Role of Documentation in (OO) Software Development

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Outline

- Documenting software
  - Motivation
  - Types and purpose of documentation
  - Documentation needed for CS 491-2
- Object-oriented software engineering
  - Why building software is *real* engineering
  - Various software methodologies
  - Importance of modeling

Software Engineering

- Appreciating Software Engineering
  - Build complex software systems within time and budget in the context of frequent change
  - SE *is* an engineering discipline: analyze, design, and then implement
- Technical vs managerial knowledge (hard vs soft skills)

SE Methodologies

- Every software needs
  - Analysis (*what* to do)
  - Design (*how* to do)
  - Implementation & Testing
- Process/algorithm used for development
  - Waterfall
  - Prototyping
  - Iterative
    - Incremental
    - XP (eXtreme Programming)
  - ...

Motivation Behind Documentation

- Effective use of software
- Communication medium among developers
  - Working in teams unavoidable! Need to express ideas well both verbally and written
  - Soft skills (e.g. communicational skills) just as important as technical skills
  - Written ideas are more concrete and avoid ambiguities and incompleteness
  - Flow of information
    - across teams of different responsibilities
    - as team members change

Types of Documentation

- Process documentation
  - Records process of development and maintenance
  - Plans, estimates, schedules, process quality docs, project standards
- Product documentation (focus of this talk!)
  - Describes a particular product being developed
  - User/exposed documentation
    - End-user documentation, administrator documentation, etc.
  - System/internal documentation (most CS491-2 docs)
    - From viewpoint of developers and maintainers

Problem Statement: report organization cs491

- Introduction
  - Description
  - *Constraints (e.g. economical)*
  - *Professional and ethical Issues*
- Requirements
- References

Typically written by the client

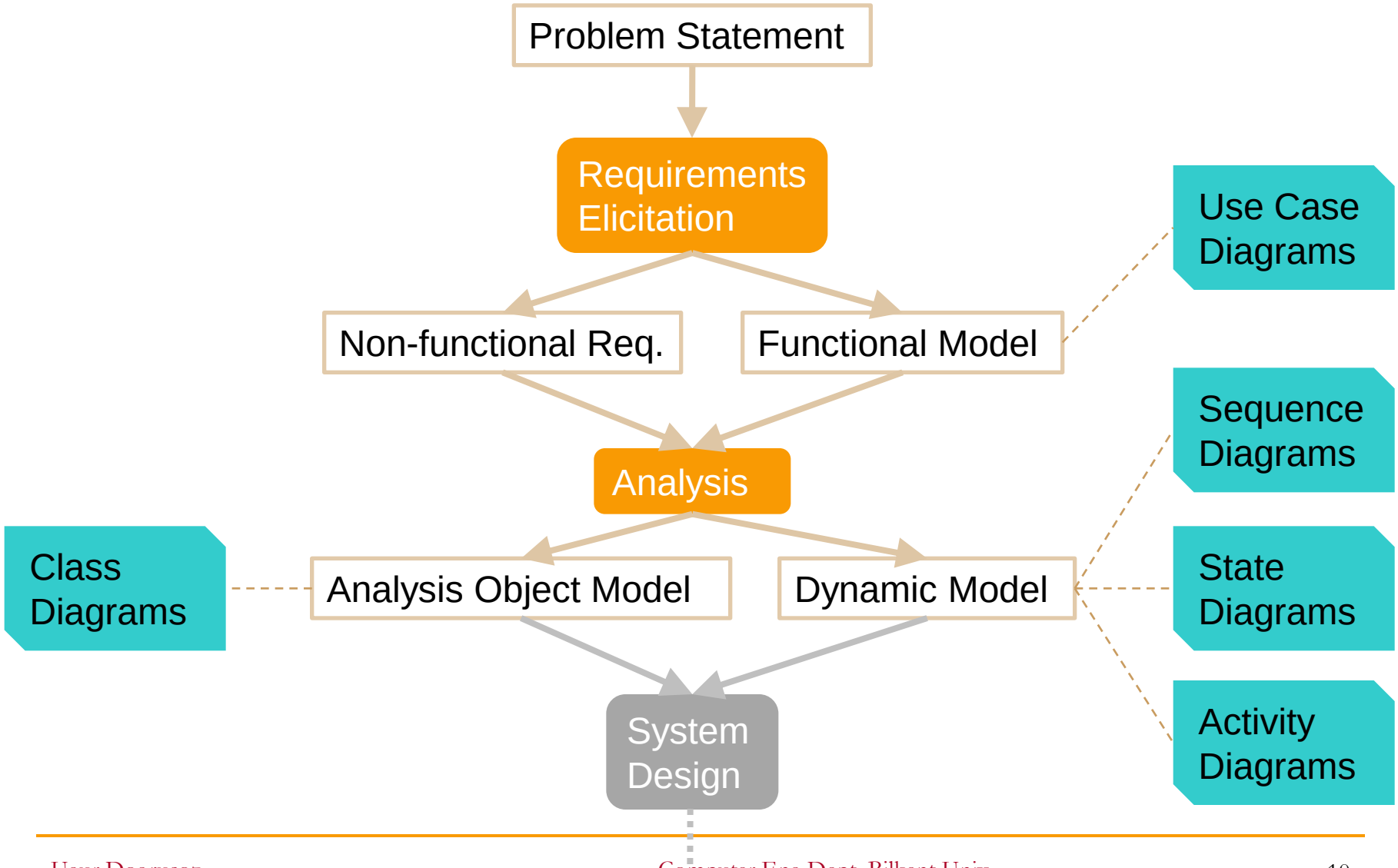
Modeling

- To understand
  - real-life system to be automated (model it “as is”)
  - software system to be built (model it “as you want it to be”)
- Same idea as
  - blueprints for building bridges, houses, etc.
  - layouts for manufacturing VLSI chips

