Assignment 2 – Databases.

Question 1)

Given R(W, X, Y, Z)
And so :
Z → W
Y → {X, Z}
{W, X} → Y

I-

The candidate key is {Y}.

Proof :

First we prove that Y is actually a candidate key.

Given Y we can get {X, Z} (by the dependencies above).
And so, given Z that we get on the previous operation, we can get W (Also by the dependencies above).

So, given Y we get only one line (W, X, Y, Z) of the table R.

Second we prove that X, W, and Z are not candidate-keys.

Given X, we can't get anything else.
Given W, we can't get anything else.
Given Z, we can can get W, then anything else.

So no one of those sets may be a candidate key.

Third, by the minimality of the candidate key Y, we conclude that any others sets may be smaller that the set {Y}, {X}, {W}, {Z}.

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II-

The relation is a NF2 relation.

Proof :

Assuming that the relation is a NF1 (we can't really verify this and it's not in our interest), we need to show that the claim of the NF2 relation are respected.

1- As we said the relation is NF1 (by assumption).
2- Since the candidate key is {Y} (found in the I-) we are looking about all the subset(s) of the candidate key. Only the empty set is a subset of the candidate key by the axiom of the empty set {∅}.
From here, it's trivial to see that any attribute depends on the empty set, and then of any subset of the candidate key.

By this we can said that the relation is NF2.

We are now going to show that the relation is not a NF3 relation.
By the dependencies above we have Z → W.
By definition, Z is not a super key (we already show that Z is not a candidate key, so by the same way, we show that it’s not a super key).
By definition W is a non-prime attribute since his is not include into the candidate key.
So we have a non prime attribute which depends on a non super key attribute. So, this is not respect the claim of the NF3.

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Question 2)

Given R(W, X, Y, Z)
And so :
Candidates keys :
(W, X, Y), (W, X, Z)
The relation is found in a NF3 relation.

If saying that a relation found in a NF3 relation means that it’s doesn’t belong to an higher NF (NF3.5) the answer should be the next one :
As we can easily see, all the attributes belong to a one of the candidates keys.
So, by definition there is not non-prime attribute.
So, no matter which dependencies we have, the relation will always be at least a NF3 relation by empty way (אופן ריק).
Now, we’re focusing about the fact that the relation isn’t a NF3.5 relation.
To be a NF3.5 relation, the dependencies must be one of the permutations of the next set :
A = {
{{X, Y, W} → Z}; // {X, Y, W} // is actually a super key so the condition is maintained.
{{X, Y, Z} → W}; // {X, Y, Z} // is actually a super key so the condition is maintained.
{{any set A} → {subset of A}} // existing by empty way
}
So since we don’t want the relation being a NF3.5 relation, all the dependencies can’t be one of the permutations of the set A. All the rest is allow.

If saying that a relation found in a NF3 relation doesn’t mean that it’s doesn’t belong to an higher NF, every dependencies are allow, and as said above, if it’s a NF3.5 relation, the dependencies are reduce to the set A, and so go one.

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