Object-Oriented Design

Lecturer: Raman Ramsin

Lecture 1: UML Overview
UML – Unified Modeling Language

The Unified Modeling Language (UML) is a standard language for specifying, visualizing, constructing and documenting the artifacts of software systems, as well as for business modeling and other non-software systems.

The UML represents a collection of best modeling practices that have proven successful in the modeling of large and complex systems.
Influences on UML

- Database design
- Entity-Relational Modelling
  - Codd et al., 1980
    - Multiple views of static relationships; design based on users' concepts
  - Coad, 1990
- OMT
  - Rumbaugh et al., 1991
- SOMA
  - Graham, 1991
    - Rulesets, OO PAK, business modelling
- OPEN
  - Graham et al., 1997
    - Process, notation
- Object Management Group
  - co-ordinator
- Ada
  - Large system modular, real-time programming
  - Beck et al.
- Smalltalk
  - C++
  - Meyer, 1988
- Eiffel
  - Larch, Z & UML c. 1980
  - Coleman et al., 1994
  - Objectory
    - Jacobson et al., 1992
      - A process for object-oriented design
- Syntropy
  - Cook & Daniels, 1994
- Fusion
  - Odell, 1991
    - Activity diagrams
  - Real Time OOM
    - Selic et al., 1994
- UML
  - 1997
- Catalysis
  - D'Souza and Wills, 1999

[Graham 2001]
UML 2 Diagram Superstructure
<table>
<thead>
<tr>
<th>Diagram</th>
<th>Book Chapters</th>
<th>Purpose</th>
<th>Lineage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>11</td>
<td>Procedural and parallel behavior</td>
<td>In UML 1</td>
</tr>
<tr>
<td>Class</td>
<td>3, 5</td>
<td>Class, features, and relationships</td>
<td>In UML 1</td>
</tr>
<tr>
<td>Communication</td>
<td>12</td>
<td>Interaction between objects; emphasis on links</td>
<td>UML 1 collaboration diagram</td>
</tr>
<tr>
<td>Component</td>
<td>14</td>
<td>Structure and connections of components</td>
<td>In UML 1</td>
</tr>
<tr>
<td>Composite structure</td>
<td>13</td>
<td>Runtime decomposition of a class</td>
<td>New to UML 2</td>
</tr>
<tr>
<td>Deployment</td>
<td>8</td>
<td>Deployment of artifacts to nodes</td>
<td>In UML 1</td>
</tr>
<tr>
<td>Interaction overview</td>
<td>16</td>
<td>Mix of sequence and activity diagram</td>
<td>New to UML 2</td>
</tr>
<tr>
<td>Object</td>
<td>6</td>
<td>Example configurations of instances</td>
<td>Unofficially in UML 1</td>
</tr>
<tr>
<td>Package</td>
<td>7</td>
<td>Compile-time hierarchic structure</td>
<td>Unofficially in UML 1</td>
</tr>
<tr>
<td>Sequence</td>
<td>4</td>
<td>Interaction between objects; emphasis on sequence</td>
<td>In UML 1</td>
</tr>
<tr>
<td>State machine</td>
<td>10</td>
<td>How events change an object over its life</td>
<td>In UML 1</td>
</tr>
<tr>
<td>Timing</td>
<td>17</td>
<td>Interaction between objects; emphasis on timing</td>
<td>New to UML 2</td>
</tr>
<tr>
<td>Use case</td>
<td>9</td>
<td>How users interact with a system</td>
<td>In UML 1</td>
</tr>
</tbody>
</table>
Structure Diagrams

Class Diagram

[Diagram showing class relationships and attributes]

[Fowler 2004]
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Structure Diagrams

Object Diagram (1)

Department

- degree: String[] = {"graduate", "undergraduate", "both"}

1

department

mathStat: Department

statistics: Department

math: Department

appliedMath: Department

mathEd: Department

[Fowler 2004]

Department of Computer Engineering

Sharif University of Technology
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Structure Diagrams

Object Diagram (2)

[Fowler 2004]
Structure Diagrams

Package Diagram

[Image of a package diagram showing dependencies and packages labeled Accounting, Bank, UI, Ordering, Shipping, CustomerDB, StockDB]

[Fowler 2004]
Structure Diagrams

Composite Structure Diagram

[Fowler 2004]
Structure Diagrams

Component Diagram

[Diagram of component diagram with labels: Till, Message Queue, Sales Server, Transaction Processor, Accounting Driver, Accounting System, sales message]
Structure Diagrams

Deployment Diagram

[Fowler 2004]
Behavior Diagrams

Use-Case Diagram

[Use-Case Diagram]

[Fowler 2004]
Behavior Diagrams

Activity Diagram

- Customer
  - Insert card
  - Enter pin
  - Enter amount
  - Take money from slot

- ATM Machine
  - Authorize
    - [Valid PIN]
    - [Invalid PIN]
  - Check account balance
    - [balance >= amount]
    - [balance < amount]
  - Debit account

- Bank
  - Show balance
  - Eject card

Swimlane

Start
End
Behavior Diagrams

State Machine Diagram

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[Fowler 2004]
Behavior Diagrams: Interaction Diagrams

Sequence Diagram

[Fowler 2004]
Behavior Diagrams: Interaction Diagrams

Communication/Collaboration Diagram

[Fowler 2004]
Behavior Diagrams

Timing Diagram (1)

[Diagram showing timing and behavior of a system with labels such as 'User', 'Wait Access', 'Wait Card', 'Idle', 'No Card', 'Has Card', 'AC System', and 'User Accepted' with timelines and events marked at specific points such as 'Code', 'OK [1..4]', and 'Idle'.]

[Fowler 2004]
Behavior Diagrams

Timing Diagram (2)

[Fowler 2004]
Behavior Diagrams

Interaction Overview Diagram

[Fowler 2004]
References

