MCQs

D C ? D A

C E D B A

E A D D C

E A

Q18

$\{T \mid \exists P \in Play\,(P.actor = \text{"}Angelina\ Jolie\text{"} \land\ P.movie = T.title)\}$

Q19

```
SELECT DISTINCT P2.actor
FROM play P1, play P2
WHERE P1.movie = P2.movie
AND P1.actor = "Angelina Jolie"
```

Q20

$\pi_{Play.movie}(\sigma_{actor=\text{"}Angelina\ Jolie\text{"} \land location=\text{"}Cambodia\text{"}}(Scene \otimes_{Scene.name=Play.scene} Play))$

Q21

(unsure about this)

$\{T \mid \exists A \in Actor\ \forall P_1 \in Play\ \exists P_2 \in Play$
$(P_1.actor = A.name \Rightarrow (P_1.movie = P_2.movie \land P_2.actor = \text{"}Angelina\ Jolie\text{"})$
$\land\ A.name = T.name)\}$

Q22

Not in syllabus. . . ?

Q23

The name of the actors that have not acted in any movies.

```
SELECT name
FROM actor
WHERE NOT EXISTS (
SELECT *
FROM play
WHERE play.actor = actor.name
)
```

Q24

- $C \to C, B$, given
- $AC \to ACB$, by augmentation
- $AB \to ABCE$, given
- $ACB \to ABCE$, by augmentation
- $AC \to ABCE$, by transitivity
- $ACD \to ABCDE$, by augmentation
- $\therefore$ ACD is a super key

Q25

Attempt to decompose into BCNF

Break down the FDs so the RHS are singletons

- $AB \to A$
- $AB \to B$
- $AB \to C$
- $AB \to E$
- $C \to C$
- $C \to B$

Remove the trivial FDs

1. $AB \to C$
2. $AB \to E$
3. $C \to B$

$AB^+ = ABCE$, hence AB is a not super key, and 1 violates BCNF, we decompose R into

$$R_1 = (A, B, C) \; R_2 = (A, B, D, E)$$

1. $F_{R1} = \{AB \rightarrow C, C \rightarrow B\}$
2. $F_{R2} = \{AB \rightarrow E\}$

For R_1, $AB^+ = ABC$ therefore a super key, but $C^+ = CB$, so $C \rightarrow B$ violates BCNF, we decompose R_1 into

$$R_3 = (B, C) \; R_4 = (A, C)$$

1. $F_{R3} = \{C \rightarrow B\}$
2. $F_{R4} = \varnothing$

For R_3, $C^+ = CB$, so it does not violate BCNF.

Back to R_2, $AB^+ = ABE$, not a superkey, it still violates BCNF, we decompose R_2 into

$$R_5 = (A, B, E) \; R_6 = (A, B, D)$$

1. $F_{R5} = \{AB \rightarrow E\}$
2. $F_{R6} = \varnothing$

For R_5, $AB^+ = ABE$, so it does not violate BCNF.

Therefore, a BCNF decomposition of R is

$$R_3 = (B, C),\ R_4 = (A, C),\ R_5 = (A, B, E),\ R_6 = (A, B, D)$$

$$F_{R3} \cup F_{R4} \cup F_{R5} \cup F_{R6} = \{C \rightarrow B, AB \rightarrow E\}$$

In the original relation R we have $AB \rightarrow C \in F$, but AB^+ w.r.t. $(F_{R3} \cup F_{R4} \cup F_{R5} \cup F_{R6})$ is ABE, and $C \notin AB^+$, so the decomposition was not dependency preserving.

Attempt to decompose into 3NF

1. $AB \rightarrow C$
2. $AB \rightarrow E$
3. $C \rightarrow B$

First we check for redundant attributes:

1. $A^+ = A, B^+ = B$, so neither is redundant
2. same as above
3. singleton on LFS, not redundant

Then we check for redundant FDs:

1. Without $AB \rightarrow C$, $AB^+ = ABE$, $C \notin AB^+$, so it is not redundant
2. Without $AB \rightarrow E$, $AB^+ = ABC$, reason per above
3. Without $C \rightarrow B$, $C^+ = C$, reason per above

Therefore $\{AB \rightarrow C, AB \rightarrow E, C \rightarrow B\}$ is a minimal cover, and $\{AB \rightarrow CE, C \rightarrow B\}$ an extended minimal cover for R

We have $ABD^+ = ABCDE$, so we choose ABD as the key. Therefore we have the following decomposition:

$$R_1 = (A, B, C, E),\ R_2 = (C, B),\ R_3 = (A, B, D)$$

Since $R_2 \subset R_1$, we remove R_2 and the following is a decomposition of R in 3NF, which is always lossless-join and dependency-preserving:

$$R_1 = (A, B, C, E),\ R_2 = (A, B, D)$$