Fall 2025

L18 MVC & Exercise

CS 1530 Software Engineering

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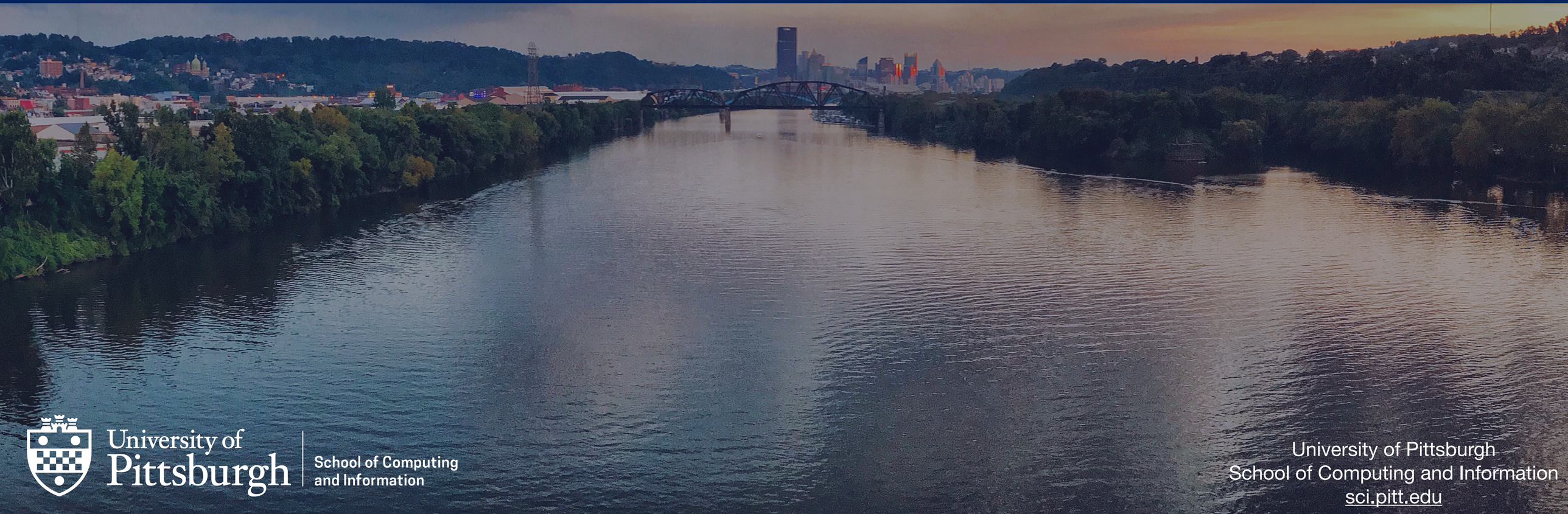

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- Material from these notes is obtained from various sources, including, but not limited to, the following:
  - Bruegge, & Dutoit. Object–oriented software engineering. using UML, patterns, and Java. Pearson, 2009.
  - Gamma, Erich, Richard Helm, Ralph Johnson, and John Vlissides. Design Patterns. Pearson, 1994.
  - Sommerville, Ian. "Software Engineering" Pearson. 2011.
  - http://scrum.org/

Learning goals

- You can model a UML component diagram

Today's roadmap

- MVC
- Model a subsystem decomposition

MVC architectural style — Motivation

- **Problem:**
  - Systems with high coupling tend to require modifications to both boundary objects (presentation/user interface) and entity objects (data) when changes are made to either component
  - Developers cannot work in parallel (UI changes can be made affect the underlying data or logic)
- **Solution:** decouple entity objects (data) from boundary objects (presentation)

