

CS127 Homework 4

Due: October 17th, 2014 3:00PM

Warmup 1 (Textbook Problem 8.6)

Compute the closure of the following set F of functional dependencies for relation schema $R(A, B, C, D, E)$.

$$\begin{aligned} A &\rightarrow BC \\ CD &\rightarrow E \\ B &\rightarrow D \\ E &\rightarrow A \end{aligned}$$

List the candidate keys for R .

Warmup 2 (Textbook Problem 8.9)

Given the database schema $R(a, b, c)$, and a relation r on the schema R , write an SQL query to test whether the functional dependency $b \rightarrow c$ holds on relation r . Also write an SQL assertion that enforces the functional dependency; assume that no null values are present. (Although part of the SQL standard, such assertions are not supported by any database implementation currently.)

Warmup 3 (Textbook Problem 8.21 (modified))

Normalize the following schema, with given constraints, to BCNF.

books(*accessionno*, *isbn*, *title*, *author*, *publisher*)
users(*userid*, *name*, *deptid*, *deptname*)
 $accessionno \rightarrow isbn$
 $isbn \rightarrow title$
 $isbn \rightarrow publisher$
 $isbn \rightarrow author$
 $userid \rightarrow name$
 $userid \rightarrow deptid$
 $deptid \rightarrow deptname$

Warmup 4 (Textbook Problem 8.29 (e))

Consider the following set F of functional dependencies on the relation schema $r(A, B, C, D, E, F)$:

$$\begin{aligned} A &\rightarrow BCD \\ BC &\rightarrow DE \\ B &\rightarrow D \\ D &\rightarrow A \end{aligned}$$

Give a BCNF decomposition of r using the original set of functional dependencies.

Problem 5 (To Be Graded)

Consider again the simplified university registrar database from the previous homeworks:

Student			Course			Enrollment			
name	gradyear	gpa	title	semester	instructor	name	title	semester	grade
Amy	2016	3.95	CS33	2014F	Doeppner	Eliza	CS33	2014F	A
Ben	2015	3.87	CS127	2014F	Zdonik	Eliza	CS127	2014F	A
Carl	2016	3.29	CS195	2013F	Kraska	Ben	CS127	2012F	A
Dan	2017	3.43	CS127	2012F	Zdonik	Carl	CS195	2013F	C
Eliza	2015	4.0	CS136	2012S	Fonseca	Carl	CS127	2014F	B

The keys for each relation are as follows:

- *Student*: name (all student names are assumed to be unique)
- *Course*: title and semester
- *Enrollment*: name, title, and semester

Answer the following questions:

1. Is the database a lossless decomposition of a universal relation $Student \bowtie Enrollment \bowtie Course$? Why or why not?
2. List all of the functional dependencies that can be inferred from keys.
3. Now assume that each student can be enrolled in only 1 course per semester. Does this new constraint change the keys for any of the relations? If not, explain why. Otherwise, give the new keys.
4. Suppose that students can now have advisors. Given each of the following constraints, describe how you would modify the database to preserve BCNF and list any new functional dependencies.
 - a. Each student can have only 1 advisor.
 - b. Each advisor can have only 1 student.
 - c. Each student can have multiple advisors, and each advisor can have multiple students.