Modeling

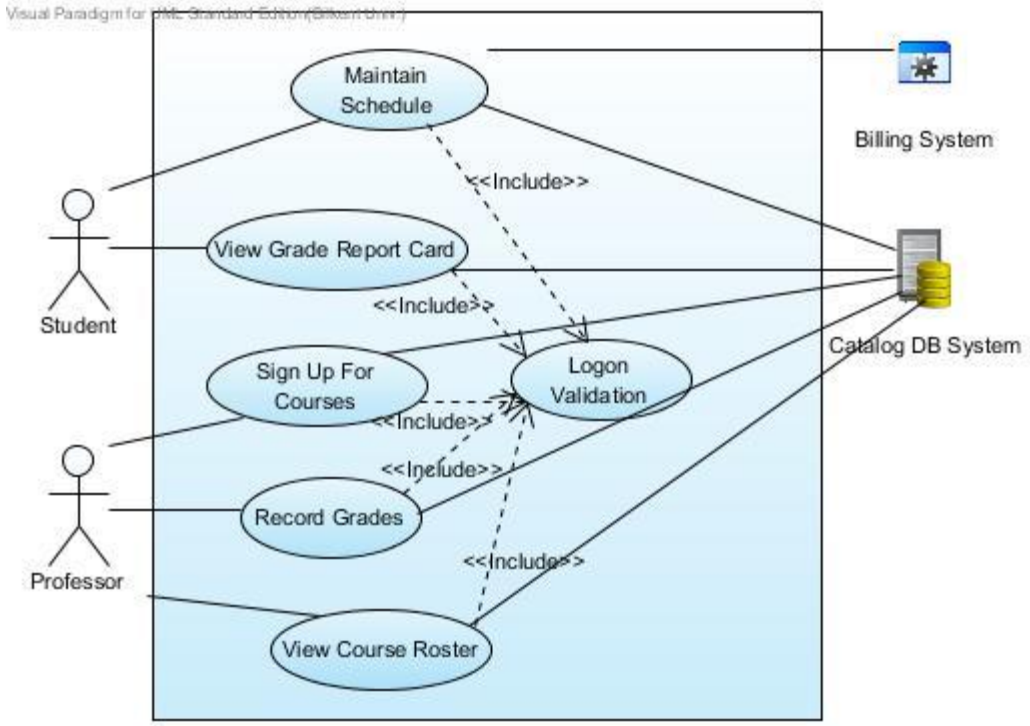
- Textual (e.g. long textual descriptions or X3D) or visual/graphical (e.g. sketches or flowchart)
- UML (Unified Modeling Language) is a visual modeling language to specify, visualize, modify, construct and document the artifacts of an object-oriented software-intensive system under development
  - Helps you model both application and software domains!

