, D) \rightarrow (A, B, C, D, E, F, G)$  (17) union

$(A, B, D) \rightarrow (A, B, C, D, E, F, G)$  (47) augmentation

**(A, B, D) is SK(R)**

III-3- Suppose  $\lambda = (A, B, E)$ , it must be proven that  $(A, B, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B) \rightarrow (A, B, C)$  (11) proven

$(A, B, E) \rightarrow (A, B, C, E)$  (48) augmentation

We cannot continue.

(A, B, E) is not a SK(R)

III-4- Suppose  $\lambda = (A, B, F)$ , it must be proven that  $(A, B, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B) \rightarrow (A, B, C)$  (11) proven

$(A, B, F) \rightarrow (A, B, C, F)$  (49) augmentation

$F \rightarrow (F, G)$  (10) proven

$(A, B, F) \rightarrow (A, B, F, G)$  (50) augmentation

$(A, B, F) \rightarrow (A, B, C, F, G)$  (51) union

We cannot continue.

(A, B, F) is not a SK(R)

III-5- Suppose  $\lambda = (A, B, G)$ , it must be proven that  $(A, B, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B) \rightarrow (A, B, C)$  (11) proven

$G \rightarrow G$  (30) proven

$(A, B, G) \rightarrow (A, B, C, G)$  (52) augmentation

We cannot continue.

(A, B, G) is not a SK(R)

III-6- Suppose  $\lambda = (B, C, D)$ , it must be proven that  $(B, C, D) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(B, C) \rightarrow (B, C)$  (25) proven

$D \rightarrow (D, E)$  (8) proven

$(B, C, D) \rightarrow (B, C, D, E)$  (53) augmentation

We cannot continue.

(B, C, D) is not a SK(R)

III-7- Suppose  $\lambda = (B, C, E)$ , it must be proven that  $(B, C, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(B, C) \rightarrow (B, C)$  (25) proven

$(B, C, E) \rightarrow (B, C, E)$  (54) augmentation

We cannot continue.

$(B, C, E)$  is not a SK(R)

III-8- Suppose  $\lambda = (B, C, F)$ , it must be proven that  $(B, C, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(B, C) \rightarrow (B, C)$  (25) proven

$F \rightarrow (F, G)$  (10) proven

$(B, C, F) \rightarrow (B, C, F, G)$  (55) augmentation

We cannot continue.

$(B, C, F)$  is not a SK(R)

III-9- Suppose  $\lambda = (B, C, G)$ , it must be proven that  $(B, C, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(B, C) \rightarrow (B, C)$  (25) proven

$(B, C, G) \rightarrow (B, C, G)$  (56) augmentation

We cannot continue.

$(B, C, G)$  is not a SK(R)

III-10- Suppose  $\lambda = (C, D, E)$ , it must be proven that  $(C, D, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, E) \rightarrow (D, E)$  (38) proven

$(C, D, E) \rightarrow (C, D, E)$  (57) augmentation

We cannot continue.

$(C, D, E)$  is not a SK(R)

III-11- Suppose  $\lambda = (C, D, F)$ , it must be proven that  $(C, D, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, F) \rightarrow (D, E, F, G)$  (41) proven

$(C, D, F) \rightarrow (C, D, E, F, G)$  (58) augmentation

We cannot continue.

$(C, D, F)$  is not a SK(R)

III-12- Suppose  $\lambda = (C, D, G)$ , it must be proven that  $(C, D, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, G) \rightarrow (D, E, G)$  (42) proven

$(C, D, G) \rightarrow (C, D, E, G)$  (59) augmentation

We cannot continue.



(C, D, G) is not a SK(R)

III-13- Suppose  $\lambda = (D, E, F)$ , it must be proven that  $(D, E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, E) \rightarrow (D, E)$  (38) proven  
 $(E, F) \rightarrow (E, F, G)$  (43) proven  
 $(D, E, F) \rightarrow (D, E, F, G)$  (60) augmentation

We cannot continue.

(D, E, F) is not a SK(R)

III-14- Suppose  $\lambda = (D, E, G)$ , it must be proven that  $(D, E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, E) \rightarrow (D, E)$  (38) proven  
 $(D, E, G) \rightarrow (D, E, G)$  (61) augmentation

We cannot continue.

