Software Engineering with Objects and Components

Open Issues and Course Summary

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A Revision of SEOC

- Is software engineering with objects and components a good way of building systems?
- Software development process
  - Lifecycle models and main stages
  - Process management
  - Testing
  - Maintenance and Evolution
- Introduction to UML Diagrams
  - Use cases
  - Class models
  - CRC cards
  - Interaction diagrams
  - State diagrams
  - Implementation diagrams
- Reuse and components
- Dependable systems

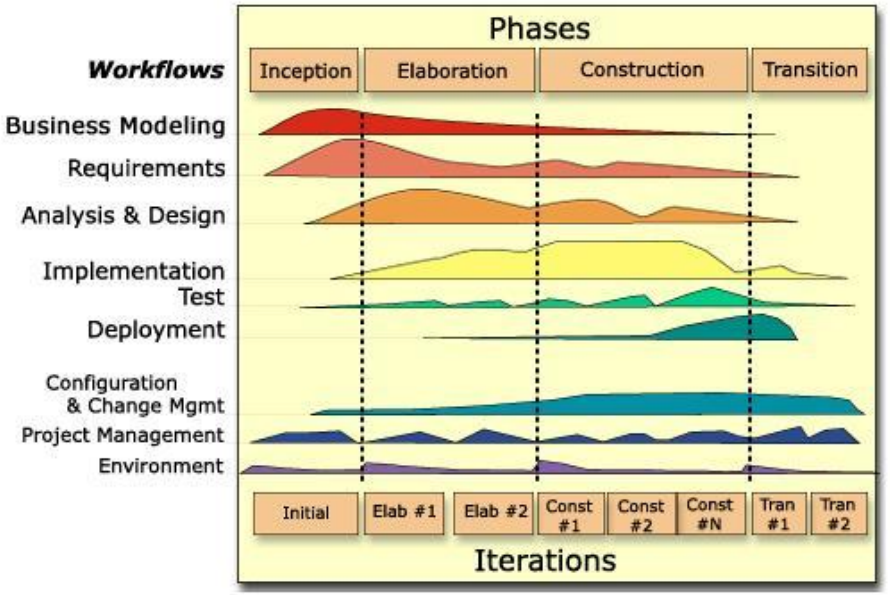
A Revision of SEOC

- Why are we doing this?
  - To build **good systems**
    - What are good systems?
    - Why do we need them?
- Why a unified language?
- A unified language should be (and UML is?)
  - Expressive
  - Easy to use
  - Unambiguous
  - Tool supported
  - Widely used

SEOC and Development Processes

- **Development process**
  - Risk management is central
  - Iteration to control risk
  - Architecture-centric and component-based
- (Unified?) design methodology
  - **Pros**: dependable, assessment, standards
  - **Cons**: constraints, overheads, generality
  - Unified modelling language combines pros while avoiding cons
- The unified process
  - **Inception**, **Elaboration**, **Construction**, **Transition**
  - There are many other processes (e.g., Spiral, Extreme Programming, etc.)

(Rational) Unified Process - RUP



UML: Status and Issues

- **History**:
  - **1989-1994** OO "method wars"
  - **1994-1995** three Amigos and birth of UML
  - **Oct 1996** feedback invited on **UML 0.9**
  - **Jan 1997** **UML 1.0** submitted as RFP (Request for Proposal) to OMG (Object Management Group)
  - **Jun 1999** **UML 1.3** released
  - **Sep 2000** (some UML 2.0 RFP's submitted
  - **Feb 2001** **UML 1.4** draft specification released
  - **UML 1.5**;
  - Current Version: **UML 2.0**. adopted in late 2003
- **Open issues**
  - UML semantics
  - Tool support
  - OCL (Object Constraint Language)

What's new in UML 2.0

- **Nested Classifiers**: In UML, almost every model building block you work with (classes, objects, components, behaviors such as activities and state machines, and more) is a classifier. In UML 2.0, you can nest a set of classes inside the component that manages them, or embed a behavior (such as a state machine) inside the class or component that implements it.
- **Improved Behavioral Modeling**: In UML 1.X, the different behavioral models were independent, but in UML 2.0, they all derive from a fundamental definition of a behavior (except for the Use Case, which is subtly different but still participates in the new organization).
- **Improved relationship between Structural and Behavioral Models**: UML 2.0 lets you designate that a behavior represented by (for example) a State Machine or Sequence Diagram is the behavior of a class or a component

