Apply (SSN, college, name, HSCode, HSCity, sports)

SSN → name

HSCode → HSCity

K	SS
✓	✓

A. { SSN, college, HSCode, ~~HSCity~~, sports }

✓ B. { SSN, college, HSCode, HSCity, name, sports }

C. { SSN, college, name }

$S(A, B, C, D, E)$

$AB \rightarrow D$

$C \rightarrow E$

$DE \rightarrow BC$

1. You can "remove" attributes on the right-hand side (RHS)

$DE \rightarrow BC$ is equivalent to

$$\left[\begin{array}{l} DE \rightarrow B \\ DE \rightarrow C \end{array}\right]$$

2. You cannot "remove" attributes on the LHS

Movies(title, year, length)

title, year → length

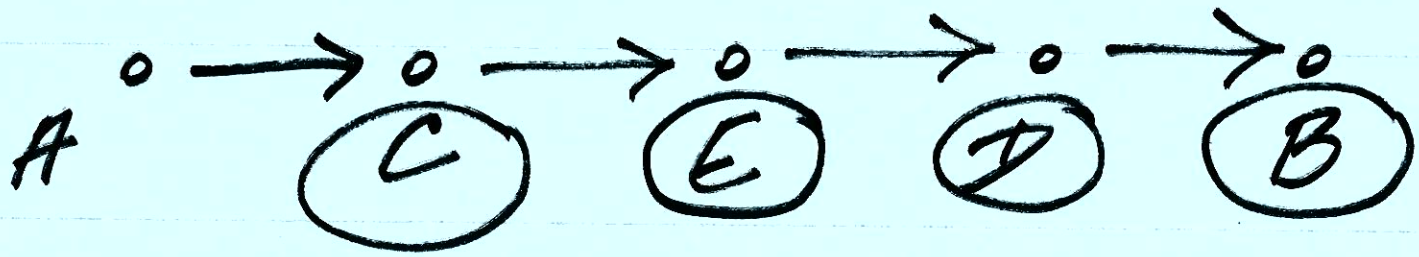
The closure of C is CEDB

$U(A, B, C, D, E)$

- ✓ $A \to C$ (–)
- ✓ $C \to E$ III
- ✓ $E \to D$ III
- ✓ $D \to B$ III

Does $C \to B$ $\equiv$ hold? ✓ yes

Does $C \to A$ $\equiv$ hold? No



The closure algorithm for computing closure of given set of attributes

0. Make X the initial closure set

1. Iterate
   - if there is a FD whose LHS is a subset of X
   ⇒ add the FD's RHS to X
   - no more unused FDs
2. Stop when
   - or no more attributes

3. Return X

$R(A, B, C)$

$A \to B$

$B \to C$

Does $A \to C$ hold? Yes

Does $C \to B$ hold? No

The "closure" answers:

(1) The closure of A is ABC

(2) The closure of C is C

R(ABCD)

AB → C

C → D

D → A

Does CD → A hold?

Does CD → B hold?

With the closure algorithm: We can

1. Prove whether a candidate FD holds
2. Find all derived FDs

R(ABCD)

AB → C

C → D

D → A

"Does candidate FD hold?
– for instance,
CD → A
or
CD → B

A+ = A

B+ = B

B → B

C+ = CDA

D+ = DA

AB+ = ABCD

AC+ = ACD

BC+ = BCDA

AD+ = AD

BD+ = BDAC

CD+ = CDA

ABC+ = ABCD

ABD+ = ABCD

ACD+ = ACD

BCD+ = ABCD

ABCD+ = ABCD

Keys: AB, BC, BD

Superkeys: AB, BC, BD, ABC, ABD, BCD, ABCD

Derived FDs:

$C \to A$

$AB \to D$

$AC \to D$

$BC \to D$

$BC \to A$

$BD \to A$

$BD \to C$

$CD \to A$

$ABC \to D$

$ABD \to C$

$BCD \to A$

$U(ABCDE)$

$A \to C$

$C \to E$

$E \to D$

$D \to B$

~~R.~~

Find all FDs in the projection of U onto CDB

$C \to D$
$C \to B$
$D \to B$
$CD \to B$

$R(CDB)$

$CB \to D$

$C+ = CEDB$
$D+ = DB$
$B+ = B$

$CD+ = CEDB$
$CB+ = CEDB$
$DB+ = DB$
$CDB+ = CDB$

You never need to submit trivial FDs as part of any assignment

$R(ABCDE)$

$AB \rightarrow DE$

$C \rightarrow E$

$D \rightarrow C$

$E \rightarrow A$

Project the FDs onto (ABC)