Modeling the Conceptual Domain

CSCI 4448/5448: Object-Oriented Analysis & Design

Lecture 15

Acknowledgement & Materials Copyright

- I'd like to start by acknowledging Dr. Ken Anderson
- Ken is a Professor and the Chair of the Department of Computer Science
- Ken taught OOAD on several occasions, and has graciously allowed me to use his copyrighted material for this instance of the class
- Although I will modify the materials to update and personalize this class, the original materials this class is based on are all copyrighted © Kenneth M. Anderson; the materials are used with his consent; and this use in no way challenges his copyright

Before we start: Teams and Project Submissions

- Folks, unless you have a real personal issue (illness, etc.), I will not offer extensions on projects. Please use your day pass (1 per project) if you need an extra 24 hours to avoid a late penalty.
- Team management is up to you. You cannot start a coding project on the day before or the day a project is due and then blame it being late on team communications. **We assign these projects 2 weeks before they come due!** Talk to your teammates, start the work sooner – it's just going to get more complex.
- You manage your own teamwork, so if you need to find a new team, that's your call and your effort. I do not want solo projects if at all avoidable, and I expect you to make the effort to find a team.
- Teams all receive the same grade on projects. I am considering a system to request individual grading in cases where teams breakdown, but it is not available yet.
- Please, please work with your teammates! This is the way it works in industry; you must support and communicate with your teams to succeed!

Working at the Conceptual Level

- One of the first steps in developing an OO design is discovery of the entities in your system that have responsibilities – that will turn into classes and objects
- A conceptual level of a university may include entities such as:
  - Students, instructors, professors, staff, classes, transcripts, registrar, buildings, classrooms, etc.
- How can you determine which of these entities will become part of your application's class structures?