Requirements Capture

- Users have different potentially conflicting views of the system
- Users usually fail to express requirements clearly
  - Missing information
  - Superfluous and redundant information
  - Inaccurate information
- Users are poor at imagining what a system will be like
- Identifying all the work needing support by the system is difficult

Static Structures

- Desirable to build system quickly and cheaply
- Desirable to make system easy to maintain and modify
- Identifying classes
  - Data driven design
  - Responsibility driven design
  - Use case driven design
  - Design by contract
- Class diagrams document: classes (attributes, operations) and associations (multiplicities, generalisations)
- System is some collection of objects in class model

Validating the Class Model

- **CRC Cards**: class, responsibility and collaborators
- UML interaction diagrams
- CRC cards and quality
  - Too many responsibilities implies low cohesion
  - Too many collaborators implies high coupling
- CRC cards used to
  - Validate class model, using role play
  - Record changes
  - Identify opportunities to refactor

Interactions

- **Sequence and Communication diagrams**
  - documents how classes realize use cases
  - thus, help to validate design
- Other uses: design patterns, component use, packages
- Instance versus generic
- Procedural versus concurrent
- Law of Demeter
- Creation and deletion of objects
- timing

Other UML Diagrams…

- Describing object behaviour
  - State diagrams
  - Activity diagrams
- Implementation diagrams
  - Package Diagrams
  - Composite Structures
  - Component Diagrams
  - Deployment Diagrams

Other Software Engineering Issues

- **Testing**
  - **Testing strategies**: top down versus bottom up, black box versus glass box, stress testing
  - **Categories** (unit, integration, acceptance)
  - Regression testing
  - Test plans
  - OO and component issues
- **Reuse** and components
  - **Type of reuse**: Knowledge (artefacts, patterns), software (code, inheritance, template, component, framework)
  - success stories, pitfalls and difficulties with (component) reuse
  - Reuse not free and requires management

What else did SEOC cover?

- **Maintenance and Evolution**
  - Accounts for significant part of project costs and developer effort
  - Types: corrective, adaptive, perfective, preventive
  - …is hard, requires management,…
  - Dealing with legacy code: redevelop, transform (restructure, re-engineer, recapture), encapsulate
- **Software Quality**
- **High Dependability Engineering**
  - Lots of scary stories…
  - Software engineering borrows heavily from traditional engineering
  - Although software is significantly different
    - Focus on process rather than product
    - More complex and less visible
    - Fails in different ways
    - Is far more subject to change

SEOC Lecture Notes

- Lecture Note 01 - SEOC Overview.
- Lecture Note 02 - Requirements Engineering.
- Lecture Note 03 - Use Cases.
- Lecture Note 04 - Software Design.
- Lecture Note 05 - Class Diagrams.
- Lecture Note 06 - CRC Cards.
- Lecture Note 07 - Project Management.
- Lecture Note 08 - Package Diagrams.
- Lecture Note 09 - Composite Structures.
- Lecture Note 10 - Component Diagrams.
- Lecture Note 11 - Deployment Diagrams.
- Lecture Note 12 - Sequence Diagrams.
- Lecture Note 13 - Communication Diagrams.
- Lecture Note 14 - Activity Diagrams.
- Lecture Note 15 - Statechart Diagrams.
- Lecture Note 16 - Software Construction.
- Lecture Note 17 - Software Testing.
- Lecture Note 18 - Software Maintenance and Evolution.
- Lecture Note 19 - Reuse and Components.
- Lecture Note 20 - Software Quality.
- Lecture Note 21 - Engineering High-Dependability Systems.
- Software Engineering: An industry perspective - Invited Industry Speakers of JPMorgan delivered the lecture.
- Lecture Note 22 - SEOC - Open Issues and Course Summary.

SEOC Practical and Resources

SEOC Practical

- Requirements gathering, UML Design and Java Implementation
- Group project
- 3 teams in each tutorial group
- Tutorials

SEOC Resources

- References complementing and extending lecture notes
- Main Tools
  - ArgoUML, Eclipse

Software Engineering Any Magic/Silver Bullet?

See (in the resource web page)
a (kind of historical) list of papers on "**Software Engineering Bullets**"