(D, E, G) is not a SK(R)

III-15- Suppose  $\lambda = (A, C, D)$ , it must be proven that  $(A, C, D) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, D) \rightarrow (A, B, C, D, E, F, G)$  (17) union  
 $(A, C, D) \rightarrow (A, B, C, D, E, F, G)$  (62) augmentation

**(A, C, D) is SK(R)**

III-16- Suppose  $\lambda = (E, F, G)$ , it must be proven that  $(E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(E, F) \rightarrow (E, F, G)$  (43) proven  
 $(E, F, G) \rightarrow (E, F, G)$  (63) augmentation

We cannot continue.

(E, F, G) is not a SK(R)

III-17- Suppose  $\lambda = (A, C, E)$ , it must be proven that  $(A, C, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, C) \rightarrow (A, B, C)$  (12) proven  
 $(A, C, E) \rightarrow (A, B, C, E)$  (64) augmentation

We cannot continue.

(A, C, E) is not a SK(R)

III-18- Suppose  $\lambda = (A, C, F)$ , it must be proven that  $(A, C, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, C) \rightarrow (A, B, C)$  (12) proven  
 $(A, C, F) \rightarrow (A, B, C, F)$  (65) augmentation

$(C, F) \rightarrow (C, F, G)$  (36) proven  
 $(A, C, F) \rightarrow (A, C, F, G)$  (66) augmentation  
 $(A, C, F) \rightarrow (A, B, C, F, G)$  (67) union  
 We cannot continue.  
 $(A, C, F)$  is not a SK(R)

III-19- Suppose  $\lambda = (A, C, G)$ , it must be proven that  $(A, C, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, C) \rightarrow (A, B, C)$  (12) proven  
 $(A, C, G) \rightarrow (A, B, C, G)$  (68) augmentation  
 We cannot continue.  
 $(A, C, G)$  is not a SK(R)

III-20- Suppose  $\lambda = (A, D, E)$ , it must be proven that  $(A, D, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, D) \rightarrow (A, B, C, D, E, F, G)$  (17) union  
 $(A, D, E) \rightarrow (A, B, C, D, E, F, G)$  (69) augmentation

**(A, D, E) is SK(R)**

III-21- Suppose  $\lambda = (A, D, F)$ , it must be proven that  $(A, D, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, D) \rightarrow (A, B, C, D, E, F, G)$  (17) union  
 $(A, D, F) \rightarrow (A, B, C, D, E, F, G)$  (70) augmentation

**(A, D, F) is SK(R)**

III-22- Suppose  $\lambda = (A, D, G)$ , it must be proven that  $(A, D, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, D) \rightarrow (A, B, C, D, E, F, G)$  (17) union  
 $(A, D, G) \rightarrow (A, B, C, D, E, F, G)$  (71) augmentation

**(A, D, G) is SK(R)**

III-23- Suppose  $\lambda = (A, E, F)$ , it must be proven that  $(A, E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, E) \rightarrow (A, B, C, E)$  (18) proven  
 $(A, E, F) \rightarrow (A, B, C, E, F)$  (72) augmentation  
 $F \rightarrow (F, G)$  (10) proven  
 $(A, E, F) \rightarrow (A, E, F, G)$  (73) augmentation  
 $(A, E, F) \rightarrow (A, B, C, E, F, G)$  (74) union

We cannot continue.

(A, E, F) is not a SK(R)

III-24- Suppose  $\lambda = (A, E, G)$ , it must be proven that  $(A, E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, E) \rightarrow (A, B, C, E)$  (18) proven

$(A, E, G) \rightarrow (A, B, C, E, G)$  (75) augmentation

We cannot continue.

(A, E, G) is not a SK(R)

III-25- Suppose  $\lambda = (A, F, G)$ , it must be proven that  $(A, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, F) \rightarrow (A, B, C, F, G)$  (21) proven

$(A, F, G) \rightarrow (A, B, C, F, G)$  (76) augmentation

We cannot continue.

(A, F, G) is not a SK(R)

III-26- Suppose  $\lambda = (B, D, E)$ , it must be proven that  $(B, D, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, E) \rightarrow (D, E)$  (38) proven

$(B, D, E) \rightarrow (B, D, E)$  (77) augmentation

We cannot continue.

