University of Toronto
CSC343

In-class Exercises: BCNF

1. **FD recap.**

   (a) Create an instance of relation $R(A, B, C, D, E)$ that violates this functional dependency: $ABC \rightarrow DE$.

   Solutions: Here is one example

A	B	C	D	E
a1	b1	c1	d1	e1
a1	b1	c1	d1	e2

   (b) Suppose we have a relation $R(A, B, C, D, E)$. Does the instance below violate the functional dependency $DB \rightarrow A$?

A	B	C	D	E
5	3	2	1	6
5	3	3	1	2
5	8	4	1	5

2. **Is a relation in BCNF?**

   (a) Suppose we have a relation Students(SID, email, course, term, prof), and that these FDs hold:
   { SID → email; course, term → prof; SID, course → grade. }. Is this relation in BCNF?

   Solution: No. $SID^+ = \{SID, email\}$ which is not all the attributes.

   (b) Suppose we have a relation Customers(name, DOB, address, favouriteCar, manufacturer) and these FDs hold:
   { name → DOB, favouriteCar; favouriteCar → manufacturer }. Is this relation in BCNF?

   Solution: No. Calculate the closure of name to see that it is not all the attributes.
   $name^+ = \{name, DOB, favouriteCar, manufacturer\}$. It does not include $address$.

   (c) Suppose we have a relation Parts(part, manufacturer, seller, price) and these FDs hold:
   { part → manufacturer; part, seller → price }. Is this relation in BCNF?

   Solution: No. $part^+ = \{part, manufacturer\}$ which does not include seller or price.

   (d) Suppose we have a relation R(A, B, C, D, E) and these FDs hold:
   { B → AC; CB → E; A → D }. Is this relation in BCNF?

   Solution: No. $A^+ = \{A, D\}$which is not the whole set of attributes of R.

3. **How does BCNF help?** Consider again the relation relation Parts(part, manufacturer, seller, price) with these FDs: { part → manufacturer; part, seller → price }.

   (a) Keeping in mind the FDs, make an instance of this relation that has redundant information.

   Solution: Here is one of an infinite number of possibilities

part	manufacturer	seller	price
p1	man1	seller1	45.99
p1	man1	seller2	30.49

   (b) If we applied the decomposition step from BCNF decomposition, what attributes would each of the new relations have?

   Solution:
   $R_1(part, manufacturer)$ and $R_2(part, seller, price)$

   (c) Project the FDs onto each of the new relations

   Solution:
   R projected onto R_1: $T = \{part \rightarrow manufacturer\}$
   R projected onto R_2: $T = \{part, seller \rightarrow price\}$

   (d) Put the same data as in part (a) into your new schema. Is there any redundancy?

   Solution: Do this with your own data. Here is the solution for the example answer above.

part	manufacturer
p1	man1

part	seller	price
p1	seller1	45.99
p1	seller2	30.49

   (e) Is it *possible* to create redundancy with this new schema?

   Solution: No.