Functional Dependency FD

Domain Range

a ----------> 1

b ----------> 2

c ----------> 3

4

```
y : square(x)
int square(int x)
{
    return x * x;
}
```

x	y
3	9
4	16
3	9
5	25
-3	9
1	1
0	0
-1	1
-3	9

If for every unique value of X I get the same value for Y then X functionally defines Y or Y is functionally dependent on X

$$X \longrightarrow Y$$

attributes

A	B	C	D	E
a1	b1	c1	d1	e1
a2	b1	C2	d2	e1
a3	b2	C1	d1	e1
a4	b2	C2	d2	e1
a5	b3	C3	d1	e1

rows / records

Table R

$C \longrightarrow D$ ✓

$D \longrightarrow C$ X

$B \longrightarrow E$ ✓

$A \longrightarrow B$ ✓

$B \longrightarrow A$ X

$BC \longrightarrow D$ ✓

$BC \longrightarrow A$ ✓

$CD \longrightarrow A$ X

Armstrong Axioms

1. If $B \subseteq A$ then
   $A \rightarrow B$
   Reflexivity
   $A \rightarrow A$

   name, age, address → age

2. If $A \rightarrow B$ then
   $AX \rightarrow BX$
   Augumentation

   name → sex
   name, age → sex, age

3. If $A \rightarrow B$ and $B \rightarrow C$ then
   $A \rightarrow C$
   Transitivity

   roll# → name
   name → sex
   roll# → sex

4. If $A \rightarrow B$ & $A \rightarrow C$ then
   $A \rightarrow BC$
   Union

   roll# → name
   roll# → address
   roll# → name, address

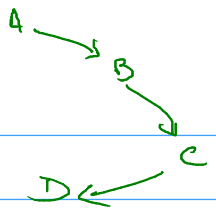
5. If $A \rightarrow B$ & $X \rightarrow Y$ then
   $AX \rightarrow BY$
   Composition

   roll# → s.name
   cid → t.name
   roll#, cid → s.name, t.name

6. If $AX \rightarrow BY$ then
   $AX \rightarrow B$ & $AX \rightarrow Y$
   Decomposition
   reverse of Union

   roll#, cid → s.name, t.name, grade
   roll#, cid → s.name
   roll, cid → t.name
   roll#, cid → grade

7. If $A \rightarrow B$ & $BC \rightarrow D$ then
   $AC \rightarrow D$
   Pseudo Transitivity



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

$A \to B \quad B \to C \quad C \to D \quad E \to f \quad F \to E$

$A \to A$	Reflexivity	
$A \to B$	given	
$A \to C$	transitivity	$A \to B,\ B \to C$
$A \to D$	transitivity	$A \to B,\ B \to C,\ C \to D$
$A \to E$	not possible	

$AF \to E$

$A \to A$	Reflexivity
$F \to E$	Given
$AF \to AE$	Composition

Decomposition:
- $AF \to A$
- $AF \to E$

$AE \to ABCDEF$

A:
- $A \to A$ Reflexivity
- $A \to B$ Given
- $A \to C$ Given
- $A \to D$ Given

E:
- $E \to E$ Reflexivity
- $E \to F$ Given

Union:
- $A \to ABCD$
- $E \to EF$

$AE \to ABCDEF$ composition

Closure

R(A, B, C, D, E)

$A \to BC$ $C \to B$ $D \to E$ $E \to D$

① $A^+ \to ABC$

$B^+ \to B$

$C^+ \to CB$

$D^+ \to DE$

$E^+ \to ED$

② $AB^+ \to ABC$

AC^+

$AD^+ \to ADBCE$

$AE^+ \to AEBCD$

BC^+

$BD^+ \to BDE$

BE^+

CD^+

CE

DE^+

③ ABC^+

ABD^+

ABE^+

ACD^+

ACE^+

ADE^+

BCD^+

BCE^+

BDE^+

CDE^+

④ $ABCD^+$

$ABCE^+$

$ABDE^+$

$ACDE^+$

$BCDE^+$

⑤ $ABCDE^+ \to ABCDE$

# of possible combinations $= 2^n - 1$

Superkey : Set of attributes whose closure contain all attributes of Relation

HW-1

① R(A, B, C, D, E)

A → BC, C → B, D → E, E → D

② R(A B C D E)

A → B B → C D → C

Find closure of all possible combinations

also identify superkeys