OO Analysis w/ UML

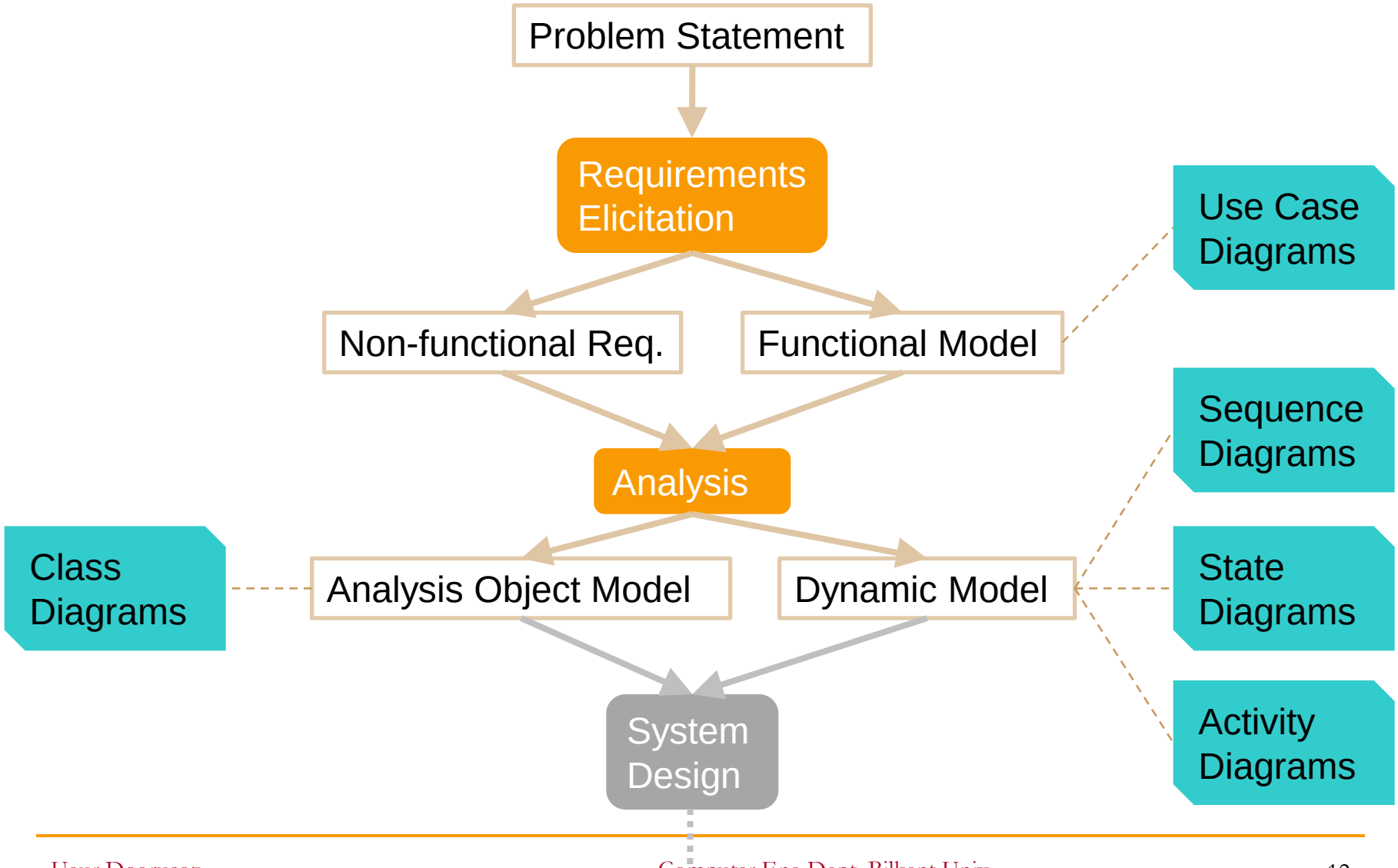


Analysis: UML use case diagrams

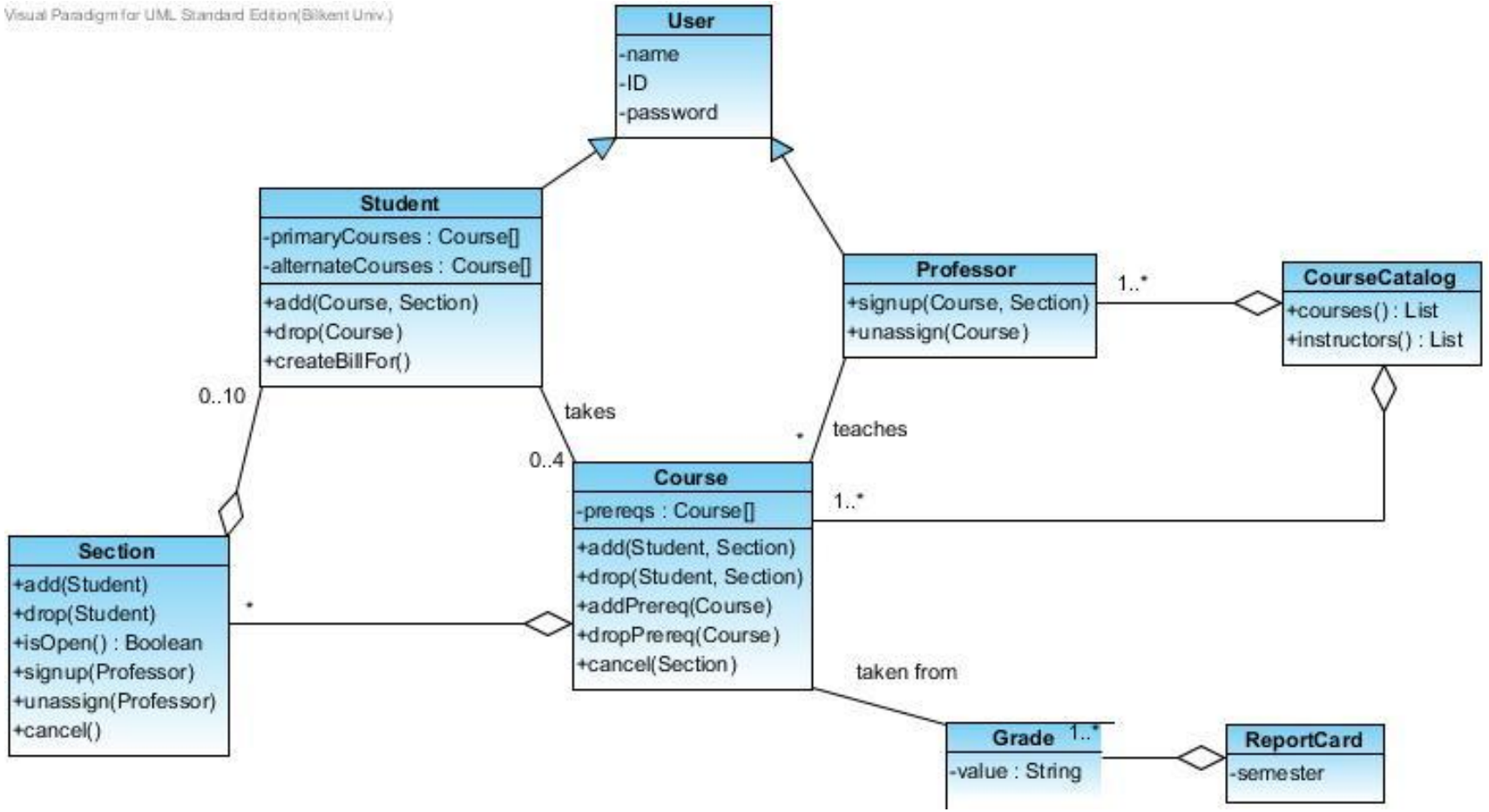
- Summary of use case model: relationships between actors and use cases