Conceptual Modeling Approaches

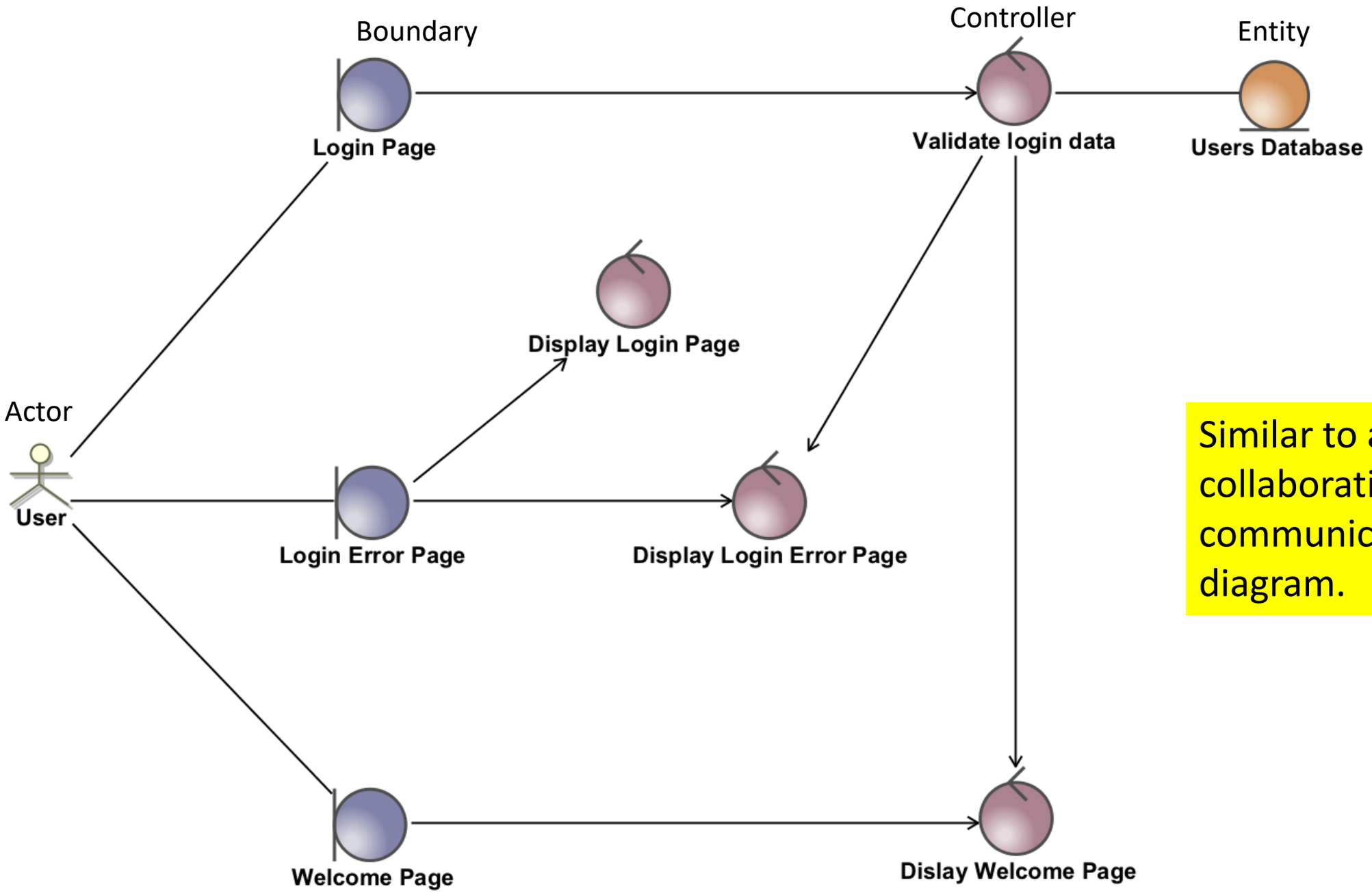
- You've seen one of these modeling approaches already –
  - Developing UML class and object diagrams (with other diagrams in support)
- Today we'll look at some other approaches, including:
  - Robustness diagrams
  - Object Role Model (ORM) diagrams
  - Class Responsibility Collaborator (CRC) models
  - Logical data models (LDMs)
  - Analysis patterns
    - All from The Object Primer, Scott Ambler, 2005, Cambridge
- Later, we'll also look at
  - Design Pattern-Driven Design
    - aka Thinking in Patterns
  - Commonality and Variability Analysis
  - Analysis Matrix

Robustness Diagrams

- This is an approach based on analysis of use cases
- Analyze the steps of use cases to ensure consistency with other use cases in your overall model
- You're trying to confirm the robustness of the use requirements for the system you're building
- Add Actors
- Add Boundary Elements for major UI elements (screens, reports)
  - Only talk to controllers and actors
- Add Entities for business concepts/support
  - Only talk to controllers
- Add Controllers for process management
  - Can talk to controllers, boundary, and entity objects, not actors
- Optionally add Use Case references to bridge activities on diagrams

  - https://docs.nomagic.com/display/MD190/Robustness+diagram

Robustness Diagrams



Similar to a UML collaboration or communication diagram.

