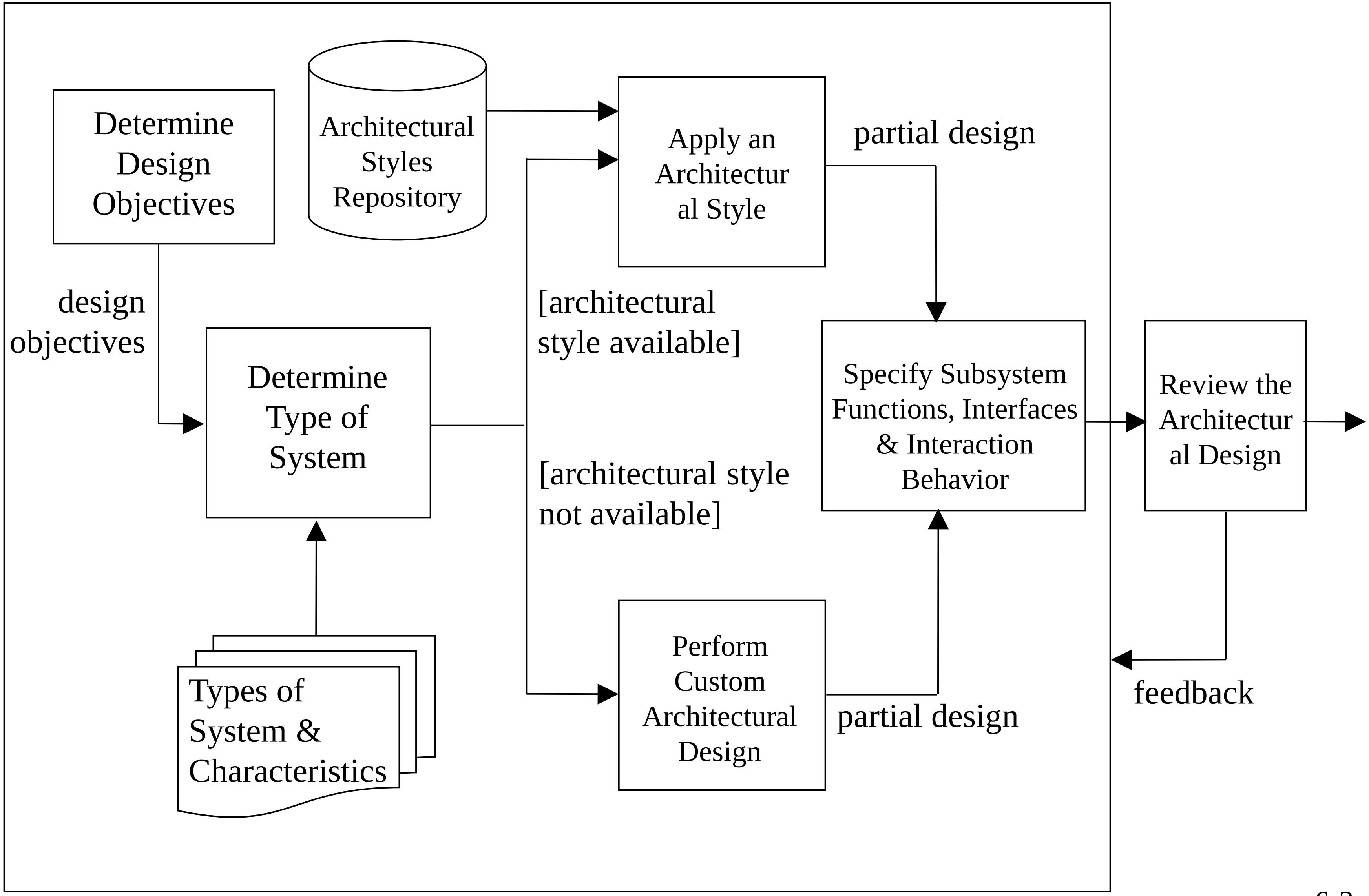
Object-Oriented Software Engineering: An Agile Unified Methodology by David Kung

Chapter 6: Architectural Design

Key Takeaway Points

- The software architecture of a system or subsystem refers to the style of design of the structure of the system including the interfacing and interaction among its subsystems and components.
- Different types of systems require different design methods and architectural styles.
- Guidelines for Architectural Design
  1. Adapt an architectural style when possible.
  2. Apply software design principles.
  3. Apply design patterns.
  4. Check against design objectives and design principles.
  5. Iterate the steps if needed.

