

Software Architecture Roadmap



This Talk

Overview

- ❖ Software architecture has emerged as an important area of concern for practitioners and researchers.
- ❖ Considerable progress has been made in developing an engineering basis for architectural design.
- ❖ The changing face of software technology raises some exciting new challenges and opportunities

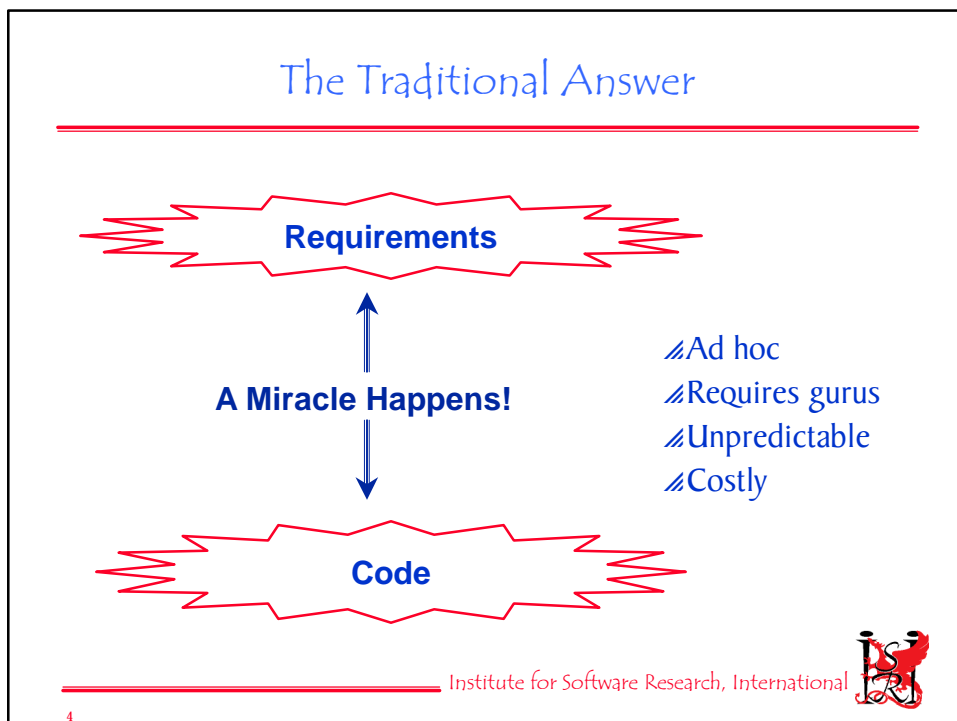
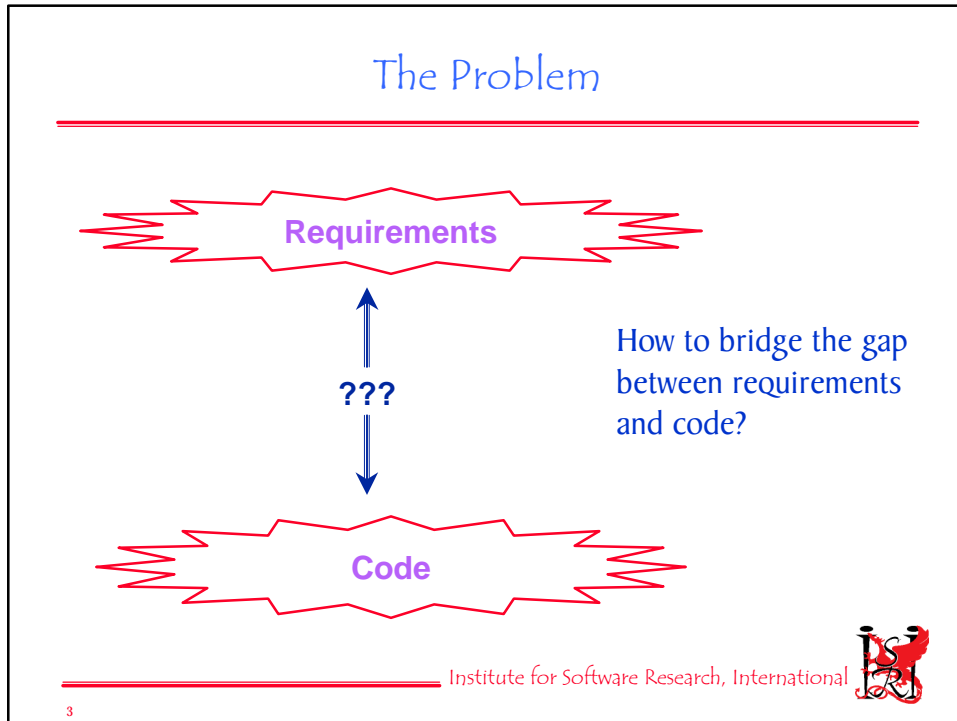
Talk Outline

