

# DISTRIBUTED COMPUTING SYSTEMS

Client-Server Model

# CLIENT-SERVER INTERACTION

# PROBLEM: CENTRALIZATION VS DECENTRALIZATION

- ⊙ This is one of the oldest problems in IT
- ⊙ Example:
  - ⊙ *King J.L. Centralized versus decentralized computing: organizational considerations and management options//ACM Computing Surveys. Vol. 15, Issue 4. 1983. (P). 319-349.*

# PRIOR TO THE 70'S: THE CENTRALIZED MODEL

- ⊙ Until the mid 70-ies of the last century - centralized model:
  - ⊙ The high cost of telecommunications equipment
  - ⊙ Low power computing systems

# 80 's - 90 's: MAINFRAMES

- ◎ The emergence of time Division systems and remote terminals - the premise of client-server architecture.
- ◎ Mainframe resources were provided to end users through a remote connection.
- ◎ Further development of telecommunication systems and the advent of personal computers gave impulse to the development of client-server paradigm of data processing

# CLIENT-SERVER ARCHITECTURE

- ⊙ According to the paradigm of client-server architecture:
  - ⊙ one or more clients and one or more servers
  - ⊙ together with the base operating system
  - ⊙ and environment interactions
  - ⊙ form a single system providing distributed computing and data analysis

# APPLICATION OF CLIENT-SERVER MODEL

- ③ The process of development of distributed application is complex and one of the most important tasks is to decide
  - ③ *how to divide the application functionality between the client and the server.*

# LEVELS OF CLIENT-SERVER ARCHITECTURE



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- ◎ Today they highlight 3 main levels of client-server architecture:
  - ◎ The presentation tier (the user interface)
  - ◎ The business logic tier (processing)
  - ◎ The data tier

# THE PRESENTATION TRIER

- ⦿ Typically implemented on clients
- ⦿ Provides methods for interaction with your application
- ⦿ The simplest option:
  - ⦿ character display (Terminal) to the mainframe