Architectural Design Process


Determine Design Objectives
Architectural Styles Repository
Apply an Architectur al Style
partial design
design objectives
Determine Type of System
[architectural style available]
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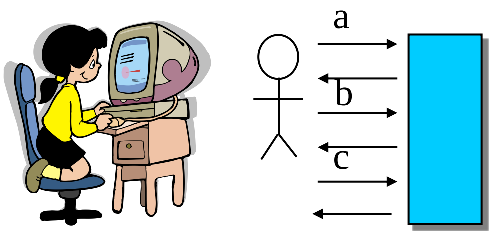
Specify Subsystem Functions, Interfaces & Interaction Behavior
Review the Architectur al Design
feedback
Types of System & Characteristics
Perform Custom Architectural Design
partial design

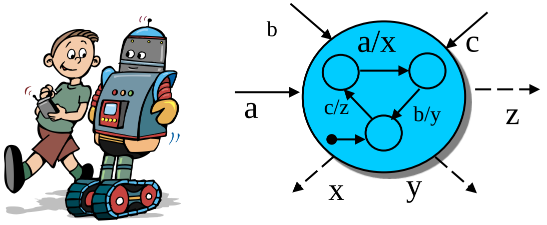
Architectural Design Considerations

- Ease of change and maintenance.
- Use of commercial off-the-shelf (COTS) parts.
- System performance – does the system require to process real-time data or a huge volume of transactions?
- Reliability.
- Security.
- Software fault tolerance.
- Recovery.

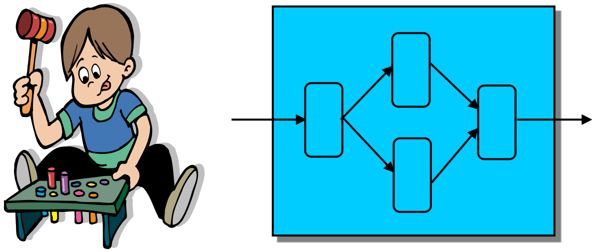
Four Common Types of Systems



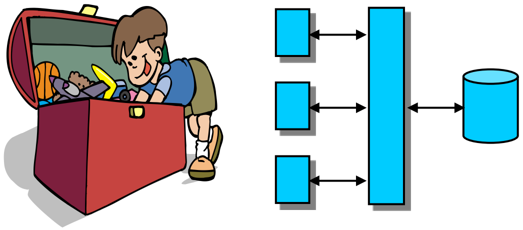
(a) Interactive subsystem



(b) Event-driven subsystem



(c) Transformational subsystem



(d) Database subsystem

Characteristics of Interactive Systems

- The interaction between system and actor consists of a relatively fixed sequence of actor requests and system responses.
- The system has to process and respond to each request.
- Often, the system interacts with only one actor during the process of a use case.
- The actor is often a human being although it can also be a device or another subsystem.
- The interaction begins and ends with the actor.
- The actor and the system exhibit a “client-server” relationship.
- System state reflects the progress of the business process represented by the use case.

Characteristics of Event-Driven Systems

- It receives events from, and controls external entities.
- It does not have a fixed sequence of incoming requests; requests arrive at the system randomly.
- It does not need to respond to every incoming event. Its response is state dependent—the same event may result in different responses depending on system state.
- It interacts with more than one external entity at the same time.
- External entities are often hardware devices or software components rather than human beings.
- Its state may not reflect the progress of a computation.
- It may need to meet timing constraints, temporal constraints, and timed temporal constraints.

Characteristics of Transformational Systems

- Transformational systems consist of a network of information-processing activities, transforming activity input to activity output.
- Activities may involve control flows that exhibit sequencing, conditional branching, parallel threads, synchronous and asynchronous behavior.
- During the transformation of the input into the output, there is little or no interaction between system and actor—it is a batch process.
- Transformational systems are usually stateless.
- Transformational systems may perform number crunching or computation intensive algorithms.
- The actors can be human beings, devices, or other systems.

