

Question 1

Attributes

- eventname
- edate
- starttime
- duration
- URL
- description
- host
- panelistname
- panelistemail
- participantid
- participantname
- participantemail
- participantaddress
- ticketprice

Functional Dependencies

- edate starttime => duration URL description host
- participantid => participantname participantemail participantaddress ticketprice
- edate starttime panelistname => panelistemail

Relation checks

Keys

```
edate starttime participantid panelistname
```

BCNF

Not satisfied, because

- edate starttime => duration URL description host is not trivial and edate starttime is not a superkey

3NF

Not satisfied, because

- edate starttime => duration URL description host is not trivial, edate starttime is not a superkey, and duration, URL, description, host are not prime

attributes

Question 2

Decomposition

Projection of functional dependencies

- $R_1(A, B, C, F, G)$
 - $F_1 = \{ AFG \rightarrow B, ABC \rightarrow F \}$
- $R_2(A, B, C, D, E)$
 - $F_2 = \{ AC \rightarrow D, AC \rightarrow E \}$

Union

```
Fp = F1 union F2 = { AFG -> B, ABC -> F, AC -> D, AC -> E }
F = { AC -> D, AC -> E, BE -> F, AFG -> B }
```

Check

- $AC \rightarrow D$ is in F_p
- $AC \rightarrow E$ is in F_p
- $BE \rightarrow F$ is not in F_p
 - Compute with respect to F_p : $BE^+ = \{ B, E \}$, F is not computed
- $AFG \rightarrow B$ is in F_p

F_p is not equivalent to F , so this decomposition is not dependency preserving.

Question 3

Table

Note: Changes are bolded

Initial State

REL	A	B	C	D	E	F	G
R1	a	b	c	d	e1	f1	g1
R2	a	b	c	d2	e	f2	g
R3	a3	b	c3	d3	e	f	g3
R4	a	b4	c4	d4	e	f4	g

Apply $AC \rightarrow BD$

REL	A	B	C	D	E	F	G
R1	a	b	c	d	e1	f1	g1
R2	a	b	c	d	e	f2	g
R3	a3	b	c3	d3	e	f	g3
R4	a	b4	c4	d4	e	f4	g

Apply **BC** -> **E**

REL	A	B	C	D	E	F	G
R1	a	b	c	d	e	f1	g1
R2	a	b	c	d	e	f2	g
R3	a3	b	c3	d3	e	f	g3
R4	a	b4	c4	d4	e	f4	g

Apply **BE** -> **DF**

REL	A	B	C	D	E	F	G
R1	a	b	c	d	e	f1	g1
R2	a	b	c	d	e	f	g
R3	a3	b	c3	d	e	f	g3
R4	a	b4	c4	d4	e	f4	g

Relation R2 has no subscript, so this decomposition is lossless.

Question 4

Section a

Keys

ABGHF

3NF

Not satisfied, because **AD** -> **CE** is not trivial and **AD** is not superkey

Section b

- **R1(A, D, C, E)**

- $R_2(B, E, F, G)$
- $R_3(A, G, C)$
- $R_4(A, B, G, H, F)$

Section c

BCNF

- $R_1(A, D, C, E)$
 - $F_1 = \{ AD \rightarrow CE, C \rightarrow D \}$
 - Key: AD
 - Not Satisfied, $C \rightarrow D$ is not trivial and C is not a super key
- $R_2(B, E, F, G)$
 - $F_2 = \{ BEF \rightarrow G \}$
 - Key : BEF
 - Satisfied, because $BEF \rightarrow G$ is not trivial and BEF is a superkey
- $R_3(A, G, C)$
 - $F_3 = \{ AG \rightarrow C \}$
 - Key: AG
 - Satisfied, because $AG \rightarrow C$ is not trivial and AG is a superkey
- $R_4(A, B, G, H, F)$
 - $F_4 = \{ \}$
 - Key: $ABGHF$
 - Satisfied

Question 5

Splitting Rules

- $AC \rightarrow B$
- $AC \rightarrow D$
- $BC \rightarrow B$
- $BC \rightarrow E$
- $ABC \rightarrow E$

Remove Trival

- $AC \rightarrow B$
- $AC \rightarrow D$
- $BC \rightarrow E$
- $ABC \rightarrow E$