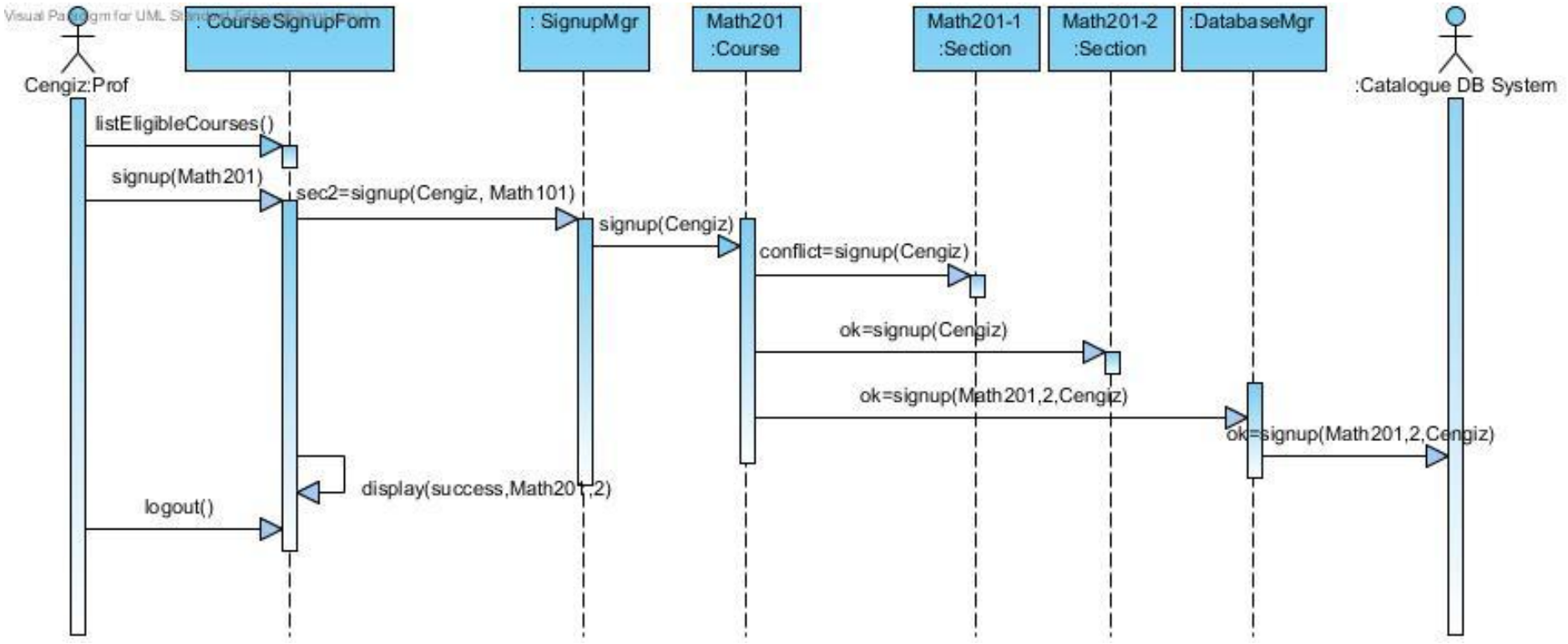
OO Analysis w/ UML



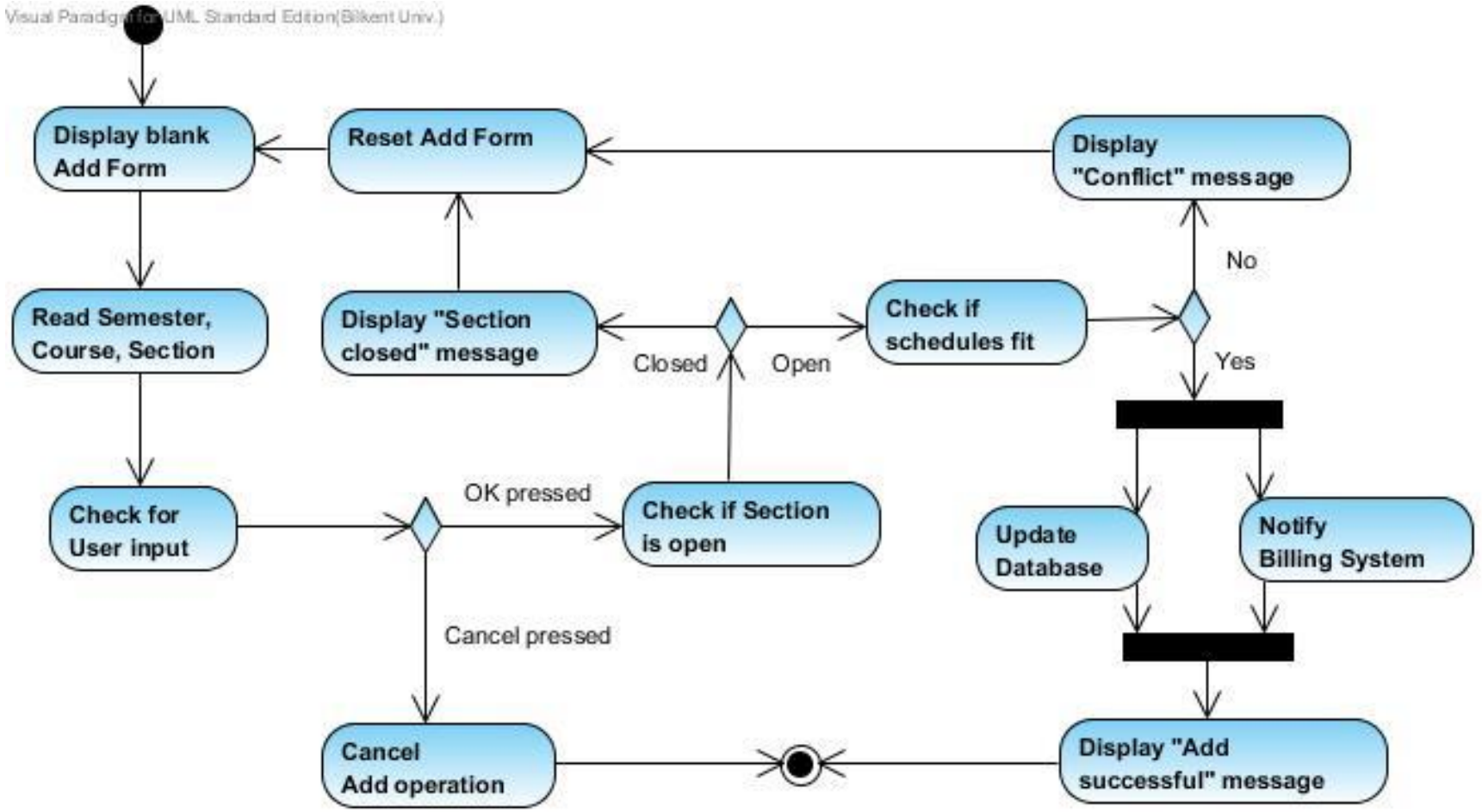
Analysis: object model



Analysis: UML sequence diagrams

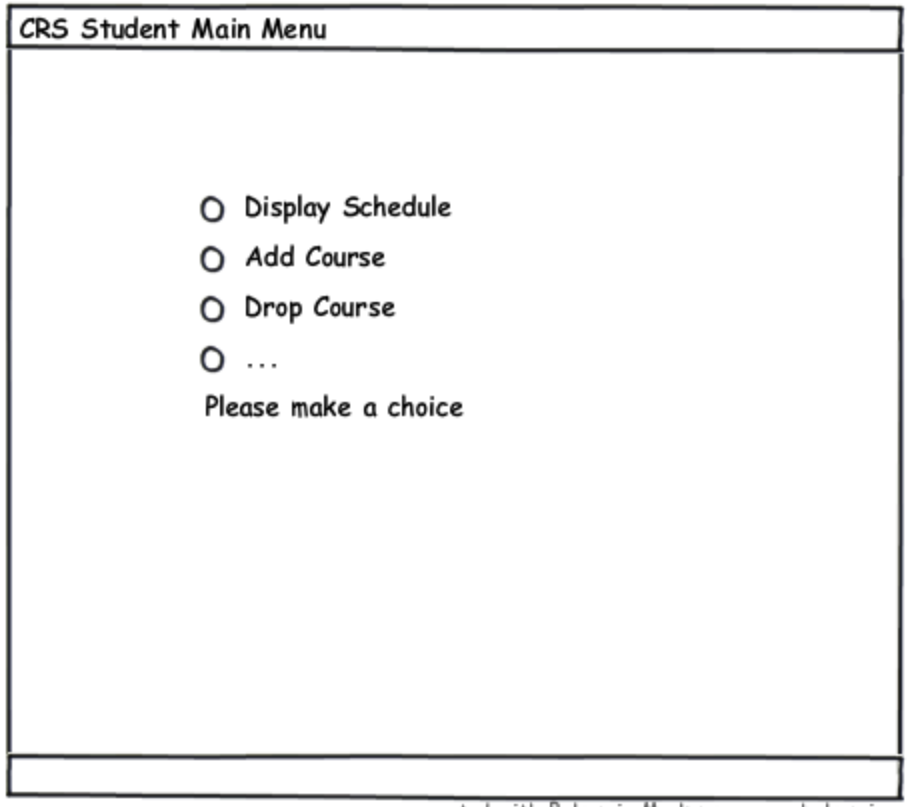


Analysis: UML activity diagrams



Analysis: user interface

- User Interface
  - Menus a
  - Navigati
  - Mock-up



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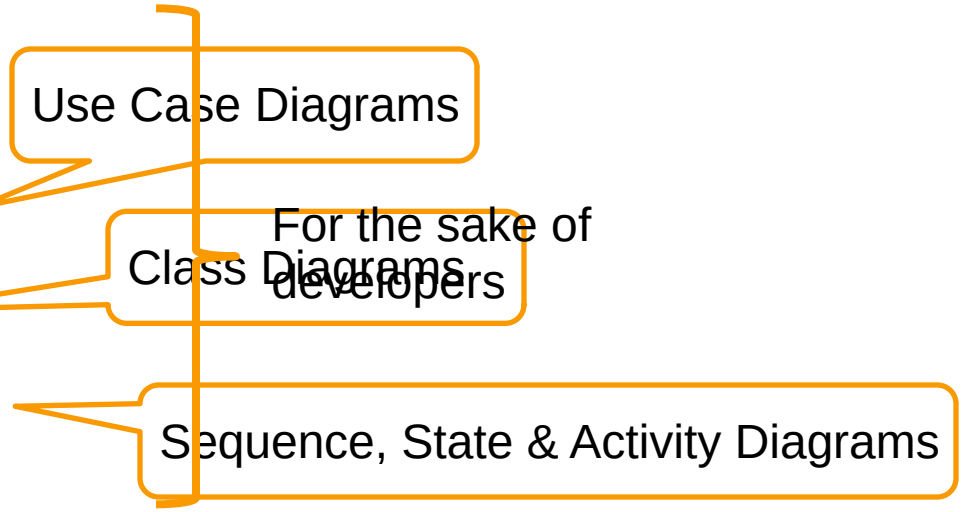
Analysis: report organization CS491

- Introduction
- Current system (if any)
- Proposed system
  - Overview
  - Functional requirements
  - Nonfunctional requirements
  - Constraints ("Pseudo requirements")
- System models
  - ...
- Glossary & References

Share w/ customer; forms a basis for a contract w/ customer!

Analysis: report organization CS491

- ...
- System models
  - Scenarios
  - Use case model
  - Object model
  - Dynamic models
  - User interface
- Glossary
- References