MVC architectural style — Definition

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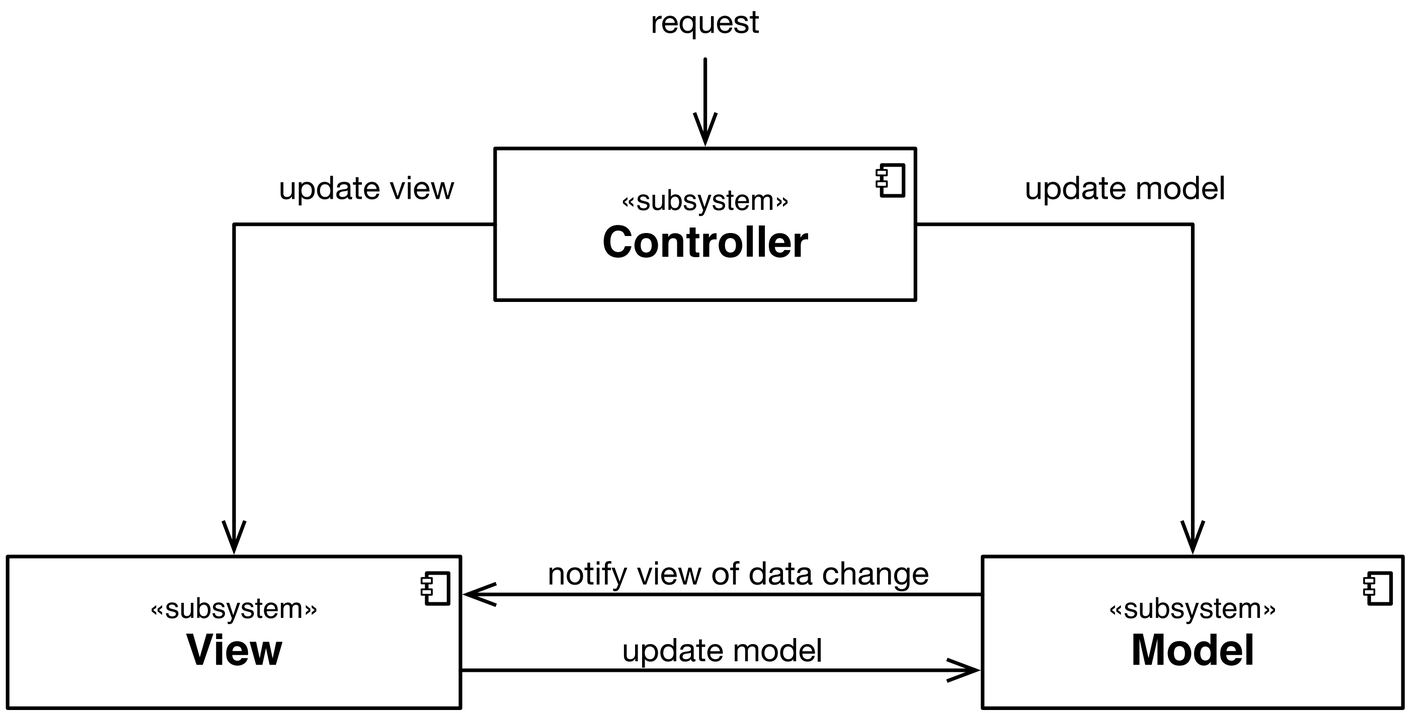
- Model-view-controller (MVC) architectural style
- MVC separates a system into three main components:
  - Model — processes and stores entity objects
  - View — displays data (boundary objects) to the user
  - Controller — Acts as an intermediary between Model and View
- MVC promotes a clear separation of concerns and modularity in application design
- Commonly used when developing user interfaces
  - Widely used in web development, desktop applications, mobile app development, …
- Enhances code maintainability and reusability

MVC architectural style — Overview

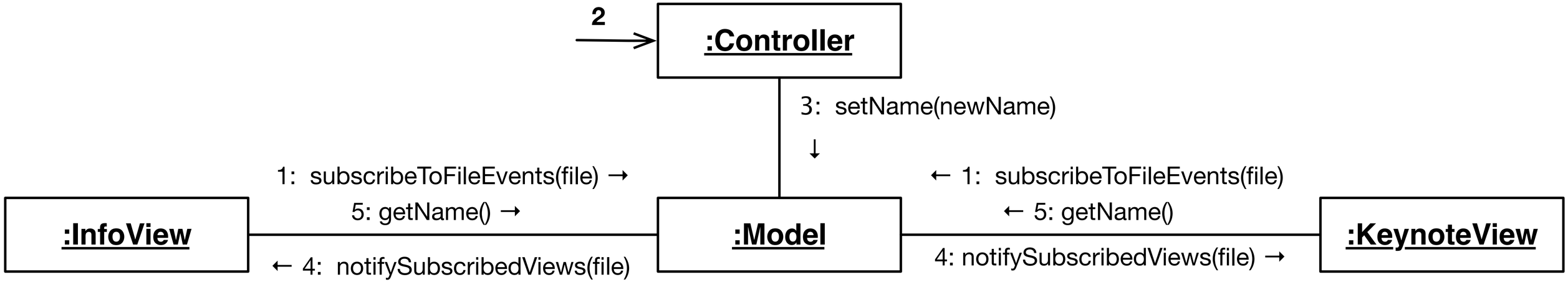
- MVC typically operates on a cycle of user interactions
- User input triggers actions within the Controller
- The Controller updates the Model based on these actions
- Changes in the Model are reflected in the View



