

**COSC 3P32 – File and Database Systems**  
**Winter 2020**  
**Assignment #3**

**Due Date:** 31<sup>st</sup> March, noon

**Late Date:** 3<sup>rd</sup> April, noon

**This assignment accounts for 5% of your final grade and is worth a total of 50 marks.**

**This assignment is to be completed *individually*.**

**Question 1 [4 marks]**

Consider the following relation:

Assignments(*cid, aid, atype, duedate, latedate, weight*).

In this relation, *cid* is the course ID, *aid* is the assignment ID and *atype* is the assignment type.

Using a single letter for each attribute, we can represent *cid* as C, *aid* as A, *atype* as T, *duedate* as D, *latedate* as L, and *weight* as W.

Express each of the following statements as FDs:

- a) (*cid, aid*) is the key of Assignments.
- b) There is only one assignment for a given course with a given *duedate*.
- c) Assignments with the same *duedate* also have the same *latedate*.
- d) All assignments of the same type for the same course have the same weight.

**Question 2 [20 marks]**

Consider the relation schema  $R=VWXYZ$ ,

with the set of functional dependencies  $F=\{VW \rightarrow XY, V \rightarrow X, W \rightarrow Z, YZ \rightarrow Z, Z \rightarrow V\}$ .

- a) [3x2 marks] Give three **independent** reasons why the following table cannot possibly be a legal instance of R.

V	W	X	Y	Z
v1	w1	x1	y1	z1
v2	w1	x2	y2	z1
v2	w2	x1	y2	z2

- b) [2x2 marks] Show the functional dependencies that hold on each of  $R_1=VWX$  and  $R_2=WYZ$ . You do not need to show trivial functional dependencies, or those implied by others in the same set, but you must show all others.
- c) [2 marks] Is the decomposition of R into  $R_1=VWX$  and  $R_2=WYZ$  lossless-join? Why or why not?
- d) [5 marks] Find a lossless-join BCNF decomposition of R (note: you *cannot* use the decomposition from part (c) above). At each step, you must show all FDs that hold on each of the resulting relations. You do not need to show FDs that are trivial or implied by other FDs in the same set, but you must show all others.
- e) [3 marks] Is your decomposition found in part (d) dependency-preserving? Why or why not?

### Question 3 [11 marks]

Consider the relation schema  $R=ABCDEFGHI$ ,  
with the set of functional dependencies  $F=\{A \rightarrow BGH, CD \rightarrow A, D \rightarrow EG, E \rightarrow BC, G \rightarrow E\}$ .

- [6 marks] Find a minimal cover for  $F$ .
- [2 marks] Find all candidate key(s) of  $R$ .
- [3 marks] Use 3NF Synthesis to find a 3NF decomposition of  $R$  that is both lossless-join and dependency-preserving. You must show all FDs that hold on each of the resulting relations. You do not need to show FDs that are trivial or implied by other FDs in the same set, but you must show all others.

### Question 4 [15 marks]

Consider the following database schema, in which the keys of each relation are underlined:

Restaurant(*rname*, *address*, *phone*, *stars*)

Chef(*cname*, *specialdish*, *rating*)

CooksFor(*cname*, *rname*, *salary*)

Offers(*rname*, *dishname*, *price*)

For each of the following general constraints, create CHECK constraints, assertions or triggers (as appropriate) to ensure that the constraint holds. Note: in the case of CHECK constraints, you do *not* need to provide the entire set of statements required to create the appropriate table, just the CHECK constraint itself.

- [2 marks] Write a CHECK constraint to ensure that every restaurant has between 0 and 5 stars (inclusive).
- [2 marks] Write a CHECK constraint to ensure that no restaurant offers a dish that costs less than 5.00.
- [3 marks] Write an assertion to ensure that every restaurant must have at least one chef.
- [3 marks] Write an assertion to ensure that for every dish, there is at least one chef for whom that is their special dish.
- [5 marks] When the number of stars assigned to a restaurant increases, then all chefs who cook for that restaurant must receive a 10% raise. Write a trigger that will modify *salary* accordingly.

### Submission Requirements:

- Your assignment must be submitted electronically as a PDF document. To do this, create a directory on Sandcastle containing the PDF file for this assignment, and run the script submit3p32 from this directory. Further details on electronic submission can be found here: <https://www.cosc.brocku.ca/help/esubmit>
- Note that all department policies concerning academic misconduct still apply in the case of electronic submission.