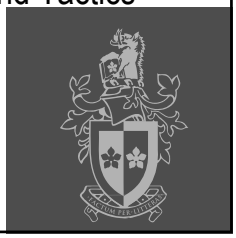
SWINBURNE UNIVERSITY OF TECHNOLOGY

SWE30003
Software Architectures and Design

Lecture 9

Architecture Design Case Study and Tactics



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Logistical matters

- Weekly submissions – A & Q
  - Week 2: 214 and 202 out of 270;
  - Week 3: 222 and 215 out of 270;
  - Week 4: 202 and 199 out of 266;
  - Week 5: 217 and 210 out of 265;
  - Week 6: 213 and 211 out of 265;
  - Week 7: 194 and 186 out of 265;
  - Week 8: 196 and 190 out of 263;
  - Week 9: 192 and 191 out of 263;

  No late submission, hurdle requirement
- Assignment 2: close soon
- Assignment 3 to be released

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Question to Answer – Week 8

Would a messenger application be considered as peer to peer or client/server architecture considering communication is generally direct to the other peer once the IP address of a remote user has been identified by the server? Justify your answer.

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Principal References – this week

- Len Bass, Paul Clements, and Rick Kazman, *Software Architecture in Practice (4th Edition)*, Addison-Wesley, 2021, Chapters 3 – 14. *OR*
- Len Bass, Paul Clements, and Rick Kazman, *Software Architecture in Practice (3rd Edition)*, Addison-Wesley, 2013, Chapters 4 – 13.

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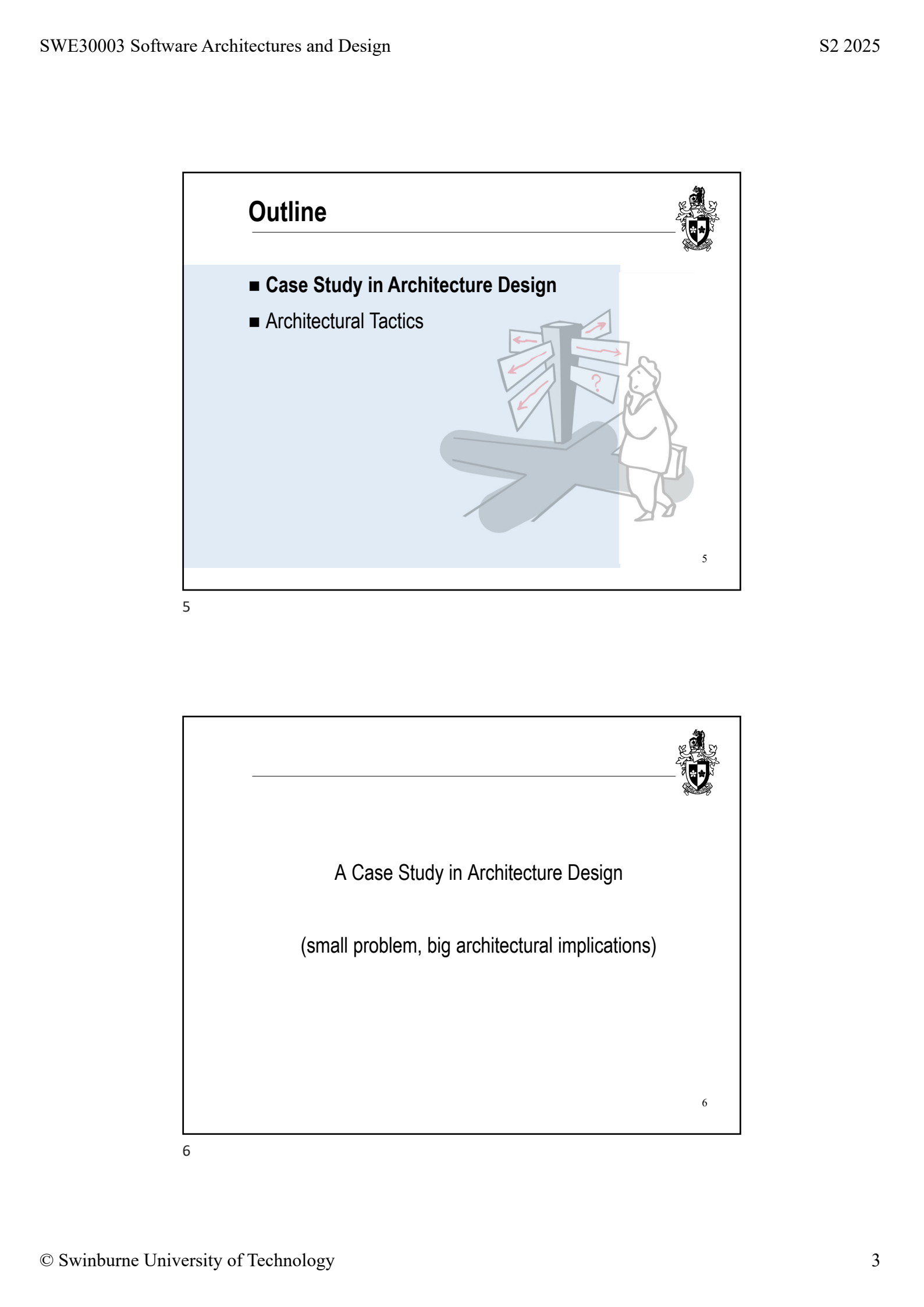
Outline



