SS ZG653 (RL 2.1): Software Architecture

Software Structure and Views

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Views and Architectural Structure- Recap..

- Architecture is a set of Views
  - Each view represents certain architectural aspects of the system, created for a stakeholder
  - All the views combined together form the consistent whole
- A Structure is the underlying part of a view- essentially the set of elements, and their properties
  - A view corresponding to a structure is created by using these elements and their inter-relationships

Many Views exist

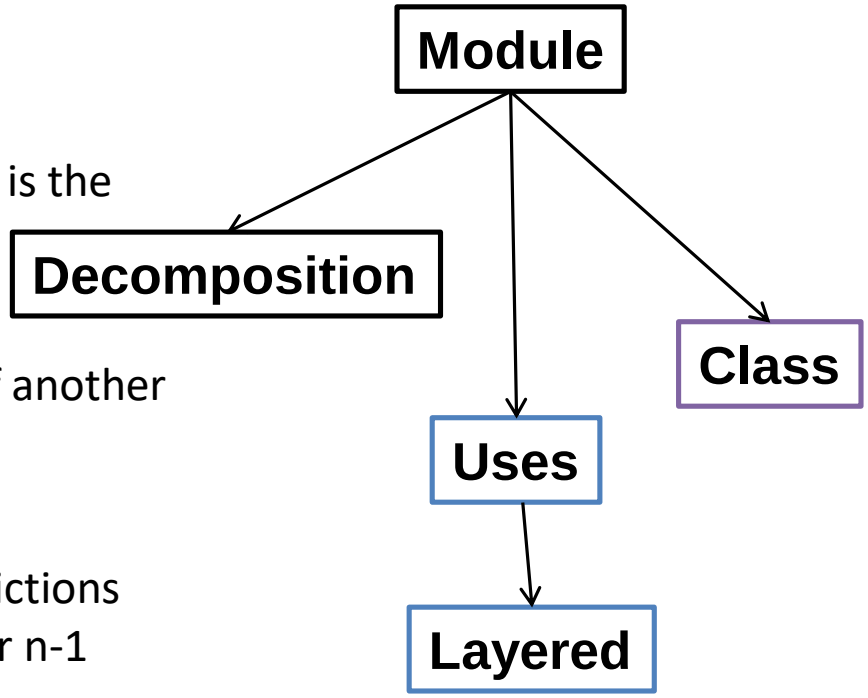
- Rational Unified Process/Kruchten 4+1 view (uses UML notations to describe these views)
- Siemens architecture framework- Conceptual, Module, Code, Execution views
- C4ISR framework – Operational, system and technical
- Classical approach – Data flow and control flow views
- RM-ODP (suitable for distributed system development) – 5 viewpoints

Three Structures will be covered

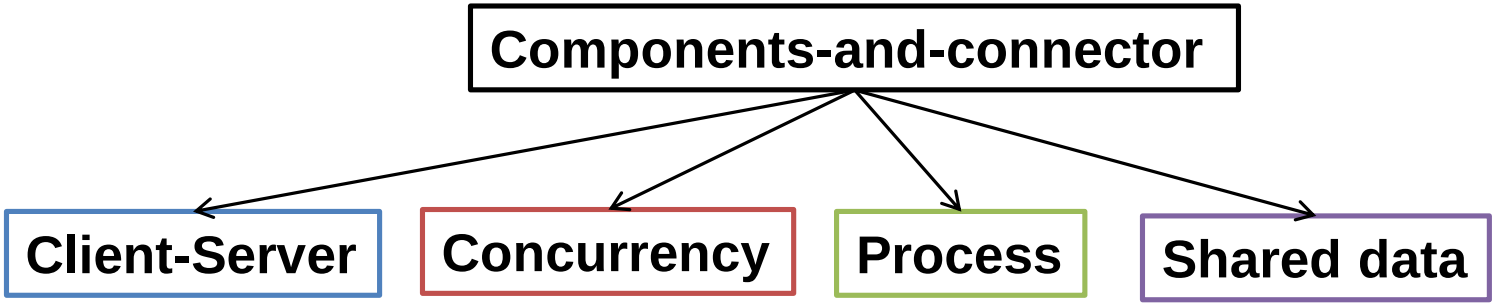
- Module Structure
  - How is the system to be structured as a set of functional units (modules)?
- Component-and-connector structures
  - Here component means a computation unit at runtime
  - Connector is the communication channel between the components
  - Models parallel execution
- Allocation structures
  - How is the system to relate to non-software structures in it's environment (CPU or cluster of CPUs, File Systems, Networks, Development Teams …)

