

## Assignment 1

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Course	CSI2132 A - Databases I
Academic year	2019/2020
Semester	Winter
Instructor	Paula Branco
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Every student must submit the assignment **individually** through Brightspace

### Exercise 1 (45%)

Consider the schema  $R = (A, B, C, D, E, G)$  and the set  $F$  of functional dependencies:

$$F = \{ A \rightarrow BC, BD \rightarrow E, AD \rightarrow E, CD \rightarrow AB \}$$

- a) **(5%)** Find a nontrivial functional dependency containing no extraneous attributes that is logically implied by the above four dependencies and explain how you found it.
- b) **(10%)** Find all candidate keys of  $R$ .
- c) **(10%)** Use the BCNF decomposition algorithm to find a BCNF decomposition of  $R$ . Start with  $A \rightarrow BC$ . Explain your steps.
- d) **(10%)** For your decomposition, state whether it is lossless and explain why.
- e) **(10%)** For your decomposition, state whether it is dependency preserving and explain why.

### Exercise 2 (25%)

Consider the schema  $R = (A, B, C, D, E, G)$  and the set  $F$  of functional dependencies:

$$F = \{ AB \rightarrow CD, ADE \rightarrow GDE, B \rightarrow GC, G \rightarrow DE \}$$

- a) **(5%)** Provide a list of all candidate keys.
- b) **(10%)** Find the canonical cover for  $F$ , along with an explanation of the steps you took to generate it.

- c) **(10%)** Use the 3NF decomposition algorithm to generate a 3NF decomposition of R, and show all the necessary steps.

### Exercise 3 (30%)

Consider the following relational schema:

*Sale*(clerk, store, city, date, item, size, color) // a clerk sold an item on a particular day

*Item*(item, size, color, price) // prices and available sizes and colors for items

Make the following assumptions, and only these assumptions, about the real world being modeled:

- Each clerk works in one store.
  - Each store is in one city.
  - A given item always has the same price, regardless of size or color.
  - Each item is available in one or more sizes and one or more colors, and each item is available in all combinations of sizes and colors for that item.
  - *Sale* does not contain duplicates: If a clerk sells more than one of a given item in a given size and color on a given day, still only one tuple appears in relation *Sale* to record that fact.
- a) **(10%)** Specify a set of completely nontrivial functional dependencies for relations *Sale* and *Item* that encodes the assumptions described above and no additional assumptions.
- b) **(10%)** Based on your functional dependencies in part (a), specify all candidate keys for relations *Sale* and *Item*.
- c) **(10%)** Is the schema in Boyce-Codd Normal Form (BCNF) according to your answers to a) and b)? If not, give a decomposition into BCNF.