

Chapter 9

■ Architectural Design

Slide Set to accompany

Software Engineering: A Practitioner's Approach, 7/e

by Roger S. Pressman

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Why Architecture?

The architecture is not the operational software. Rather, it is a representation that enables a software engineer to:

- (1) **analyze the effectiveness of the design** in meeting its stated requirements,
- (2) **consider architectural alternatives** at a stage when making design changes is still relatively easy, and
- (3) **reduce the risks** associated with the construction of the software.

Why is Architecture Important?

- Representations of software architecture are an enabler for communication between all parties (stakeholders) interested in the development of a computer-based system.
- The architecture highlights early design decisions that will have a profound impact on all software engineering work that follows and, as important, on the ultimate success of the system as an operational entity.
- Architecture “constitutes a relatively small, intellectually graspable mode of how the system is structured and how its components work together” [BAS03].

Architectural Descriptions

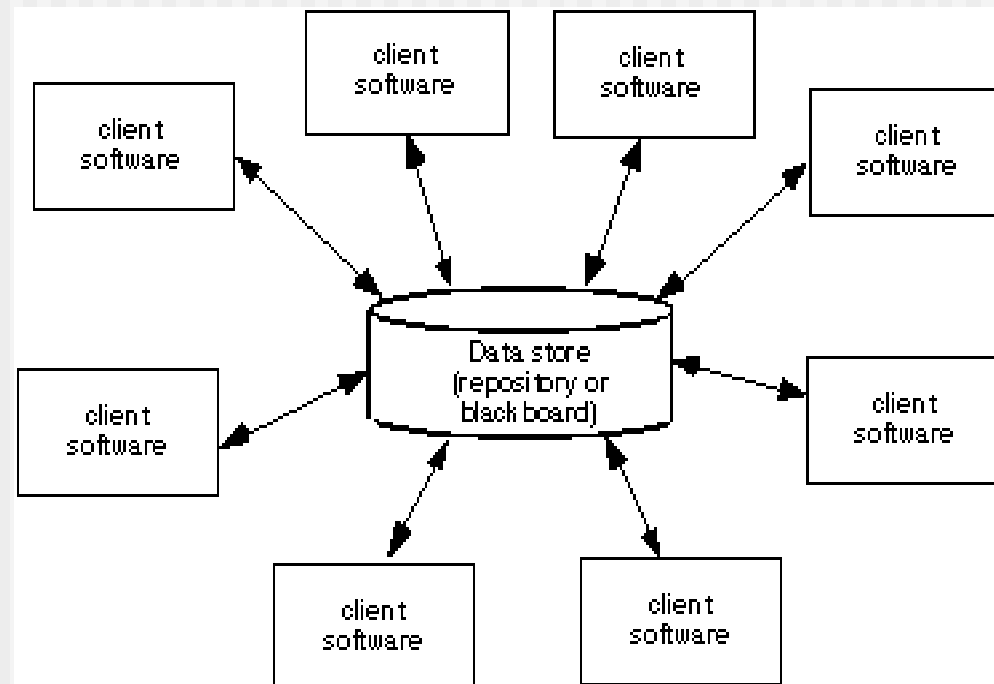
- The IEEE Computer Society has proposed IEEE-Std-1471-2000, *Recommended Practice for Architectural Description of Software-Intensive System*, [IEE00]
 - to establish a conceptual framework and vocabulary for use during the design of software architecture,
 - to provide detailed guidelines for representing an architectural description, and
 - to encourage sound architectural design practices.
- The IEEE Standard defines an *architectural description* (AD) as a “a collection of products to document an architecture.”
 - The description itself is represented using multiple views, where each *view* is “a representation of a whole system from the perspective of a related set of [stakeholder] concerns.”

Architectural Styles

Each style describes a system category that encompasses: (1) a **set of components** (e.g., a database, computational modules) that perform a function required by a system, (2) a **set of connectors** that enable “communication, coordination and cooperation” among components, (3) **constraints** that define how components can be integrated to form the system, and (4) **semantic models** that enable a designer to understand the overall properties of a system by analyzing the known properties of its constituent parts.