# THE BUSINESS LOGIC TIER

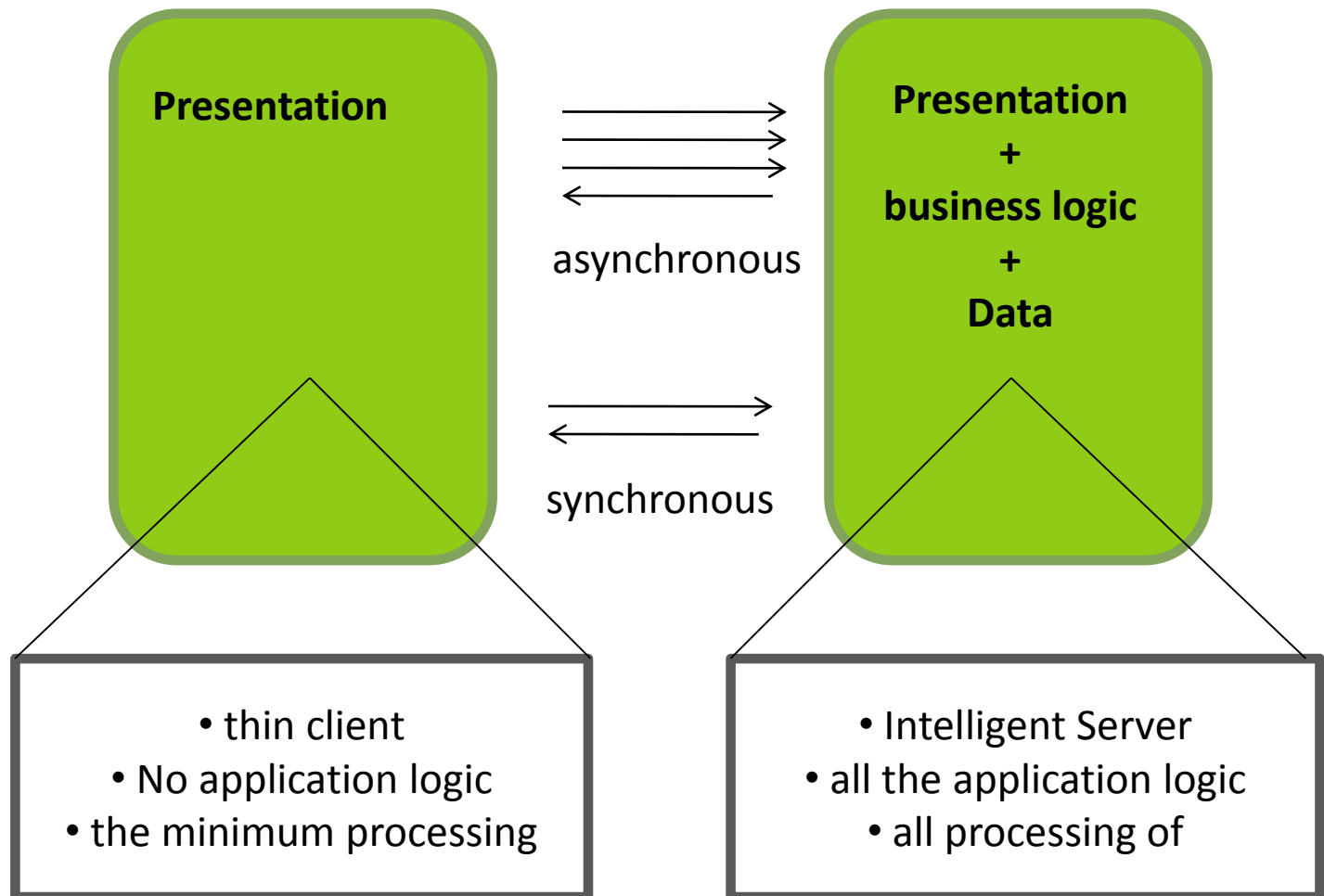
- ◎ Business logic is a set of rules, principles and dependencies of behavior of domain objects.
- ◎ Synonym: Domain Logic.
- ◎ Example:
  - ◎ the formula for the calculation of the salary + taxes;
  - ◎ evaluation of quality of education based on student evaluations;
  - ◎ rejection of the hotel upon race cancellation by the airline.