- **Case Study in Architecture Design**
- Architectural Tactics

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A Case Study in Architecture Design

(small problem, big architectural implications)

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Keywords in Context

"The Key Word in Context (KWIC) index system accepts an ordered set of lines, each line is an ordered set of words, and each word is an ordered set of characters. Any line may be "circularly shifted" by repeatedly removing the first word and appending it at the end of the line. The KWIC index system outputs a listing of all circular shifts of all lines in alphabetical order [ignoring case]."

David Parnas, *On the Criteria to be Used in Decomposing Systems into Modules*, 1972

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Keywords in Context (cont.)

Input:

Software Architectures and Design
Keyword in Context

Output:

and Design Software Architectures
Architectures and Design Software
Context Keyword in
Design Software Architectures and
in Context Keyword
Keyword in Context
Software Architectures and Design

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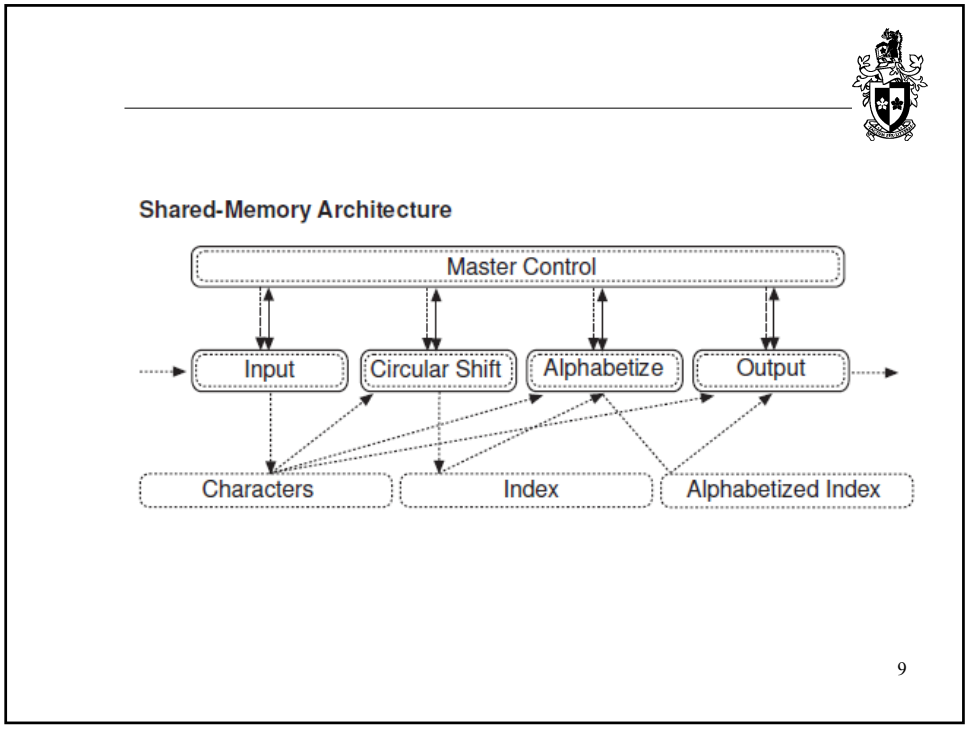
Shared-Memory Architecture
Master Control
Input
Circular Shift
Alphabetize
Output
Characters
Index
Alphabetized Index
9

