Quiz 13 Relational Design

Question 1: Consider the relation R(A, B, C, D, E) with functional dependencies

$A \rightarrow C, E$ (equivalent to $A \rightarrow C$ and $A \rightarrow E$)

$C, D \rightarrow E$ (NOT equivalent to $C \rightarrow E$ and $D \rightarrow E$)

Which of the following is a key for R?

~~{ A }~~ (closure of {A} is {A, C, E}

~~{ A, B }~~ (closure of {A} is {A, B, C, E}

{ A, B, D } (closure of {A, B, D} is {A, B, C, D, E})

~~{ C, E }~~ (closure of {C, E} is {C, E})

~~{ E }~~ (closure of {E} is {E})

The closure of {A, B, D} includes all attributes. The closure of the other choices does not

Take a big step towards identifying keys (in most but not all cases) by observing that any attribute that is not on the right-hand side (RHS) of any FD, must be part of a key. Note that A,B,D not on RHS of any FD (in general, however, this is not alone sufficient for identifying keys).

When I say "key", I will (almost) always mean "minimal key" (A,B,D is a minimal key – no proper subset of its attributes are also a "key")

Question 2: Consider the relation S(F, G, H, I) with functional dependencies

F, G —> H

I, F —> G

Which of the following is a decomposition of S into BCNF relations, S1 and S2?

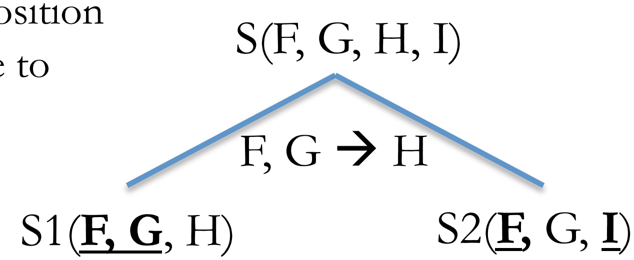
First, what are the (minimal) keys? F and I are not on the RHS of any FD, so must be part of any key. {I, F} → {F, G, I} → {F, G, H, I}. {I, F} is the only minimal key.

~~S1(F, G), S2(H, I)~~ (no basis for natural join)

~~S1(F, G, H), S2(I)~~ (no basis for natural join)

~~S1(F, G, H, I), S2()~~ (F, G → H is assignable S1(F, G, H, I), but F,G is not a key of this relation, so S1 not in BCNF)

S1(F, G, H), S2(F, G, I) (this is obtained by using standard decomposition technique. The LHS of each FD assignable to to a relation is a key of that relation



F,G is basis for natural join

~~S1(H, G), S2(F, I)~~ (no basis for natural join)

S1(F, G, I), S2(F, H, I) F,G → H not assignable to either relation. I,F → G is assignable to S1 (and I,F → H is assignable to S2), and I,F is the key for both S1 and S2. {I,F} is basis of natural join. Both S1 and S2 are in BCNF.

This decomposition is not *dependency preserving*, however (relevant to an aside made by Widom on limits of BCNF). Note that F,G →H is not assignable to either relation. To enforce this FD requires joining S1 and S2