- https://docs.nomagic.com/display/MD190/Robustness+diagram

Object Role Modeling

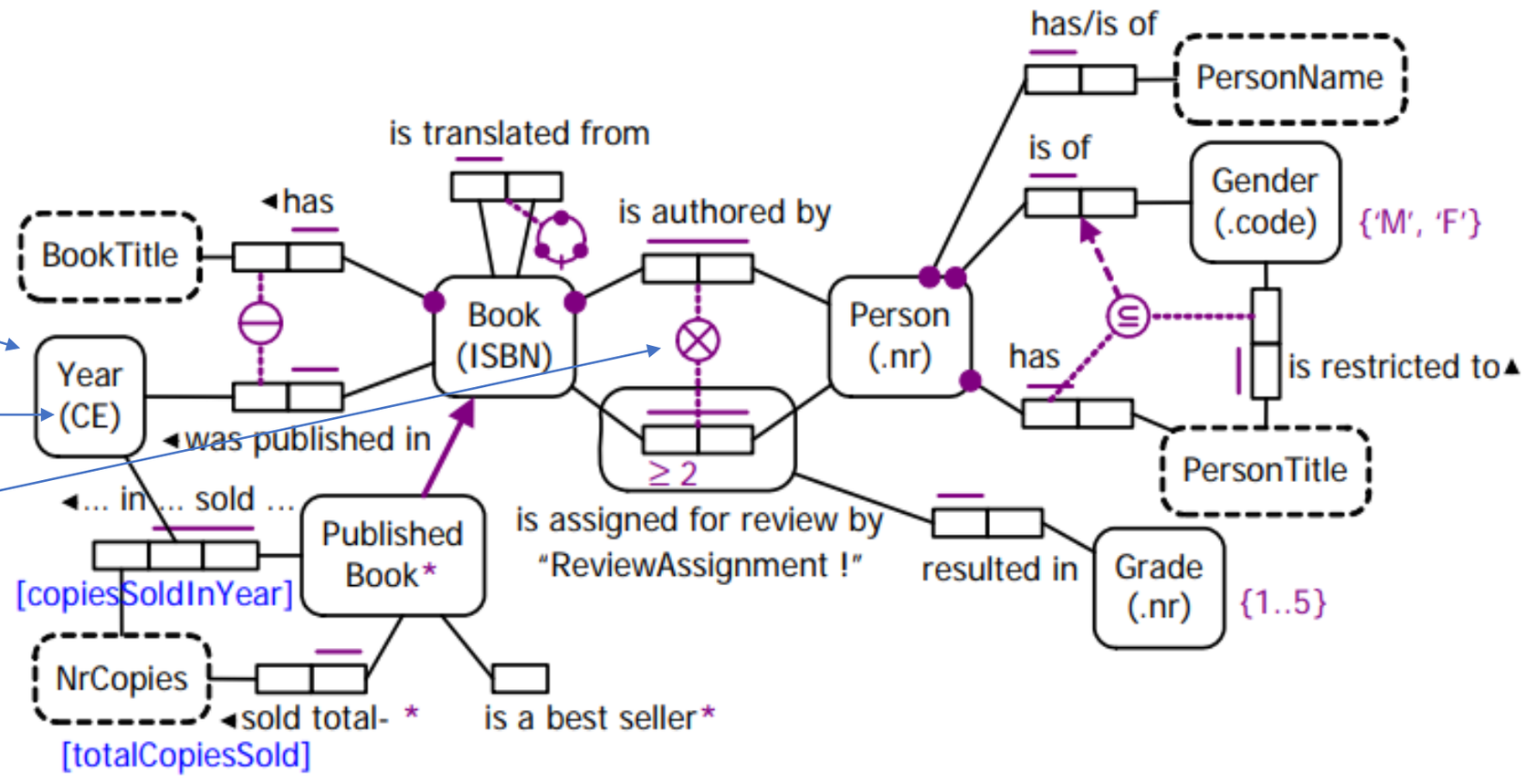
- A powerful method for designing and querying database models at the conceptual level, where the application is described in terms easily understood by non-technical users
- In practice, ORM data models often capture more business rules, and are easier to validate and evolve than data models in other approaches
- From http://www.orm.net/

- I find ORM models to get complex quickly. I believe higher level diagrams, such as UML class diagrams are likely a better way to capture conceptual designs…

