

Informatics 43

LECTURE 6-2

EMILY NAVARRO

Today's Lecture

- Design phase of software engineering
- Designs
- Abstraction
- Design notations / diagrams
 - UML diagrams
 - Other diagrams

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- Design phase of software engineering
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Software design



Requirements



Code

Software design

Requirements



Code

Software design

Requirements

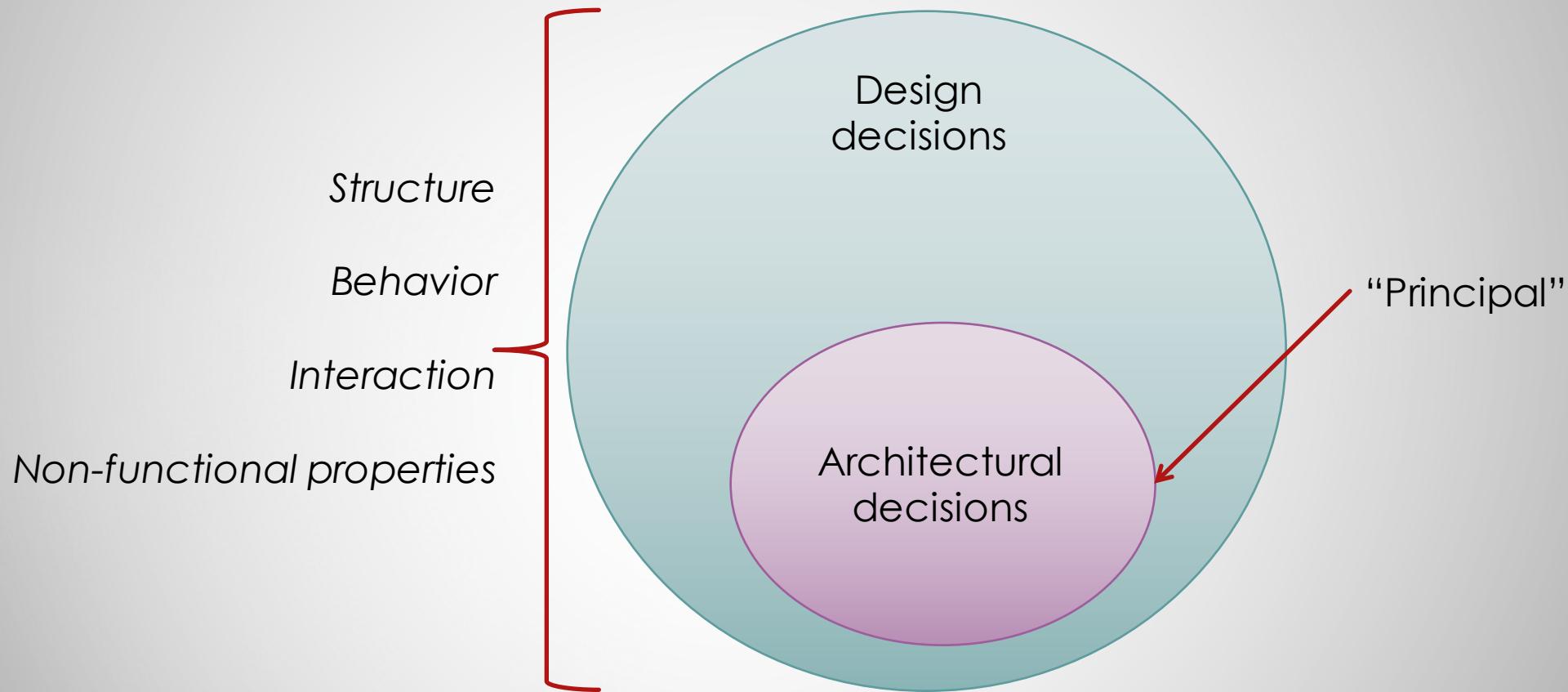


Architecture & **Design**

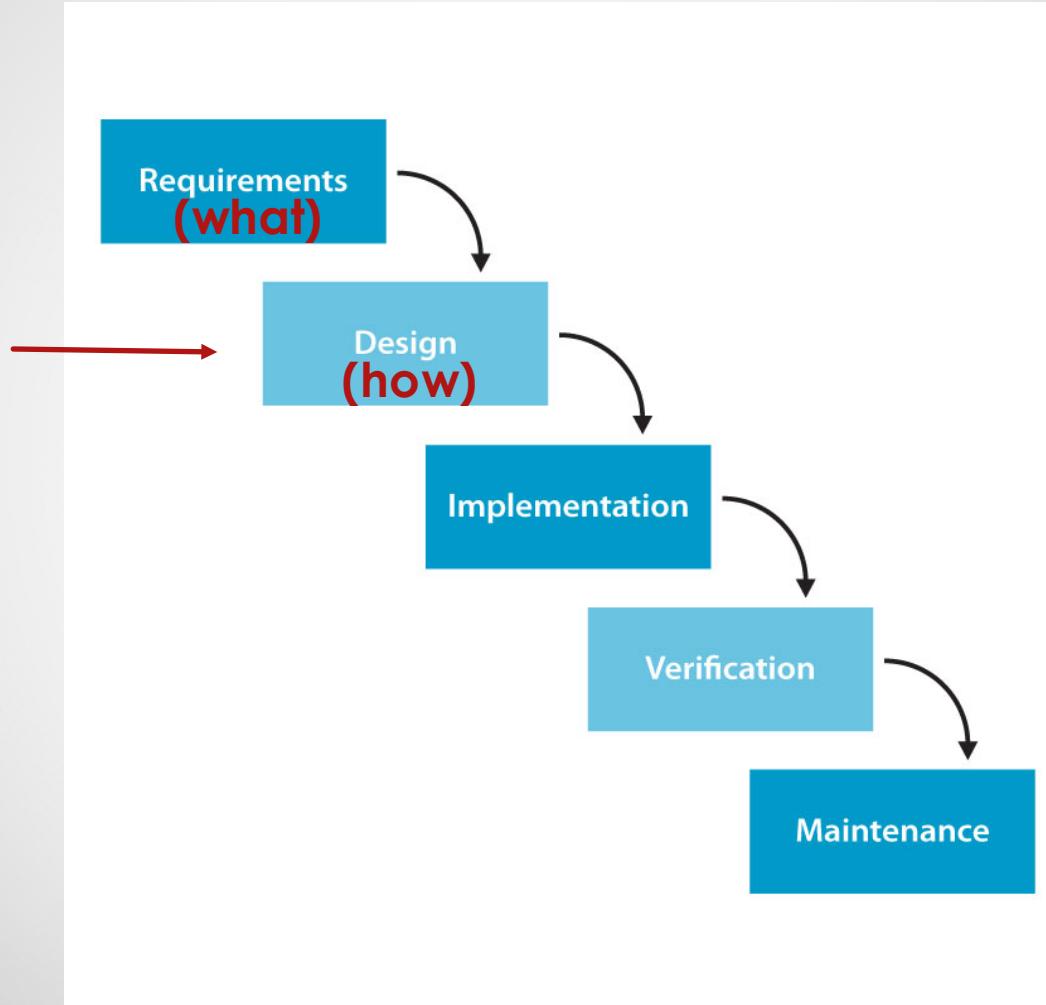


Code

Software design



Design Phase of Software Engineering



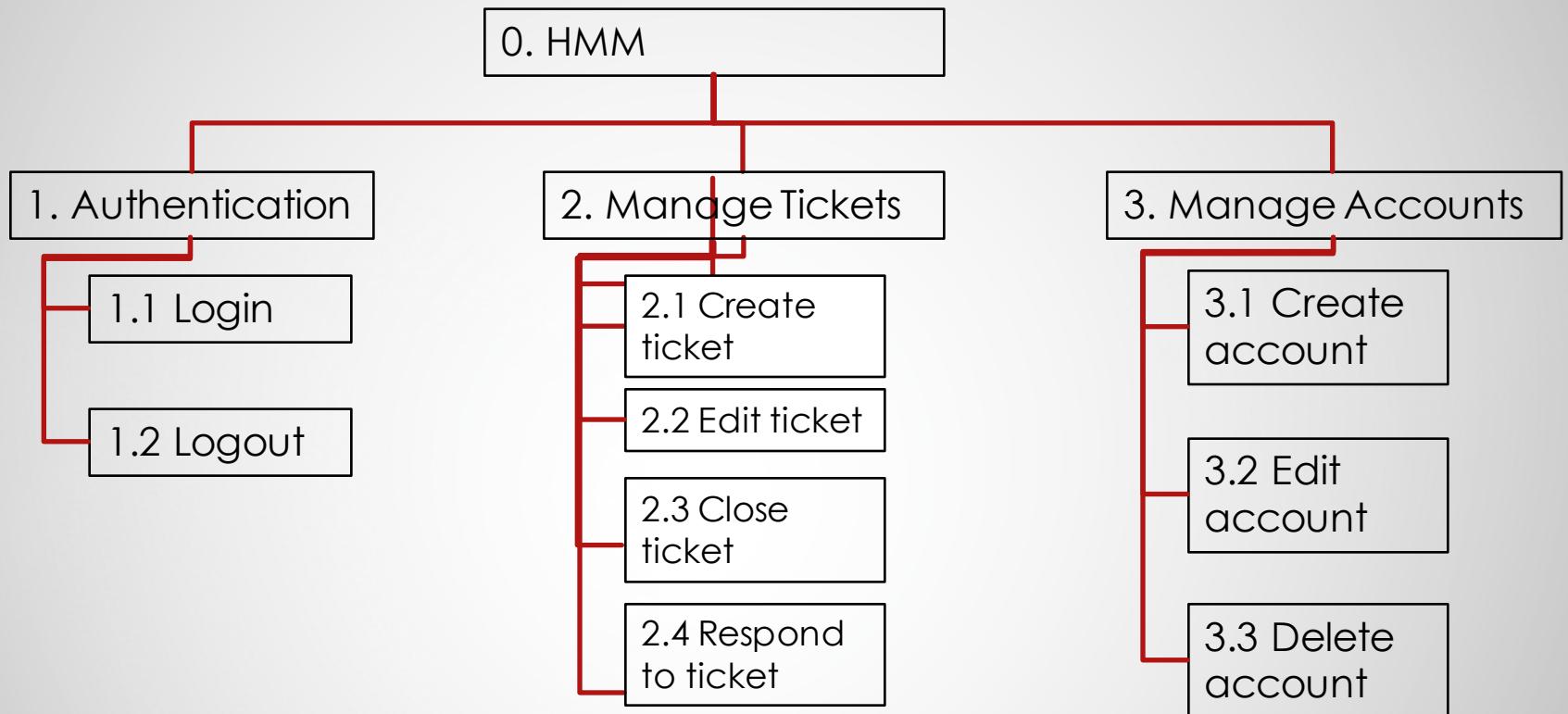
Software Design Goals/Activities

- Making system-wide decisions