[Example] MVC

- A website:
  - Model → HTML (handles knowledge of the website)
  - View → CSS (presentation)
  - Controller → browser (manipulates data through, e.g., user input forms)
- Mac:
  - Locate a file (keynote presentation) in the file browser (Finder)
  - Open the file's info view
  - Open the file in keynote
  - Change the file's name (the new name is synced across all views)

[Example] Update File name



Informal UML communication diagram: attributes & objects are missing

I18 - Order system (MVC)

⏳ 10min

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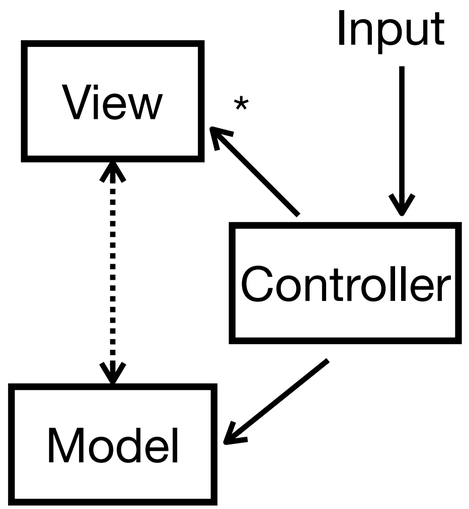
- Review: https://github.com/pitt-1530/order-app-mvc-refactor
- Describe how you would refactor the system to use the Model-View-Controller architecture

Deisgn goals

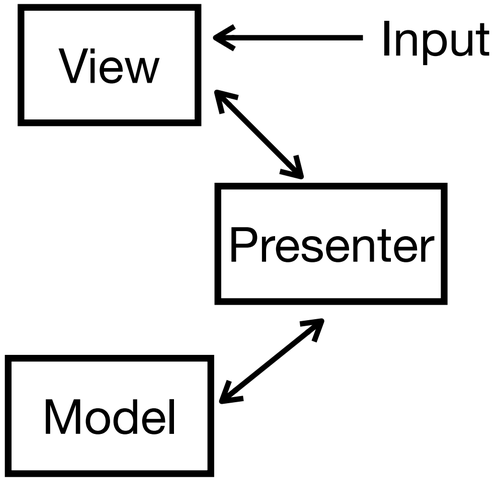
- Maintainability: Each component isolated
- Modifiability: UI changes don’t break logic
- Reusability: Same model works for different interfaces
- Parallel development: Teams work on different subsystems

Variations of MVC



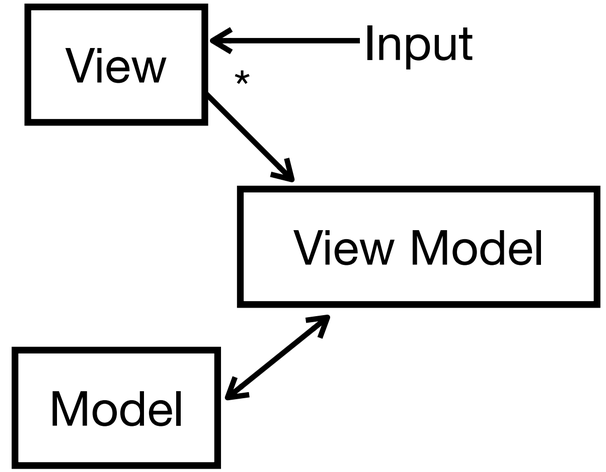
MVC
(Model-View-Controller)

Presenter replaces controller, View is passive



MVP
(Model-View-Presenter)

ViewModel exposes data, View updates automatically via data binding



MVVM
(Model-View-Viewmodel)