Object Role Model (ORM) diagrams

- Depicts objects, relationships, roles, constraints, and examples

- Entity
- Value
- Reference
- Set Comparison Constraints

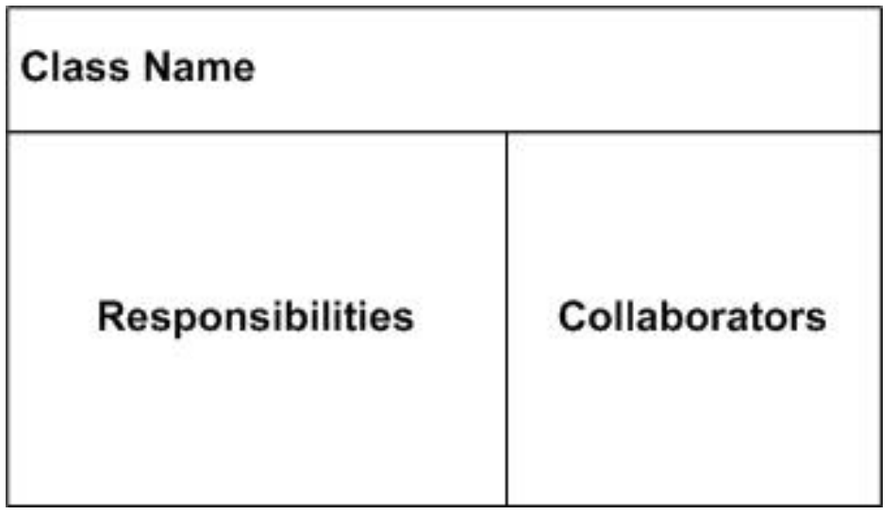


- http://www.orm.net/

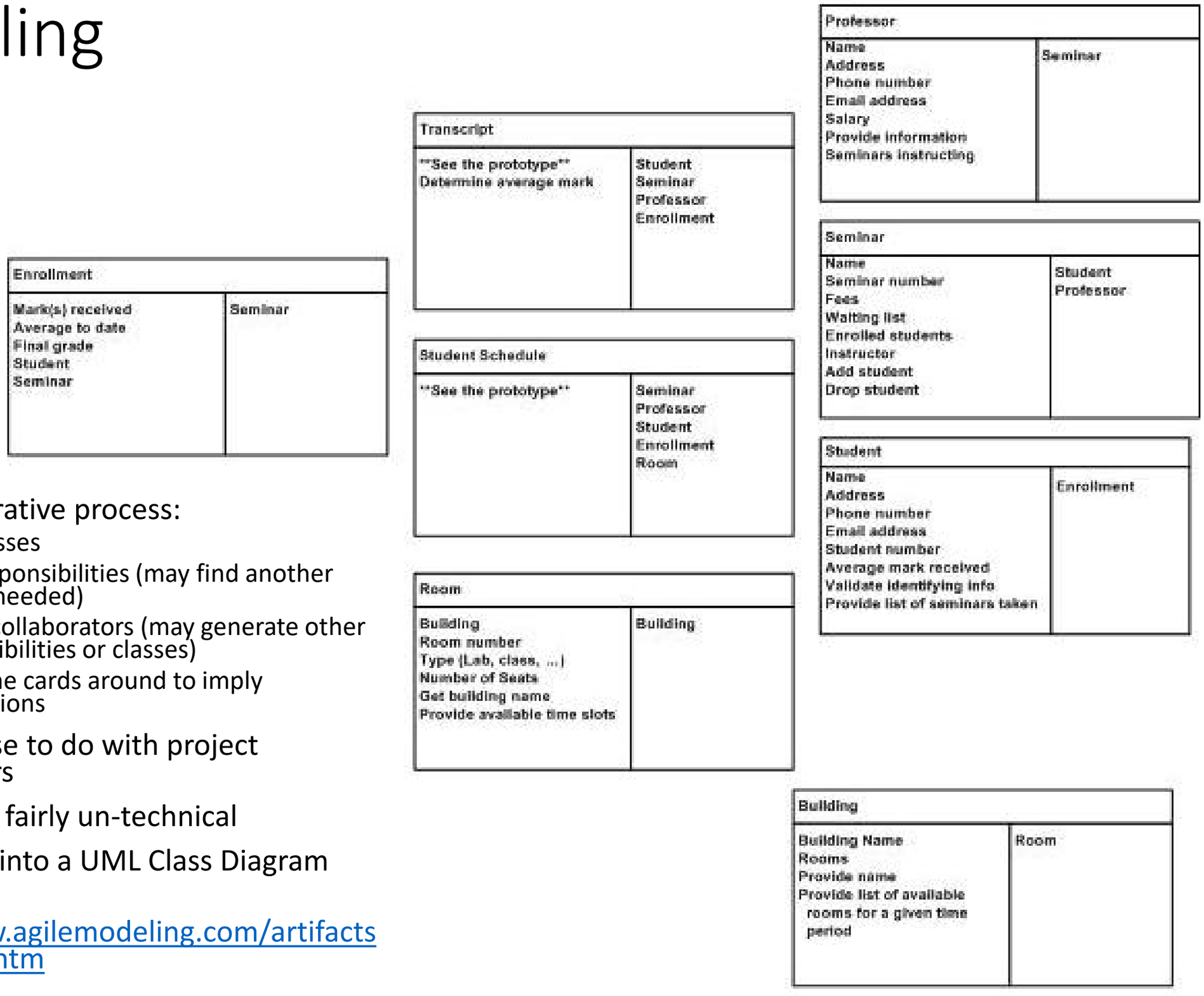
Fig. 2. An ORM schema for a book publishing domain

