University College of Applied Sciences

Engineering Department

Introduction to Database

HW4

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Answer the following five questions:

14.24 - Consider the universal relation R = {A, B, C, D, E, F, G, H, I} and the set of functional dependencies F = { {A, B} -> {C}, {A} -> {D, E}, {B} -> {F}, {F} ->

{G, H}, {D} -> {I, J} }. What is the key for R? Decompose R into 2NF, then 3NF relations.

| A minimal set of attributes whose closure includes all the attributes in R is a key.  Since the closure of {A, B}, {A, B}+ = R, one key of R is {A, B} (in this case, it is the only key).  **To normalize R intuitively into 2NF and then 3NF, we will do the following steps:**  First, identify partial dependencies that violate 2NF. These attributes are functionally dependent on either part of the key, {A} or {B}, alone. We can calculate the closures {A}+ and {B}+ to determine partially dependent attributes:  {A}+ = {A, D, E, I, J}. Hence {A} -> {D, E, I, J} ({A} -> {A} is a trivial dependency)  {B}+ = {B, F, G, H}, hence {A} -> {F, G, H} ({B} -> {B} is a trivial dependency)  **To normalize into 2NF**, we remove the attributes that are functionally dependent on the part of the key (A or B) from R and place them in separate relations R1 and R2, along with the part of the key they depend on (A or B), which are copied into each of these relations but also remains in the original relation, which we call R3 below:  **R1** = {A, D, E, I, J}, **R2** = {B, F, G, H}, **R3** = {A, B, C}  The new keys for **R1, R2, R3** are underlined.  Next, we look for transitive dependencies in R1, R2, and R3. The relation R1 has the transitive dependency {A} -> {D} -> {I, J}, so we remove the transitively dependent attributes {I, J} from R1 into a relation R11 and copy the attribute D they are dependent on into R11. The remaining attributes are kept in a relation R12. Hence, R1 is decomposed into R11 and R12 as follows:  R11 = {D, I, J}, R12 = {A, D, E} The relation R2 is similarly decomposed into R21 and R22 based on the transitive dependency {B} -> {F} -> {G, H}: R2 = {F, G, H}, R2 = {B, F}  **The final set of relations in 3NF are {R11, R12, R21, R22, R3}** |
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