

# Software Design and Architecture

QUALITY ATTRIBUTES AND TRADE-OFFS IN  
SOFTWARE ARCHITECTURE

# Quality Attributes

- ▶ Quality attributes are closely related to architectural styles.
- ▶ Each architectural style supports some quality features.
- ▶ An architectural style encapsulates tradeoffs among many conflicting quality attributes.

## List of sample quality attributes:

- ▶ Performance
- ▶ Reliability
- ▶ Portability
- ▶ Usability
- ▶ Security
- ▶ Testability
- ▶ Maintainability
- ▶ Adaptability
- ▶ Modifiability
- ▶ Scalability.

# Types of Quality Attributes

- ▶ Implementation Attributes (not observable at runtime)
- ❖ Interoperability
- ❖ Maintainability & extensibility
- ❖ Testability
- ❖ Portability
- ❖ Scalability
- ❖ Flexibility

# Types of Quality Attributes

- ▶ Runtime attributes (observable at runtime)
  - ❖ Availability
  - ❖ Security
  - ❖ Performance
  - ❖ Usability

# Types of Quality Attributes

- ▶ Business attributes
- ❖ Time to market
- ❖ Cost
- ❖ Lifetime

# Tradeoff

Tradeoff between system performance

- ▶ Time
- ▶ Resource
- ▶ System Reliability
- ▶ Availability.

## ▶ **Tradeoff between scalability and performance.**

For example, one typical approach to increase the scalability of a service is to replicate servers. To ensure consistency of all servers (e.g., to make sure that each server has the same logically consistent data), performance of the whole service is sacrificed.

- ▶ **Tradeoff between space and time.** For example, to increase the time efficiency of a hash table means to decrease its space efficiency.
- ▶ **Tradeoff between reliability and performance.** For instance, Java programs are well protected against buffer overflow due to its security measures such as boundary check on arrays. Such reliability features come at the cost of time efficiency, compared with the simpler and faster C language which provides the “dangerous” yet efficient pointers.

# Architectural Styles

- ▶ An architectural style (also known as “architecture pattern”) abstracts the common properties of a family of similar designs.
- ▶ An architectural style contains a set of rules, constraints, and patterns of how to structure a system into a set of elements and connectors.
- ▶ It governs the overall structure design pattern of constituent element types and their runtime interaction of flow control and data transfer.

The key components of an architectural style are listed as follows:

- ▶ Elements that perform functions required by a system
- ▶ Connectors that enable communication, coordination, and cooperation among elements
- ▶ Constraints that define how elements can be integrated to form the system
- ▶ Attributes that describe the advantages and disadvantages of the chosen structure

# Types of Architectural Styles

- ▶ MVC, PAC (Interaction Oriented)
- ▶ Repository, Blackboard (Data Centered)
- ▶ Object-Oriented
- ▶ Layered, Virtual Machine, Main/Subroutine (Hierarchy)
- ▶ Multi-tier, Client/Server (Distributed)
- ▶ Event-Based, Buffered Messaging (Asynchronous Communication)

# Summary

- Describe the quality attributes
- Describe trade-offs in software architecture
- Software Architectural Styles