Database System

Homework #5 (Chapter 15 & 21)

15.19. Suppose we have the following requirements for a university database that is used to keep track of students' transcripts:

a. The university keeps track of each student's name (Sname), student number (Snum), social security number (Ssn), current address (Sc_addr) and phone (Sc_phone), permanent address (Sp_addr) and phone (Sp_phone), birth date (Bdate), sex (Sex), class (Class) (freshman, sophomore, ..., graduate), major department (Major_code), minor department (Minor_code) (if any), and degree program (Prog) ('b.a.', 'b.s.', ..., 'ph.d.'). Both Ssn and student number have unique values for each student.

b. Each department is described by a name (Dname), department code (Dcode), office number (Doffice), office phone (Dphone), and college (Dcollege). Both name and code have unique values for each department.

c. Each course has a course name (Cname), description (Cdesc), course number (Cnum), number of semester hours (Credit), level (Level), and offering department (Cdept). The course number is unique for each course.

d. Each section has an instructor (Iname), semester (Semester), year (Year), course (Sec_course), and section number (Sec_num). The section number distinguishes different sections of the same course that are taught during the same semester/year; its values are 1, 2, 3, ..., up to the total number of sections taught during each semester.

e. A grade record refers to a student (Ssn), a particular section, and a grade (Grade).

Design a relational database schema for this database application. First show all the functional dependencies that should hold among the attributes. Then, design relation schemas for the database that are each in 3NF or BCNF. Specify the key attributes of each relation. Note any unspecified requirements, and make appropriate assumptions to render the specification complete.

15.24. Consider the universal relation $R = \{A, B, C, D, E, F, G, H, I\}$ and the set of functional dependencies $F = \{ \{A, B\} \rightarrow \{C\}, \{A\} \rightarrow \{D, E\}, \{B\} \rightarrow \{F\}, \{F\} \rightarrow \{G, H\}, \{D\} \rightarrow \{I, J\} \}$. What is the key for R? Decompose R into 2NF, then 3NF relations.

15.27. Consider a relation $R(A,B,C,D,E)$ with the following dependencies:

$$AB \rightarrow C, \; CD \rightarrow E, \; DE \rightarrow B$$

Is AB a candidate key of this relation? If not, is ABD? Explain your answer.

21.23. Consider the three transactions T1, T2, and T3, and the schedules S1 and S2 given below. Draw the serializibility (precedence) graphs for S1 and S2 and state whether each schedule is serializable or not. If a schedule is serializable, write down the equivalent serial schedule(s).

T_1: $r_1(X)$; $r_1(Z)$; $w_1(X)$;

T_2: $r_2(Z)$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$;

T_3: $r_3(X)$; $r_3(Y)$; $w_3(Y)$;

S_1: $r_1(X)$; $r_2(Z)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $w_1(X)$; $w_3(Y)$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$;

S_2: $r_1(X)$; $r_2(Z)$; $r_3(X)$; $r_1(Z)$; $r_2(Y)$; $r_3(Y)$; $w_1(X)$; $w_2(Z)$; $w_3(Y)$; $w_2(Y)$;