CISC 322

Software Architecture

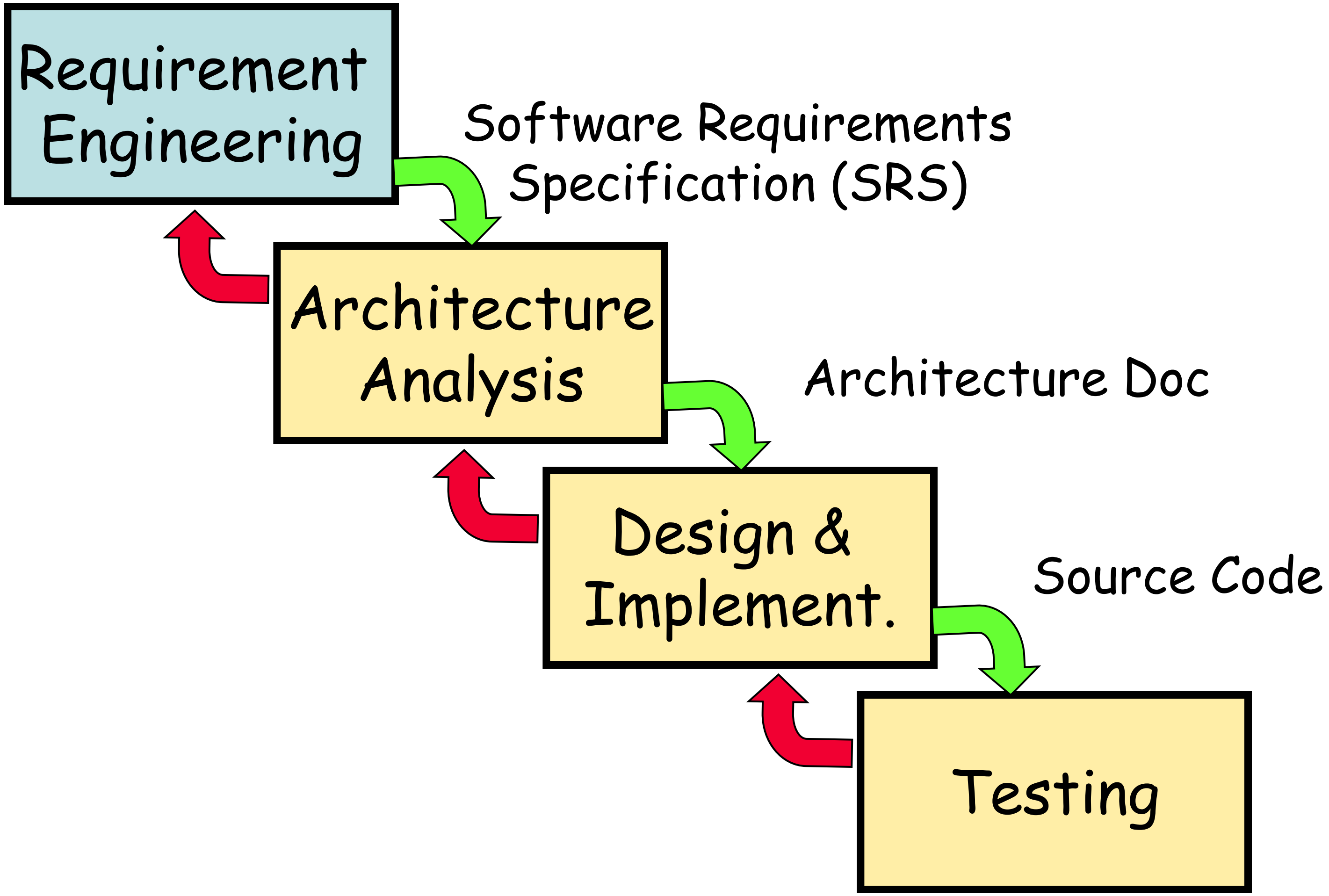
Lecture 02:

Course Overview

Emad Shihab

Adapted from: Ahmed E. Hassan

Waterfall Development Process



Course Overview

- Requirements
- Architectural Styles
- Architecture Recovery
- Design Patterns
- Project Scheduling
- Software Estimation

Requirements

Where Do Requirements Come From?