(B, D, E) is not a SK(R)

III-27- Suppose  $\lambda = (B, D, F)$ , it must be proven that  $(B, D, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, F) \rightarrow (D, E, F, G)$  (41) proven

$(B, D, F) \rightarrow (B, D, E, F, G)$  (78) augmentation

We cannot continue.

(B, D, F) is not a SK(R)

III-28- Suppose  $\lambda = (B, D, G)$ , it must be proven that  $(B, D, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, G) \rightarrow (D, E, G)$  (42) proven

$(B, D, G) \rightarrow (B, D, E, G)$  (79) augmentation

We cannot continue.

(B, D, G) is not a SK(R)

III-29- Suppose  $\lambda = (B, E, F)$ , it must be proven that  $(B, E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(E, F) \rightarrow (E, F, G)$  (43) proven

$(B, E, F) \rightarrow (B, E, F, G)$  (80) augmentation

We cannot continue.

(B, E, F) is not a SK(R)

III-30- Suppose  $\lambda = (B, E, G)$ , it must be proven that  $(B, E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(E, G) \rightarrow (E, G)$  (44) proven

$(B, E, G) \rightarrow (B, E, G)$  (81) augmentation

We cannot continue.

(B, E, G) is not a SK(R)

III-31- Suppose  $\lambda = (B, F, G)$ , it must be proven that  $(B, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(F, G) \rightarrow (F, G)$  (45) augmentation

$(B, F, G) \rightarrow (B, F, G)$  (82) augmentation

We cannot continue.

(B, F, G) is not a SK(R)

III-32- Suppose  $\lambda = (C, E, F)$ , it must be proven that  $(C, E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(E, F) \rightarrow (E, F, G)$  (43) proven

$(C, E, F) \rightarrow (C, E, F, G)$  (83) augmentation

We cannot continue.

(C, E, F) is not a SK(R)

III-33- Suppose  $\lambda = (C, E, G)$ , it must be proven that  $(C, E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(E, G) \rightarrow (E, G)$  (44) proven

$(C, E, G) \rightarrow (C, E, G)$  (84) augmentation

We cannot continue.

(C, E, G) is not a SK(R)

III-34- Suppose  $\lambda = (C, F, G)$ , it must be proven that  $(C, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(F, G) \rightarrow (F, G)$  (45) proven

$(C, F, G) \rightarrow (C, F, G)$  (85) augmentation

We cannot continue.

(C, F, G) is not a SK(R)

III-35- Suppose  $\lambda = (D, F, G)$ , it must be proven that  $(D, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, F) \rightarrow (D, E, F, G)$  (41) proven

$(D, F, G) \rightarrow (D, E, F, G)$  (86) augmentation

We cannot continue.

(D, F, G) is not a SK(R)

**IV – Suppose  $\lambda$  consist of 4 attributes, the possible values of  $\lambda$  are:**

{(A, B, C, D), (A, B, C, E), (A, B, C, F), (A, B, C, G), (B, C, D, E), (B, C, D, F), (B, C, D, G), (C, D, E, F), (C, D, E, G), (D, E, F, G), (A, C, D, E), (A, C, D, F), (A, C, D, G), (A, D, E, F), (A, D, E, G), (A, E, F, G), (B, D, E, F), (B, D, E, G), (B, E, F, G), (C, E, F, G), (A, B, D, E), (A, B, D, F), (A, B, D, G), (A, B, E, F), (A, B, E, G), (A, B, F, G), (A, C, E, F), (A, C, E, G), (A, C, F, G), (A, D, F, G), (B, C, E, F), (B, C, E, G), (B, C, F, G), (B, D, F, G), (C, D, F, G)}

Based on (17), it needs (A, D) to be a SK(R), so we have:

**(A, B, C, D) is SK(R)**

**(A, C, D, E) is SK(R)**

**(A, C, D, F) is SK(R)**

**(A, C, D, G) is SK(R)**

**(A, D, E, F) is SK(R)**

**(A, D, E, G) is SK(R)**

**(A, B, D, E) is SK(R)**

**(A, B, D, F) is SK(R)**

**(A, D, E, G) is SK(R)**

**(A, D, F, G) is SK(R)**

Then we will compute the other values of  $\lambda$ :

IV-1- Suppose  $\lambda = (A, B, C, E)$ , it must be proven that  $(A, B, C, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B, C) \rightarrow (A, B, C)$  (46) proven

$(A, B, C, E) \rightarrow (A, B, C, E)$  (87) augmentation

We cannot continue.