Class Responsibility Collaborator (CRC) Modeling

- Initially a teaching concept, became a modeling approach
- Classes are objects, people, places, things…
- Responsibilities are anything a class knows or does.
- Collaborators are anything you need to interact with to perform a responsibility
- From http://www.agilemodeling.com/artifacts/crcModel.htm



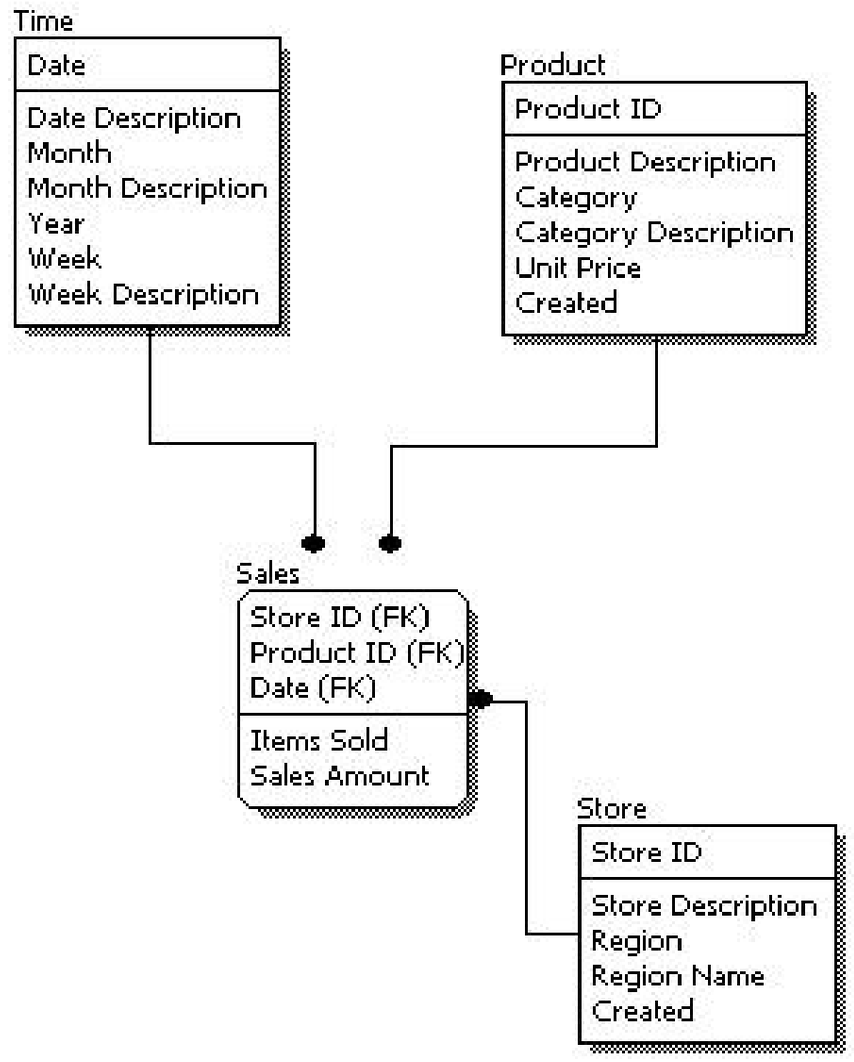
Class Responsibility Collaborator (CRC) Modeling