- Data-centered architectures
- Data flow architectures
- Call and return architectures
- Object-oriented architectures
- Layered architectures

Data-Centered Architecture



Layered Architecture

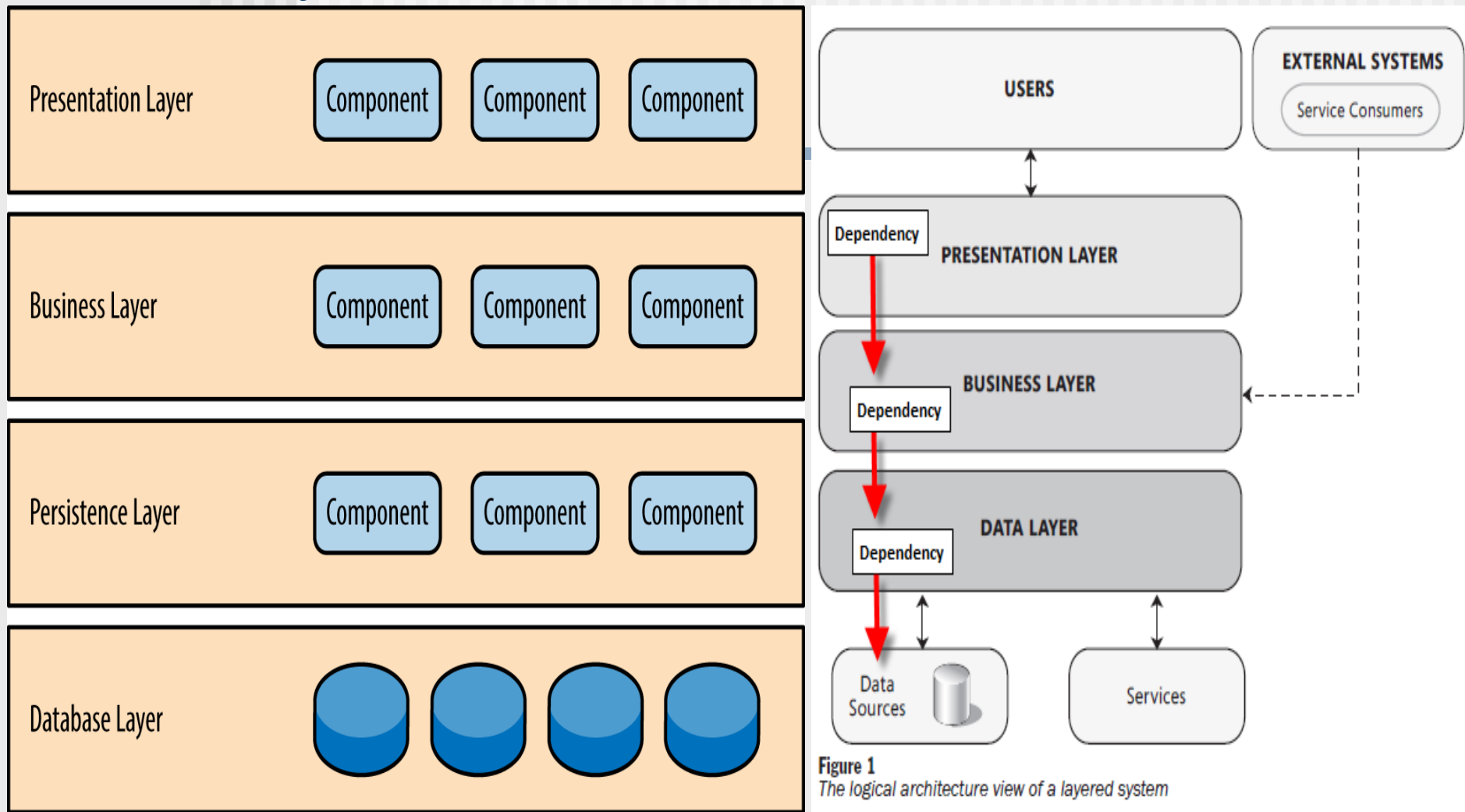
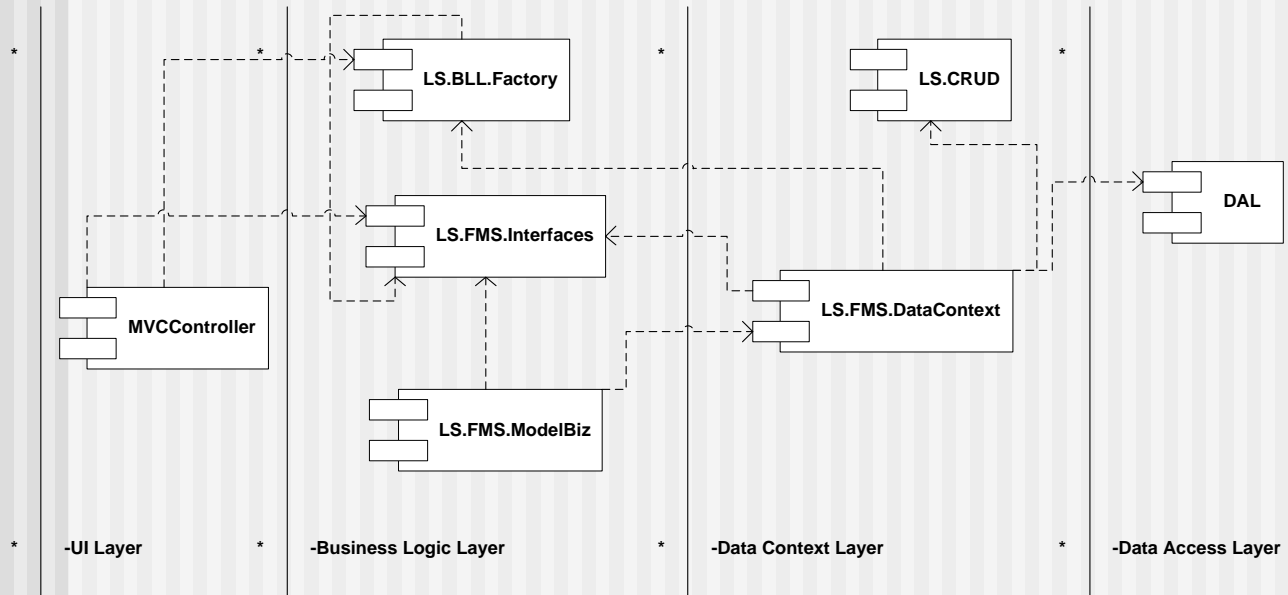
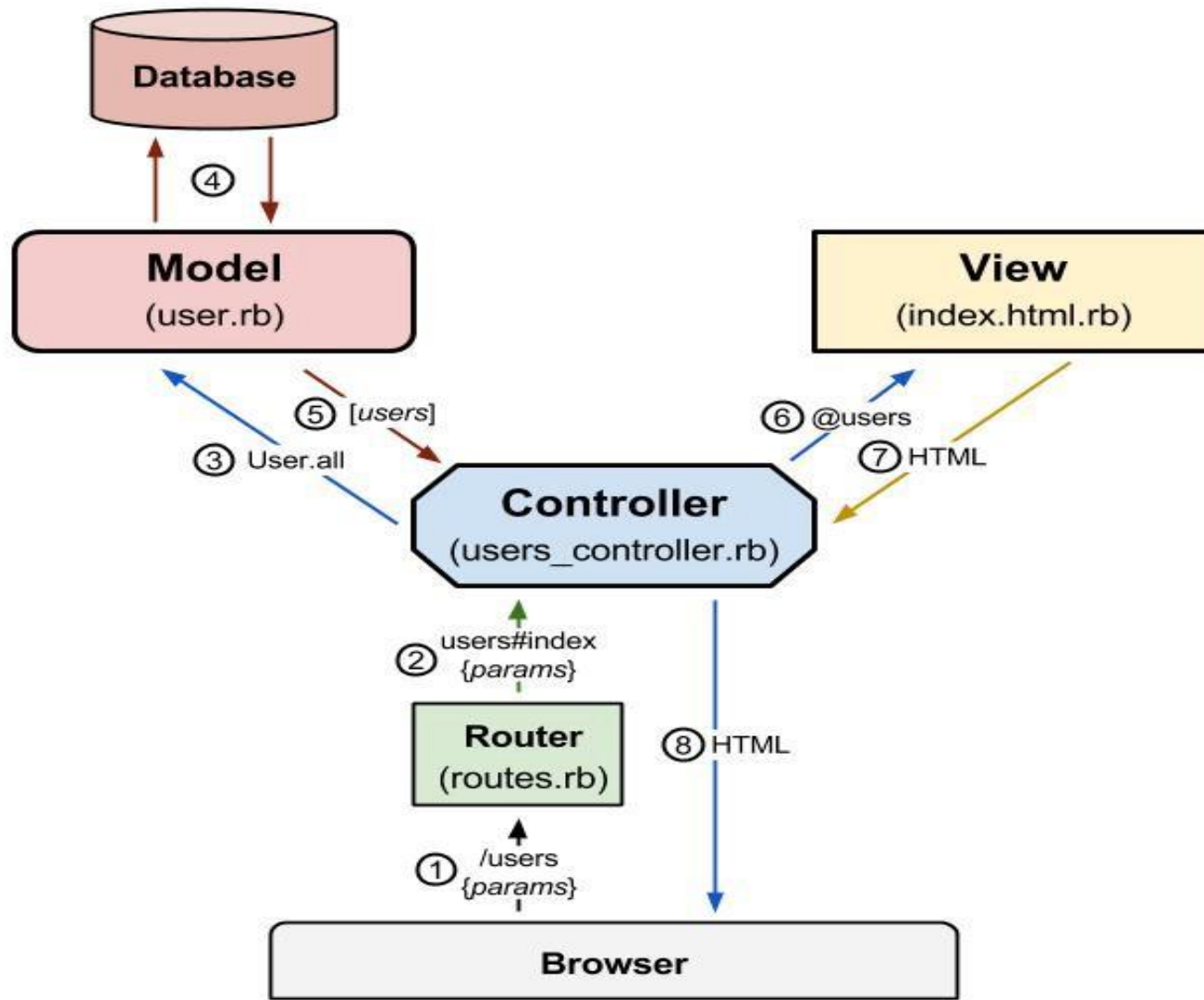