(A, B, C, E) is not a SK(R)

IV-2- Suppose  $\lambda = (A, B, C, F)$ , it must be proven that  $(A, B, C, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B, F) \rightarrow (A, B, C, F, G)$  (51) proven

$(A, B, C, F) \rightarrow (A, B, C, F, G)$  (88) augmentation

We cannot continue.

(A, B, C, F) is not a SK(R)

IV-3- Suppose  $\lambda = (A, B, C, G)$ , it must be proven that  $(A, B, C, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B, C) \rightarrow (A, B, C)$  (46) proven

$(A, B, C, G) \rightarrow (A, B, C, G)$  (89) augmentation

We cannot continue.

(A, B, C, G) is not a SK(R)

IV-4- Suppose  $\lambda = (B, C, D, E)$ , it must be proven that  $(B, C, D, E) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(C, D, E) \rightarrow (C, D, E)$  (57) proven

$(B, C, D, E) \rightarrow (B, C, D, E)$  (90) augmentation

We cannot continue.

$(B, C, D, E)$  is not a SK(R)

IV-5- Suppose  $\lambda = (B, C, D, F)$ , it must be proven that  $(B, C, D, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(C, D, F) \rightarrow (C, D, E, F, G)$  (58) proven

$(B, C, D, F) \rightarrow (B, C, D, E, F, G)$  (91) augmentation

We cannot continue.

$(B, C, D, F)$  is not a SK(R)

IV-6- Suppose  $\lambda = (B, C, D, G)$ , it must be proven that  $(B, C, D, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(C, D, G) \rightarrow (C, D, E, G)$  (59) proven

$(B, C, D, G) \rightarrow (B, C, D, E, G)$  (92) augmentation

We cannot continue.

$(B, C, D, G)$  is not a SK(R)

IV-7- Suppose  $\lambda = (C, D, E, F)$ , it must be proven that  $(C, D, E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, E, F) \rightarrow (D, E, F, G)$  (60) proven

$(C, D, E, F) \rightarrow (C, D, E, F, G)$  (93) augmentation

We cannot continue.

$(C, D, E, F)$  is not a SK(R)

IV-8- Suppose  $\lambda = (C, D, E, G)$ , it must be proven that  $(C, D, E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, E, G) \rightarrow (D, E, G)$  (61) proven

$(C, D, E, G) \rightarrow (C, D, E, G)$  (94) augmentation

We cannot continue.

$(C, D, E, G)$  is not a SK(R)

IV-9- Suppose  $\lambda = (D, E, F, G)$ , it must be proven that  $(D, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(E, F, G) \rightarrow (E, F, G)$  (63) proven

$(D, E, F, G) \rightarrow (D, E, F, G)$  (95) augmentation

We cannot continue.

$(D, E, F, G)$  is not a SK(R)

IV-10- Suppose  $\lambda = (A, E, F, G)$ , it must be proven that  $(A, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, E, F) \rightarrow (A, B, C, E, F, G)$  (74) proven

$(A, E, F, G) \rightarrow (A, B, C, E, F, G)$  (96) augmentation

We cannot continue.

$(A, E, F, G)$  is not a SK(R)

IV-11- Suppose  $\lambda = (B, D, E, F)$ , it must be proven that  $(B, D, E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, E, F) \rightarrow (D, E, F, G)$  (60) proven

$(B, D, E, F) \rightarrow (B, D, E, F, G)$  (98) augmentation

We cannot continue.

$(B, D, E, F)$  is not a SK(R)

IV-12- Suppose  $\lambda = (B, D, E, G)$ , it must be proven that  $(B, D, E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, E, G) \rightarrow (D, E, G)$  (61) proven

$(B, D, E, G) \rightarrow (B, D, E, G)$  (99) augmentation

We cannot continue.

$(B, D, E, G)$  is not a SK(R)

IV-13- Suppose  $\lambda = (B, E, F, G)$ , it must be proven that  $(B, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(E, F, G) \rightarrow (E, F, G)$  (63) proven

$(B, E, F, G) \rightarrow (B, E, F, G)$  (100) augmentation

We cannot continue.