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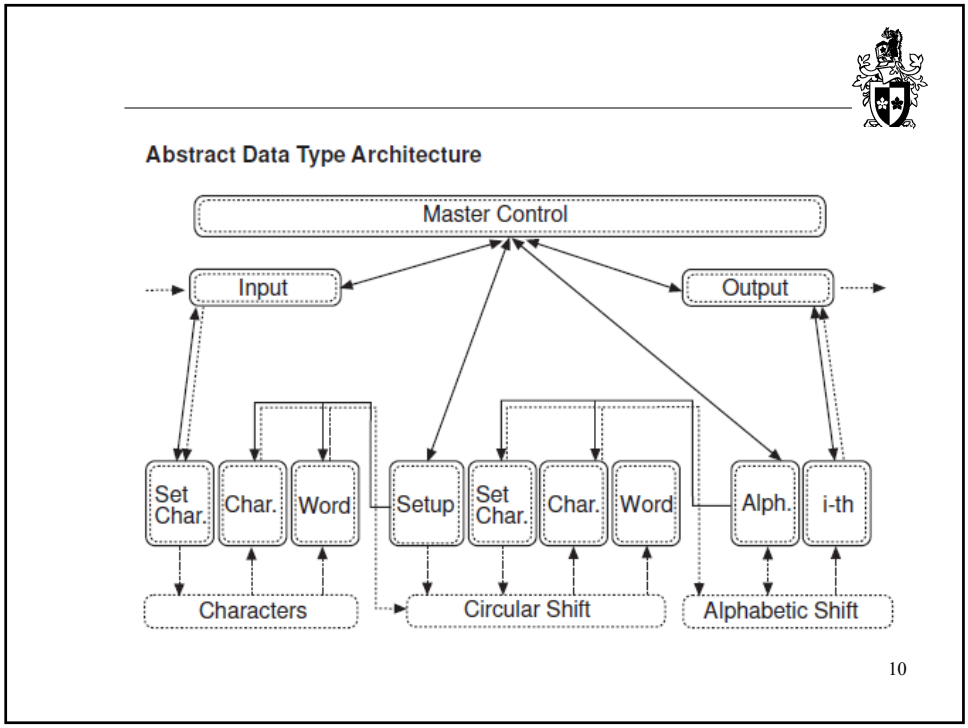
Abstract Data Type Architecture
Master Control
Input
Output
Set Char.
Char.
Word
Setup
Set Char.
Char.
Word
Alph.
i-th
Characters
Circular Shift
Alphabetic Shift
10