When to use MVC

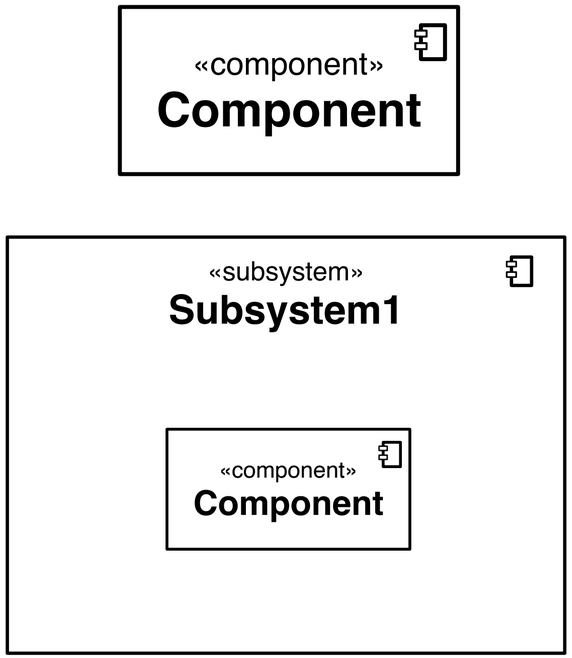
- Multiple synchronized views of the same model
- Exchangeable views and controllers
- Exchangeability of look and feel
- Considerations
  - Increased complexity
  - Potential for excessive number of updates
  - Close coupling of views and controllers to model

Today's roadmap

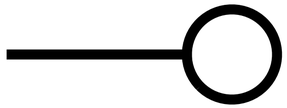
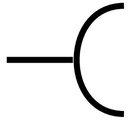
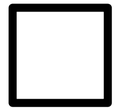
- MVC
- Model a subsystem decomposition

[Recap] UML component diagram

- High-level view of the system's design using components and dependencies
- A **UML component** represents a system part (such as classes, packages, or subsystems)
- UML component diagrams are used for:
  - **Architectural design and planning**
  - Identifying system components and their interactions
  - Representing the high-level structure of a software system
- Represented as a rectangle with a tabbed rectangle symbol inside