$(B, E, F, G)$  is not a SK(R)

IV-14- Suppose  $\lambda = (C, E, F, G)$ , it must be proven that  $(C, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(E, F, G) \rightarrow (E, F, G)$  (63) proven

$(C, E, F, G) \rightarrow (C, E, F, G)$  (101) augmentation

We cannot continue.

$(C, E, F, G)$  is not a SK(R)

IV-15- Suppose  $\lambda = (A, B, E, F)$ , it must be proven that  $(A, B, E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B, F) \rightarrow (A, B, C, F, G)$  (51) proven

$(A, B, E, F) \rightarrow (A, B, C, E, F, G)$  (102) augmentation

We cannot continue.

$(A, B, E, F)$  is not a SK(R)

IV-16- Suppose  $\lambda = (A, B, E, G)$ , it must be proven that  $(A, B, E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B, G) \rightarrow (A, B, C, G)$  (52) proven

$(A, B, E, G) \rightarrow (A, B, C, E, G)$  (103) augmentation

We cannot continue.

$(A, B, E, G)$  is not a SK(R)

IV-17- Suppose  $\lambda = (A, B, F, G)$ , it must be proven that  $(A, B, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B, F) \rightarrow (A, B, C, F, G)$  (51) proven

$(A, B, F, G) \rightarrow (A, B, C, F, G)$  (104) augmentation

We cannot continue.

$(A, B, F, G)$  is not a SK(R)

IV-18- Suppose  $\lambda = (A, C, E, F)$ , it must be proven that  $(A, C, E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, C, F) \rightarrow (A, B, C, F, G)$  (67) proven

$(A, C, E, F) \rightarrow (A, B, C, E, F, G)$  (105) augmentation

We cannot continue.

$(A, C, E, F)$  is not a SK(R)

IV-19- Suppose  $\lambda = (A, C, E, G)$ , it must be proven that  $(A, C, E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, C, G) \rightarrow (A, B, C, G)$  (68) proven

$(A, C, E, G) \rightarrow (A, B, C, E, G)$  (106) augmentation

We cannot continue.

$(A, C, E, G)$  is not a SK(R)

IV-20- Suppose  $\lambda = (A, C, F, G)$ , it must be proven that  $(A, C, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, F, G) \rightarrow (A, B, C, F, G)$  (76) proven

$(A, C, F, G) \rightarrow (A, B, C, F, G)$  (107) augmentation

We cannot continue.

$(A, C, F, G)$  is not a SK(R)

IV-21- Suppose  $\lambda = (B, C, E, F)$ , it must be proven that  $(B, C, E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(C, E, F) \rightarrow (C, E, F, G)$  (83) proven

$(B, C, E, F) \rightarrow (B, C, E, F, G)$  (108) augmentation

We cannot continue.

$(B, C, E, F)$  is not a SK(R)



IV-22- Suppose  $\lambda = (B, C, E, G)$ , it must be proven that  $(B, C, E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(C, E, G) \rightarrow (C, E, G)$  (84) proven

$(B, C, E, G) \rightarrow (B, C, E, G)$  (109) augmentation

We cannot continue.

$(B, C, E, G)$  is not a SK(R)

IV-23- Suppose  $\lambda = (B, C, F, G)$ , it must be proven that  $(B, C, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(C, F, G) \rightarrow (C, F, G)$  (85) proven

$(B, C, F, G) \rightarrow (B, C, F, G)$  (110) augmentation

We cannot continue.

$(B, C, F, G)$  is not a SK(R)

IV-24- Suppose  $\lambda = (B, D, F, G)$ , it must be proven that  $(B, D, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, F, G) \rightarrow (D, E, F, G)$  (86) proven

$(B, D, F, G) \rightarrow (B, D, E, F, G)$  (111) augmentation

We cannot continue.

$(B, D, F, G)$  is not a SK(R)

IV-25- Suppose  $\lambda = (C, D, F, G)$ , it must be proven that  $(C, D, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, F, G) \rightarrow (D, E, F, G)$  (86) proven

$(C, D, F, G) \rightarrow (C, D, E, F, G)$  (112) augmentation

We cannot continue.