 - Architecture, languages, libraries, platforms
- Making lower-level decisions in an *iterative* manner
 - Studying the problem
 - Identifying solutions
 - Creating abstractions

Approaches to Software Design (Textbook)

- Software architecture
- Functional decomposition
- Relational database design
- Object-oriented design and UML
- User interface design
- (Sketching)

Functional Decomposition



Relational Database Design

Hypothetical Relational Database Model

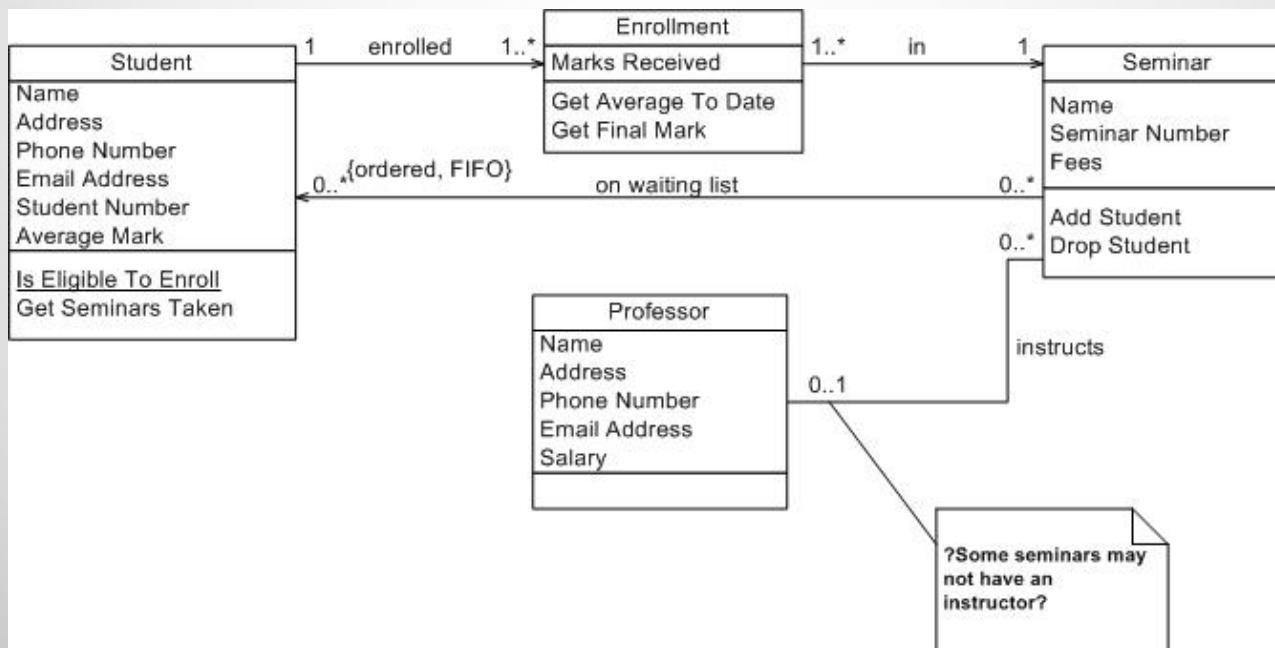
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03-4472822	Random House	123 4th Street, New York
04-7733903	Wiley and Sons	45 Lincoln Blvd, Chicago
03-4859223	O'Reilly Press	77 Boston Ave, Cambridge
03-3920886	City Lights Books	99 Market, San Francisco

