Tutorial 2: Normalisation

1. Define Functional Dependency, 2nd Normal Form, 3rd Normal Form and Non-Loss Decomposition.

2. This problem comes from Ritchie (3rd Edition, page 130). A Financial consultancy provides consultants to work on clients' projects. Each Consultant works on only one project at a time, but a project may employ more than one consultant. The following (un-normalized) table gives sample data about current assignments.

Consultant ID (C#)	Project no. (P#)	Hours (Hours)	Project Name (Pname)	Consultant Name (Cname)	Project Location (Ploc)	Fee Rate (Fee)
C1	P1	450	Apollo	Gray	Glasgow	100
C2	P2	90	Zeus	Brown	Edinburgh	90
C3	P2	20	Zeus	White	Edinburgh	95
C4	P3	135	Mercury	Green	Aberdeen	150

Ritchie tells us that the Hours value is the total hours worked on the project so far, per consultant. He also tells us that the fee rate value depends on the combination of the consultant involved and the project.

(a) Using this table as an example, explain how anomalies can arise from the use of un-normalised data.

(b) What are the functional dependencies in the above table? What are the candidate keys?

(c) Design a decomposition to produce relations in 3NF identifying the primary keys and foreign keys.

(d) The consultancy is restructured so that consultants are now allowed to work on more than one project at a time. How does this affect the functional dependencies and therefore the decomposition? Show the new decomposition.

3. A relation has four attributes, as in the following table:

Property Number(N)	Street Address (A)	City (C)	Postcode (P)
P105	10 Acacia Avenue	Edinburgh	EH10 1ZX
P972	11 Acacia Avenue	Edinburgh	EH10 1ZX
P655	10 Acacia Avenue	Perth	PH9 1AB
P390	27 Union Street	Stirling	FK9 7BN
P217	14 Drover Lane	Glasgow	G12 7AS

All street addresses are unique within cities. As one would expect, the area corresponding to a postcode falls within only one city (e.g. FK9 7BN is completely contained in Stirling and none of it is in Falkirk).

(a) Identify all functional dependencies among the attributes.

(b) Identify all key attributes (all those which are part of a candidate key).

(c) In which normal form is this relation?

For all parts, be careful to consider and state any assumptions made.