Assignment 5

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Problem 1

- **Repetition of Information** is a condition in a relational database where the values of one attribute are determined by the values of another attribute in the same relation, and both values are repeated throughout the relation.
- **Inability to represent information** is a condition where a relationship exists amoung only a proper subset of the attributes in a relation.

Problem 2

The three design goals are lossless-join decompositions, dependency preserving decompositions, and minimization of repetition of information. They are desirable so we can maintain an accurate database, check correctness of updates quickly, and use the smallest amount of space possible.

Problem 3

4NF is more desirable than BCNF because it reduces the repetition of information.

Problem 4

The goal is to prove $\alpha \to \beta\gamma \Longrightarrow \alpha \to \beta \wedge \alpha \to \gamma$

By axiom of reflexivity, we obtain $\beta\gamma \to \beta$ and $\beta\gamma \to \gamma$

By axiom of transitivity and $\alpha \to \beta\gamma$, we obtain $\alpha \to \beta$ and $\alpha \to \gamma$

Problem 5

Attribute closure:

$A \to ABCDE$

$B \to BD$

$C \to C$

$D \to D$

$E \to ABCDE$

$AB \to ABCDE$

$AC \to ABCDE$

$AD \to ABCDE$

$AE \to ABCDE$
$BC \to ABCDE$
$BD \to BD$
$BE \to ABCDE$
$CD \to ABCDE$
$CE \to ABCDE$
$DE \to ABCDE$
$ABC \to ABCDE$
$ABD \to ABCDE$
$ABE \to ABCDE$
$ACD \to ABCDE$
$ACE \to ABCDE$
$ADE \to ABCDE$
$BCD \to ABCDE$
$BDE \to ABCDE$
$CDE \to ABCDE$
$ABCD \to ABCDE$
$ABCE \to ABCDE$
$ABDE \to ABCDE$
$ACDE \to ABCDE$
$BCDE \to ABCDE$

It's easy to find the candidate keys are A, BC, CD, E.

Problem 6

Assume we have a relation $R(person, hobby, research\_interest)$.

person	hobby	research_interest
Alice	badminton	AI
Alice	tennis	database
Alice	badminton	database
Alice	tennis	AI
Bob	badminton	AI

There is no functional dependency so R is in BCNF. But there is a multivalued dependency $person \twoheadrightarrow hobby$ so R is not in 4NF.