AuthorID	AuthorName	AuthorBDay
345-28-2938	Haile Selassie	14-Aug-92
392-48-9965	Joe Blow	14-Mar-15
454-22-4012	Sally Hemmings	12-Sept-70
663-59-1254	Hannah Arendt	12-Mar-06

ISBN	AuthorID	PubID	Date	Title
1-34532-482-1	345-28-2938	03-4472822	1990	Cold Fusion for Dummies
1-38482-995-1	392-48-9965	04-7733903	1985	Macrame and Straw Tying
2-35921-499-4	454-22-4012	03-4859223	1952	Fluid Dynamics of Aquaducts
1-38278-293-4	663-59-1254	03-3920886	1967	Beads, Baskets & Revolution

Object-Oriented Design and UML

- An “object” contains both data and methods
- A “class” is a blueprint for making objects



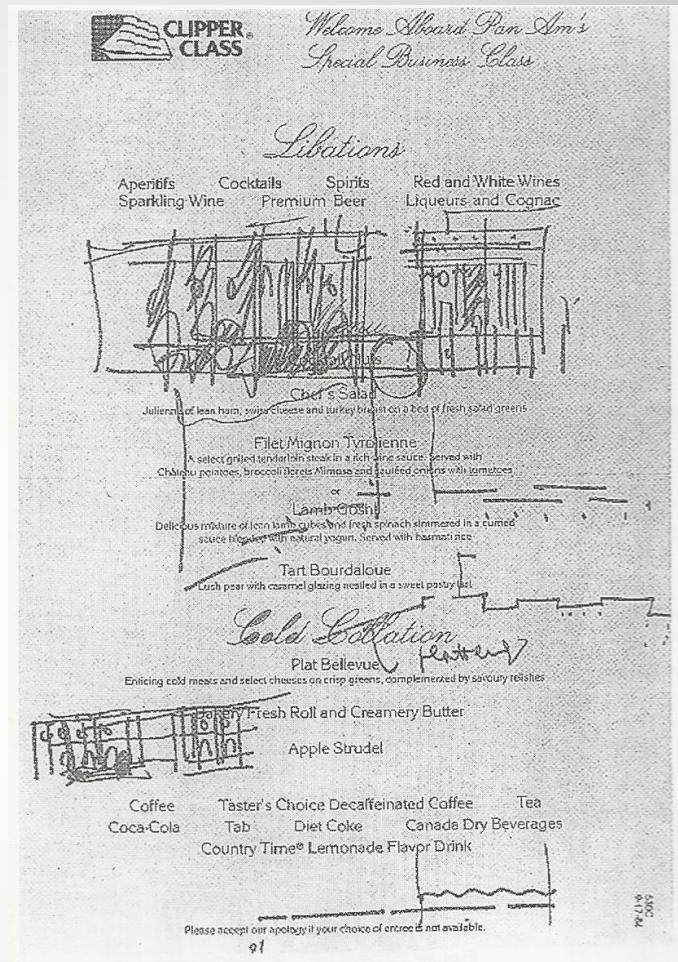
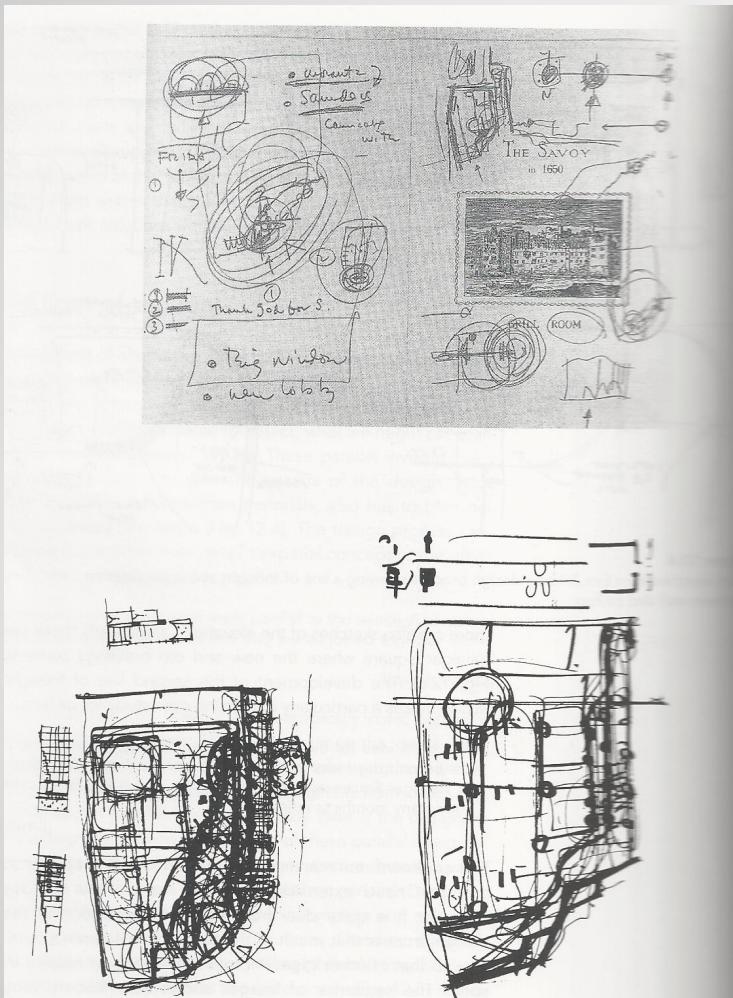
User Interface Design



