Advanced Databases - Exercise Sheet No. 1

Third Year of the “Computer Engineering” Program

Exercise I

Consider the following set of functional dependencies for a relation R (U: = {A, B, C, D, E, G, H}):
F = {AB → C, B → D, CD → E, CE → GH, G → A}.
Show that
1) BG → DH ∈ F+
2) CD → B ∉ F+
3) ABC → DEG ∈ F+

Exercise II

Consider the following set of functional dependencies for a relation R (U: = {A, B, C, D, E, G, H}):
F = {BC → D, DG → A, DE → G, C → E, H → B}.
Verify whether the following dependencies hold:
1) CH → AE
2) BC → DEG
3) ADEG → BC

Exercise III

Consider the following set of functional dependencies for a relation R(U := {A, B, C, D, E, G, H}):
F = { AC → B, C → D, BD → E, BE → GH, G → A }.
1) Demonstrate why attribute C must be part of every key of R(U).
2) Determine, with proof, all the keys of R(U) corresponding to F.

Exercise IV

Consider the following sets of functional dependencies:
F = { AB → C, B → A, AD → E, BD → I },
G = { AB → C, B → A, AD → EI }.
Verify whether the assertion F+ = G+ holds.

Exercise V

Consider the following relation:
COMMANDE (ProductNum, ProductName, ClientNum, ClientName, Date, UnitPrice, Number, VAT)
(The amount of VAT naturally depends on the product.)

1) Determine the functional dependencies in the relation "COMMANDE." What are the candidate keys?
2) In which normal form is the relation "COMMANDE"? Explain why it is not in a higher normal form.
3) Decompose the relation "COMMANDE" into relations of a higher normal form. Provide each resulting relation in the format RELATION(Attribute1, ...), underlining the attributes of the primary key.

Exercise VI

Consider the following set of functional dependencies for a relation R(U := {A, B, C, D, E, F}):
DF := { A → BC, C → AD, E → ABC, F → CD, CD → BEF }.
1) List all the keys of R.
2) Explain why R is in Third Normal Form (3NF).