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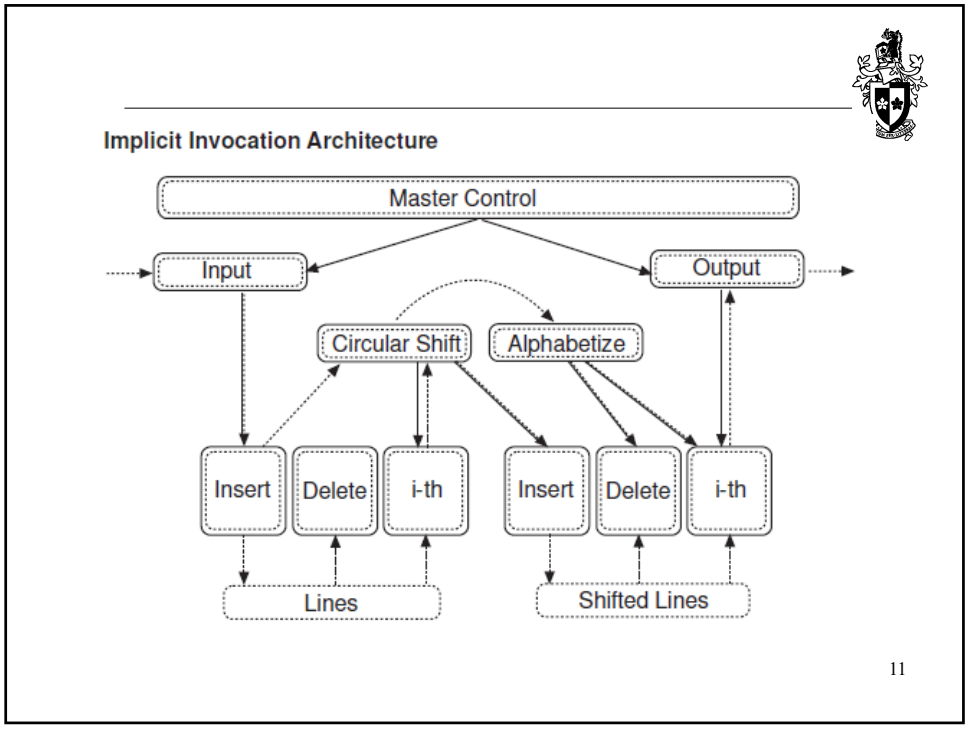
Implicit Invocation Architecture
Master Control
Input
Output
Circular Shift
Alphabetize
Insert
Delete
i-th
Insert
Delete
i-th
Lines
Shifted Lines
11

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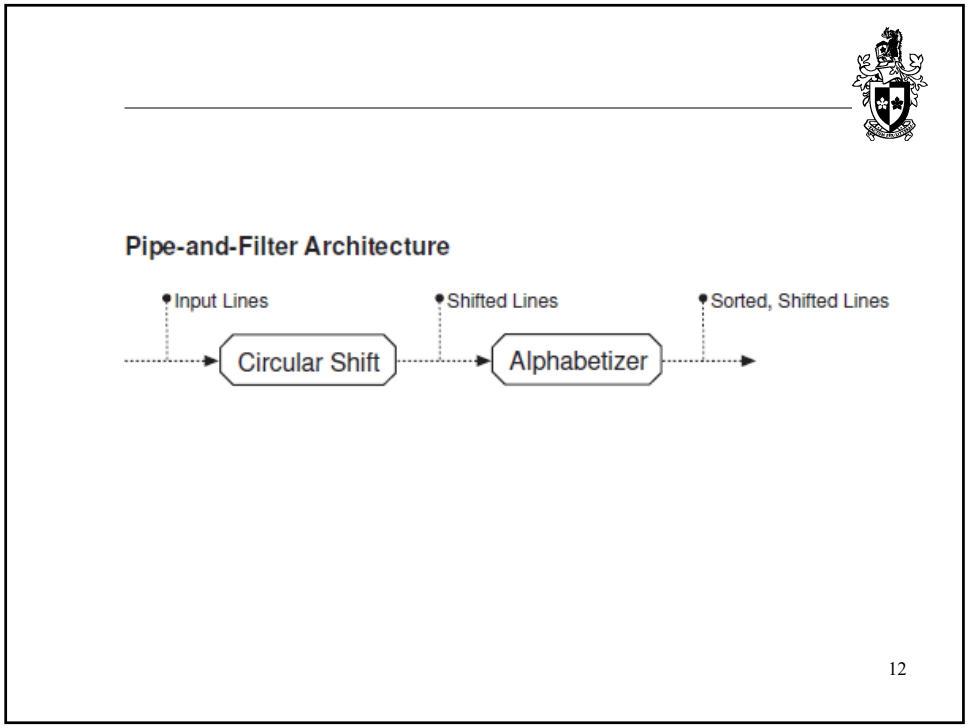
Pipe-and-Filter Architecture
Input Lines
Shifted Lines
Sorted, Shifted Lines
Circular Shift
Alphabetizer
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Keyword in Context - Forces