Characteristics of Object-Persistence Systems

- It provides object storage and retrieval capabilities to other subsystems.
- It hides the implementation from the rest of the system.
- It is responsible only for storing and retrieving objects, and does little or no business processing except performance considerations.
- It is capable of efficient storage, retrieval, and updating of a huge amount of structured and complex data.

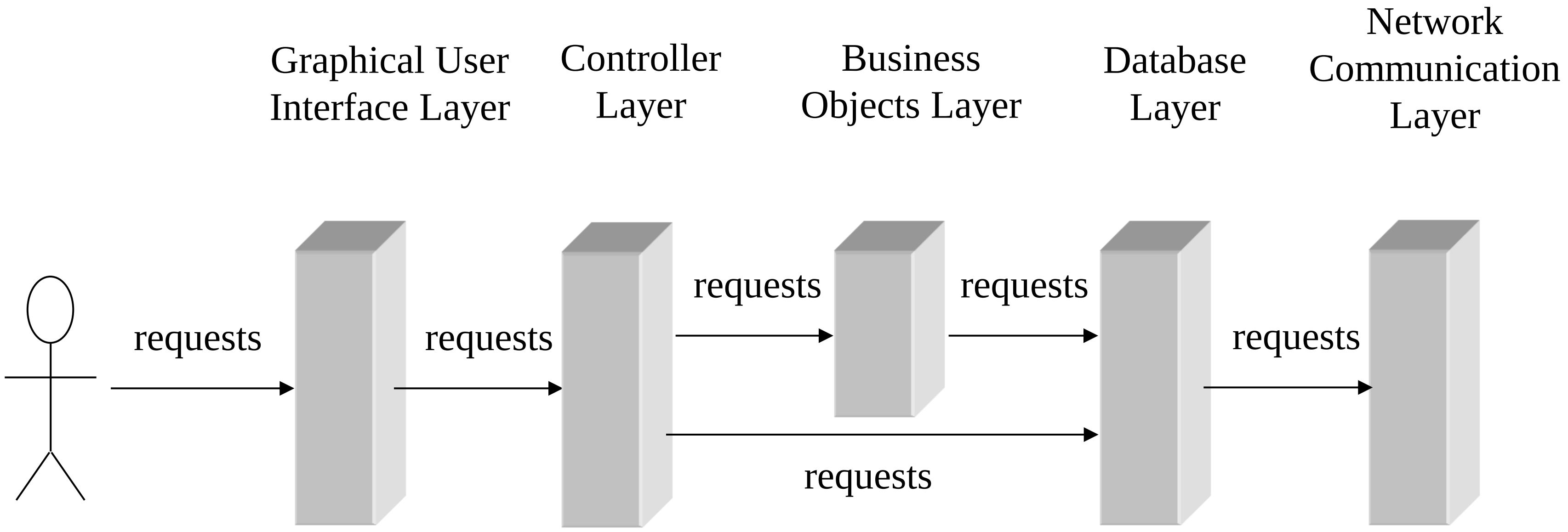
Class Discussion

- Find examples of
  - interactive systems
  - event-driven systems
  - transformational systems, and
  - object-persistence systems
- Show that the example systems possess the properties listed on previous slides, respectively.
- Why do different types of systems require different design methods?