- General iterative process:
  - Find classes
  - Find responsibilities (may find another class is needed)
  - Define collaborators (may generate other responsibilities or classes)
  - Move the cards around to imply connections
- Nice exercise to do with project stakeholders
- Can remain fairly un-technical
- Will evolve into a UML Class Diagram
- From http://www.agilemodeling.com/artifacts/crcModel.htm

Logical Data Models (LDMs)

- Data focused model to describe data in detail without specifics of implementation in a database
- Includes all entities and relationships, with attributes and keys identified
- Database normalization can be applied to these models
- https://www.1keydata.com/datawarehousing/logical-data-model.html

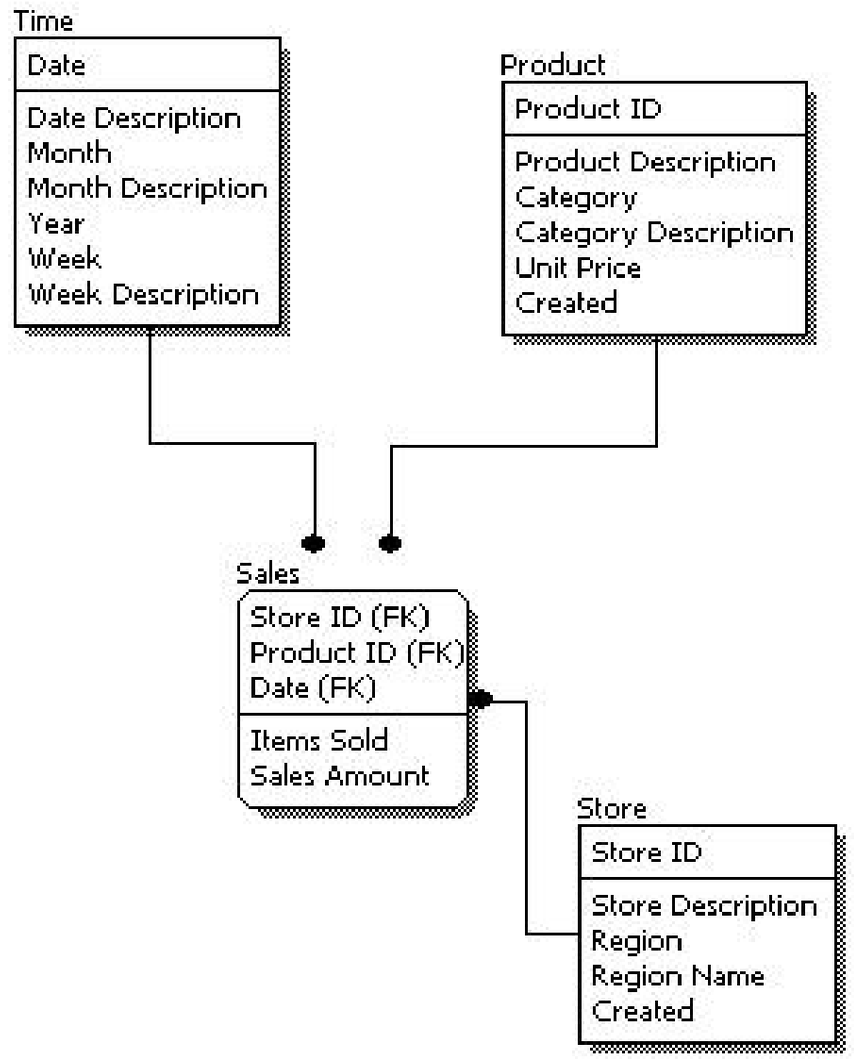


Logical Data Models (LDMs)

Typical process:

1. Specify primary keys for all entities
2. Find the relationships between different entities.
3. Find all attributes for each entity.
4. Resolve many-to-many relationships.
5. Normalization.