- Changes in processing scheme
  - Eager vs. lazy processing
- Changes in (internal) data representation
  - ☞ *Important if large input data sets need to be processed!*
- Enhancements to functionality
  - *Omit "noise words" (e.g., 'a', 'an', 'the') in a circular shift*
- Performance
  - Time complexity vs. space complexity
- Reuse

☞ *Identify a solution and analyze it using the above criteria.*

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Architecture & quality

- KWIC – Shared Memory
  - + performance
  - - modifiability
- KWIC – ADT
  - + modifiability
  - - performance (speed and space)

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Architecture & quality (ctd)

- KWIC – Implicit Invocation
  - + extentensibility
  - - control (order …)
  - - space
- KWIC – PnF
  - + intuitive/understanding
  - + reuse
  - - - performance (speed and space)

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Break

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Outline

- Case Study in Architecture Design
- **Architectural Tactics**

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Architectural Tactics

An *architectural tactic* is a transformation on an architecture or a change to the input to a system that results in the improvement of a specific quality attribute(s).

Examples:

- *Information hiding* is a transformation on an architecture that improves modifiability
- *Redundancy* is a transformation on an architecture that improves availability, reliability, and/or performance.
- *Reducing the arrival rate of requests* is a change to the input of a system that improves latency/response time.

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Tactics - Scalability

Scalability:

- *Scale-up (vertical scaling)*
- *Scale-out (horizontal scaling)*
- *Moderation of the arrival rate of requests*

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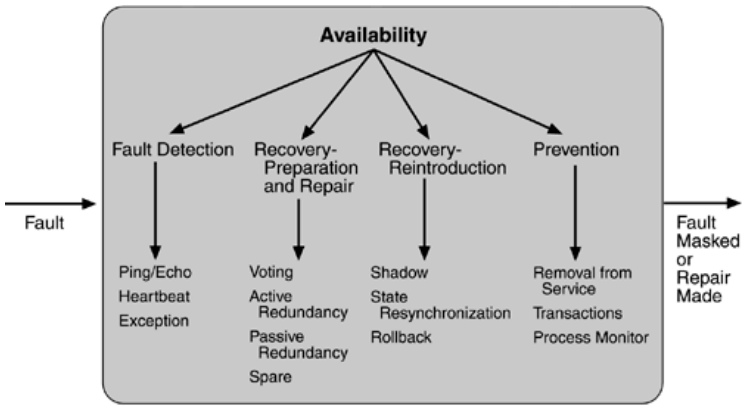
Tactics - Availability



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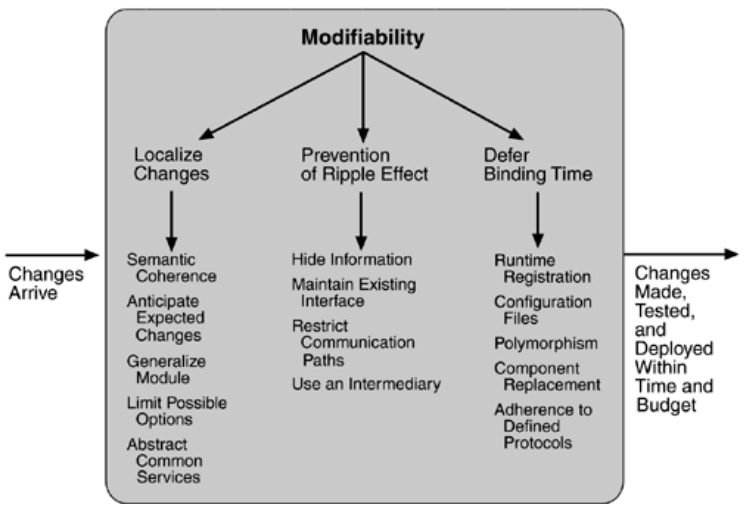
Tactics - Modifiability