Software Structures

- Module Structure includes
  - Decomposition
    - Sub-modules
    - All sub-mobiles combined together is the module
  - Uses
    - A modules uses the functionality of another module for its behavior
  - Layered
    - Hierarchical organization with restrictions that layer n uses the service of layer n-1
  - Class or generalization
    - Similar to OO concept

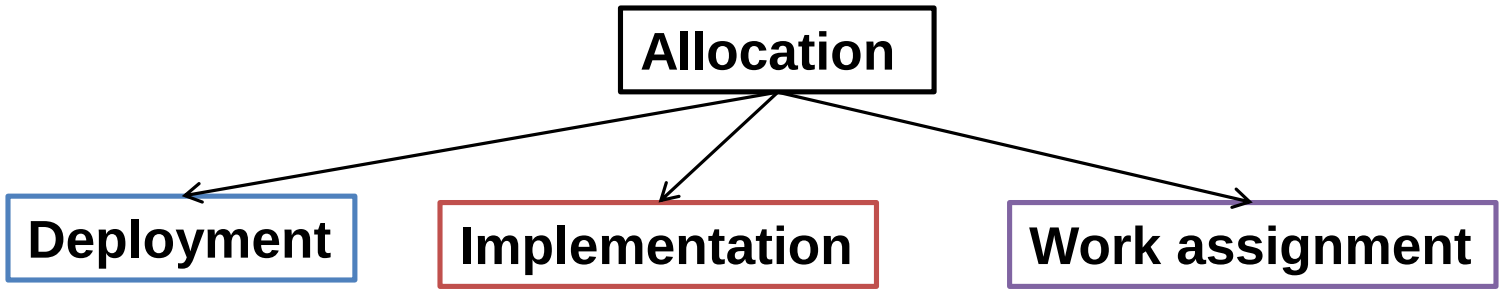


Component and Connectors



- Client-Server
  - Components are clients and servers and connectors are how they interact
- Concurrency
  - Opportunities of parallelism, where connectors are logical thread of execution dependency
- Process, or communicating processes
  - Components that are processes and connectors are how they communicate
- Shared data, or repository
  - Components have data store, and connectors describe how data is created, stored, retrieved

Allocation



- Deployment
  - Units are software (processes from component-connector) and hardware processors
  - Relation means how a software is allocated or migrated to a hardware
- Implementation
  - Units are modules (from module view) and connectors denote how they are mapped to files, folders
- Work assignment
  - Assigns responsibility for implementing and integrating the modules to people or team

Architectural Structures

Software Structure	Relations	Useful For
Decomposition	Is a sub-module of	Resource allocation and project structuring; information hiding, encapsulation; configuration control
Uses	Requires the correct presence of	Engineering subsets; engineering extensions
Layered	Requires the correct presence of; uses the services of; provides abstraction to	Incremental development; implementing systems on top of “virtual machines” portability
Class	Is an instance of; shares access methods of	In object-oriented design systems, producing rapid most-alike implementations from a common template

Architectural Structures

Software Structure	Relations	Useful For
Client-Server	Communicates with; depends on	Distributed operation; separation of concerns; performance analysis; load balancing
Process	Runs concurrently with; may run concurrently with; excludes; precedes; etc.	Scheduling analysis; performance analysis
Concurrency	Runs on the same logical thread	Identifying locations where resource contention exists, where threads may fork, join, be created or be killed
Shared Data	Produces data; consumes data	Performance; data integrity; modifiability

Architectural Structures

Software Structure	Relations	Useful For
Deployment	Allocated to; migrates to	Performance, availability, security analysis
Implementation	Stored in	Configuration control, integration, test activities
Work assignment	Assigned to	Project management, best use of expertise, management of commonality

Which Structure to Choose?

- Many opinions exist
- We will consider 4+1 view. This has been institutionalized as Rational Unified Process of Architecture description