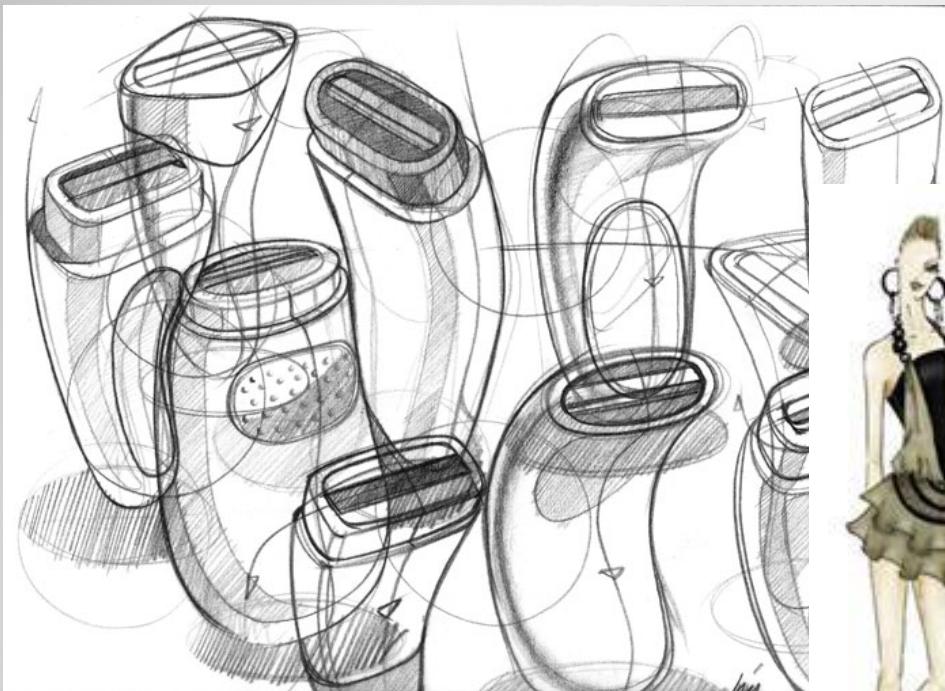
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Designs



