

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
- edate starttime panelistname => panelistemail
- edate starttime participantid => ticketprice

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

- $R1(A, B, C, F, G)$
 - $F1 = \{ AFG \rightarrow B, ABC \rightarrow F \}$
- $R2(A, B, C, D, E)$
 - $F2 = \{ AC \rightarrow D, AC \rightarrow E \}$

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

Fp 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
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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

ABHFG, ABHFD, ABHFC, ABHFE

Prime Attributes

A, B, C, D, E, F, G, H

3NF

Satisfied, all attributes are in Prime Attributes, so no matter how the right hand side changes, 3NF will always true.

Question 5

Splitting Rules

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

Remove Trivial

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

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
- $ABC \rightarrow E$
 - Can remove
 - For F' , $ABC^+ = \{ A, B, C, D, E \}$
 - For F , $ABC^+ = \{ A, B, C, D, E \}$
 - Equivalent/Same

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
 -

So we have:

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

Combining Rule

Already in form of Minimal Basis:

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

Question 6

Find Violation

Keys

```
oname mid
```

Result

- cname -> df url email
 - violate
- cname mid -> mname
 - violate
- oname -> oposition
 - violate
- oname -> 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