

Exercise 3.2.1: Consider a relation with schema $R(A, B, C, D)$ and FD's $AB \rightarrow C$, $C \rightarrow D$, and $D \rightarrow A$.

- a) What are all the nontrivial FD's that follow from the given FD's? You should restrict yourself to FD's with single attributes on the right side.
- b) What are all the keys of R ?
- c) What are all the superkeys for R that are not keys?

Exercise 3.2.2: Repeat Exercise 3.2.1 for the following schemas and sets of FD's:

- I) $S(A, B, C, D)$ with FD's $A \rightarrow B$, $B \rightarrow C$, and $B \rightarrow D$.
- II) $T(A, B, C, D)$ with FD's $AB \rightarrow C$, $BC \rightarrow D$, $CD \rightarrow A$, and $AD \rightarrow B$
- III) $U(A, B, C, D)$ with FD's $A \rightarrow B$, $B \rightarrow C$, $C \rightarrow D$, and $D \rightarrow A$

Exercise 3.2.10: Suppose we have relation $R(A, B, C, D, E)$, with some set of FD's, and we wish to project those FD's onto relation $S(A, B, C)$. Give the FD's that hold in S if the FD's for R are:

- a) $AB \rightarrow DE$, $C \rightarrow E$, $D \rightarrow C$, and $E \rightarrow A$.
- b) $A \rightarrow D$, $BD \rightarrow E$, $AC \rightarrow E$, and $DE \rightarrow B$.
- c) $AB \rightarrow D$, $AC \rightarrow E$, $BC \rightarrow D$, $D \rightarrow A$, and $E \rightarrow B$.
- d) $A \rightarrow B$, $B \rightarrow C$, $C \rightarrow D$, $D \rightarrow E$, and $E \rightarrow A$.