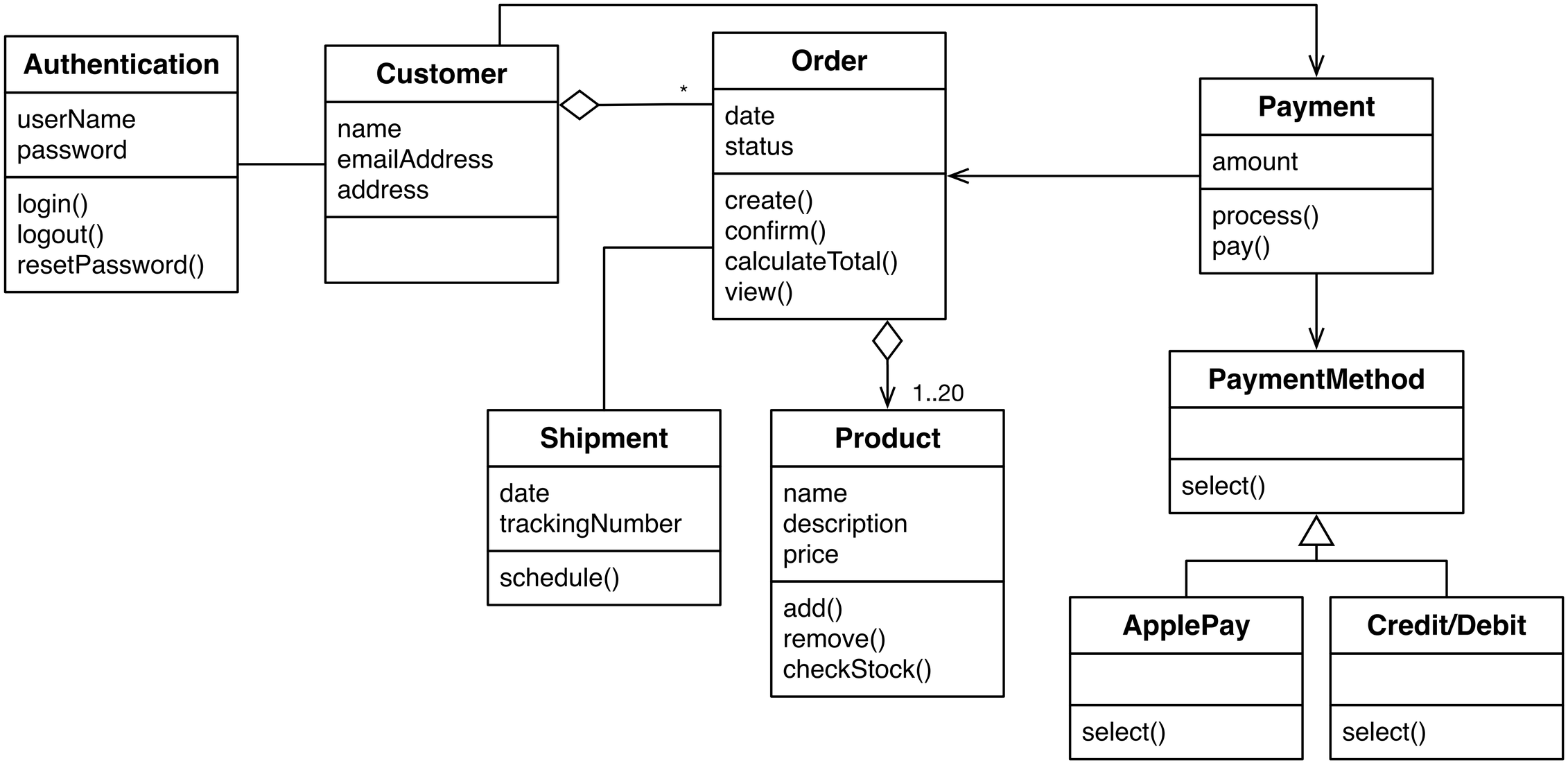
[Recap] UML interfaces

- Define how components interact with each other or with external entities
- Specify the required and provided services:
  - Lollipop: provided interface 
  - Socket: required interface 
  - Dependency 
    (a component depends on the implementation of another component)
  - A **port** specifies a distinct interaction point between the component and its environment 
    - Ports are depicted as small squares on the sides of classifiers
    - Ports allow to group interfaces