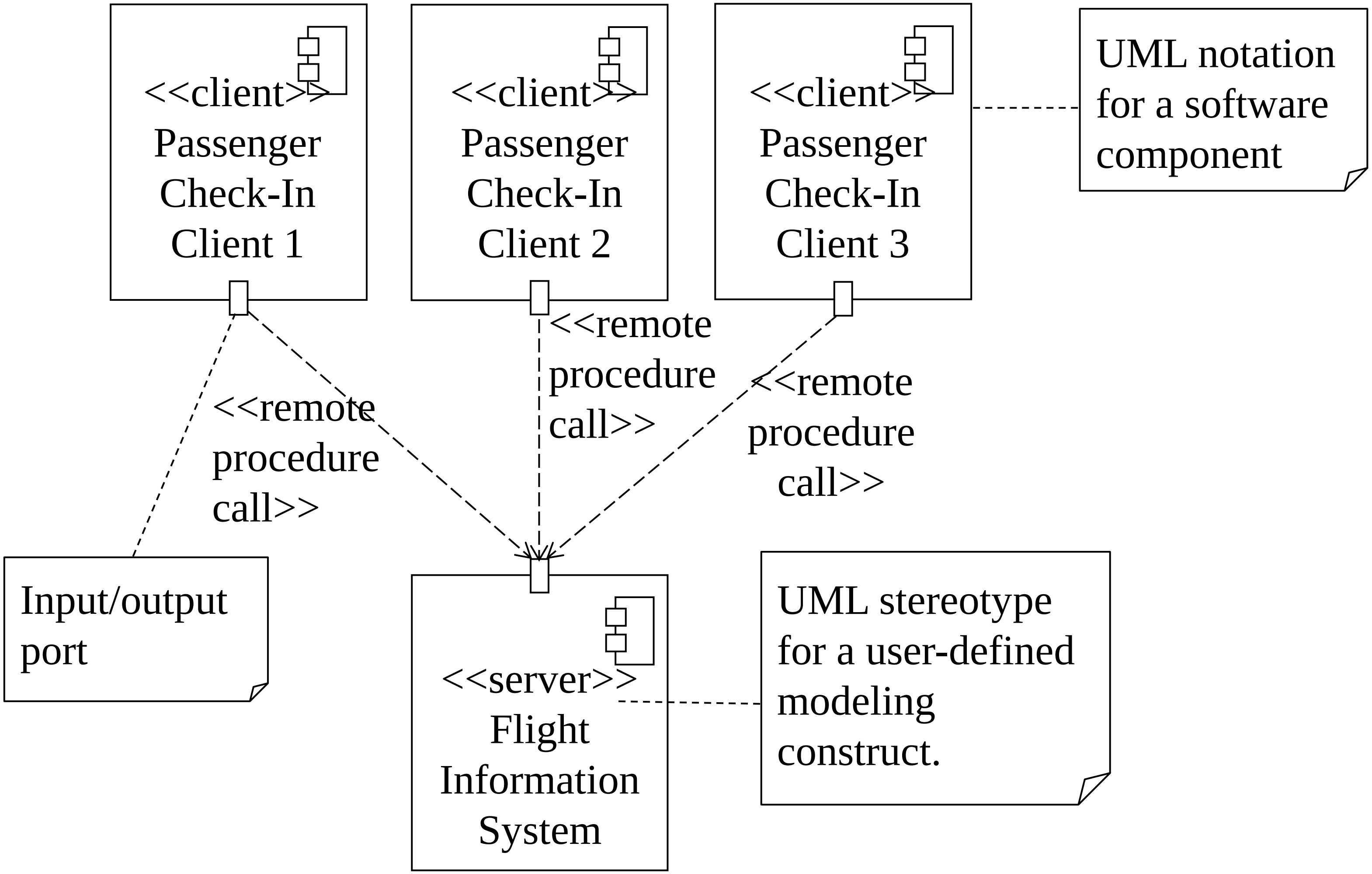
System Types and Architectural Styles

Type of System	Architectural Style
Interactive System	N-Tier
Event-Driven System	Event-Driven
Transformational System	Main Program and Subroutines
Object-Persistence Subsystem	Persistence Framework
Client-server	Client-server
Distributed, decentralized	Peer-to-peer
Heuristic problem-solving	Blackboard