Figure 1
The logical architecture view of a layered system

Example



MVC Architecture



Architectural Design

- The software must be placed into context
 - the design should define the external entities (other systems, devices, people) that the software interacts with and the nature of the interaction
- A set of architectural archetypes should be identified
 - An *archetype* is an abstraction (similar to a class) that represents one element of system behavior
- The designer specifies the structure of the system by defining and refining software components that implement each archetype

Analyzing Architectural Design

1. Collect scenarios.
2. Elicit requirements, constraints, and environment description.
3. Describe the architectural styles/patterns that have been chosen to address the scenarios and requirements:
 - module view
 - process view
 - data flow view
4. Evaluate quality attributes by considered each attribute in isolation.
5. Identify the sensitivity of quality attributes to various architectural attributes for a specific architectural style.
6. Critique candidate architectures (developed in step 3) using the sensitivity analysis conducted in step 5.

Architectural Complexity

- the overall complexity of a proposed architecture is assessed by considering the *dependencies* between components within the architecture [Zha98]
 - *Sharing dependencies* represent dependence relationships among consumers who use the same resource or producers who produce for the same consumers.
 - *Flow dependencies* represent dependence relationships between producers and consumers of resources.
 - *Constrained dependencies* represent constraints on the relative flow of control among a set of activities.