- ❖ The role of Software Architecture -- what it's good for.
- ❖ Evolution of the field -- forces that have shaped its development.
- ❖ Challenges and opportunities -- new forces for change.

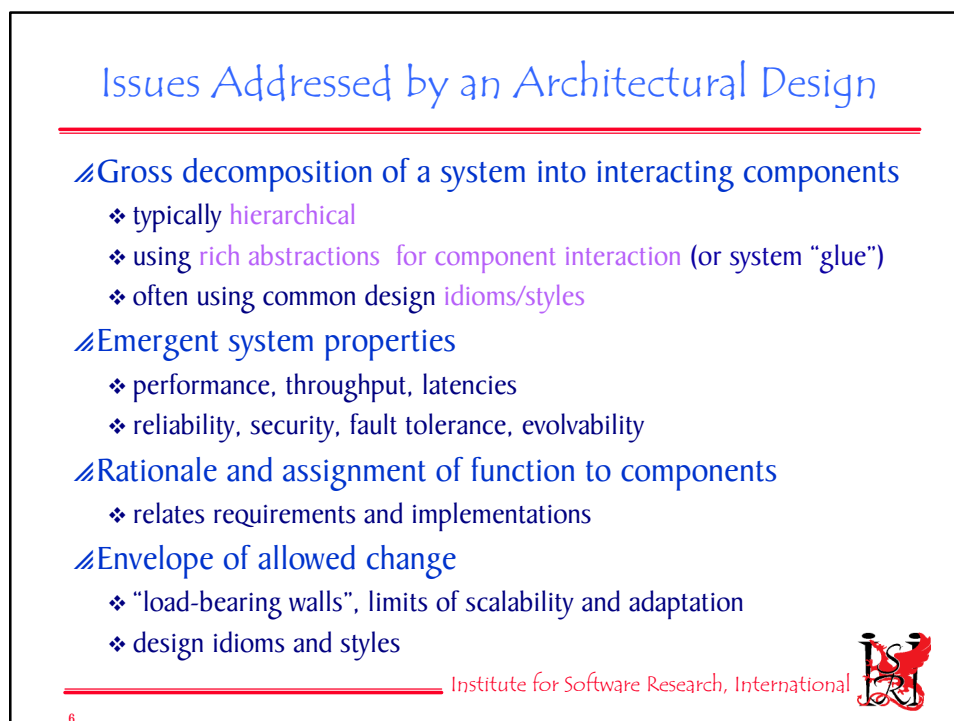
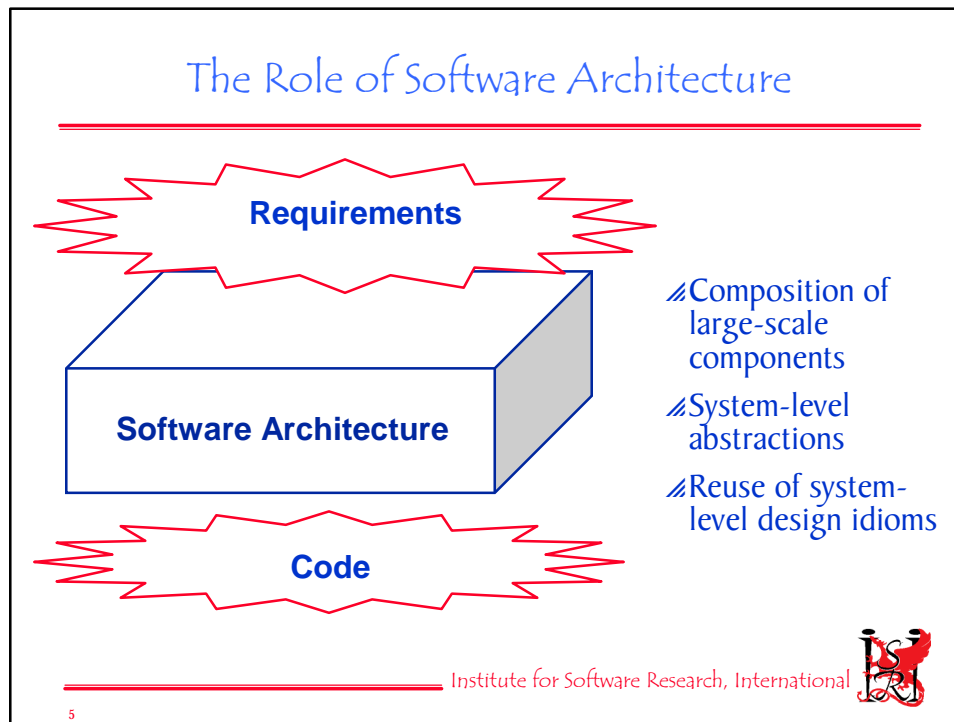
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How Should a Software Architecture Help?