N-Tier Architecture

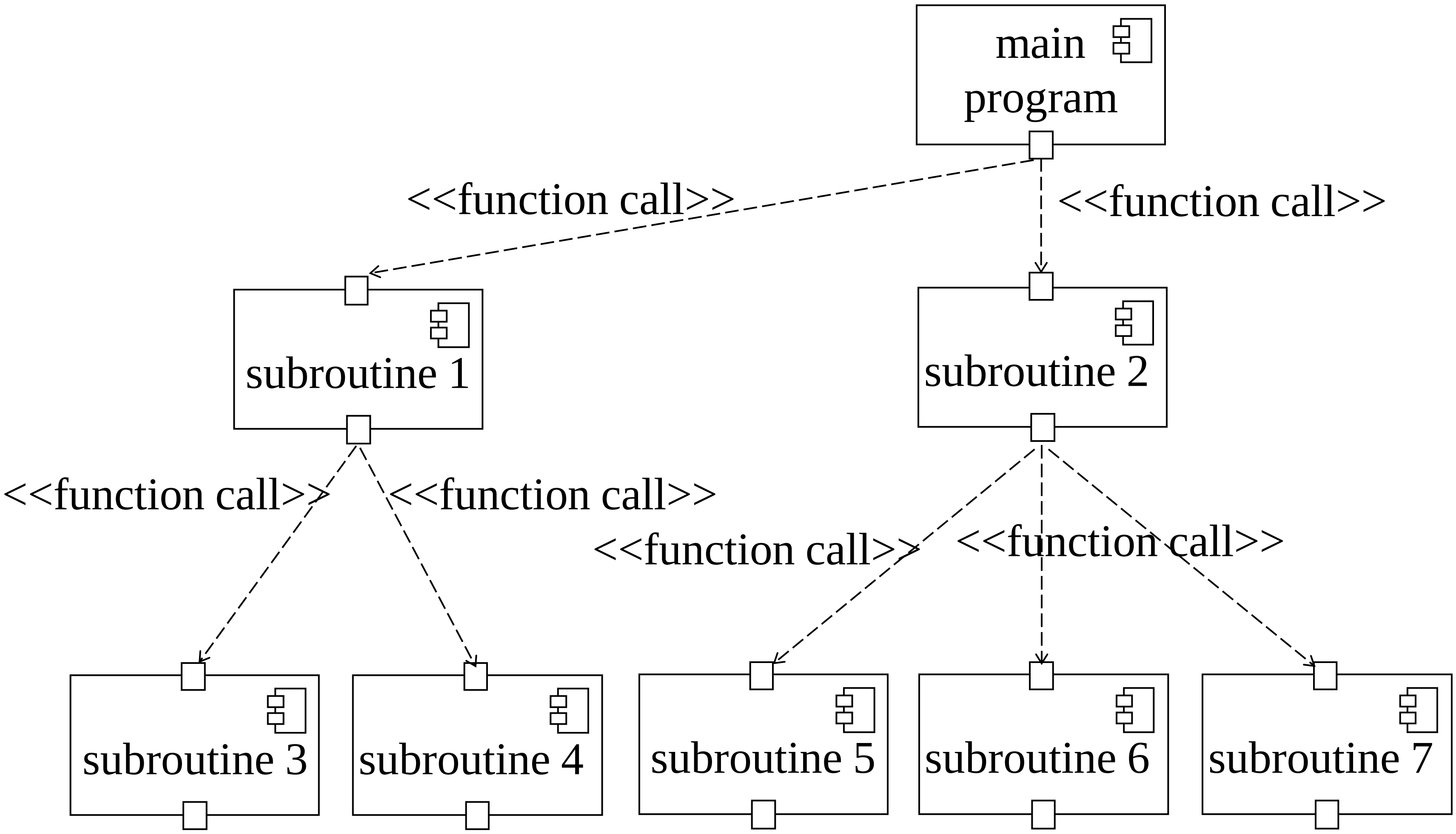


Client-Server Architecture

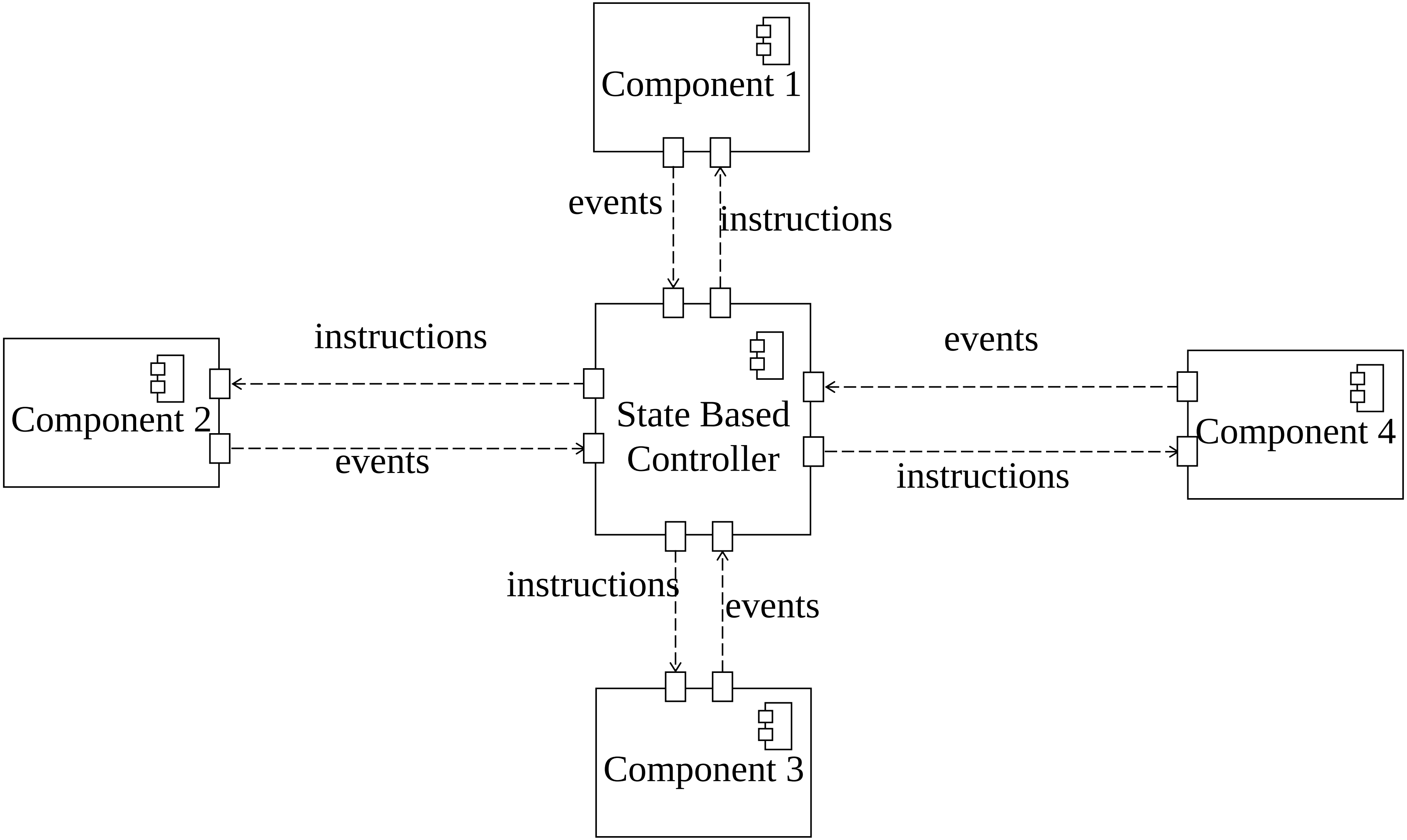


<<client>>
Passenger Check-In Client 1
<<client>>
Passenger Check-In Client 2
<<client>>
Passenger Check-In Client 3
UML notation for a software component
<<remote procedure call>>
<<remote procedure call>>
<<remote procedure call>>
Input/output port
<<server>>
Flight Information System
UML stereotype for a user-defined modeling construct.