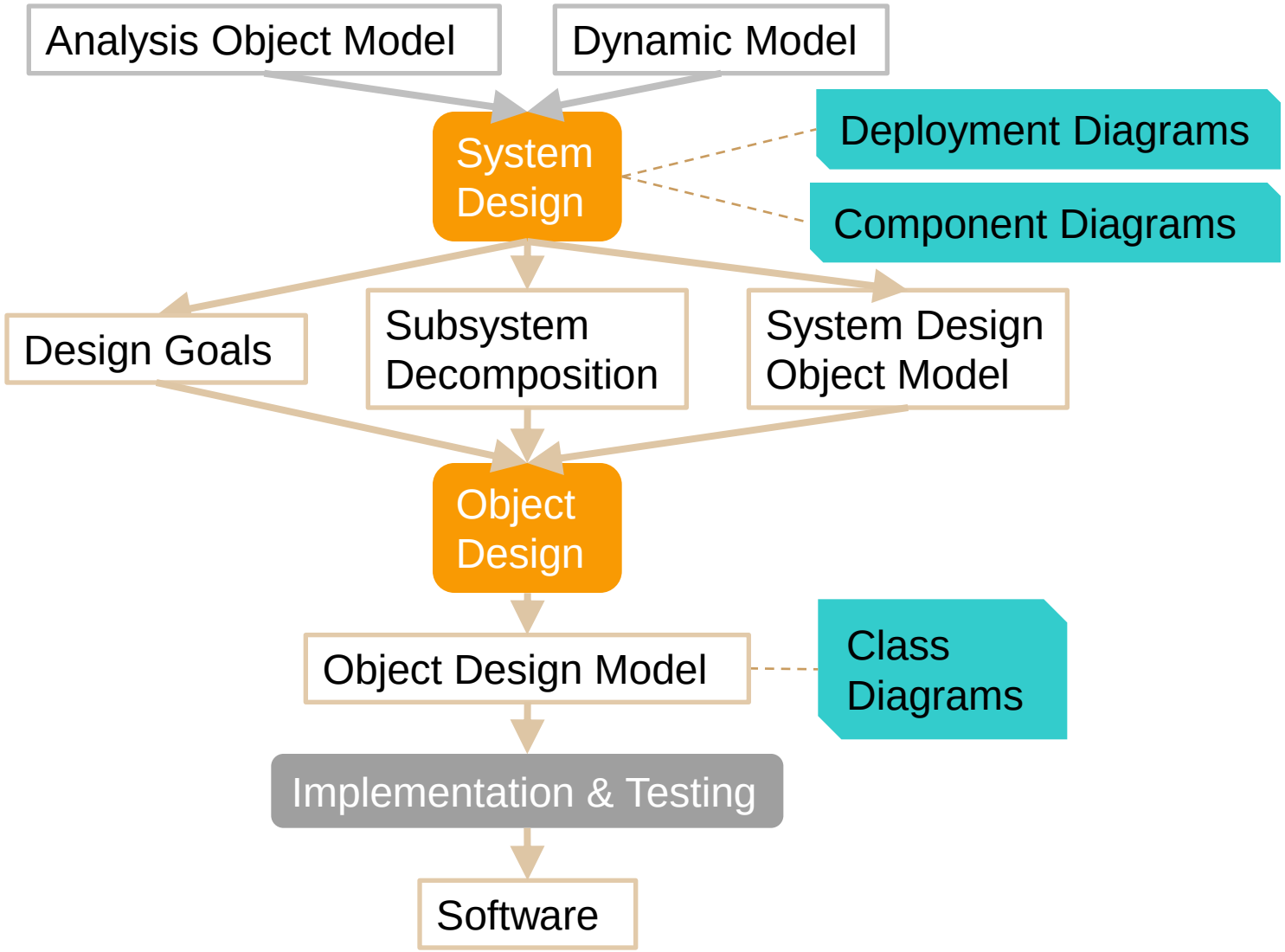
Analysis: summary

- Application domain is modeled to fully understand the real-life system
  - “as is” (vs. “as you want it to be”)
- Resulting model
  - specifies exactly what the system is going to do
  - is a contract between developer and customer
  - is input to design phase

OO Design w/ UML

- Analysis: focuses on the application domain
- Design: focuses on the solution domain
  - The solution domain is changing very rapidly
  - Design knowledge is a moving target
- what vs. how

OO Design w/ UML



Design goals: typical tradeoffs

- Functionality v. Usabi
- Cost v. Robustness
- Efficiency v. Portability
- Rapid development v. Functionality
- Cost v. Reusability
- Backward Compatibility v. Readability
- Space v. Speed

A low cost system does not do much error checking (e.g., 5.00 or 5.00 Euros)

It' d be very difficult to build a real-time game that is portable.

Design: subsystem decomposition

- Subsystem
  - Collection of classes, associations, operations, events and constraints that are closely interrelated with each other
  - Great way to handle complexity