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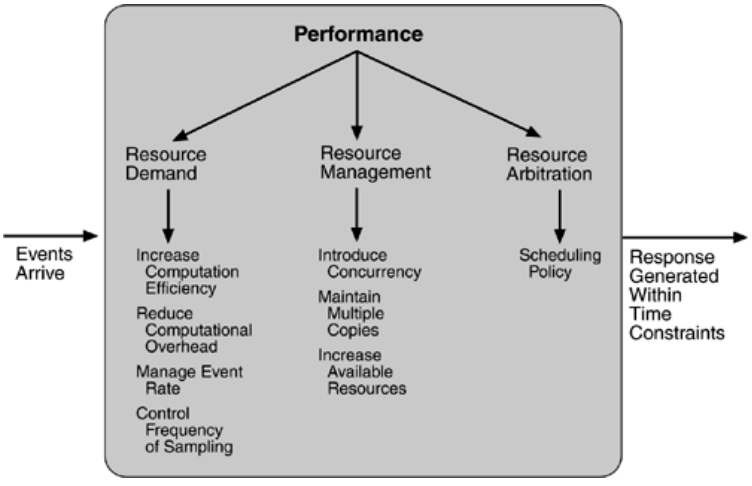
Tactics - Performance



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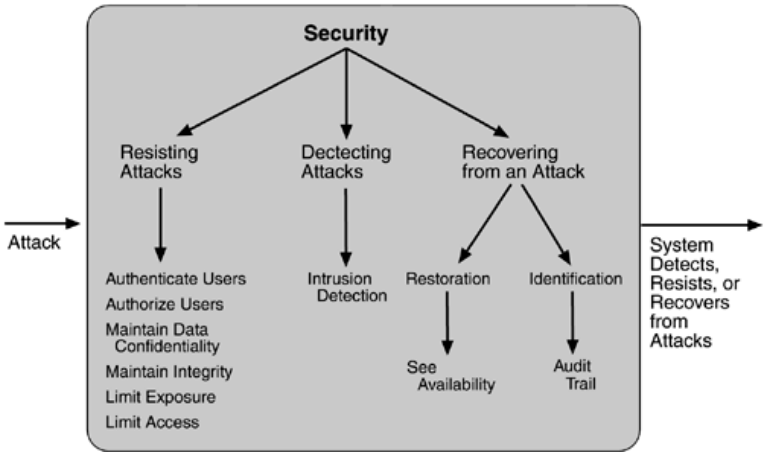
Tactics - Security



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Patterns vs. Tactics

"*Any pattern implements several tactics, often concerned with different quality attributes, and any implementation of the pattern also makes choices about tactics.*"

— Len Bass et al., Software Architecture in Practice, 2013

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Tactics in Patterns/Styles

What Architectural Tactics are used/applied in the following Patterns/Architectural Styles:

- ☐ Template Method
- ☐ Composite
- ☐ Observer / MVC
- ☐ Layers

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Further Information

A number of articles on Canvas (under week 9) provide more details, including

- Pre-readings
- Parnas article
- Garlan article

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Questions for Review

1. What is the purpose of the Shared-Memory Architecture and the Abstract Data Type Architecture, and how do they differ from one another when it come to the solutions they are utilized for?
2. To what degree does available hardware constrain the choice of architectural style? Are there any architectural styles that are impossible or highly impractical to implement without a certain hardware configuration?
3. What is the Independent Component Architecture? Why would you use the Independent Component Architecture over another architecture?
4. What architectural style should we use to design a remote system to control multiple robot hands in car assemble process in car factory?

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Question to Answer – Week 9

The spec of the "Question to Answer" is under the corresponding assignment setup, which will be released after this lecture.

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Required Reading for Week 10

Service Oriented Architectures (SOAP, REST, and Micro-Services) – one or more in order as pre-reading:

- Michael N. Huhns, Munindar P. Singh: Service-Oriented Computing: Key Concepts and Principles. IEEE Internet Comput.9(1): 75-81 (2005) (Link to an external site)
- Stefan Tilkov: A Brief Introduction to REST. InfoQ (2007) (Link to an external site)
- Chris Richardson: Microservices: Decomposing Applications for Deployability and Scalability. InfoQ (2014) (Link to an external site)
- P Jamshidi, C Pahl, NC Mendonça, J Lewis, S Tilkov: Microservices: The journey so far and challenges ahead. IEEE Software (2018) (Link to an external site)

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