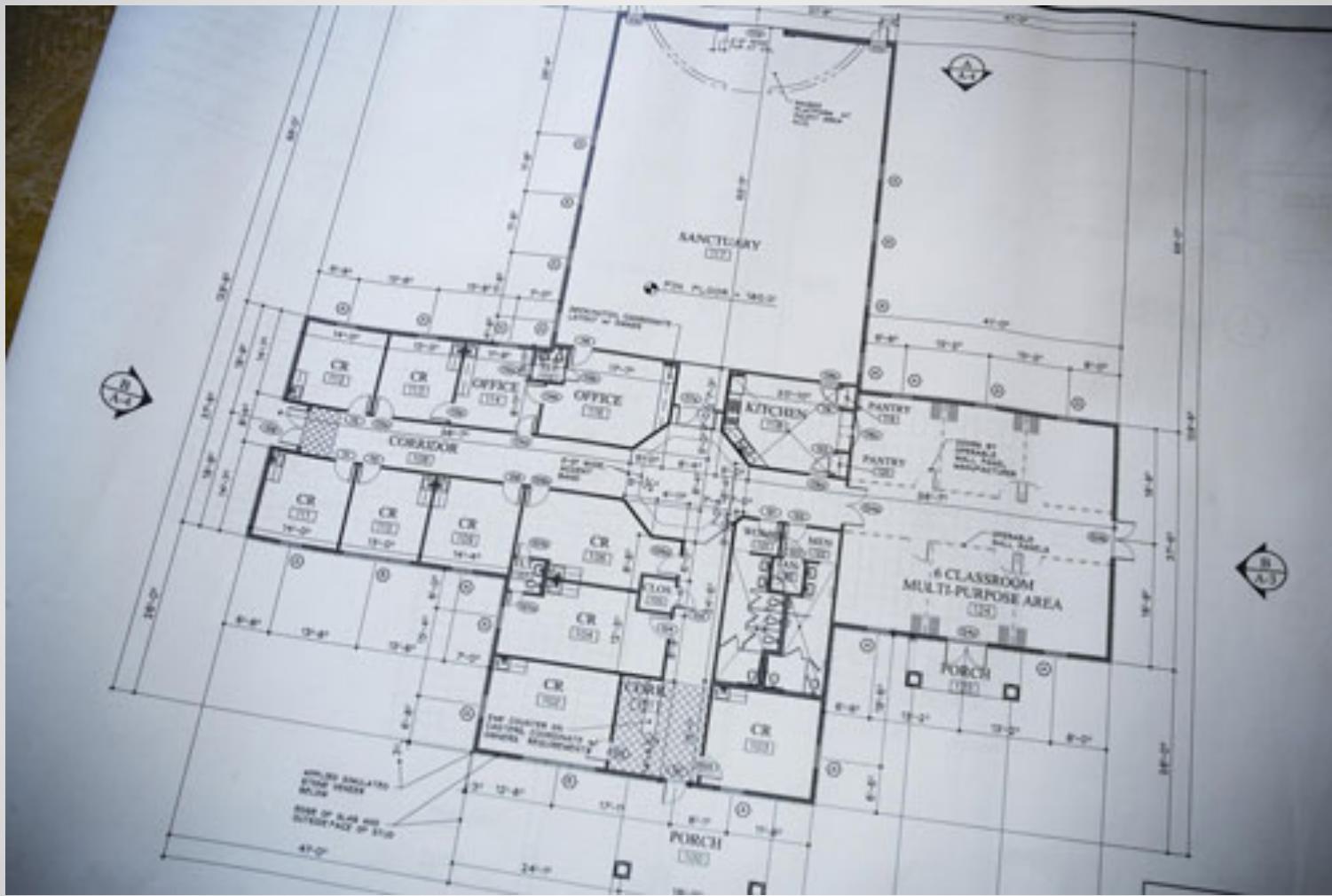
Designs



Designs



Designs



Designs



Designs



Purpose of designs

- Designs to *think*
- Designs to *talk*
- Designs to *prescribe*

Designs are developed **iteratively**

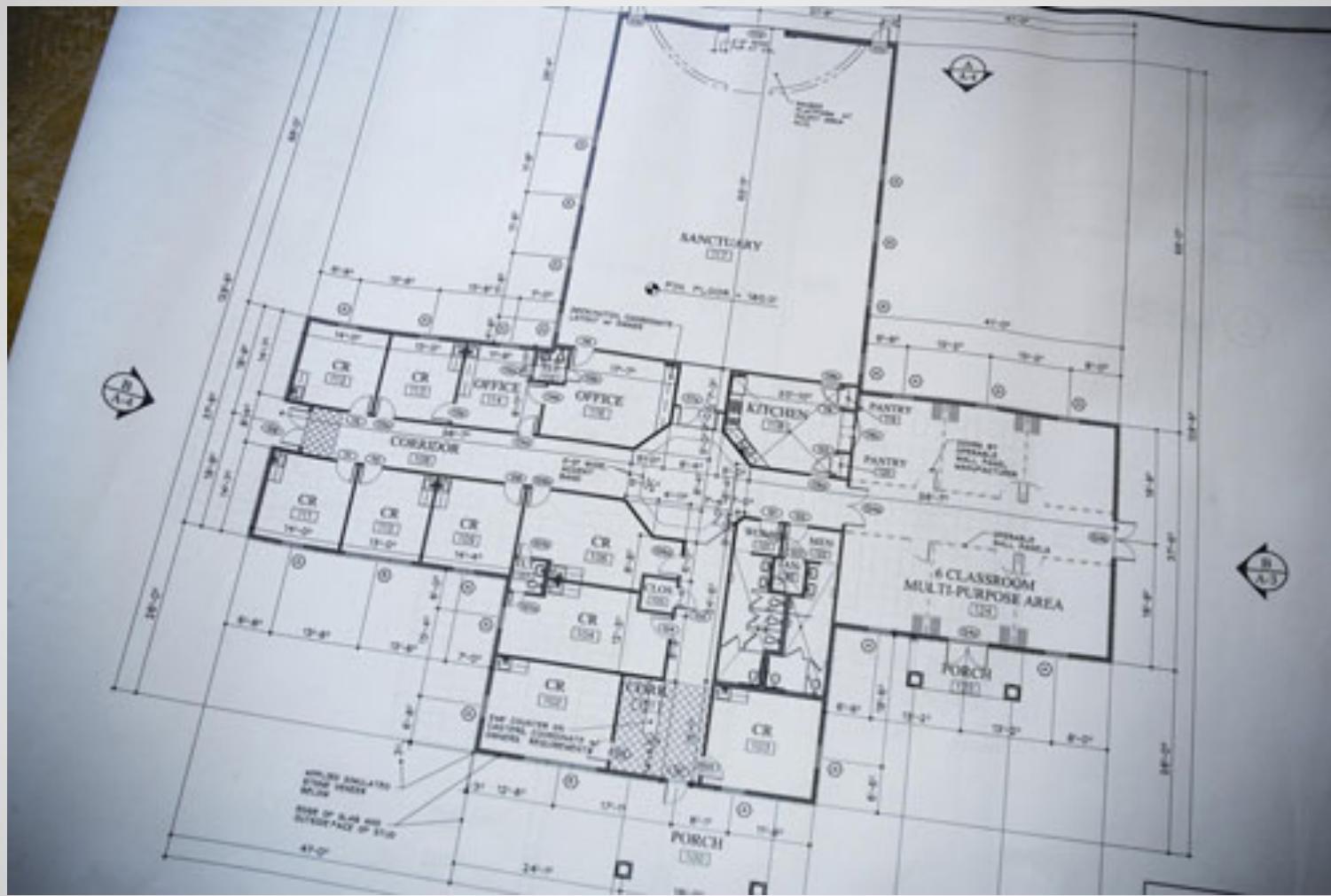
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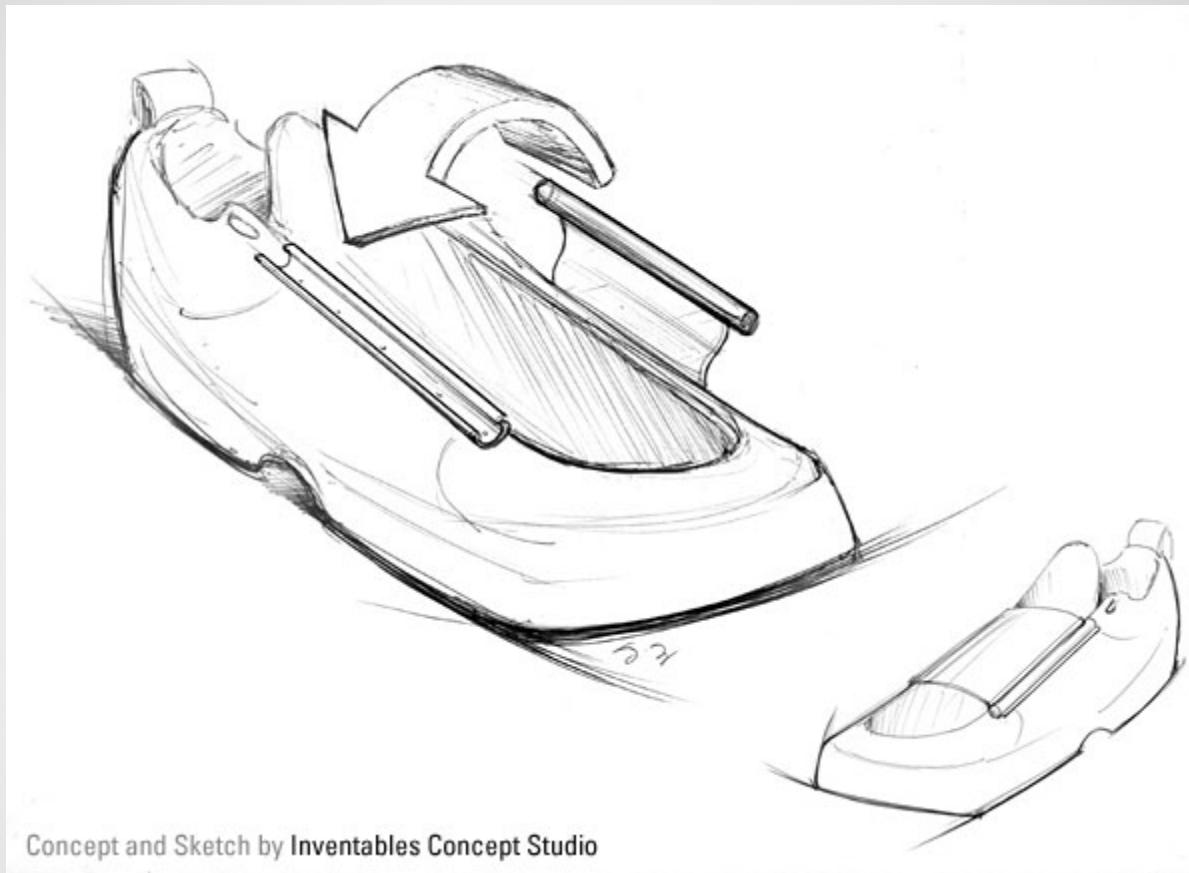
Abstraction

- Abstractions are formed by removing irrelevant information and retaining relevant information
- Every design notation supports a certain kind of abstraction