$(C, D, F, G)$  is not a SK(R)

**V – Suppose  $\lambda$  consist of 5 attributes, the possible values of  $\lambda$  are:**

{(A, B, C, D, E), (A, B, C, D, F), (A, B, C, D, G), (A, B, C, E, F), (A, B, C, E, G), (A, B, C, F, G), (A, B, D, E, F), (A, B, D, E, G), (A, B, D, F, G), (A, B, E, F, G), (B, C, D, E, F), (B, C, D, E, G), (B, C, D, F, G), (C, D, E, F, G), (A, C, D, E, F), (A, C, D, E, G), (A, C, D, F, G), (A, C, E, F, G), (A, D, E, F, G), (B, D, E, F, G), (B, C, E, F, G)}

Based on (17), it needs (A, D) to be a SK(R), so we have:

**(A, B, C, D, E) is SK(R)**

**(A, B, C, D, F) is SK(R)**

**(A, B, C, D, G) is SK(R)**

**(A, B, D, E, F) is SK(R)**

**(A, B, D, E, G) is SK(R)**

**(A, B, D, F, G) is SK(R)**

**(A, C, D, E, F) is SK(R)**

**(A, C, D, E, G) is SK(R)**

**(A, C, D, F, G) is SK(R)**

**(A, D, E, F, G) is SK(R)**

Then we will compute the other values of  $\lambda$ :

V-1- Suppose  $\lambda = (A, B, C, E, F)$ , it must be proven that  $(A, B, C, E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B, E, F) \rightarrow (A, B, C, E, F, G)$  (102) proven

$(A, B, C, E, F) \rightarrow (A, B, C, E, F, G)$  (113) augmentation

We cannot continue.

$(A, B, C, E, F)$  is not a SK(R)

V-2- Suppose  $\lambda = (A, B, C, E, G)$ , it must be proven that  $(A, B, C, E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B, E, G) \rightarrow (A, B, C, E, G)$  (103) proven

$(A, B, C, E, G) \rightarrow (A, B, C, E, G)$  (114) augmentation

We cannot continue.

$(A, B, C, E, G)$  is not a SK(R)

V-3- Suppose  $\lambda = (A, B, C, F, G)$ , it must be proven that  $(A, B, C, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B, F, G) \rightarrow (A, B, C, F, G)$  (104) proven

$(A, B, C, F, G) \rightarrow (A, B, C, F, G)$  (115) augmentation

We cannot continue.

$(A, B, C, F, G)$  is not a SK(R)

V-4- Suppose  $\lambda = (A, B, E, F, G)$ , it must be proven that  $(A, B, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B, E, F) \rightarrow (A, B, C, E, F, G)$  (102) proven

$(A, B, E, F, G) \rightarrow (A, B, C, E, F, G)$  (116) augmentation

We cannot continue.

$(A, B, E, F, G)$  is not a SK(R)

V-5- Suppose  $\lambda = (B, C, D, E, F)$ , it must be proven that  $(B, C, D, E, F) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(C, D, E, F) \rightarrow (C, D, E, F, G)$  (93) proven

$(B, C, D, E, F) \rightarrow (B, C, D, E, F, G)$  (117) augmentation

We cannot continue.

$(B, C, D, E, F)$  is not a SK(R)

V-6- Suppose  $\lambda = (B, C, D, E, G)$ , it must be proven that  $(B, C, D, E, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(C, D, E, G) \rightarrow (C, D, E, G)$  (94) proven  
 $(B, C, D, E, G) \rightarrow (B, C, D, E, G)$  (118) augmentation  
We cannot continue.  
 $(B, C, D, E, G)$  is not a SK(R)

V-7- Suppose  $\lambda = (B, C, D, F, G)$ , it must be proven that  $(B, C, D, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(C, D, F, G) \rightarrow (C, D, E, F, G)$  (112) proven  
 $(B, C, D, F, G) \rightarrow (B, C, D, E, F, G)$  (119) augmentation  
We cannot continue.  
 $(B, C, D, F, G)$  is not a SK(R)

V-8- Suppose  $\lambda = (C, D, E, F, G)$ , it must be proven that  $(C, D, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, E, F, G) \rightarrow (D, E, F, G)$  (95) proven  
 $(C, D, E, F, G) \rightarrow (C, D, E, F, G)$  (120) augmentation  
We cannot continue.  
 $(C, D, E, F, G)$  is not a SK(R)