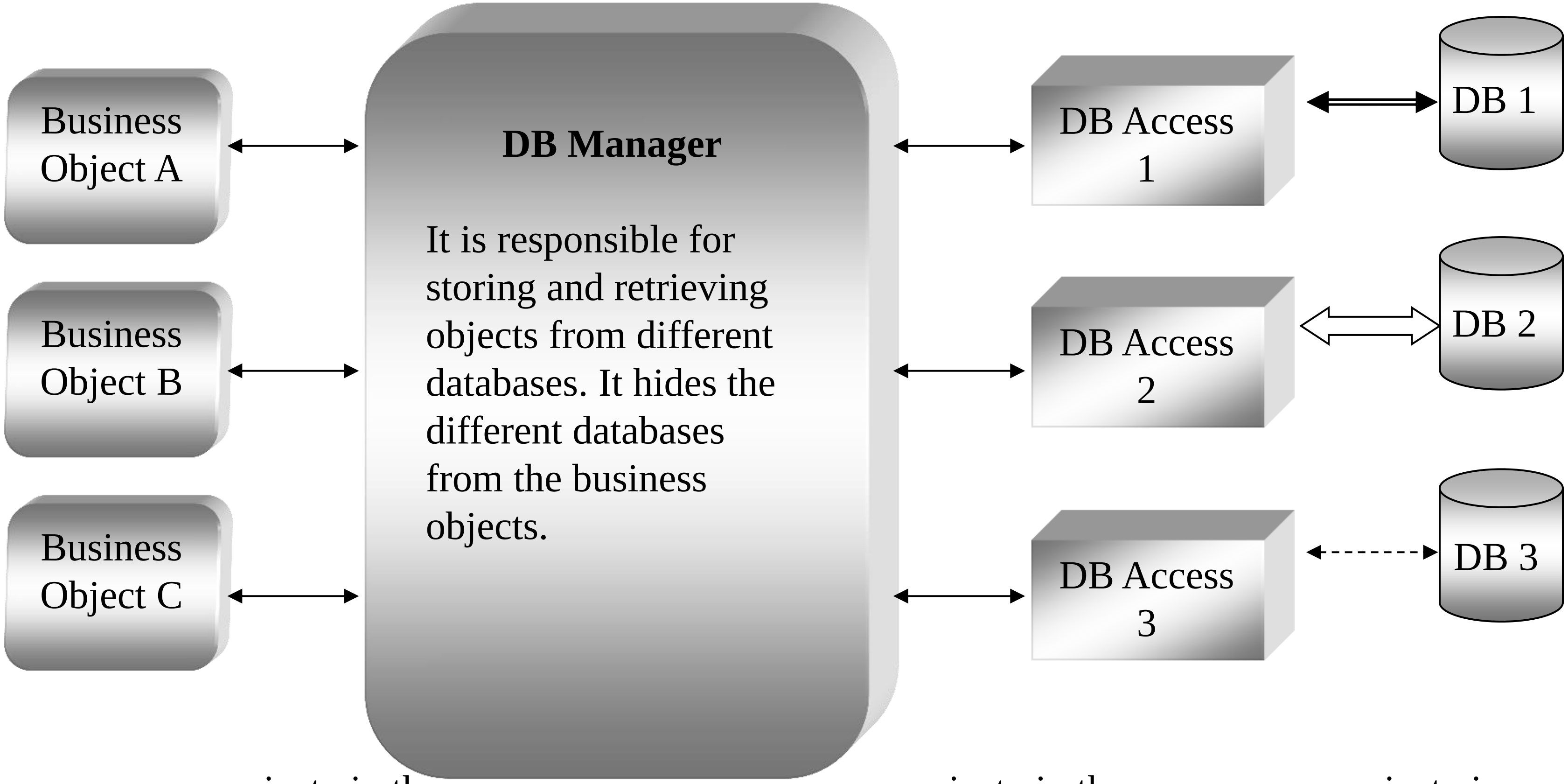
Main Program and Subroutine Architecture



Event-Driven Architecture



Object-Persistence Framework



Business Object A

Business Object B

Business Object C

DB Manager

It is responsible for storing and retrieving objects from different databases. It hides the different databases from the business objects.

