ICS 324 - HW 4

Due – November 28, 2020

Solve the following normalization questions.

1. **[4 pts]** Consider the relation `R = {A, B, C, D, E, F, G, H, I, J}` and functional dependencies

   - `{A,B}` → `{C}`
   - `{A}` → `{D,E}`
   - `{B}` → `{F}`
   - `{F}` → `{G,H}`
   - `{D}` → `{I,J}`

   What is the key for R? Decompose R into 2NF and then 3NF relations.

2. **[4 pts]** Consider a relation `R = {A, B, C, D, E}` with the following dependencies.

   - `{A, B}` → `{C}`
   - `{C, D}` → `{E}`
   - `{D, E}` → `{B}`

   Is AB a candidate key of R? What about ABD? Explain your answer.

3. **[4 pts]** Consider the relation *R*, which has attributes that hold schedules of courses and sections at a university;

   R = {Course_no, Sec_no, Offering_dept, Credit_hours, Course_level, Instructor_ssn, Semester, Year, Days_hours, Room_no, No_of_students}.

   Suppose that the following functional dependencies hold on *R*:

   - {Course_no} → {Offering_dept, Credit_hours, Course_level}
   - {Course_no, Sec_no, Semester, Year} → {Days_hours, Room_no, No_of_students, Instructor_ssn}
   - {Room_no, Days_hours, Semester, Year} → {Instructor_ssn, Course_no, Sec_no}

Try to determine which sets of attributes form keys of *R*. How would you normalize this relation?

4. **[4 pts]** This exercise asks you to convert business statements into dependencies.

   Consider the relation DISK_DRIVE (Serial_number, Manufacturer, Model, Batch, Capacity, Retailer). Each tuple in the relation DISK_DRIVE contains information about a disk drive with a unique Serial_number, made by a manufacturer, with a particular model number, released in a certain batch, which has a certain storage capacity and is sold by a certain retailer. For example, the tuple Disk_drive ('1978619', 'WesternDigital', 'A2235X', '765234', 500, 'CompUSA') specifies that WesternDigital made a disk drive with serial number 1978619 and model number A2235X, released in batch 765234; it is 500GB and sold by CompUSA. Write each of the following dependencies as an FD:

   a) The manufacturer and serial number uniquely identifies the drive.
   b) A model number is registered by a manufacturer and therefore can't be used by another manufacturer.
   c) All disk drives in a particular batch are the same model.
   d) All disk drives of a certain model of a particular manufacturer have exactly the same capacity.

5. **[4 pts]** Consider the following relation:

   `CAR_SALE (Car_id, Option_type, Option_listprice, Sale_date, Option_discountedprice)`

   This relation refers to options installed in cars (e.g., cruise control) that were sold at a dealership, and the list and discounted prices of the options. If

   - `CarID → Sale_date`
   - `Option_type → Option_listprice`
   - `CarID, Option_type → Option_discountedprice`

   Argue using the generalized definition of the 3NF that this relation is not in 3NF. Then argue from your knowledge of 2NF, why it is not even in 2NF.