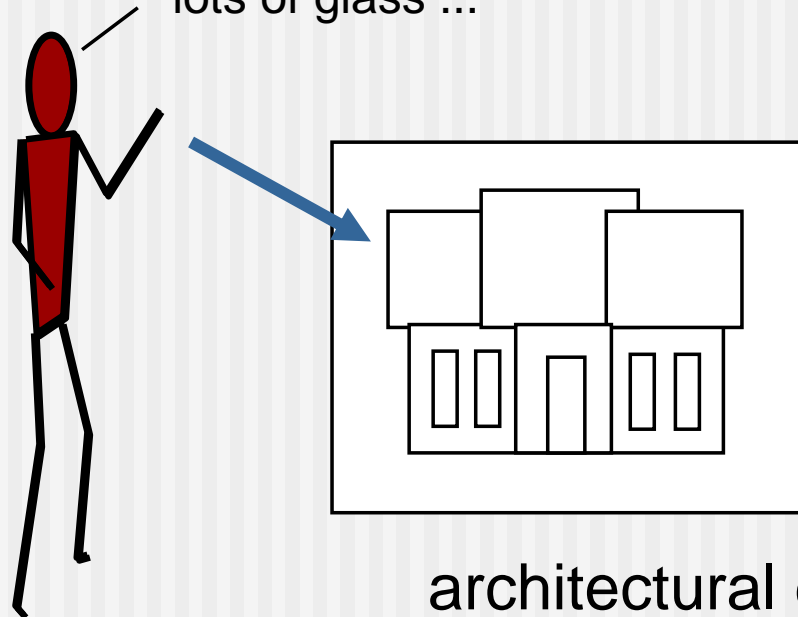
ADL

- *Architectural description language (ADL)* provides a semantics and syntax for describing a software architecture
- Provide the designer with the ability to:
 - decompose architectural components
 - compose individual components into larger architectural blocks and
 - represent interfaces (connection mechanisms) between components.