Designs/Models



Designs/Models



Concept and Sketch by Inventables Concept Studio

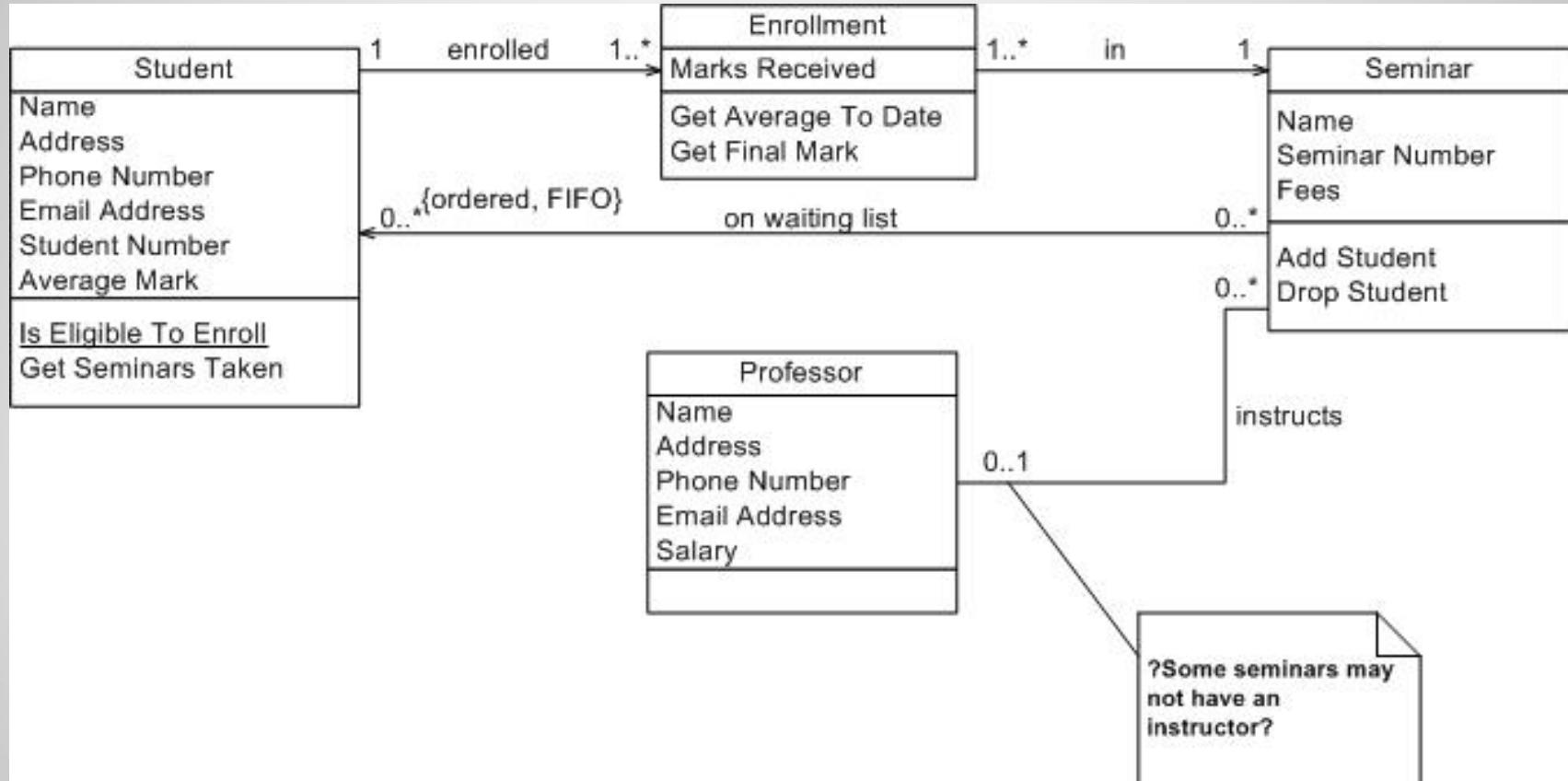
Designs/Models



Designs/Models



Designs/Models



Today's Lecture

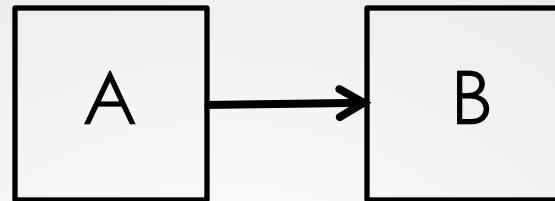
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Design notations

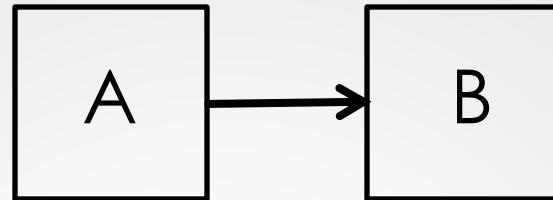
“By relieving the brain of all unnecessary work, a good notation sets it free to concentrate on more advanced problems, and in effect increases the mental power of the race.”

-A.N. Whitehead

What might this mean?



What might this mean?



- A happens before B
- A uses B
- A calls B
- A is composed of B
- B is a result of A
- A becomes like B
- A is necessary for B
- ...

A diagram is a **statement** in a **language** that has a **syntax**

Software Development Languages

Different languages are used at different stages:

Requirements

Design

Coding/Testing

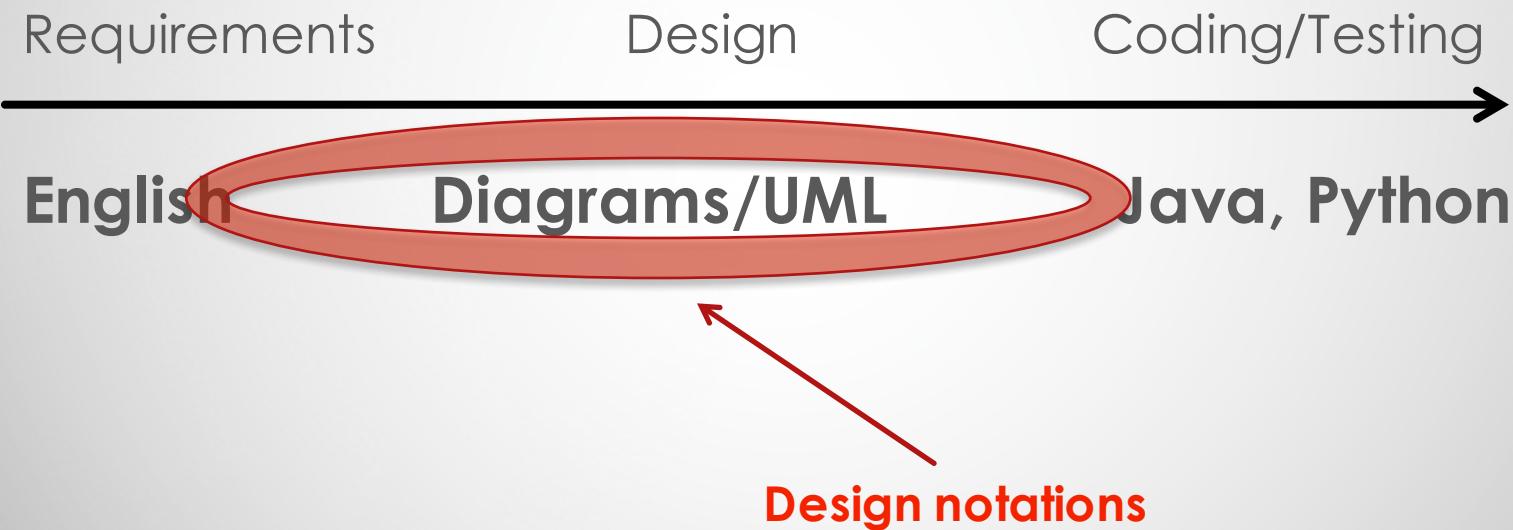
English

Diagrams/UML

Java, Python

Software Development Languages

Different languages are used at different stages:



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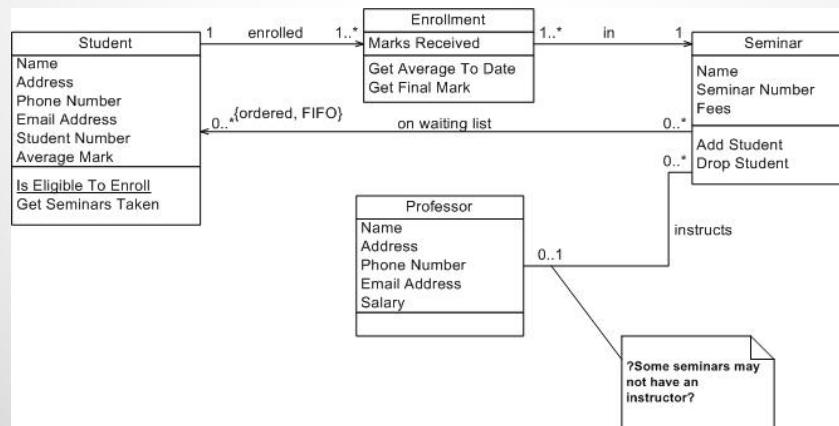
UML (Unified Modeling Language)

- Industry standard for software design/modeling
- Different types of UML diagrams are used to represent different aspects (structure, behavior, interactions) of a system
 - Class diagrams
 - Activity diagrams
 - Sequence diagrams
 - Use case diagrams
 - ...

Some following slides from
www.cs.drexel.edu/~spiros/teaching/CS575/slides/uml.ppt

UML Class Diagrams

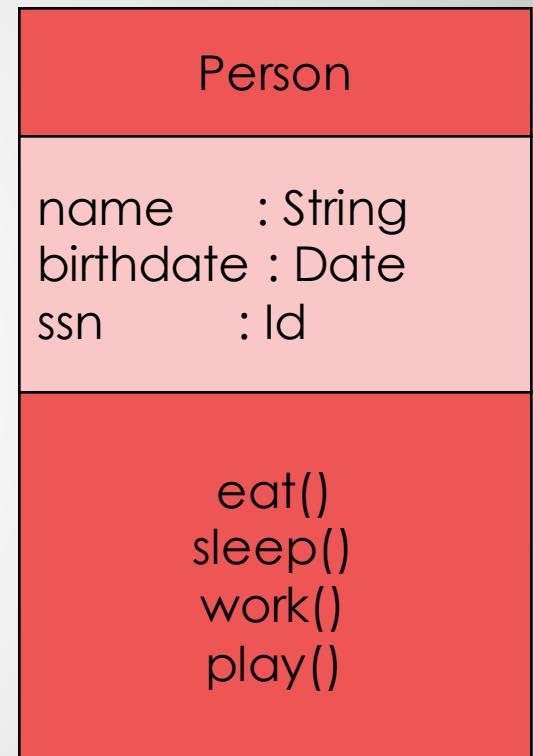
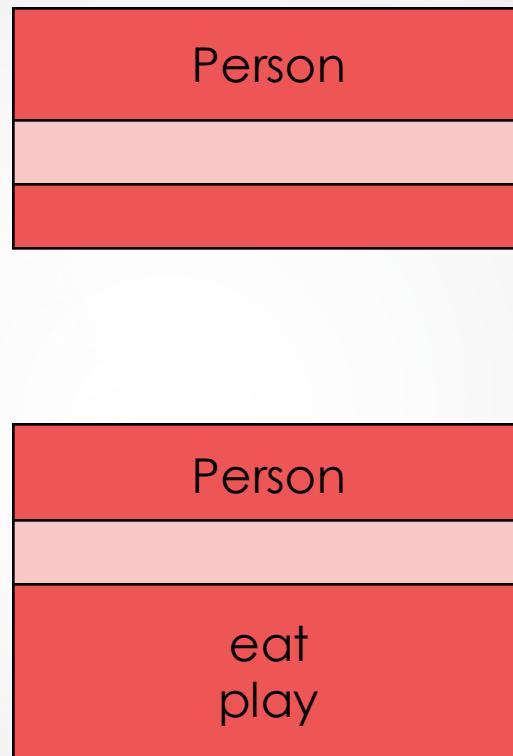
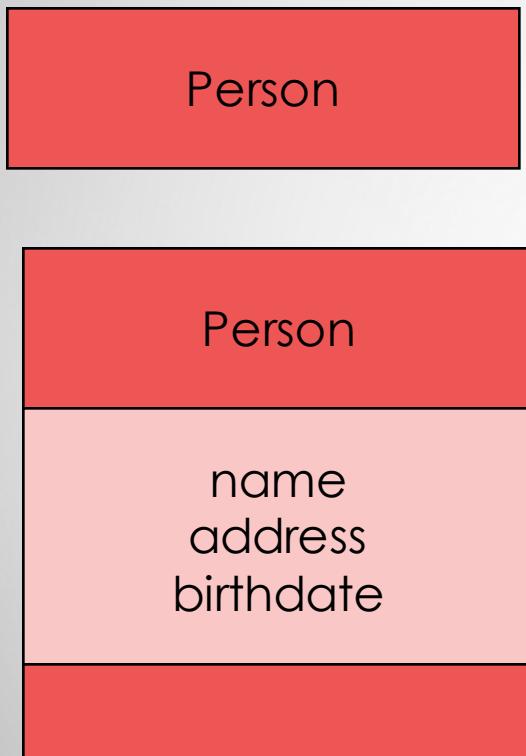
- Used in decomposing a system into modules known as classes
- Typically used to
 - model domain concepts
 - create a detailed, object oriented design of the code



