CS 2441. Schema Design: Functional Dependencies

Team Members: 
_________________________________________________

For each of the following relation schemas and sets of functional dependencies: (1) find the keys for each schema, (2) test if schema is in BCNF, and (3) test if schema is in third normal form.

1. **R(A,B,C,D)** with functional dependencies **AB → C, C → D, and D → A**.

   Keys: B is not on Right hand side, so it must be part of a key. Just B by itself is not a key. Compute \(\{AB\}^+\) and we get \(\{AB\}^+ = \{ABCD\}\) and therefore AB is a key. Similarly, compute \(\{BC\}^+\) and \(\{BD\}^+\) and both of them will also be keys. Therefore the keys are \(\{AB\}, \{BC\}, \{BD\}\). Since we have dependencies of the form \(C \rightarrow D, \text{ and } D \rightarrow A\) and these are not in BCNF since the Left hand side (LHS) is not a key or a superkey. The schema is in 3NF since all the attributes are prime attributes (part of a key) and therefore all the RHS attributes are prime attributes.

2. **R(A,B,C,D)** with functional dependencies **B → C, B → D**.

   Since A is not in any dependency, it must be part of key. The key is \(\{AB\}\). None of the dependencies satisfy BCNF or 3NF.


   The keys for the relation: since A does not appear on the right hand side, it must be part of the key. But A by itself is not a key. Check \(\{AB\}, \{AC\}\) and \(\{AD\}\). All these three are keys. The schema is not in BCNF since we have a dependency where the LHS is not a key. The schema is not in 3NF since you have a dependency of the form \(D \rightarrow E\) where the LHS is not a key and RHS is not part of a key.