ECE450 – Software Engineering II

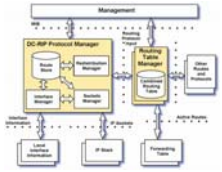
Today: **Introduction to Software Architecture**

Software "Architecture"?

- We're leaning on the construction metaphor
  - What do people refer to when they talk about "architecture"?

Software Architecture Reminder

- Simple definition: *A software architecture is the structure of a system*
  - Consider:
    - Software components
    - Their relationships
    - Interfaces to the external world
- Dealing with components is an abstraction
  - Ignore lower level details
    - What is the color of the pillars?
    - How does the sorting algorithm work?
    - Who cares at this point?



Software Architecture Reminder

- Note that there is more than one structure in a system
  - Module structure
    - Which module uses which? who calls whom?
  - Process execution structure
    - What is the chain of events that occurs when we receive input?
  - File structure
    - Databases? Libraries?
  - Physical structure
    - Network layout? Types of computers?
- Types of structures crosscut each other, so they need to be considered and handled simultaneously

Architecture and Design

- Do not confuse them!
  - When dealing with the system level we do architecture
  - When dealing with code, classes, etc., we do design
- Architecture…
  - Deals with the high-level construction of a system
    - Technology choices (language, platform, database)
    - System construction (overall structure –monolithic, 3-tiered?)
    - Modules and programs
- Design…
  - Deals with how and where to "lay down" code
    - Classes, methods, and attributes
    - Design patterns
    - Dependencies among classes
    - Subsystems, (Java) packages
- But note that the boundary between architecture and design is blurry

Why is architecture important?

- Set out the key elements and aspects of the software system
  - The most difficult to correct, the hardest to change
  - The ones that defines implementation constraints
  - The ones that enables or inhibit quality attributes (e.g. security, performance)
- Treating a system as components allows for narrower focus
  - Divide and conquer
  - Easier organization (team A works on module X, team B works on module Y)
  - Easier estimation
- Architecture documents enable early discussions on possible solutions
- Architecture documents allow for review
  - Training tools
  - Progress indicators

A word on documentation

- Does not have to be extremely detailed
  - Most of the times, annotated boxes and arrows will do
- But it does have to be extremely clear
  - For yourself
  - For your future self
  - For software designers
  - For new developers learning about your system
  - For the technical documentation
- Lack of detail != Lack of clarity
  - For every component
    - State its nature and main tasks
  - For every relationship among components
    - State who depends on whom, what sort of information is passed
  - For every external interface
    - Standards and protocols used, or at least a high-level description of the kinds of interactions

OK, OK, architecture is important. How do I do it?

- Well…
  - There's really no structured way to do it
  - All I can say is, if:
    - You know and understand the requirements, AND
    - Have some domain experience, AND
    - Have paid attention to other systems' architectures…
  - …then the shape of the system will start to form on your mind
    - Yes, it's a little bit of a black art
- But I can give you some tips
  - Reading and studying other architectures is essential
  - Iterations are good
  - Documenting the iterations is better
  - Getting feedback on each iteration is even better
  - Trying out or simulating your latest iteration "in the small" is best

"Non-Functional" Requirements must be satisfied

- Non-Functional Requirements (NFRs): All those system qualities that can't really be expressed as features
  - Performance
  - Usability
  - Security
  - Availability
  - Robustness
  - …
- The {browser, operating system, IM client} with the most features won't take off if
  - It's slow
  - We can't make sense of it
  - Has some glaring security holes
  - …
- Architectural work is **the key** time to address these problems

There are plenty of NFRs to consider

- The Usual Suspects
  - Performance
  - Usability
  - …
- Those that facilitate production and maintenance
  - Conceptual integrity
  - Modifiability
  - Reusability
  - Testability
  - …
- Those needed to keep the business running
  - Cost
  - Time
  - Projected lifetime
  - …

Successful architectures address two issues

- First issue: What is the best structure to satisfy the system's functional and behavioral requirements?
  - That is, so that it does everything it is supposed to do
  - …at the level of quality that we require?
- Second issue: What is the best structure to ensure that we can build the system given
  - Our skills and assets
  - Our business constraints (or assignment deadlines!)
  - Our competitors' offerings
- And the most important question, what is the best structure to satisfy **both** problems?