V-9- Suppose  $\lambda = (A, C, E, F, G)$ , it must be proven that  $(A, C, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, C, E, F) \rightarrow (A, B, C, E, F, G)$  (105) proven  
 $(A, C, E, F, G) \rightarrow (A, B, C, E, F, G)$  (121) augmentation  
We cannot continue.  
 $(A, C, E, F, G)$  is not a SK(R)

V-10- Suppose  $\lambda = (B, D, E, F, G)$ , it must be proven that  $(B, D, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(D, E, F, G) \rightarrow (D, E, F, G)$  (95) proven  
 $(B, D, E, F, G) \rightarrow (B, D, E, F, G)$  (122) augmentation  
We cannot continue.  
 $(B, D, E, F, G)$  is not a SK(R)

V-11- Suppose  $\lambda = (B, C, E, F, G)$ , it must be proven that  $(B, C, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(C, E, F, G) \rightarrow (C, E, F, G)$  (101) proven  
 $(B, C, E, F, G) \rightarrow (B, C, E, F, G)$  (123) augmentation  
We cannot continue.  
 $(B, C, E, F, G)$  is not a SK(R)

**VI- Suppose  $\lambda$  consist of 6 attributes, the possible values of  $\lambda$  are:**

{(A, B, C, D, E, F), (A, B, C, D, E, G), (A, B, C, D, F, G), (A, B, C, E, F, G), (A, B, D, E, F, G),  
(A, C, D, E, F, G), (B, C, D, E, F, G)}

Based on (17), it needs (A, D) to be a SK(R), so we have:

**(A, B, C, D, E, F) is SK(R)**

**(A, B, C, D, E, G) is SK(R)**

**(A, B, C, D, F, G) is SK(R)**

**(A, B, D, E, F, G) is SK(R)**

**(A, C, D, E, F, G) is SK(R)**

Then we will compute the other values of  $\lambda$ :

VI-1- Suppose  $\lambda = (A, B, C, E, F, G)$ , it must be proven that  $(A, B, C, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, B, C, E, F) \rightarrow (A, B, C, E, F, G)$  (113) proven

$(A, B, C, E, F, G) \rightarrow (A, B, C, E, F, G)$  (124) augmentation

We cannot continue.

$(A, B, C, E, F, G)$  is not a SK(R)

VI-2- Suppose  $\lambda = (B, C, D, E, F, G)$ , it must be proven that  $(B, C, D, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(B, C, D, E, F) \rightarrow (B, C, D, E, F, G)$  (117) proven

$(B, C, D, E, F, G) \rightarrow (B, C, D, E, F, G)$  (125) augmentation

We cannot continue.

$(B, C, D, E, F, G)$  is not a SK(R)

**VII- Suppose  $\lambda$  consist of 7 attributes, the possible values of  $\lambda$  is:**

$(A, B, C, D, E, F, G)$

VII-1- Suppose  $\lambda = (A, B, C, D, E, F, G)$ , it must be proven that  $(A, B, C, D, E, F, G) \rightarrow (A, B, C, D, E, F, G)$

Proof:

$(A, D) \rightarrow (A, B, C, D, E, F, G)$  (17) proven

$(A, B, C, D, E, F, G) \rightarrow (A, B, C, D, E, F, G)$  (126) augmentation

We cannot continue.

**(A, B, C, D, E, F, G) is a SK(R)**

So, we have:

$SK(R) = \{(A, D), (A, B, D), (A, C, D), (A, D, E), (A, D, F), (A, D, G), (A, B, C, D), (A, C, D, E), (A, C, D, F),$   
 $(A, C, D, G), (A, D, E, F), (A, D, E, G), (A, B, D, E), (A, B, D, F), (A, D, E, G), (A, D, F, G)\}$

(A, B, C, D, E), (A, B, C, D, F), (A, B, C, D, G), (A, B, D, E, F), (A, B, D, E, G), (A, B, D, F, G),  
(A, C, D, E, F), (A, C, D, E, G), (A, C, D, F, G), (A, D, E, F, G), (A, B, C, D, E, F), (A, B, C, D, E, G),  
(A, B, C, D, F, G), (A, B, D, E, F, G), (A, C, D, E, F, G), (A, B, C, D, E, F, G)}

**b – Compute all Candidate Key (CK)**

The candidate key is/are the Superkey which is/are not superset of another Superkey. So we have:

$CK(R) = (A, D)$

**c – Decide the PK**

The primary key is:

$PK(R) = (A, D)$