# THE DATA TIER

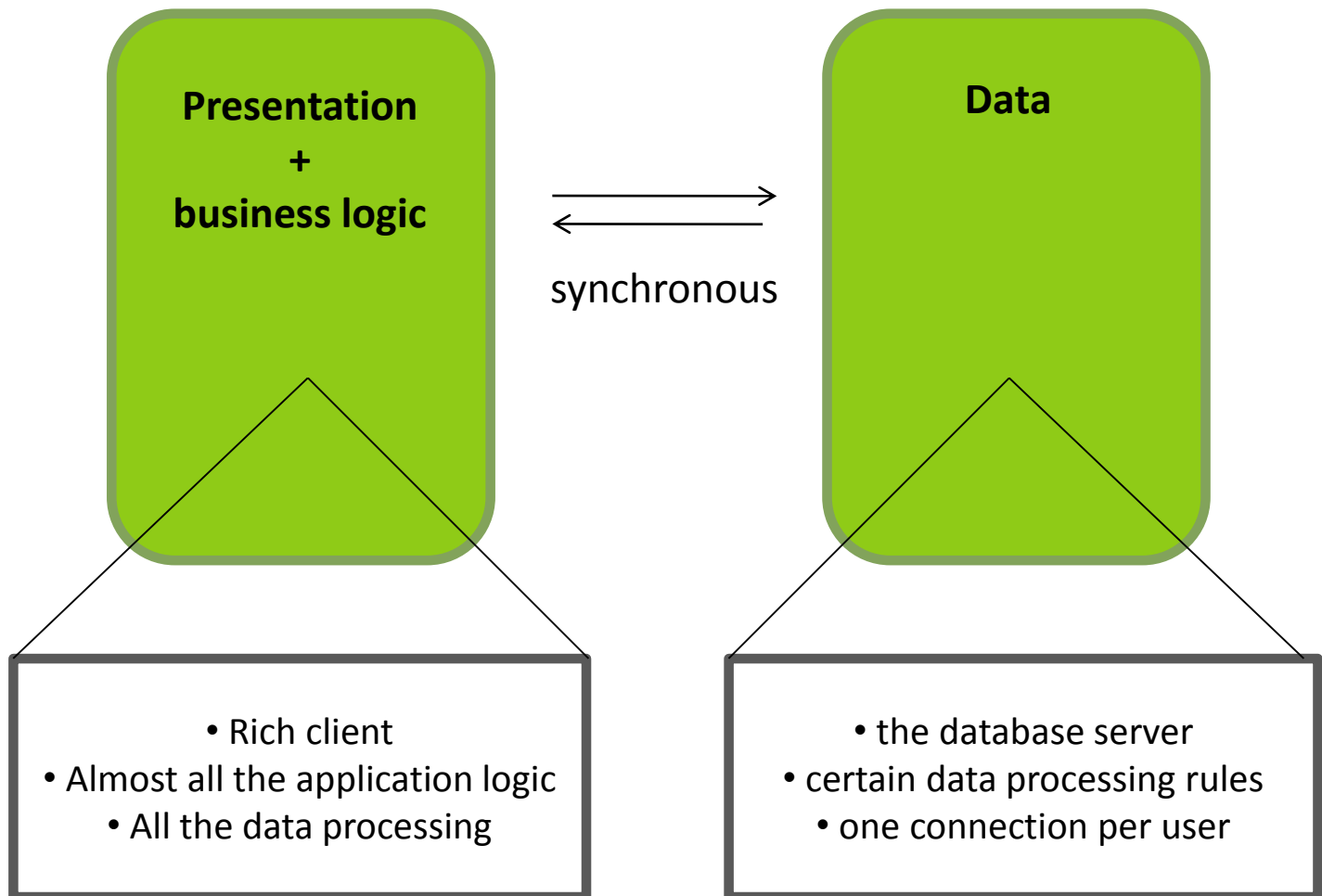
- ⊙ Applications that provide data processing
- ⊙ Data PRESERVATION requirement: when the application is closed, the data must remain in a particular place;
- ⊙ the requirement of INTEGRITY: metadata (descriptions of tables, constraints, and so on) should be checked for this level
- ⊙ Typically implemented by relational database