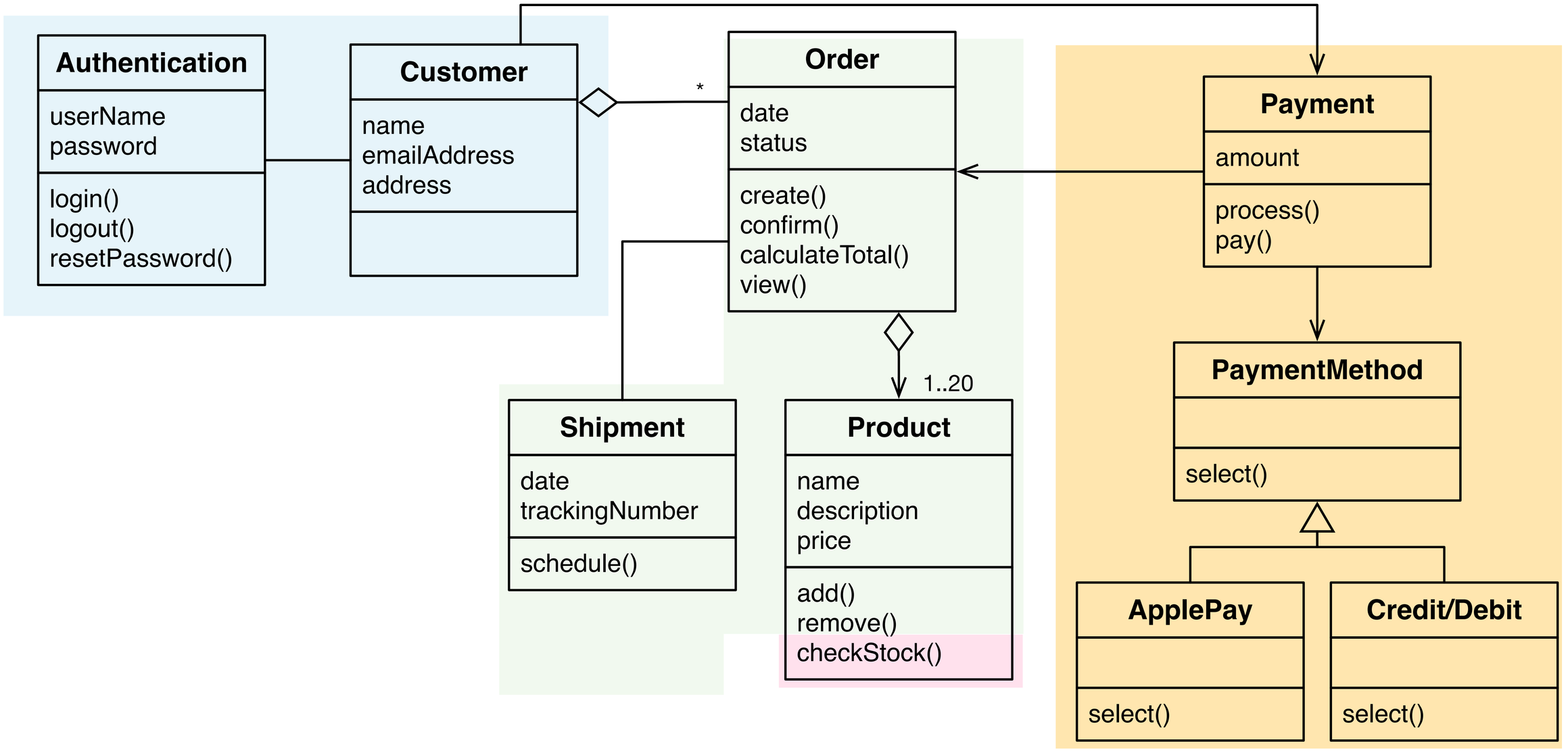
[Recap] Subsystem decomposition — Steps

1. **Identify functional components:** Break the system into functional components with distinct roles
2. **Define interfaces:** Clearly specify how subsystems interact and exchange data
3. **Organize subsystems:** E.g., organize subsystems hierarchically
4. **Assign responsibility**: Assign responsibilities to each subsystem
5. **Manage dependencies**: Minimize dependencies between subsystems

