Lecture 24: Course Summary

What we've covered in this course

Some underlying principles

Course Evaluation

Course Outline

Modeling
- Sketching vs. Blueprints (vs. programming)
- Structure vs. Behaviour vs. Function
- Abstraction, Decomposition, Projection
- UML

Maintenance and Re-engineering
- Software Evolution
- Program Comprehension
- Reverse Engineering for Design Recovery

Software Architecture
- Conway's Law
- Coupling and Cohesion
- Architectural Patterns

Software Processes
- Agile vs. Disciplined
- Iterative development
- RUP, ICONIX, XP, SCRUM,…
- QA and process improvement

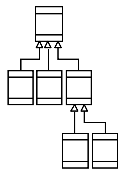
Project Management
- Resources, Time, Product, Risk
- Estimation & Prioritization
- Risk Assessment & Control
- Monitoring and Controling a project
- Organising a team

Requirements Analysis
- Requirements vs. Specifications
- Stakeholders, Goals, Obstacles
- Use Cases
- Robustness Analysis

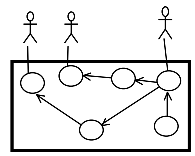
Verification and Validation
- Testing
- Static Analysis
- Inspection
- Prototyping
- Formal model analysis

Software Quality…

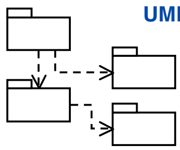
Modeling Notations



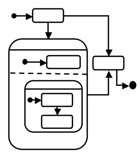
UML Class Diagrams
- information structure
- relationships between data items
- modular structure for the system



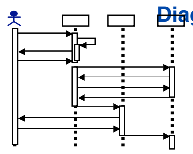
Use Cases
- user's view
- Lists functions
- visual overview of the main requirements



UML Package Diagrams
- Overall architecture
- Dependencies between components



(UML) Statecharts
- responses to events
- dynamic behavior
- event ordering, reachability, deadlock, etc



UML Sequence Diagrams
- individual scenario
- interactions between users and system
- Sequence of messages

Goal Models
- Stakeholder's goals and priorities
- Means-ends analysis and rationale
- dependencies between stakeholders

Why models are important

Abstraction
- Ignore detail to see the big picture
- Treat objects as the same by ignoring certain differences
- (beware: every abstraction involves choice over what is important)

Decomposition
- Partition a problem into independent pieces, to study separately
- (beware: the parts are rarely independent really)

Projection
- Separate different concerns (views) and describe them separately
- Different from decomposition as it does not partition the problem space
- (beware: different views will be inconsistent most of the time)

Modularization
- Choose structures that are stable over time, to localize change
- (beware: any structure will make some changes easier and others harder)

Scaling Up

Complexity grows rapidly

"For every 25% increase in problem complexity there is a 100% increase in solution complexity" (Robert Glass)

Why?

- Software development is largely an intellectual task (80% intellectual, 20% clerical)
- To scale up, you need more brains
- Software development becomes a social activity
- Coordinating more people is hard

Glass's Facts (slightly refactored)

Adapted from Robert Glass "Facts and Fallacies of Software Engineering"

People

- Most important factor is quality of your developers
- Best programmers are 28 times more effective than the worst

Tools

- There is no silver bullet
- Each tool/technique offers only small improvements
- Any new tool/technique initially causes a reduction in productivity
- Most tools become shelfware

Estimation

- Poor estimation is endemic
- Estimation is done by the wrong people, at the wrong time, and never adjusted…

Re-use

- Re-use in the small is solved;
- Re-use in the large is intractable

Requirements

- Requirements errors are the most expensive to fix during development
- Missing requirements are the hardest errors

Design

- Design is a complex, iterative process
- There is seldom one best design

Testing

- 55-60% branch coverage is typical
- 100% coverage is unachievable
- 100% coverage is insufficient

Defects

- Error removal is the most time-consuming part of software development
- Errors tend to cluster (80:20)
- Most programmers make the same mistakes

Maintenance

- Maintenance is 40-80% of software costs
- Understanding the existing product is the hardest part

How do we know what we know?

Survey research:
- To find out what's true across (some part of) the s/w industry
- To establish what is normal, common or uncommon.

Case studies:
- To understand what developers actually do
- To gain deeper insights into what happens in a small number of selected cases.

Experiments (& quasi-experiments):
- To investigate whether a particular technique has an effect on quality, development time, etc
- To test for a causal relationship.

Ethnographies:
- To understand the culture and perspective of developers
- To probes how developers themselves make sense of their context

Action research:
- To solve a pressing problem, and understand whether the solution was effective
- To focus on effecting change, and learning from the experience