An Architectural Design Method

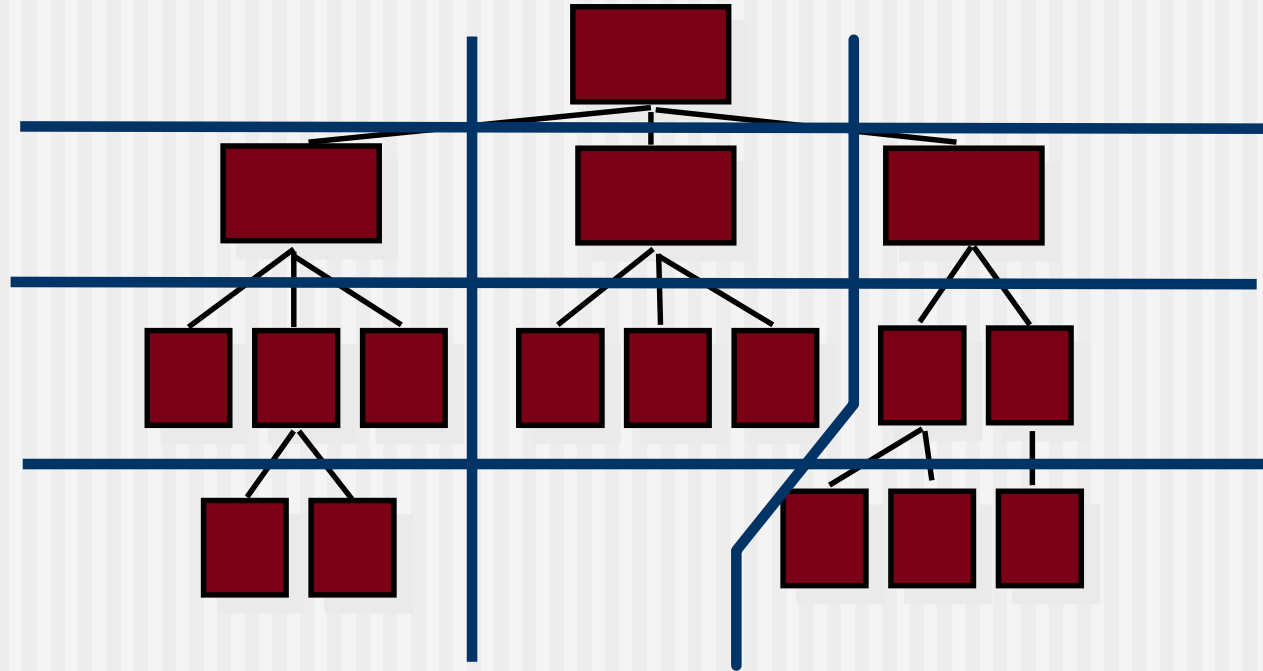
customer requirements

"four bedrooms, three baths,
lots of glass ..."



