CSE 132A
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Solutions to Homework 2

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Problem 1

(i) Construct the pattern corresponding to the query:

$$\{s : sid \mid \exists u \in student[s(sid) = u(sid)]$$
$$\wedge \forall p \in prerequisite[p(cid) = "CSE132X"$$
$$\rightarrow \exists r \in record[r(sid) = s(sid) \wedge r(cid) = p(precid) \wedge r(grade) \geq 2]]\}.$$

Problem 2

(i) Find all keys of R:

Since A cannot be determined by any given functional dependency. A must be part of the key. The keys of R are:

(1) AB
(2) AC
(3) ABC
(4) ABD
(5) ABE
(6) ACD
(7) ACE
(8) ABCD
(9) ABCE
(10) ACDE
(11) ABCDE

(ii) Find a BCNF decomposition of R with lossless join with respect to F.

$ABCDE$ *violation* : $C \to D$ since $C+ = CD$
$CD, ABCE$ *violation* : $B \to CE$ since $B+ = BCDE$
CD, BCE, AB *no violation*

(iii) Is the decomposition obtained in (ii) dependency preserving with respect to F.

No

(iv) Find 3NF decomposition of R with lossless join and dependency preserving with respect to F. Is the decomposition also in BCNF?

Step 1, rewrite FDs:

$C \to D, AC \to B, AC \to D, AC \to E, AB \to C, AB \to D, AB \to E, B \to C, B \to E$

Step 2, remove redundant FDs:

$AC \to E$ is redundant because $AC \to B, B \to E$
$AB \to D$ is redundant because $AB \to C, C \to D$
$F = \{C \to D, AC \to B, AC \to D, AB \to C, AB \to E, B \to C, B \to E\}$

Step 3, remove redundant attributes from the LHS of FDs: $AC \to D$ is redundant because $C \to D$
$AB \to C$ is redundant because $B \to C$
$F = \{C \to D, B \to E, AC \to B, B \to C\}$