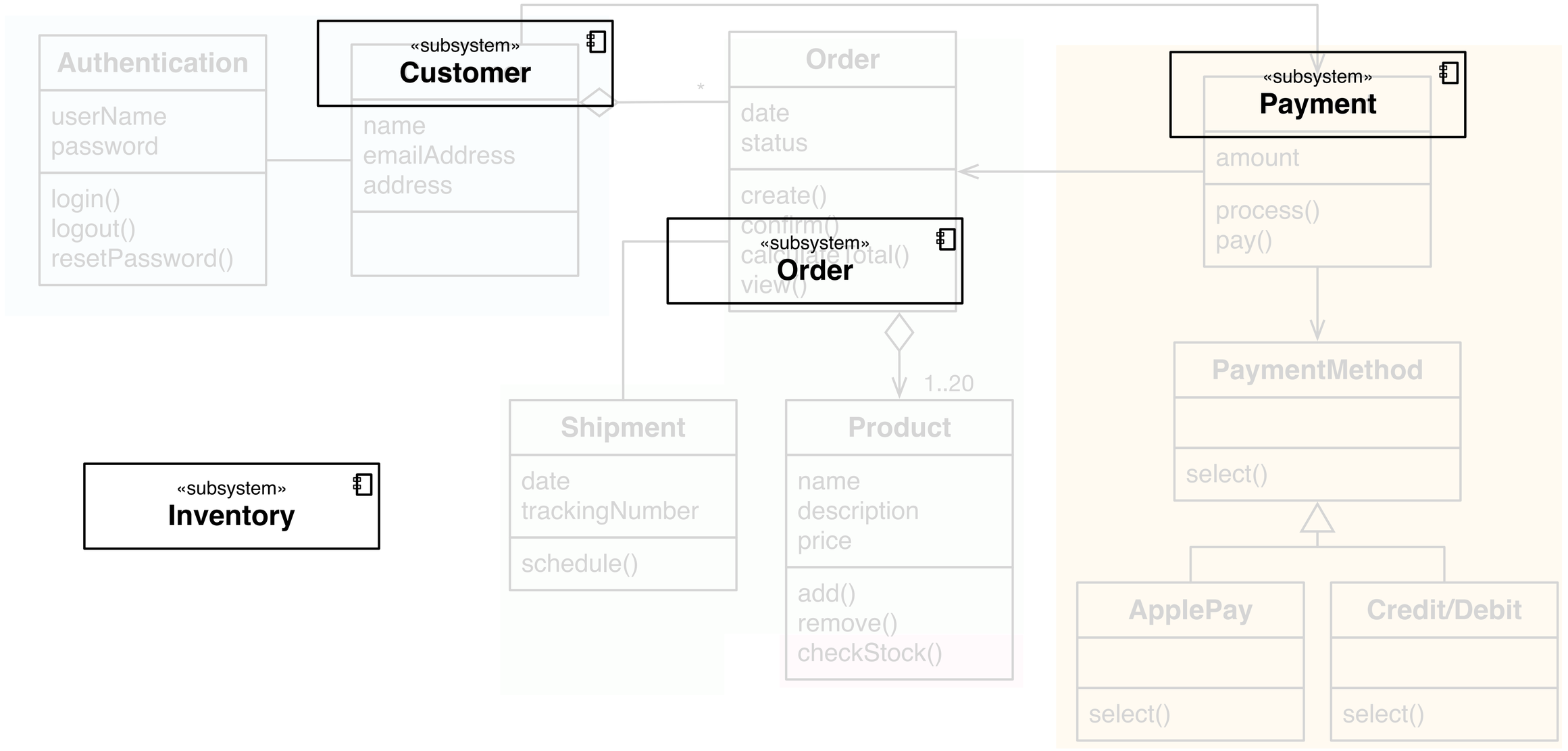
[Example] E-Commerce Ordering System



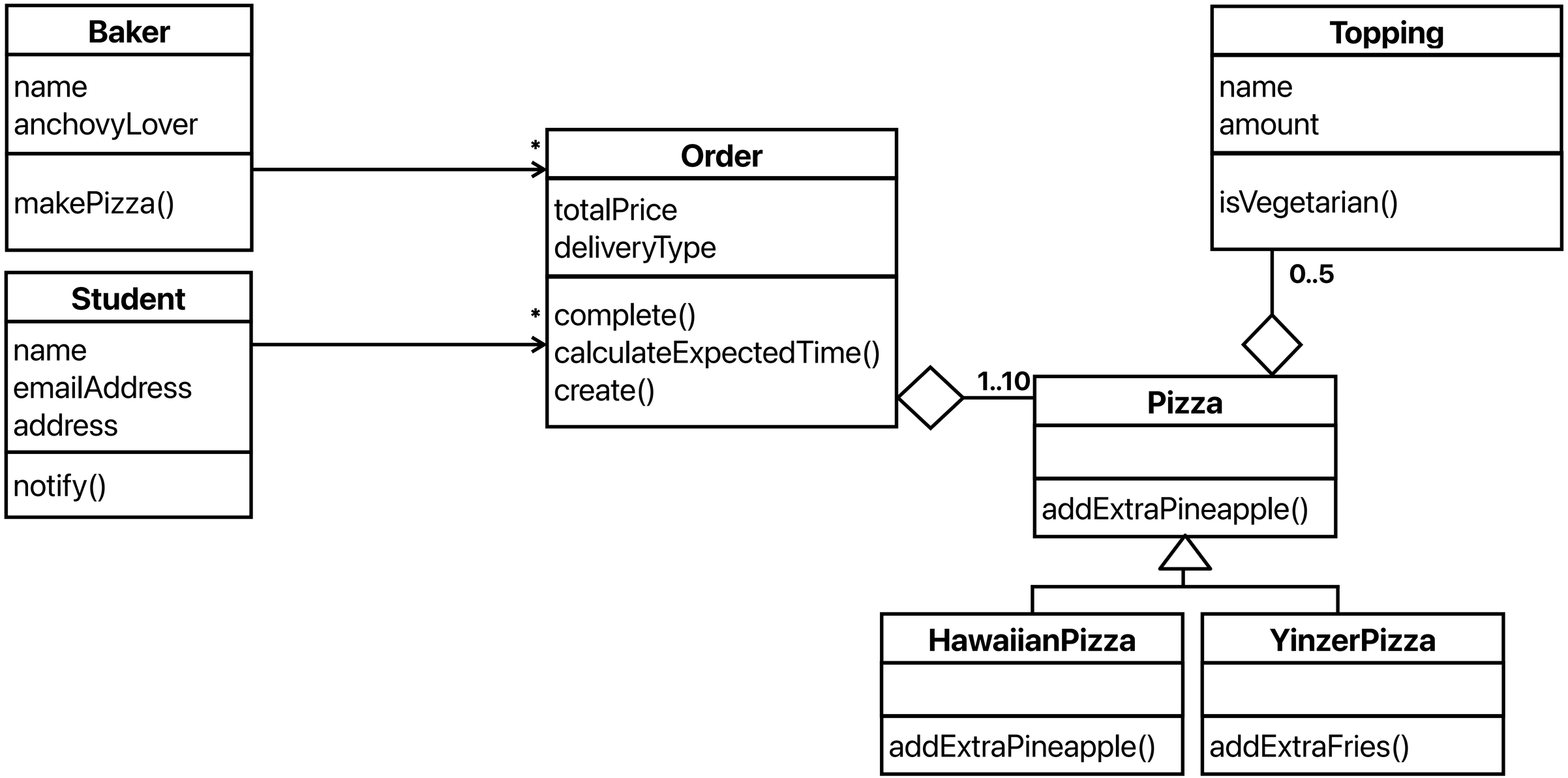
[Example] E-Commerce Ordering System - Option I



