TDDD81 Assignment 3

1.

FD1: $\{A\} \rightarrow \{B, C\}$ FD2: $\{C\} \rightarrow \{A, D\}$ FD3: $\{D, E\} \rightarrow \{F\}$

a) $\{C\} \rightarrow \{A, D\}$ => (Decomposition) $\{C\} \rightarrow \{A\}$ => ~~$\{A\} \rightarrow \{B, C\}$ => (Decomposition) $\{A\} \rightarrow \{B\}$~~

=> (Transitivity) $\{C\} \rightarrow \{B\}$

b)

$\{A\} \rightarrow \{B, C\}$ => (Decomposition) $\{A\} \rightarrow \{C\}$

$\{C\} \rightarrow \{A, D\}$ => (Decomposition) $\{C\} \rightarrow \{D\}$

(Transitivity) $\{A\} \rightarrow \{D\}$

(pseudo-transitivity) $\{D, E\} \rightarrow \{F\}$ => $\{A, E\} \rightarrow \{F\}$

2.

a) $X^+ = \{A, B, C, D\}$ b) $X^+ \{A, B, C, D, E, F\}$ = ?

3. a) $D^+ = \{D, B\}$ (using FD3). $A^+ = A$

$E^+ = \{E, F\}$ (using FD2)

$(A, B)^+ = \{A, B, C, D, E, F\}$ (using FD1) = R

$(A, B)^+$ is a superkey since all attributes are covered, $(A, B)^+ \rightarrow R$

A is not determined in the right side of the FD's, and $A^+ = A$ (and has to be included in the candidate key(s))

Therefore A is not a candidate key

$B^+ = B$, B is not a candidate key

b) Therefore $(A, B)^+$ is a candidate key

(A, C) won't work since C does not determine anything in the right side

(A, D): $(A, D)^+ = \{A, B, C, D, E, F\}$ which is a candidate key & superkey

(A, E): $(A, E)^+ = \{A, E, F\}$, Not a superkey

(A, F): $(A, F)^+ = \{A, F\}$, Not a superkey

Answer: (A, B) & (A, D) are candidate keys

b) FD2 & FD3 violate BCNF since the left hand sides are not superkeys

c) FD2 violates BCNF

$R_1(\underline{E}, F)$ with FD2 $R_2(\underline{A}, \underline{B}, C, D, E)$ with FD1, FD3

R1: E is candidate key
FD2: $E \rightarrow \{F\}$
R2: $\{A, B\}$ is candidate key
FD1: $\{A, B\} \rightarrow \{C, D, E, F\}$
FD3: $\{D\} \rightarrow \{B\}$

Decompose R2 since FD3 violates BCNF

$R_1(\underline{E}, F)$ FD2 $R_2(\underline{D}, B)$ FD3 $R_3(\underline{A}, C, D, E)$

R1: Candidate key is E
R2: Candidate key is D
R3: Candidate key is A but

This step removes the dependency of FD1, therefore we don't find a dependency-preserving decomposition

4.

a) $(A, B, C)^+ = \{A, B, C, D, E\}$, (A, B, C) is a superkey

$(B, C, D)^+ = \{A, B, C, D, E\}$ (B, C, D) is a superkey

$(C)^+ = \{D, C\}$, C is not a superkey which violates BCNF. Q.E.D

b) FD3 violates BCNF

$R_1(\underline{C}, D)$ $R_2(\underline{A}, \underline{B}, \underline{C}, E, F)$

violates both FD1 & FD2 therefore we don't find a dependency-preserving decomposition

R1: C is candidate key

R2: $\{A, B, C\}$ is candidate key but