Removing $X \rightarrow Y$

- $AC \rightarrow B$
 - Cannot remove
 - For F' , $AC^+ = \{ A, C, D \}$

- For F, $AC^+ = \{ A, C, B, D, E \}$
- Not equivalent
- $AC \rightarrow D$
 - Cannot remove
 - For F', $AC^+ = \{ A, C, B, E \}$
 - For F, $AC^+ = \{ A, C, D, B, E \}$
 - Not equivalent
- $BC \rightarrow E$
 - Cannot remove
 - For F', $BC^+ = \{ B, C \}$
 - For F, $BC^+ = \{ B, C, E \}$
 - Not equivalent
- $ABC \rightarrow E$
 - Cannot remove
 - For F', $ABC^+ = \{ A, B, C, D \}$
 - For F, $ABC^+ = \{ A, B, C, D, E \}$
 - Not equivalent

Replace $XZ \rightarrow Y$ with $X \rightarrow Y$

- $AC \rightarrow B$
 - Remove C, we have $A \rightarrow B$ for F'
 - Cannot replace
 - For F', $A^+ = \{ A, B \}$
 - For F, $A^+ = \{ A \}$
 - Not equivalent
 - Remove A, we have $C \rightarrow B$
 - Cannot replace
 - For F', $C^+ = \{ C, B \}$
 - For F, $C^+ = \{ C \}$
 - Not equivalent
- $AC \rightarrow D$
 - Remove A, we have $C \rightarrow D$ for F'
 - Cannot replace
 - For F', $C^+ = \{ C, D \}$
 - For F, $C^+ = \{ C \}$
 - Not equivalent
 - Remove C, we have $A \rightarrow D$ for F'
 - Cannot replace
 - For F', $A^+ = \{ A, D \}$
 - For F, $A^+ = \{ A \}$
 - Not equivalent
- $BC \rightarrow E$
 - Remove B, we have $C \rightarrow E$ for F'
 - Cannot replace
 - For F', $C^+ = \{ C, E \}$
 - For F, $C^+ = \{ C \}$

- Not equivalent
- Remove C, we have $B \rightarrow E$ for F'
 - Cannot replace
 - For F' , $B^+ = \{ B, E \}$
 - For F , $B^+ = \{ B \}$
 - Not equivalent
- $ABC \rightarrow E$
 - Remove A, we have $BC \rightarrow E$ for F'
 - Can replace
 - For F' , $BC^+ = \{ B, C, E \}$
 - For F , $BC^+ = \{ B, C, E \}$
 - Equivalent/Same

So we have:

- $AC \rightarrow B$
- $AC \rightarrow D$
- $BC \rightarrow E$
- $BC \rightarrow E$

Combining Rule

Minimal Basis:

- $AC \rightarrow B$
- $AC \rightarrow D$
- $BC \rightarrow E$

Question 6

Find Violation

Keys

```
oname mid
```

Result

- cname \rightarrow df url email
 - violate
- cname mid \rightarrow mname
 - violate
- oname \rightarrow oposition
 - violate
- oname \rightarrow cname
 - violate

BCNF

Pick any violation and start decomposition

- `oname -> cname`
 - `oname+ = { oname, cname, df, url, email , oposition }`
 - `R1(oname, cname, df, url, email, oposition)`
 - `F1 = {cname -> df url email, oname -> oposition, oname -> cname}`
 - Keys: `oname`
 - `cname -> df url email` violates BCNF
 - `R2(oname, mid, mname)`
 - `F2 = {}`
 - Keys: `oname mid mname`
 - Satisfied BCNF

Decompose on `cname -> df url email`, with `R1(oname, cname, df, url, email, oposition)`

- `cname -> df url email`
 - `cname+ = { cname, df, url, email }`
 - `R11(cname df url email)`
 - `F11 = { cname -> df url email }`
 - Key: `cname`
 - Satisfied BCNF
 - `R12(cname, oname, oposition)`
 - `F12 = { oname -> oposition, oname -> cname }`
 - Key: `oname`
 - Satisfied BCNF

Result

- `cname df url email`
- `cname, oname, oposition`
- `oname, mid, mname`