- Requirements come from users and stakeholders who have demands/needs
- An analyst/requirement engineer:
  - Elicits these demands/needs (raw requirements)
  - Analyzes them for consistency, feasibility, and completeness
  - Formulates them as requirements and write down a specification
  - Validates that the gathered requirements reflect the needs/demands of stakeholders:
    - *Yes, this is what I am looking for.*
    - *This system will solve my problems.*

Types of Requirements

- **Functional Requirements**
  - Specify the function of the system
  - F(input, system state) → (output, new state)
- **Non-Functional Requirements (Constraints)**
  - **Quality Requirements**
    - Specify how well the system performs its intended functions
    - Performance, Usability, Maintenance, Reliability, Portability
  - **Managerial Requirements**
    - When will it be delivered
    - Verification (how to check if everything is there)
    - What happens if things go wrong (legal responsibilities)
  - **Context / Environment Requirements**
    - Range of conditions in which the system should operate

Architectural Styles

Architectural Styles of Software Systems

- **Architectural Style**
  - Form of structure, e.g.,
    - "Pipes" between components, or
    - "Layered" system, or
    - "Bulletin board" system
  - *Analogy: Style of a building*
- It determines:
  - the vocabulary of components and connectors that can be used in instances of that style
  - a set of constraints on how they can be combined. For example, one might constrain:
    - the topology of the descriptions (e.g., no cycles).
    - execution semantics (e.g., processes execute in parallel).

Determining an Architectural Style

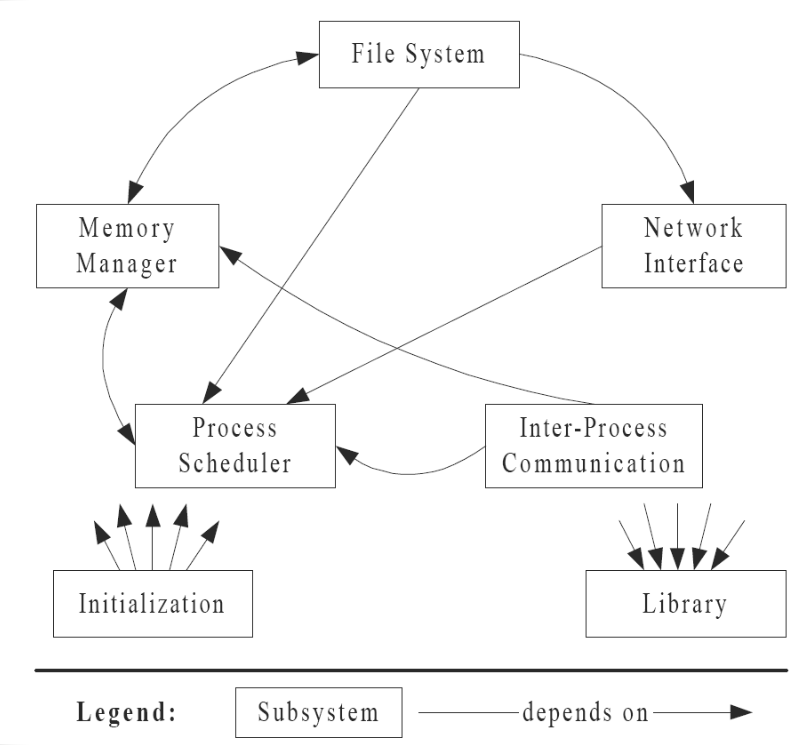
- We can understand what a style is by answering the following questions:
  - What is the **structural pattern**? (i.e., components, connectors, constraints)
  - What are the **essential invariants** of the style?
  - What are some **common examples of its use**?
  - What are the **advantages** and **disadvantages** of using that style?
  - What are some of the **common specializations** of that style?

