

# thu solutions

## Q1b

$A \rightarrow B$  holds

$B \rightarrow A$  not hold

$C \rightarrow B$  not hold

## Q2

a.  $A^+ = \{A, B\}$

b.  $ACEG^+ = \{A, B, C, E, F, G\}$

c.  $BD^+ = \{A, B, C, D, E, F, G\}$

## Q3

a.  $CDE^+ = \{A, B, C, D, E\}$

BCD

ACD

b. not in third normal form

c. not in BCNF

## Q4

a. candidate key: B

not BCNF:  $C \rightarrow D$  and  $C \rightarrow A$  does not have key on LHS

not 3NF:  $C \rightarrow D$  and  $C \rightarrow A$  does not have part of key on RHS

b. candidate key: BD

not BCNF:  $B \rightarrow C$  and  $D \rightarrow A$  does not have key on LHS

not 3NF:  $B \rightarrow C$  and  $D \rightarrow A$  does not have part of key RHS

c. candidate key: ABC, BCD

not BCNF:  $D \rightarrow A$  does not have key on LHS

in 3NF: for key ABC,  $ABC \rightarrow D$  is ok because LHS is key,  $D \rightarrow A$  is ok because RHS is part of key

d. candidate key: A

not BCNF:  $BC \rightarrow D$  does not have key on LHS

not 3NF:  $BC \rightarrow D$  does not have part of key on RHS

e. candidate key: AB, CD, BC, AD

not BCNF: for key AB,  $C \rightarrow A$  and  $D \rightarrow B$  does not have key on LHS

in 3NF for key AB

f. candidate key: A

in BCNF

in 3NF

## Q5

Team(name, captain):  $\text{name} \rightarrow \text{captain}$

Player(name, teamPlayedFor):  $\text{name} \rightarrow \text{teamPlayedFor}$

TeamColours(teamName, colour): no non-trivial fds

## Q7

a. candidate key: B

BCNF Normalisation

reduced minimal cover =  $\{C \rightarrow AD, B \rightarrow C\}$

ABCD

choose fd  $\{C \rightarrow AD\}$  and split tables

CAD  $\{C \rightarrow AD\}$  key:  $C \Rightarrow$  in BCNF

BC  $\{B \rightarrow C\}$  key:  $B \Rightarrow$  in BCNF

result

CAD, BC

### 3NF Normalisation

minimal cover =  $\{C \rightarrow D, C \rightarrow A, B \rightarrow C\}$

reduced minimal cover =  $\{C \rightarrow AD, B \rightarrow C\}$

split into tables

CAD  $\{C \rightarrow AD\}$  key: C

BC  $\{B \rightarrow C\}$  key: B

result

CAD, BC

b. candidate key: BD

### BCNF Normalisation

reduced minimal cover =  $\{B \rightarrow C, D \rightarrow A\}$

ABCD

choose fd  $\{D \rightarrow A\}$  and split tables

DA  $\{D \rightarrow A\}$  key:  $D \Rightarrow$  in BCNF

BCD  $\{B \rightarrow C\}$  key: BD

choose fd  $\{B \rightarrow C\}$  and split tables

BC  $\{B \rightarrow C\}$  key: B  $\Rightarrow$  in BCNF

BD  $\{\}$  key: BD  $\Rightarrow$  in BCNF

result

AD, BC, BD

### 3NF Normalisation

minimal cover =  $\{B \rightarrow C, D \rightarrow A\}$

reduced minimal cover =  $\{B \rightarrow C, D \rightarrow A\}$

split into tables

BC  $\{B \rightarrow C\}$  key: B

AD  $\{D \rightarrow A\}$  key: D

no table has key BD so add table

BD  $\{\}$  key: BD

result

BC, AD, BD

c. candidate key: ABC, BCD

### BCNF Normalisation

reduced minimal cover =  $\{ABC \rightarrow D, D \rightarrow A\}$

choose fd  $\{ABC \rightarrow D\}$  and split tables

ABCD  $\{ABC \rightarrow D, D \rightarrow A\}$  key: ABC

ABC  $\{\}$  key: ABC  $\Rightarrow$  in BCNF

choose  $\{D \rightarrow A\}$  and split tables

AD  $\{D \rightarrow A\}$  key: D  $\Rightarrow$  in BCNF

BCD  $\{\}$  key: BCD  $\Rightarrow$  in BCNF

result

ABC, AD, BCD

### 3NF Normalisation

minimal cover =  $\{ABC \rightarrow D, D \rightarrow A\}$

reduced minimal cover =  $\{ABC \rightarrow D, D \rightarrow A\}$

split tables

ABCD  $\{ABC \rightarrow D\}$  key: ABC

DA  $\{D \rightarrow A\}$  key: D

result

ABCD, AD

d. candidate key: A

### BCNF Normalisation

### 3NF Normalisation

minimal cover =  $\{A \rightarrow B, BC \rightarrow D, A \rightarrow C\}$

reduced minimal cover =  $\{A \rightarrow BC, BC \rightarrow D\}$

split tables

ABC  $\{A \rightarrow BC\}$  key: A

BCD  $\{BC \rightarrow D\}$  key: BC

result

ABC, BCD

e. candidate key: AB, CD, BC, AD

BCNF Normalisation