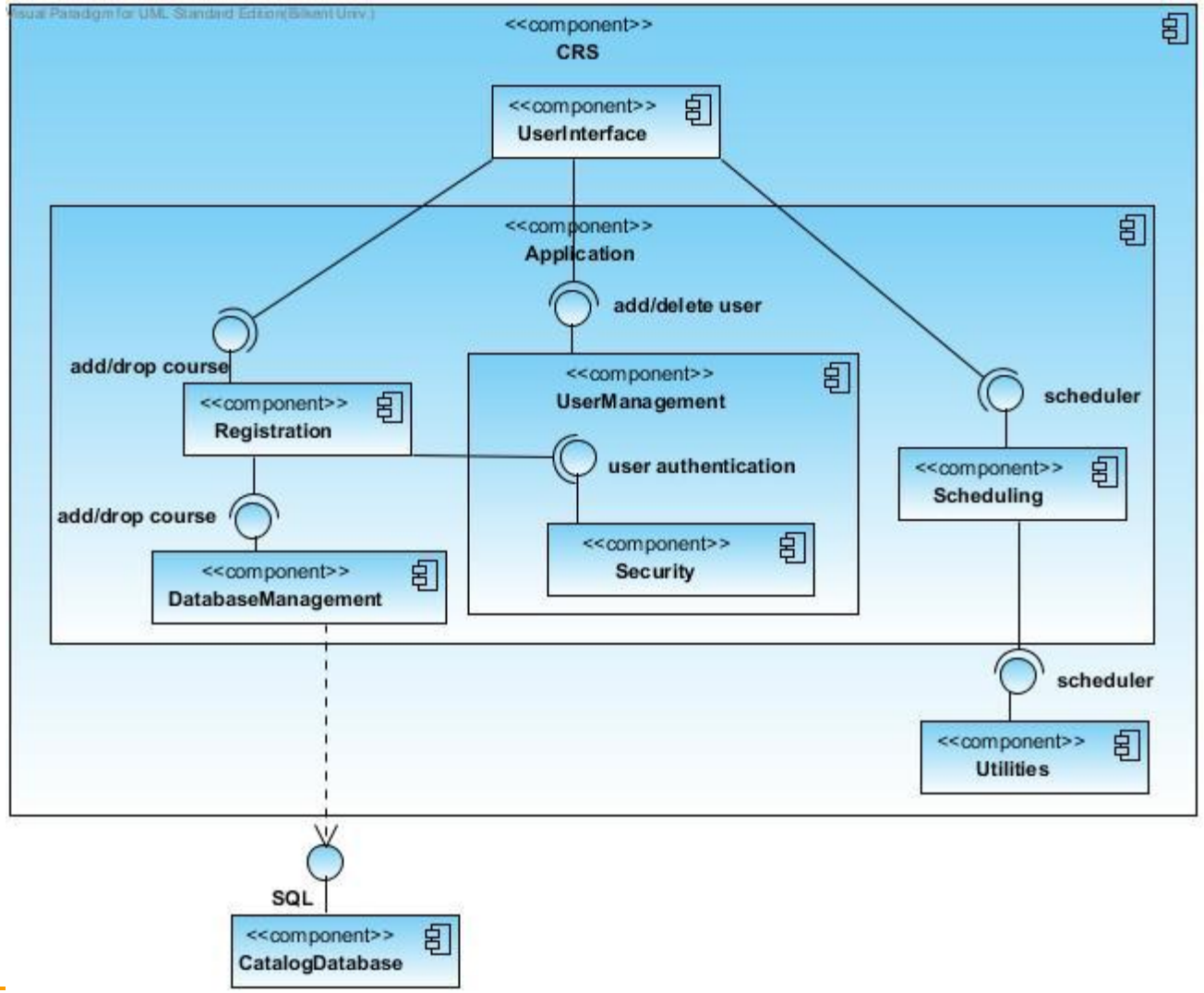
Design: subsystem decomposition

- From objects to subsystems, taking into account the non-functional requirements
- No single/fixed algorithm
  - High coherence & low coupling
- Initial decomposition usually derived from functional requirements; constantly revised as new issues addressed
- The objects and classes from the object model could be the "seeds" for the subsystems

Design: UML component diagrams

- Component Diagram:
  - Illustrates dependencies between components at design time, compilation time and runtime.

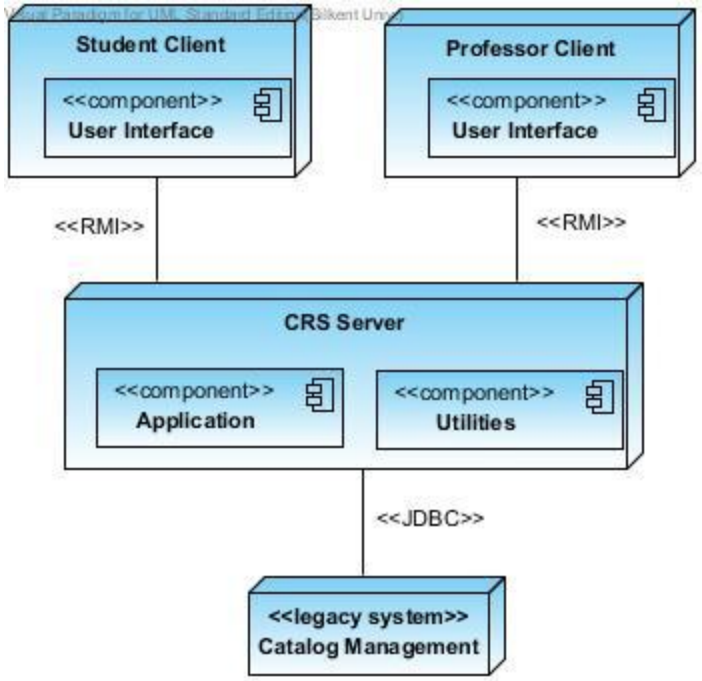
Design: UML component diagrams



Design: UML deployment diagrams

- Deployment Diagram:
  - Once we have done
    - Subsystem decomposition
    - Concurrency
    - Hardware/Software Mapping
  - Illustrates the distribution of components at run-time.
  - Deployment diagrams use nodes and connections to depict the physical resources in the system.

Design: UML deployment diagrams



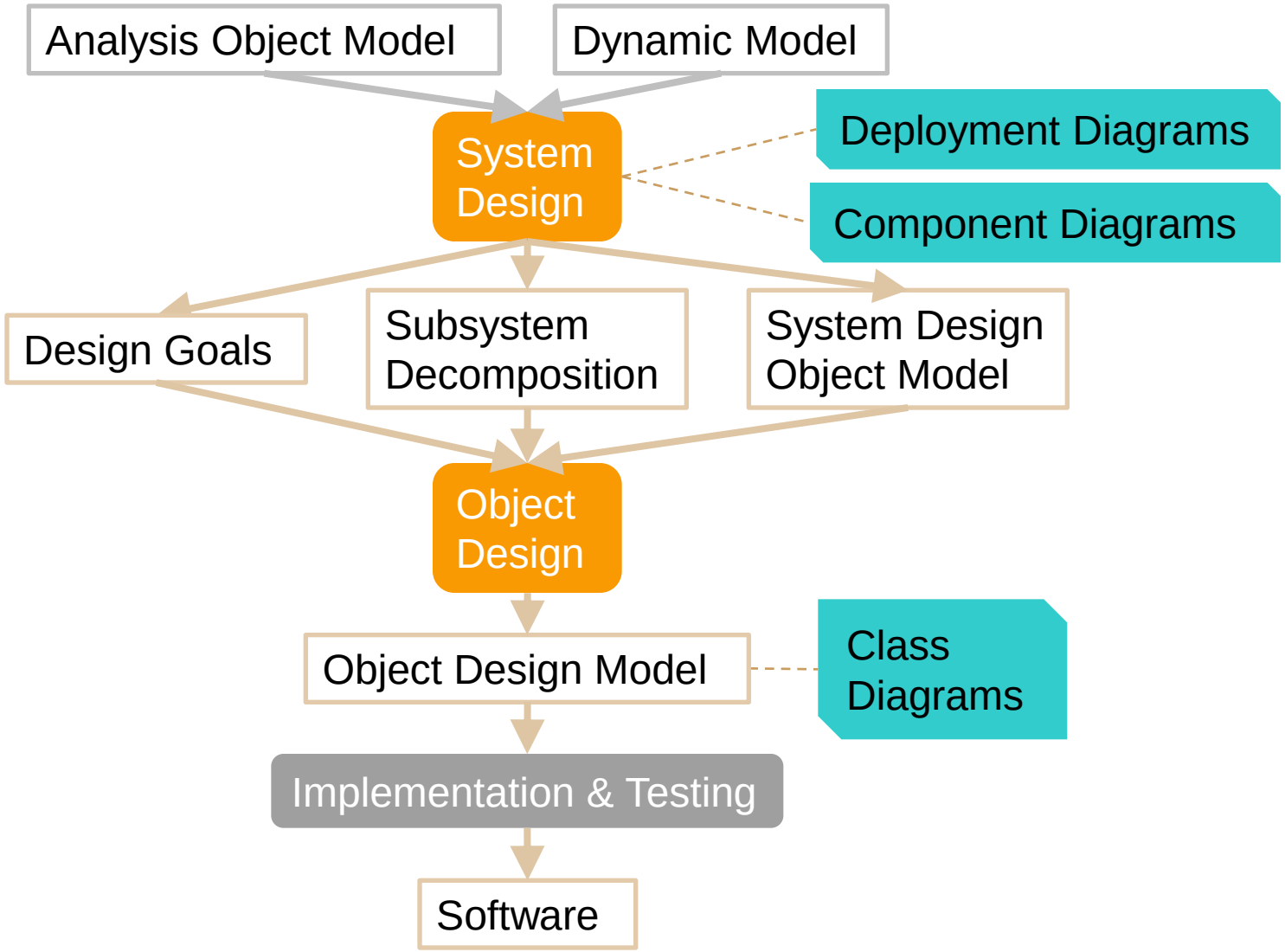
High-level design: report organization CS491