Understanding

- ❖ vocabulary for structure, system constraints

Reuse

- ❖ of components, and also of patterns for organization

Construction

- ❖ partial blueprint, compilation/construction instructions

Evolution

- ❖ allowable envelope of change

Analysis

- ❖ system-level analysis that exploits structural constraints

Management

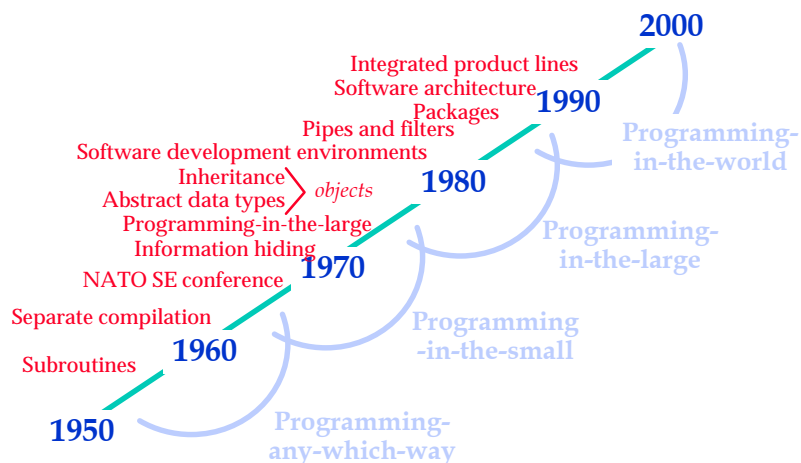
- ❖ evaluation-ready milestone

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Antecedents of Software Architecture



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Evolution of the Field

1980's

- ❖ Informal use of box and line diagrams
- ❖ Ad hoc application of arch expertise
- ❖ Diverse, uncodified use of architectural patterns and styles