Architecture Recovery

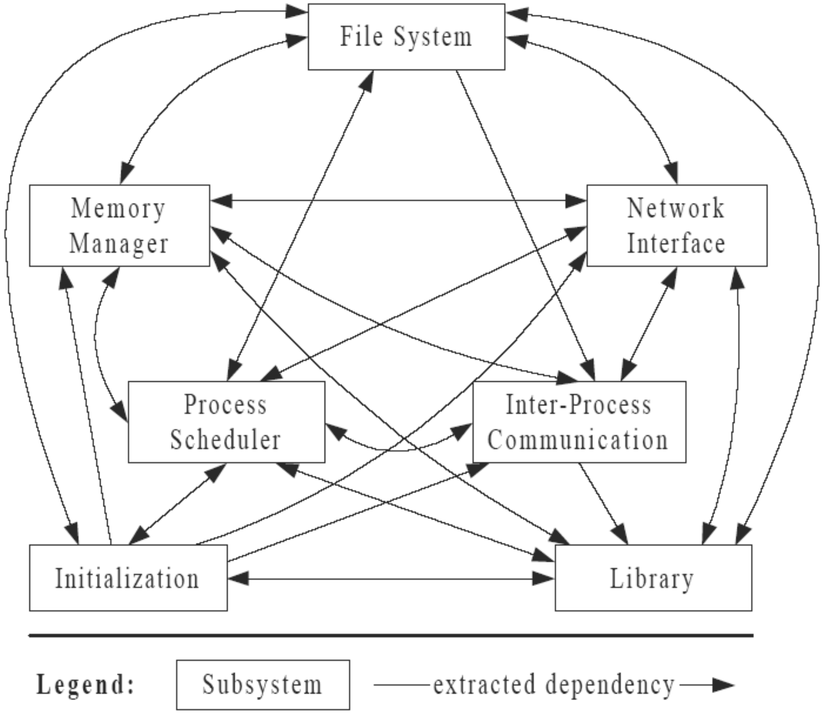
Architecture Terminology

- **Conceptual Software Architecture**
  - Abstract structure: Large piece of software with many parts and interconnections
  - *Analogy: Blueprint of house*
- **Concrete Software Architecture**
  - Actual structure: Large piece of software with many parts and interconnections
  - *Analogy: Actual structure of house*
- **Reference Architecture**
  - General architecture for an application domain
  - *Example: Common structure for compilers or for operating systems*
  - *Analogy: Typical architecture of a house*

Linux Architecture



Conceptual Architecture



Concrete Architecture

Design

Architecture vs. Design

- **Architecture**
  - Structure of system (components and connectors)
  - High level and hard to change (better get it right!)
  - Concerned with technical and non technical requirements (e.g., Security, Legal, Outsourcing)
  - Makes sense for systems with MLOCs
  - Very early in life cycle
- **Design**
  - Inner structure of the components
  - Low level (information hidding and interfaces help it change)
  - Mostly technical concerns
  - Makes sense for systems with KLOCs
  - Late in life cycle

Design Patterns

- Good designers know not to solve every problem from first principles. They reuse solutions.
- Practitioners do not do a good job of recording experience in software design for others to use.

Design Patterns (Cont'd)

- A **Design Pattern** systematically names, explains, and evaluates an important and recurring design.
- We describe a set of well-engineered design patterns that practitioners can apply when crafting their applications.

Project Scheduling

Project

- A project is
  - a temporary endeavour undertaken to create a "unique" product or service
- A project is composed of
  - a number of related activities that are directed to the accomplishment of a desired objective
- A project starts when
  - at least one of its activities is ready to start
- A project is completed when
  - all of its activities have been completed

Project plan

- A project plan is a schedule of activities indicating
  - The start and stop for each activity. The start and stop of each activity should be visible and easy to measure
  - When a resource is required
  - Amount of required project resources

Project Planning

- Managers should consider:
  - Resource availability
  - Resource allocation
  - Staff responsibility
  - Cash flow forecasting
- Mangers need to monitor and re-plan as the project progresses towards its pre-defined goal

Cost Estimation

Software cost estimation

- Predicting the resources required for a software development process

Topics covered

- Productivity
- Estimation techniques
- Algorithmic cost modelling
- Project duration and staffing

Course Webpage

- Schedule
- Project Deliverables
  - Assignment 0 (last year’s projects)
  - Assignments 1,2,3 (marking scheme)
  - Peer evaluation

Next Class…

- Tuesday Sept 14, BIOSCI 1120
- Will cover:
  - Requirements
  - Quality Attributes