[Example] E-Commerce Ordering System - Option I



[Example] Pizza Ordering System



I18 In-class: Subsystem Decomposition

⏳ 15 min

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Decompose your own or the provided pizza ordering system analysis object model into subsystems:

- Create a **UML component diagram**
- Decide on interfaces
- Remember the SOLID principles!
- **Review architectural styles: Can they solve a "problem"?**
- Add a discussion (3-6 sentences / short bullet points) how your architecture follows SOLID and which architectural style(s) you have chosen and why.
  - Describe at least 3 SOLID principles

References

- Bruegge, & Dutoit. Object–oriented software engineering. using UML, patterns, and Java. Pearson, 2009.
- Object Management Group. Unified Modeling Language. Version 2.5.1, 2017

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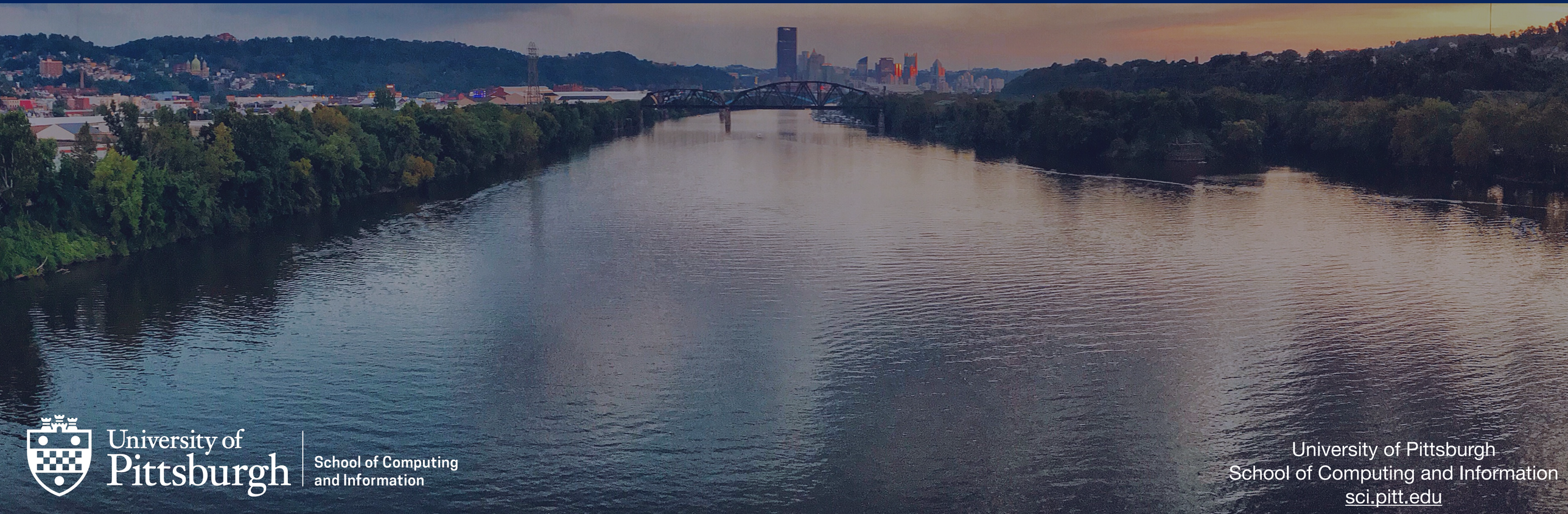

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