- Introduction
  - Purpose of the system
  - Design goals
  - Definitions, acronyms, and abbreviations
  - Overview
- Current software architecture (if any)
- …

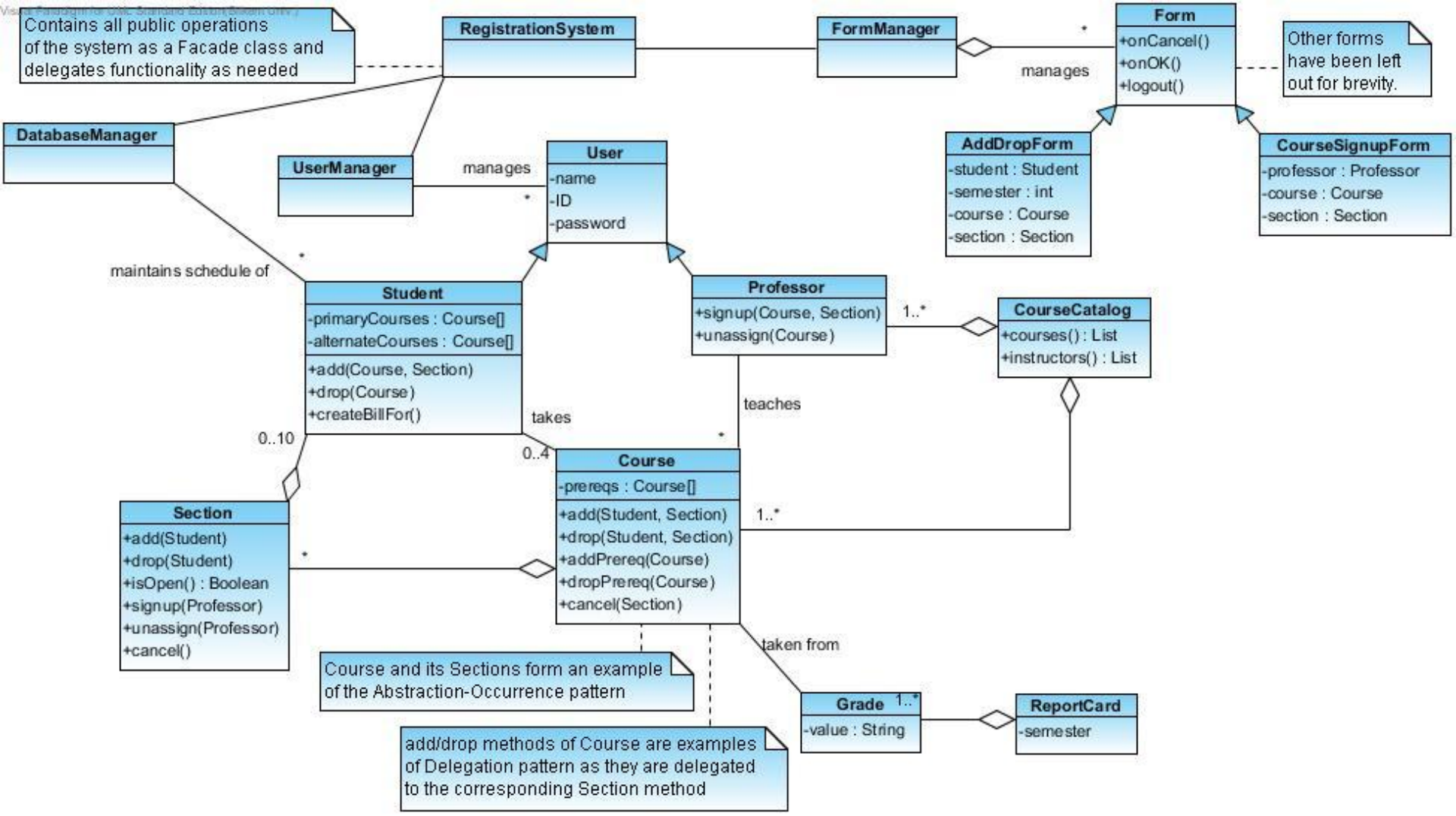
High-level design: report organization CS491

- …
- Proposed software architecture
  - Overview
  - Subsystem decomposition
  - Hardware/software mapping
  - Persistent data management
  - Access control and security
  - Global software control
  - Boundary conditions
- Subsystem services
- Glossary & References

OO Design w/ UML



Design: UML class diagrams



Low-level design: report organization CS492

- Introduction
  - Object design trade-offs
  - Interface documentation guidelines
    - Collections have an iterator() method returning an Iterator
  - *Engineering standards (e.g., UML and IEEE)*
  - Definitions, acronyms, and abbreviations
- Packages
- Class Interfaces
- Glossary & References

Final report organization CS492

- Final software architecture
- Status
- User's manual
- Misc.
  - *Impact*
  - *New tools and technologies*
  - *Library and Internet resources used*

References

- Software Documentation, Ian Sommerville, 2011
- OO Software Engineering, Using UML, Patterns, and Java, Bernd Bruegge and Allen H. Dutoit, 2010

Questions?

- Thanks for your attention!