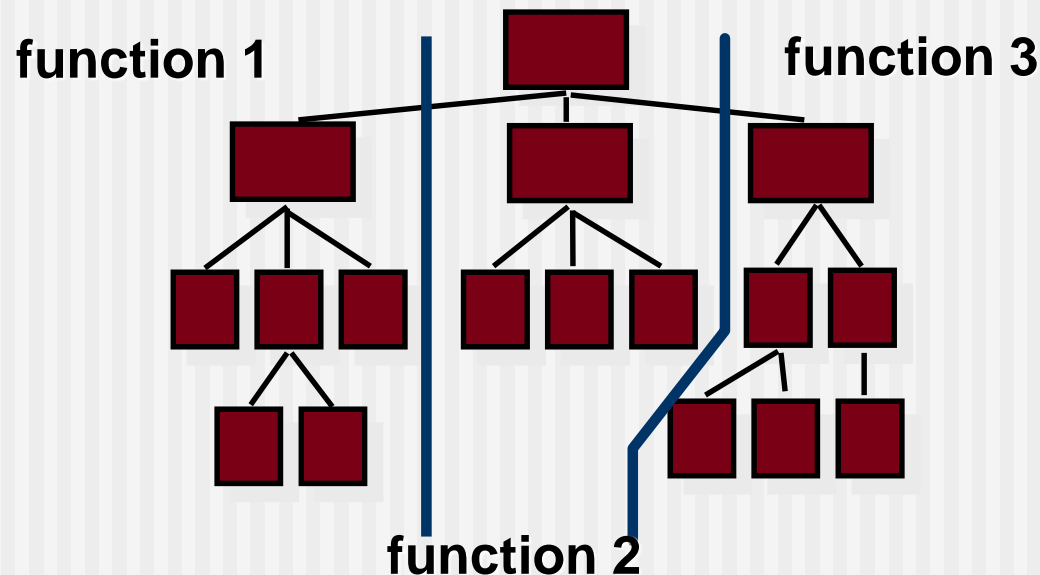
Partitioning the Architecture

- “horizontal” and “vertical” partitioning are required



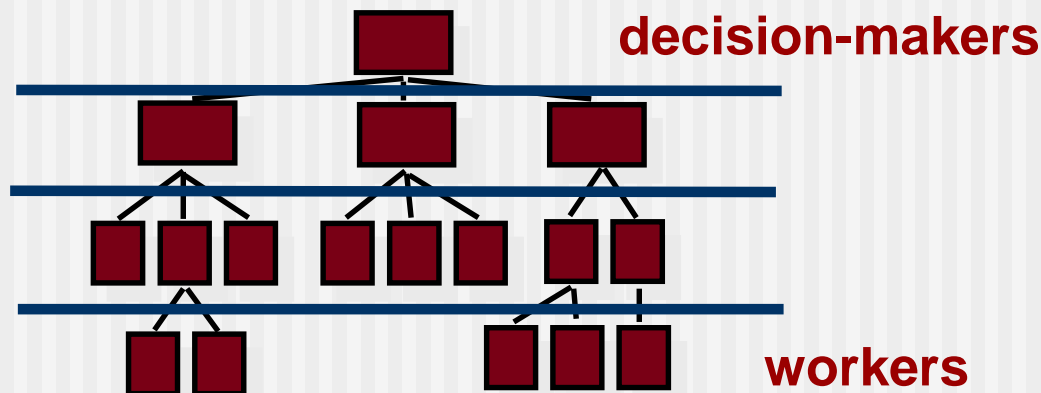
Horizontal Partitioning

- define separate branches of the module hierarchy for each major function
- use control modules to coordinate communication between functions



Vertical Partitioning: Factoring

- design so that decision making and work are stratified
- decision making modules should reside at the top of the architecture



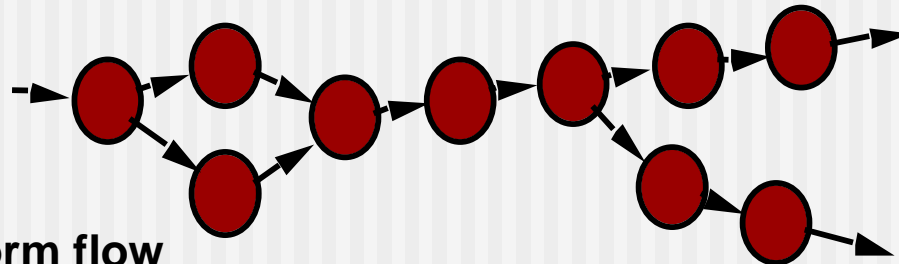
Why Partitioned Architecture?

- results in software that is easier to test
- leads to software that is easier to maintain
- results in propagation of fewer side effects
- results in software that is easier to extend

Structured Design

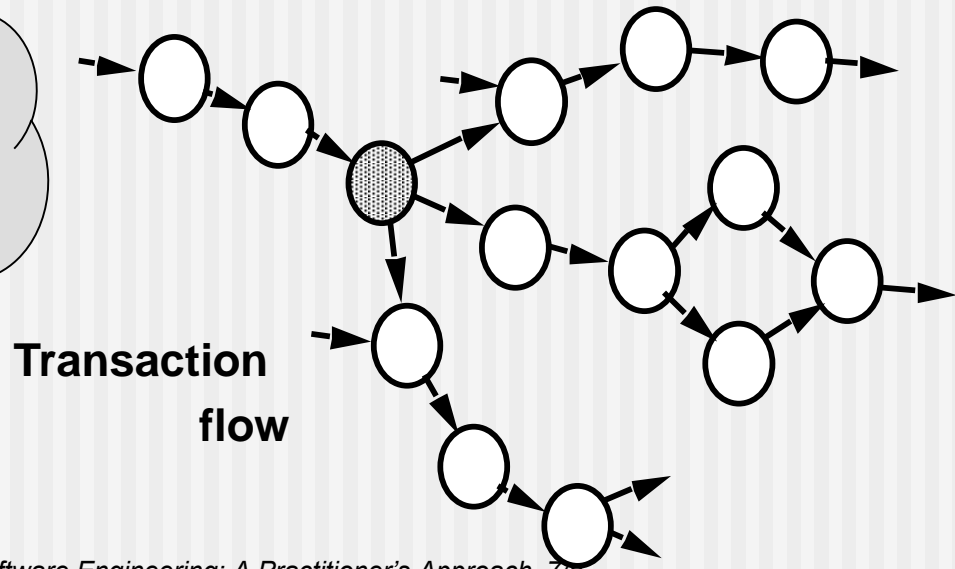
- **objective:** to derive a program architecture that is partitioned
- **approach:**
 - a DFD is mapped into a program architecture
 - the PSPEC and STD are used to indicate the content of each module
- **notation:** structure chart

Flow Characteristics



Transform flow

This edition of SEPA does not cover transaction mapping. For a detailed discussion see the SEPA website



Transaction flow