- https://www.1keydata.com/datawarehousing/logical-data-model.html



Analysis (or Process) Patterns

- A process pattern is a pattern which describes a proven, successful approach and/or series of actions for developing software
- Process Patterns have at least three types:
  - Task Process Patterns – steps to perform a typical task
    - Ex: Technical Review, Reuse First
  - Stage Process Patterns
    - Ex: Program, Rework
  - Phase Process Patterns
    - Ex: Initiate, Delivery
- Two published pattern books available
- Good example of an alternate pattern set for a different (if adjacent) discipline
- http://www.ambysoft.com/processPatternsPage.html

Analysis (or Process) Patterns

- Book outlines the serial phase steps in OO Development:
- Chapter 1: Introduction to the Object-Oriented Software Process
- Chapter 2: The Initiate Phase
- Chapter 3: The Define and Validate Initial Requirements Stage
- Chapter 4: The Define Initial Management Documents Stage
- Chapter 5: The Justify Stage
- Chapter 6: The Define Infrastructure Stage
- Chapter 7: The Construct Phase
- Chapter 8: The Model Stage
- Chapter 9: The Program Stage
- Chapter 10: The Test In The Small Stage
- Chapter 11: The Generalize Stage
- Chapter 12: Towards More Process Patterns.

- http://www.ambysoft.com/books/processPatterns.html

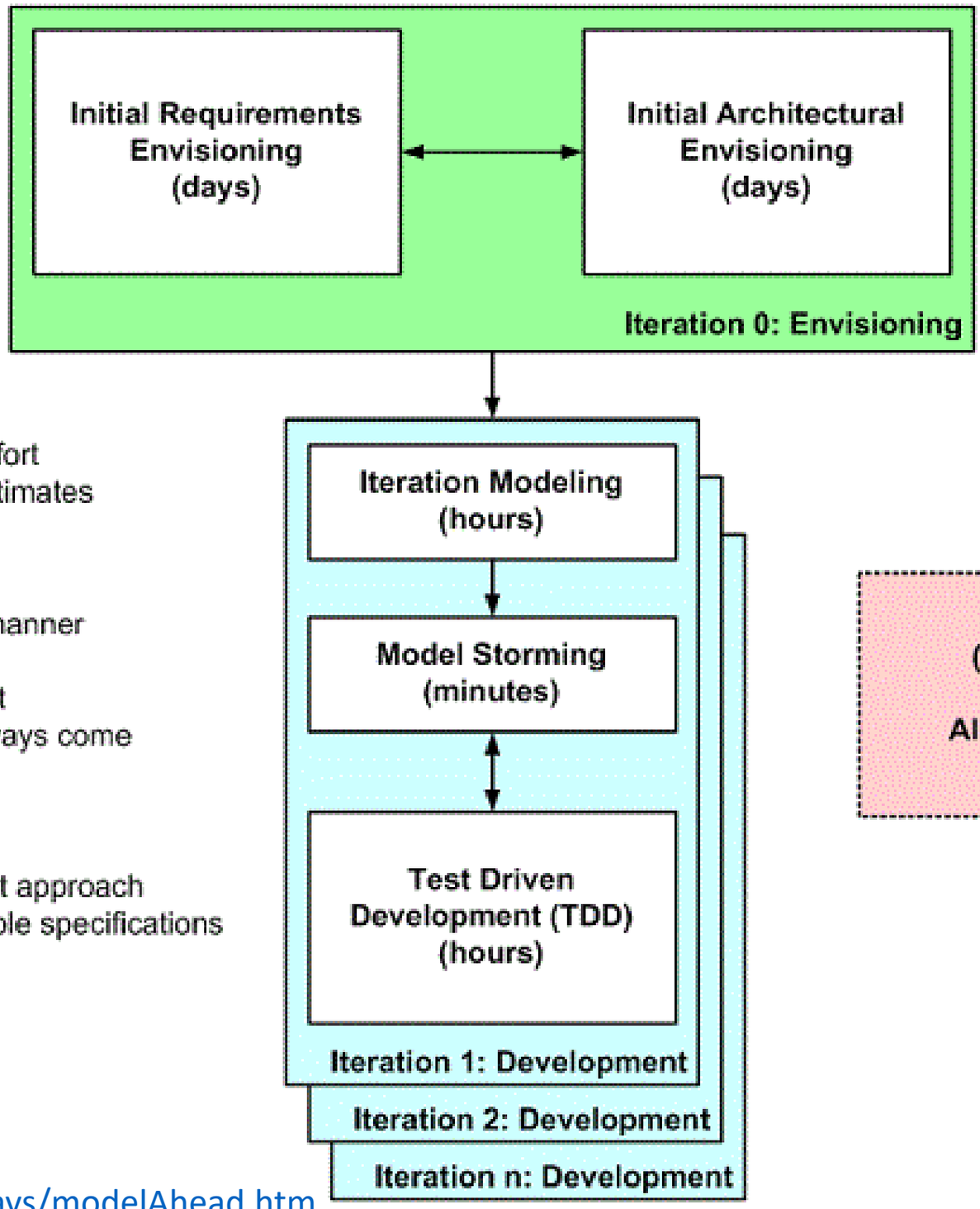
Model A Bit Ahead Pattern

- Identify the high-level scope
- Identify initial "requirements stack"
- Identify an architectural vision

- Modeling is part of iteration planning effort
- Need to model enough to give good estimates
- Need to plan the work for the iteration

- Work through specific issues on a JIT manner
- Stakeholders actively participate
- Requirements evolve throughout project
- Model just enough for now, you can always come back later

- Develop working software via a test-first approach
- Details captured in the form of executable specifications



- http://www.agilemodeling.com/essays/modelAhead.htm

Summary

- We will look at some other OO design approaches, but these are some that have been around for some time
- I think **UML modeling** is still a solid way forward