# HISTORY AND TYPES OF CLIENT-SERVER ARCHITECTURE

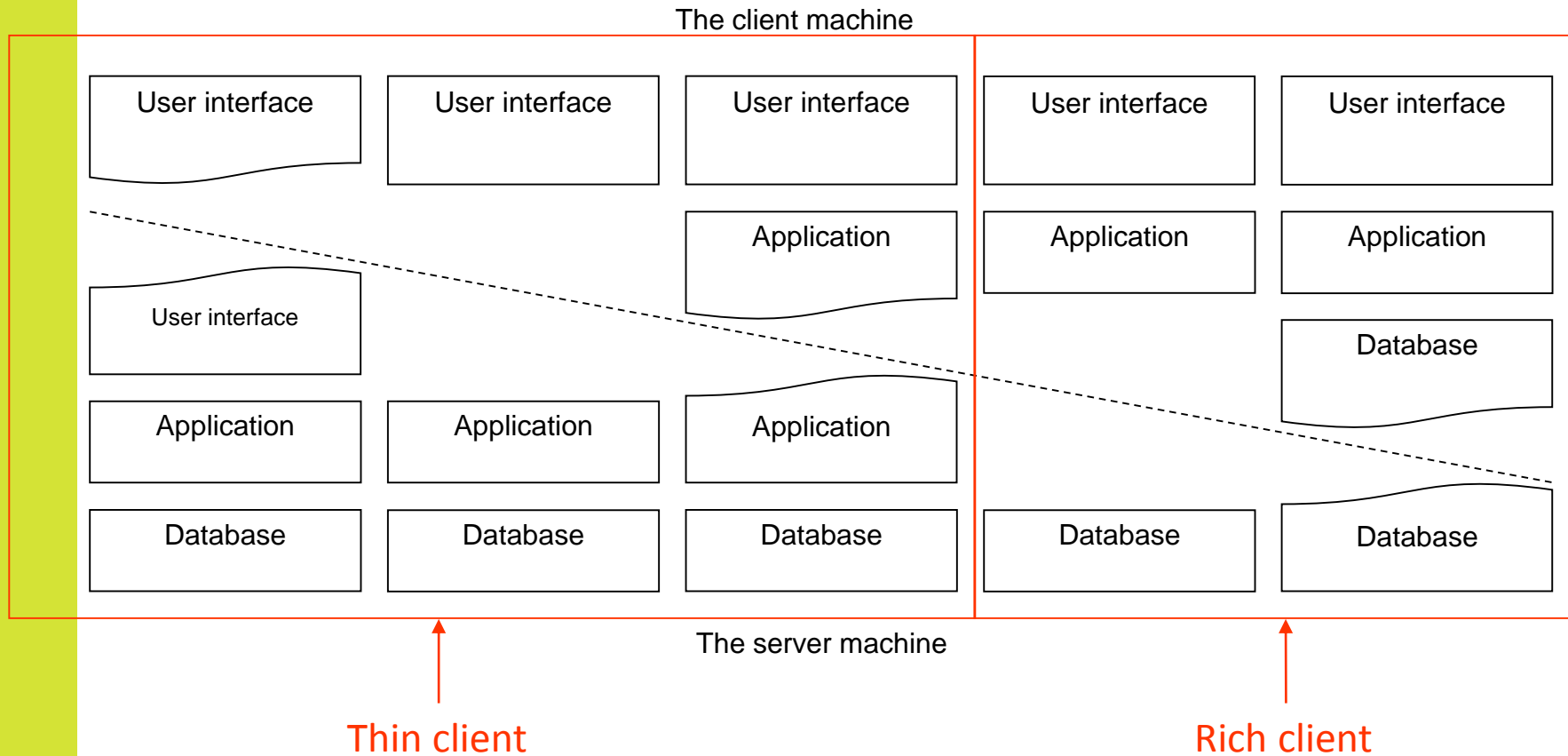
# ONE-TIER ARCHITECTURE



# TWO-TIER ARCHITECTURE



# ALTERNATIVE OPTIONS OF TWO-TIER ARCHITECTURE

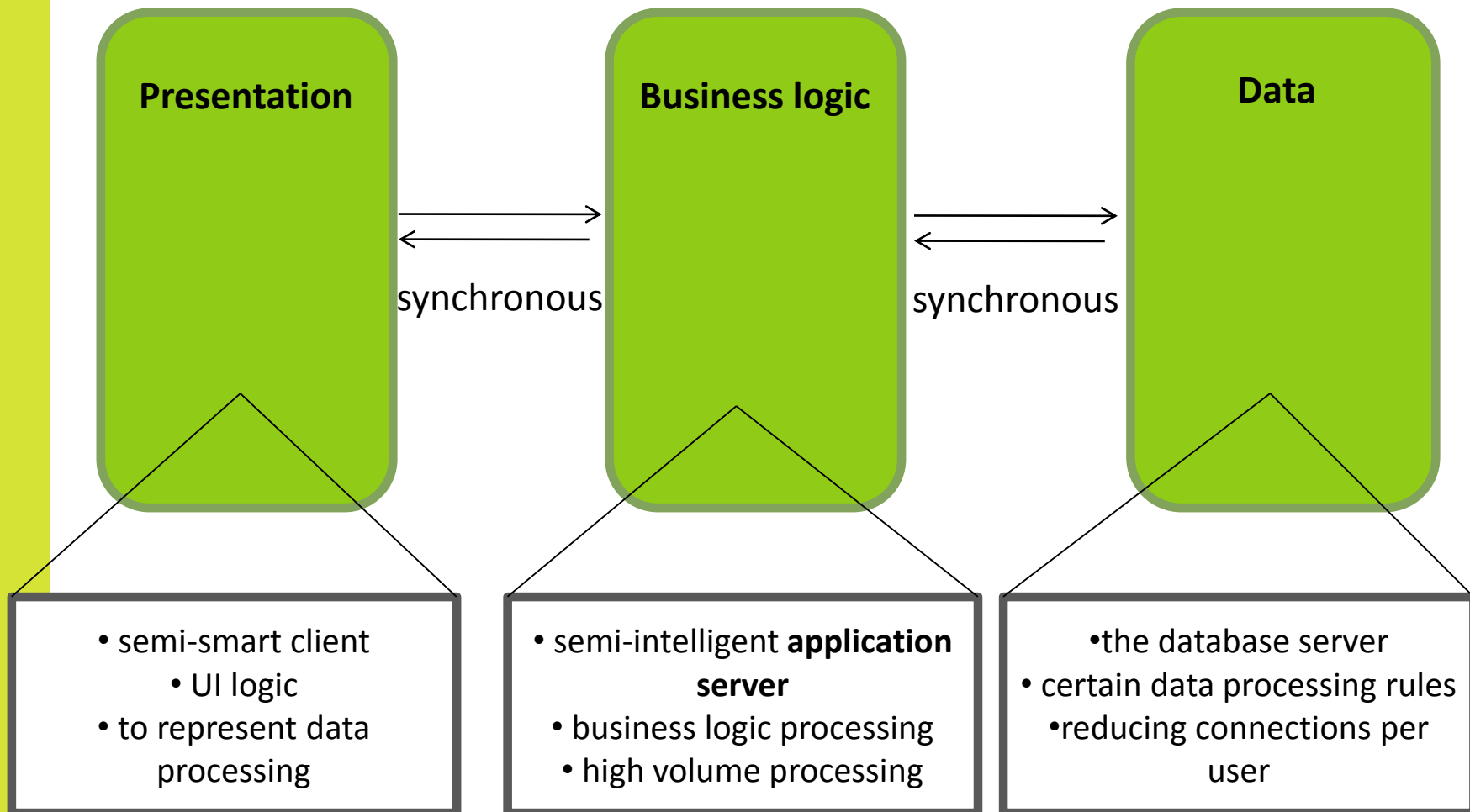




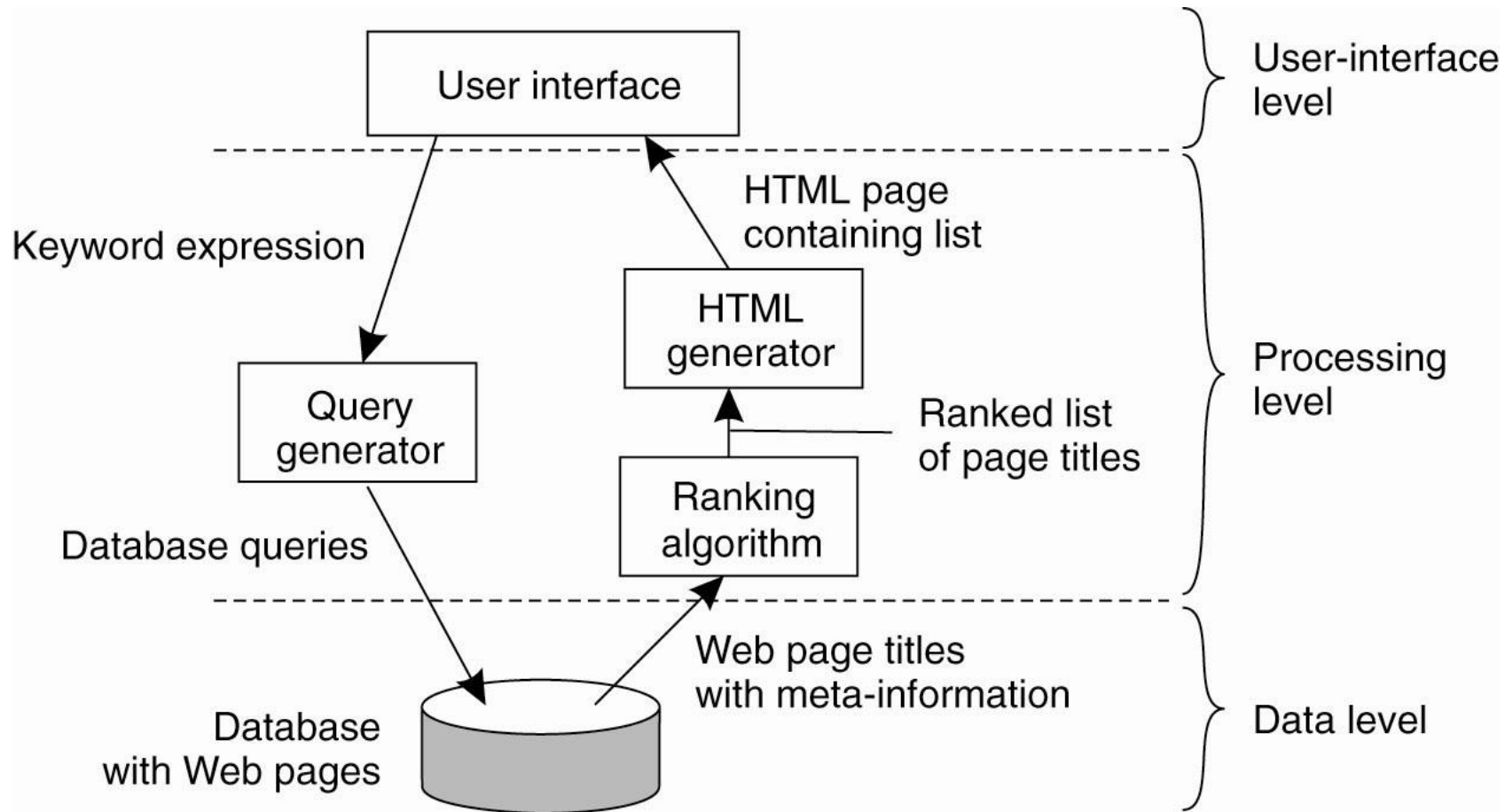
# CONS OF TWO-TIER ARCHITECTURE

- ⊙ Extraordinary expenses for maintenance of workstations that need to handle the business logic
- ⊙ Difficult to update applications when business logic changes (all clients must be reinstalled)
- ⊙ Each workstation is a unique set of software which may conflict with the client and influence on it's work

# THREE-TIER ARCHITECTURE



# APPLICATION LAYERING



The simplified organization of an Internet search engine into three different layers.

# A MODERN EXAMPLE OF MULTI-TIER ARCHITECTURES

- ① 1. Client browser->
- ② 2. IIS->
  - ③ 3. ASP.NET 2.0 runtime->
    - ④ 4. ADO.NET 2.0 data provider->
      - ⑤ 5. MySQL Server->
      - ⑥ 6. ADO.NET 2.0 data provider->
    - ⑦ 7. ASP.NET 2.0 runtime->
  - ⑧ 8. IIS->
- ⑨ 9. Client browser

# SUMMARY

- ③ There are 3 tiers in client-server architecture:
  - ③ The presentation tier (the user interface)
  - ③ The business logic tier (processing)
  - ③ The data tier