The assignment is to be turned in before Midnight (by 11:59pm) on January 24th. You should turn in the solutions to this assignment as a PDF file through the Canvas. The solutions should be produced using editing software programs, such as LaTeX or Word, otherwise they will not be graded.

1: Relational Model and SQL

Consider the following relational schema:
Emp(*eid*:integer, *ename*:string, *age*:integer, *salary*:real)
Works(*eid*:integer, *did*:integer, *pc_time*:integer)
Dept(*did*:integer, *dname*:string, *budget*:real, *managerid*:integer)

The underlined attributes are keys for their relations. Note that a manager is an employee as well and their manager id and employee id are the same. An employee can work in more than one department. The pct_time field of the Works relation shows the percentage of time that a given employee works in a given department.

A database sample (sample_db.sql) is provided with this assignment and the output of the correct queries over this sample database is given in each part of this question. We have created an account for each student on the MySQL server of our department. The access guide to the MySQL server (database_access_guide.txt) is also posted with this assignment. You can import the sample database to your account on the MySQL server and use it to ensure that your queries are correct. You do *not* need to submit any .sql file in your assignment submission and must write your final SQL query in the single PDF file that you submit for all questions in this assignment.

(a) Write the relational algebra and datalog form of the following query: Print *dname* of the departments with at least one employee who is younger than 40. (10 points)

(b) Write the SQL query of the query in part (a). (10 points)

The answer on the sample database is:

Hardware

(c) Write a SQL query to print the name of each employee whose salary exceeds the budget of any department that he or she works in. (20 points)

The answer on the sample database is:

Krassimir Wegerle

(d) Write a sql query to find the department names and number of employees that the average salaries of their employees are less than $64,000. (20 points)

The answer on the sample database is:

Software	1
Hardware	7
Customer Service	1

2: Schema Normalization

Consider a relation R with five attributes A, B, C, D, and E. You are given the following functional dependencies: A→B, BC→E, and ED→A.

(a) List all keys for R. (10 points)

(b) Is R in BCNF? If it is, explain why. If is not, decompose it into a collection of BCNF relations. (20 points)

(c) Is R in 3NF? If it is, explain why. If it is not, convert it into a collection of 3NF relations. (20 points)