- I like **CRC cards** – can be a less technical way to explore a class/object model with non-technical stakeholders, we may see them again…
- **Robustness diagrams** may be an alternate to other UML methods if they appeal to you – mixes UIs and support in with use case models
    - You might also look at UML collaboration/communication diagrams. Good article on them in Code Magazine: https://www.codemag.com/article/0205051/UML-Collaboration-Diagrams
- There are other modeling approaches for databases to consider, **LDMs** are one, there is also the generic Entity-Relationship approach (ER modeling) that is similar and common for databases; as are Data Flow Diagrams (**DFD**)
- **ORMs** are fairly complex diagrams, you'd need to commit to understanding how they're best developed and applied – not that common in my experience
- **Analysis or process patterns** are just another example of trying to capture best practices in a pattern language, and might be helpful if you were putting together or improving development practices or processes for your team to do OO systems

Next Steps

- Project 3 UML (part 1 Wed 9/29) and code repo (part2 Wed 10/6)
- Graduate research outline due Wed 9/29 – please follow the instructions in the overall graduate research assignment in Canvas Files/Class Files
- New quiz this weekend due Wed 9/29
- New Piazza discussion topic up soon for participation grade
- Coming soon…
  - Conceptual Modelling
  - Project 2 code example
  - Singleton (in textbook, Chap. 5)
  - Command (Chap. 6)
  - Façade & Adapter (Chap. 7)
- Activity on Friday this week – UML for Patterns – no notes, just your brains – you'll need paper and writing things
- Be thinking about what your team wants to do for an OO application for Projects 5/6/7 (the Semester project); you'll be providing a proposal in Project 4 part 1
- Office hours and GitHub user IDs for class staff are on Piazza and Canvas
- If you'd like to see Dwight, Max, or Roshan at times other than their office hours, ping them on Piazza or email
- If you'd like to see Bruce outside of office hours, use my appointment app: https://brucem.appointlet.com