HW3

19.2

CD	AB	E

CD^+	CDA^+	CDB^+	CDE^+
X	CDABE	CDBEA	CDEAB

Keys: ACD, BCD, CDE prime: ABCDE

All attributes are prime: 3NF ✓
A, BC, ED are not superkeys: BCNF violation

R is in 3NF but not in BCNF.

19.3 1. $Z \to Y$ X

$X \to Y$

$XZ \to Y$

2. Same thing so $Z \to Y$

$X \to Y$

$XZ \to Y$

19.5 1. $A \to B$, $C \to D$

ACE	BD	BD

ACE^+ keys: ACE
ACEBD non-prime: BD

$A \to B$, $C \to D$

non-prime 2NF violation so 1NF
sub-part of key

BCNF violation $A \to B$ $\Longrightarrow$ R_1: AB R_3: ACE
$C \to D$ $\Longrightarrow$ R_2: CD

1NF, BCNF decomposition: AB, CD, ACE

2. $AC \to E$, $B \to F$

ABC	E	F

ABC^+ keys: ABC
ABCEF non-prime: EF

$AC \to E$ $B \to F$

non-prime 2NF violation
subpart of k so 1NF

BCNF violation $B \to F \longrightarrow BF$
$E \longrightarrow AB$

1NF, BCNF decomposition: AB, BF

3. $D \to G$, $G \to H$

D	G	H

D^+ keys: D
DGH non-prime:

D, G, and H aren't all present in the R3 relation
BCNF

4. $A \to I$, $I \to A$
A and I aren't all present in the R4 relation.
BCNF

5. There are no functional dependencies given.
BCNF

19.6 1. b. $BC \rightarrow A$

2. No, we can only say that some dependencies aren't violated in this instance, like $A \rightarrow B$ and $B \rightarrow C$.

19.7 1. $C \rightarrow D$, $C \rightarrow A$, $B \rightarrow C$

B	C	AD

B^+ = BCDA keys: B non-prime: ACD

B is a singleton so at least 2NF

$C \rightarrow D$ = not a superkey → non-prime: 3NF violation

$C \rightarrow D$ and $C \rightarrow A$ are BCNF violations because B is key, so CD, CA, BC.

a. B b. 1NF c. CD, CA, BC

2. $B \rightarrow C$, $D \rightarrow A$

BD	AC

BD^+ = BDCA keys: BD non-prime: AC

$B \rightarrow C$ — subset of key → non-prime 2NF violation

BNCF viol.
$B \rightarrow C$
keys: BD

$X = B$
$Y = C$
$Z = AD$

BBC $\{B \rightarrow C\}$
key: B in BCNF

ABD $\{B \rightarrow C, A \rightarrow D\}$
key AB BCNF viol.
$B \rightarrow C$

→ BD
→ AD

a. BD b. 1NF c. AD, BC, BD

3. $ABC \to D,\ D \to A$

		BC^+	BCA^+	BCD^+
BC	AD	BC	BCAD	BCDA

keys: ABC, BCD
all prime so at least 3NF
$D \to A$, where D not superkey so BCNF violation.
No way to preserve $ABC \to D$
a. ABC, BCD b. 3NF c. No BCNF decomposition.

4. $A \to B,\ BC \to D,\ A \to C$

		A^+
A	BC	D	ABCD

keys: A
non-prime: BCD

A is singleton so at least 2NF
BC → D's not a superkey → non-prime: 3NF violation

BCNF viol.
BC → D

X=BC → BCD
Y=D
Z=A
→ ABC

a. A b. 2NF c. ABC, BCD

5. $AB \to C,\ AB \to D,\ C \to A,\ D \to B$

		AB^+	BC^+	CD^+	AD^+
	ABCD	ABCD	BCAD	CDAB	ADBC

keys: AB, BC, CD, AD
all prime so at least 3NF
$C \to A$ where C not a superkey so BCNF violation.
$AB \to C$ and $AB \to D$ won't be preserved.
a. AB, BC, CD, AD b. 3NF c. No BCNF decomposition.

19.8 1. a. i. $AB \to C$, $AC \to B$, $BC \to A$

Already a minimal cover.

ii. In BCNF since AB, AC, BC all candidate keys for ABC

iii. No decomposition, since in BCNF.

b. i. $AB \to C$, $AC \to B$, $B \to D$, $BC \to A$

Already a minimal cover.

ii. In 1NF — | | | — keys: AB, AC, BC

| | ABC | D | $B \to D$ |

subset of key → non-prime

2NF viol.

iii. ABC, BD $\quad [B \to D] \to X:B \to [BD]$

$Y:D$

$Z:AC \to [ABC]$

c. i. $AB \to C$, $AC \to B$, $BC \to A$, $E \to G$

Already a minimal cover.

ii In 1NF — | | | — keys: ABE, ACE, BCE

| E | ABC | G | $E \to G$ |

subset of key → non-prime

2NF viol.

iii. ABC, ABE, EG $\quad [E \to G] \to X:E \to [EG]$

$Y:G$

$Z:ABC \to [ABCE] \to [ABC]$

$\to [ABE]$

d. i. $E \rightarrow G$

Already a minimal cover.

ii. In 1NF | CDEH | G | keys: CDEH | $E \rightarrow G$

subset of key → non-prime

2NF viol.

iii. CDEH, EG $[E \rightarrow G] \rightarrow$ x: E, y: G, z: CDH $\rightarrow$ [EG] [CDEH]

e. i. No FDs

This is a minimal cover.

ii. In BCNF | ACEH | : | | key: ACEH

iii. No decomposition, since in BCNF.

2. a. is a dependency-preserving

b. is b. lossless-join