DB Access 1

DB Access 2

DB Access 3

DB 1

DB 2

DB 3

communicate in the object-oriented implementation language

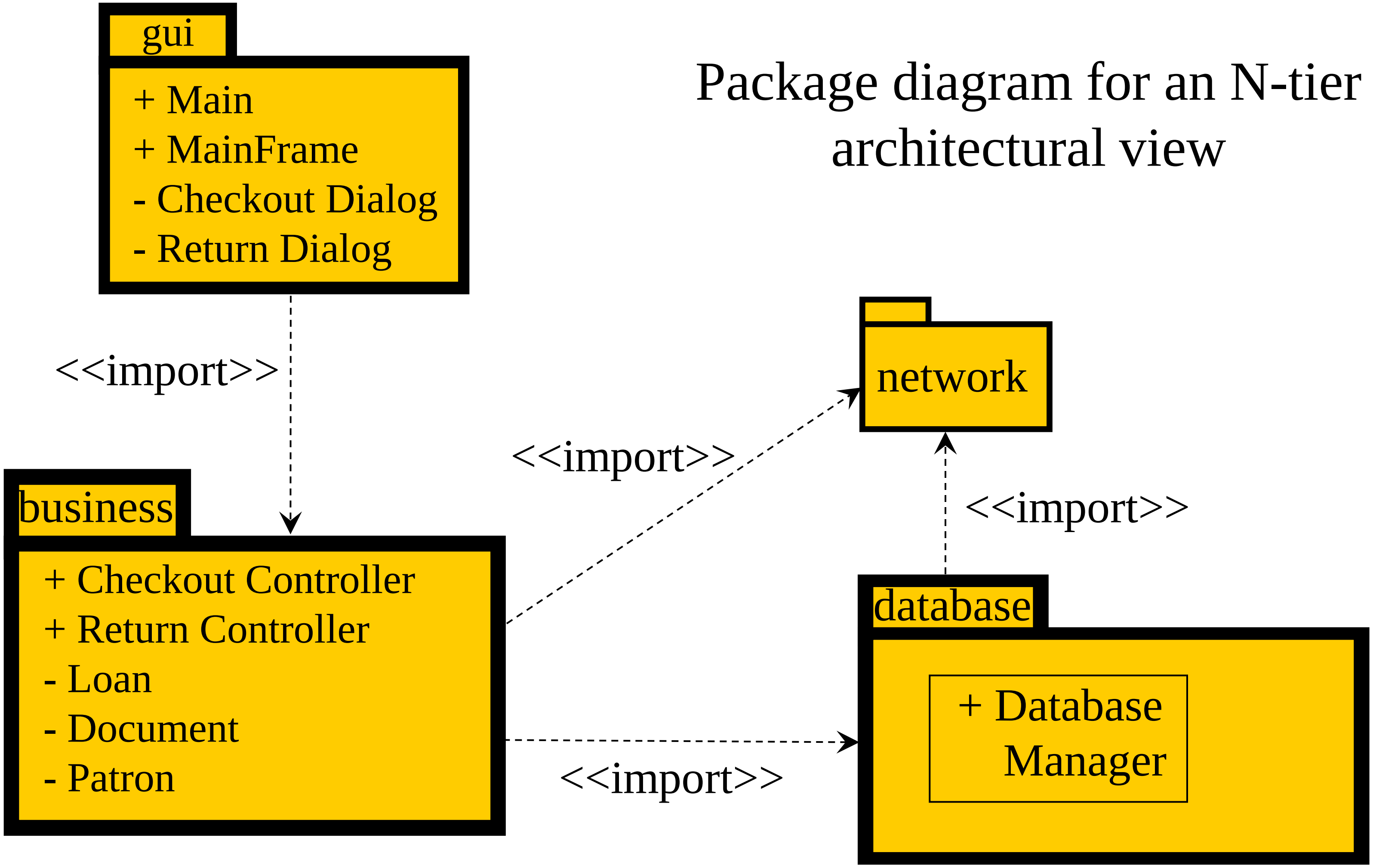
communicate in the object-oriented implementation language

communicate in a DBMS specific language

Perform Custom Architectural Design

- ***Remember***: Not all application systems development projects can reuse an existing architectural style.
- Custom architectural design may be required to meet the needs of a *specific* system.
- *Design patterns* and *COTS products* are useful for custom architectural design.

Architectural Style and Package Diagram



Package diagram for an N-tier architectural view

Legend: + public - private

Applying Software Design Principles

- Design for Change – design with a “built-in mechanism” to adapt to, or facilitate anticipated changes.
- Separation of Concerns – focusing on one aspect of the problem in isolation rather than tackling all aspects simultaneously.
- Information Hiding – shielding implementation detail of a module to reduce its change impact to other parts of the software system.

Applying Software Design Principles

- High Cohesion – achieving a higher degree of relevance of the functions of a module to the module’s core functionality.
- Low Coupling – reducing the run-time effect and change impact of a subsystem to other subsystems.
- KISS: Keep It Simple/Stupid – designing “stupid objects.”