2.1 Architecture Models

The 5 layer model of a DBMS assumes standard commercial applications. If we plan to use a DBMS for non-standard applications we have to extend or to modify our architecture. Discuss the proposed architectures on the back of this exercise for non-standard application DBMS architectures considering especially:

1. Realization effort
2. Redundancy
3. Modifiability of the user / application interface
4. Distribution in a computer network.

2.2 SQL

Given are the following relations from a games database:

- **published** with attributes game and publisher, which contains the publishers of each game.
  \[
  \text{published} = \{\text{game, publisher}\}
  \]
- **designed** with attributes game and designer, which contains the designers of each game.
  \[
  \text{designed} = \{\text{game, designer}\}
  \]
- **reviewed** with attributes game and reviewer, which contains the reviewers of each game.
  \[
  \text{reviewed} = \{\text{game, reviewer}\}
  \]

Every relation represents a n:m-relationship, i.e. the key is formed by all attributes of the relation.

Define the following queries as expressions in SQL:

a) Find all designers of the game “Tetris”.
b) Find all publishers of all games designed by “Schmidt”.
c) Find all designers who have designed more than two games.
d) Find all reviewers who have reviewed at least one game that has not yet been published.
2.3 Tuple and Domain Calculus

Represent the queries of the exercise 2.2 using the tuple and domain calculus formalisms.