INF 117
Project in Software Engineering

Lecture Notes –Winter Quarter, 2008

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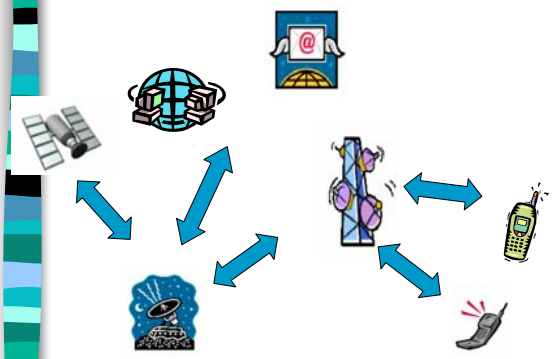
Set 6 – System Architecture

Announcements

- Due 2/15
  - Design Iteration #3 (Final)
  - Customer Milestone (Design Approved)
- Due 2/18
  - Code Iteration #1
  - Project Plan #3
- Can submit Subjective Assessments online (but only if prior to the due date)

System Architecture



Software Architecture: Essentials

- Components
  - What are the main parts?
  - What aspects of the requirements do they correspond to? Where did they come from?
  - Examples: filters, databases, GUIs, interpreters
- Connections
  - How do components communicate?
  - Examples: procedure calls, messages, pipes, event broadcast
- Constraints (including constraints on change)

How is it all organized?

Architectural design process

- System structuring
  - Decompose the system into principal sub-systems
  - identify communications between them
- Control modelling
  - A model of the control relationships between the different parts of the system
- Modular decomposition
  - The identified sub-systems are decomposed into modules

Architecture Design: Advanced

- Architectural styles
  - Restrict the way in which components can be connected
  - Prescribe patterns of interaction
  - Promote fundamental principles
  - Common styles: layered, client server, etc
- Architecture description
  - Boxes and arrows
  - UML
  - Architecture description languages

From Architecture to Modules

- Repeat the design process
  - Design the internal architecture of a component
  - Define the purpose of each module
  - Define the provided interface of each module
  - Define the required interface of each module
- Do this over and over again
  - Until each module has…
    - …a simple, well-defined internal architecture
    - …a simple, well-defined purpose
    - …a simple, well-defined provided interface
    - …a simple, well-defined required interface
- Until all modules "hook up"

Some Principles

- Rigor
  - ensures all requirements are addressed
- Separation of concerns
  - Modularity
    - allows work in isolation because components are independent of each other
    - decompose a complex system into less complex sub-systems; divide and conquer
    - (re-)use existing modules
    - understand the system in pieces
  - Abstraction
    - allows work in isolation because interfaces guarantee that components will work together

Some More Principles

- Anticipation of change
  - allows changes to be absorbed seamlessly
- What makes a good module?
  - High cohesion: all internal parts are closely related.
  - Low coupling: modules rely on each other as little as possible
  - Each module hides its internal structure.
  - Generality allows components to be reused throughout the system
  - Incrementality allows the software to be developed with intermediate working results
- Remember to document your rationale!

UML Concepts

- Display the boundary of a system & its major functions using use cases and actors
- Illustrate use case realizations with interaction diagrams
- Illustrate scenarios with use case diagrams and sequence diagrams
- Represent a static structure of a system using class diagrams
- Model the behavior of objects with state transition diagrams
- Reveal the physical implementation architecture with component & deployment diagrams

Diagrams in UML

- A diagram is a view into a model
  - Presented from the aspect of a particular stakeholder
  - Provides a partial representation of the system
  - Is (should be?) semantically consistent with other views

Types of UML Diagrams

Structure (6 types)

- Class diagrams
- Object diagram
- Package diagram
- Composite structure diagram
- Component diagram
- Deployment Diagram

Behavior (4 types)

- Activity diagram
- Use Case diagram
- State machine diagram
- Interaction diagrams
  - Sequence diagram
  - Communication diagram
  - Interaction overview diagram
  - Timing diagram

If the appropriate diagram is not part of UML
use it anyways

UML & the S/W Process (Design)

- **Use Cases**
  - Define the system Boundaries
- **Class Diagrams**
  - From a software perspective
    - Show classes & how they interrelate
- **Sequence Diagrams**
  - For Common Scenarios
    - Pick most significant scenarios from Use Cases
    - Use CRC cards or sequence diagrams to determine how the software should behave
      - Class, Responsibilities, Collaborators (CRC) cards are index cards used to represent
        - the responsibilities of classes
        - interaction between the classes
- **Package Diagrams**
  - Show large-scale organization of the system
- **State Diagrams**
  - Used for classes with complex lifecycles
- **Deployment Diagrams**
  - Show the physical layout of the software

All of these can be used for design