1990's

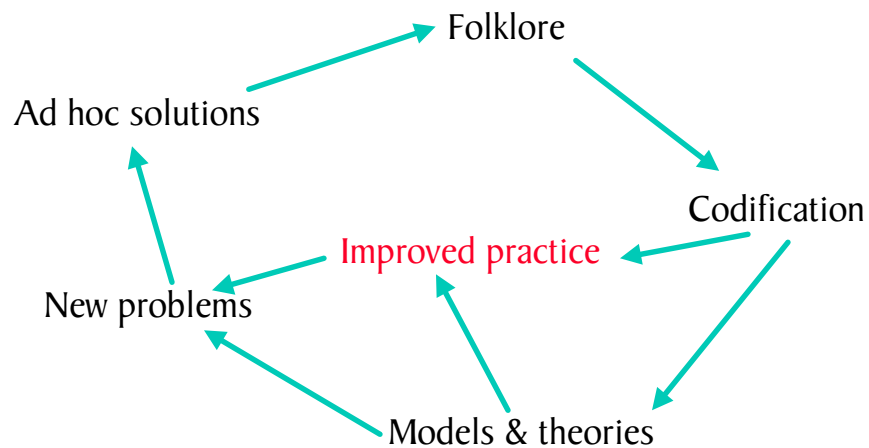
- ❖ Recognition of the value of architects in software development organizations
- ❖ Processes that require architectural design reviews and explicit architectural documentation
- ❖ Emerging use of product line architectures, commercial architectural standards, component integration frameworks
- ❖ Codification of vocabulary, notations & tools for architectural design
- ❖ Books/courses on software architecture

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Maturity: Progressive Codification Cycle



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Forces for Change: Economic

/// Changing build-vs-buy balance

- ❖ Time-to-market pressures often make construction from scratch infeasible
- ❖ Successful component frameworks enable rapid construction from third-party parts (e.g., Visual Basic)
- ❖ Industrial standards encourage uniform packaging and provide standard APIs (e.g., Enterprise JavaBeans)
- ❖ Emerging standards raise level of abstraction, promise a basis for compliance (e.g., HLA)

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Forces for Change: Technical

/// Pervasive Computing

- ❖ Proliferation of computing devices (e.g., toasters, entertainment systems, cars), many with dedicated embedded processors
- ❖ Heterogeneous capabilities (e.g., toasters vs PDAs vs cell phones vs high-end workstations)
- ❖ Mobile computing (e.g., in cars and airplanes)

/// Network-centric Computing

- ❖ Enabled by increasing connectivity of systems and information
- ❖ PCs become front ends to services & information available on the net
- ❖ Tasks performed by coalitions of resources enlisted by the user
- ❖ Coalitions must be reconfigured dynamically as resource mix changes

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Example: Network-Centric Computing

- /// Internet provides rich variety of resources
 - ❖ information, calculation, communication, services
 - ❖ Autonomous, heterogeneous, interactive
- /// Inevitably, these will be incorporated in systems
 - ❖ Coalitions, not true systems--open-shop, not closed shop development
 - ❖ Specifications scanty and less than reliable
 - ❖ Resources subject to unannounced change
 - ❖ Problems brittleness get worse
- /// Research opportunities
 - ❖ How to identify and validate a resource, then incorporate it
 - ❖ How to determine what a coalition does and keep it doing that
 - ❖ How to make it possible for nonexperts to recruit coalitions

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Research Challenges and Opportunities

- /// Better principles, notations, tools for integration frameworks
 - ❖ not just APIs
- /// SW architectures that scale with size/variability of the Internet
 - ❖ millions of nodes, frequent reconfiguration, many formats/protocols
- /// Open, dynamic resource coalitions
 - ❖ no longer under control of single organization or proprietor
- /// Techniques for bridging architectural mismatch
 - ❖ heterogeneous data formats, component technologies
- /// Ensuring suitable properties for distributed system configurations
 - ❖ even though absolute correctness is not achievable
- /// Architectures for mobility
 - ❖ resource-aware, highly dynamic, multi-device

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