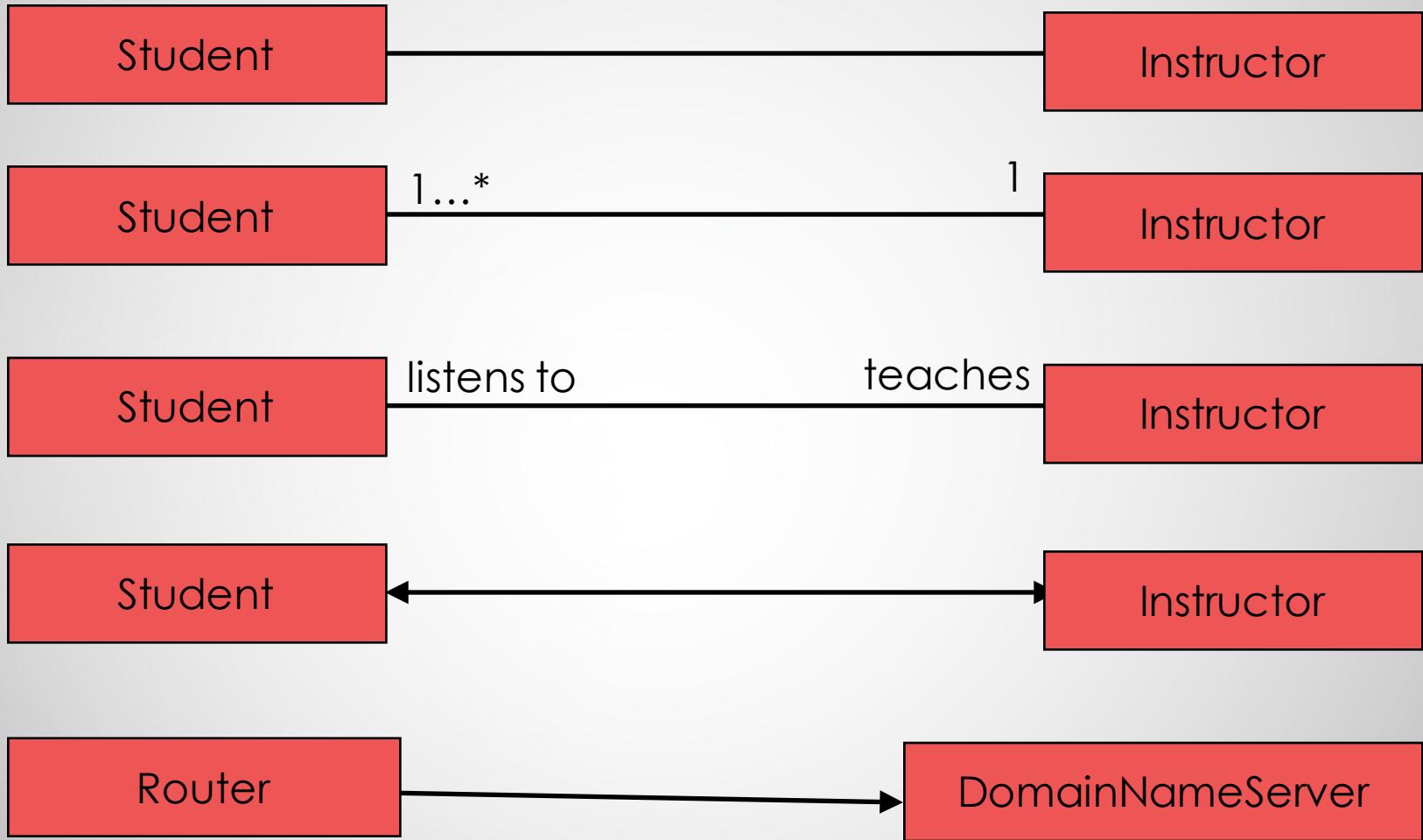
Classes



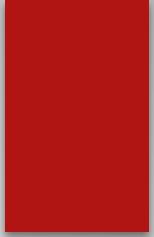
Depicting Classes



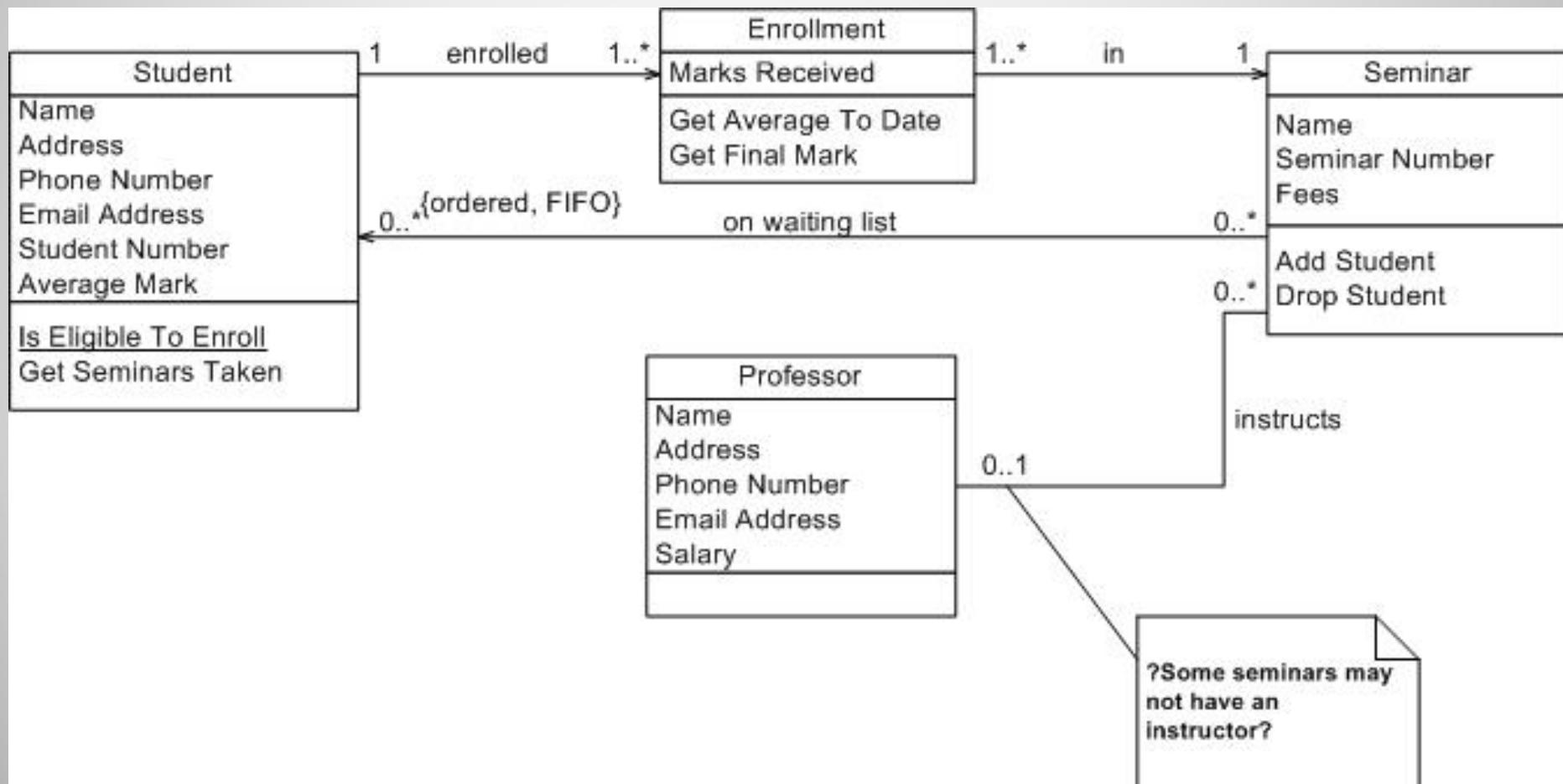
Association Relationships



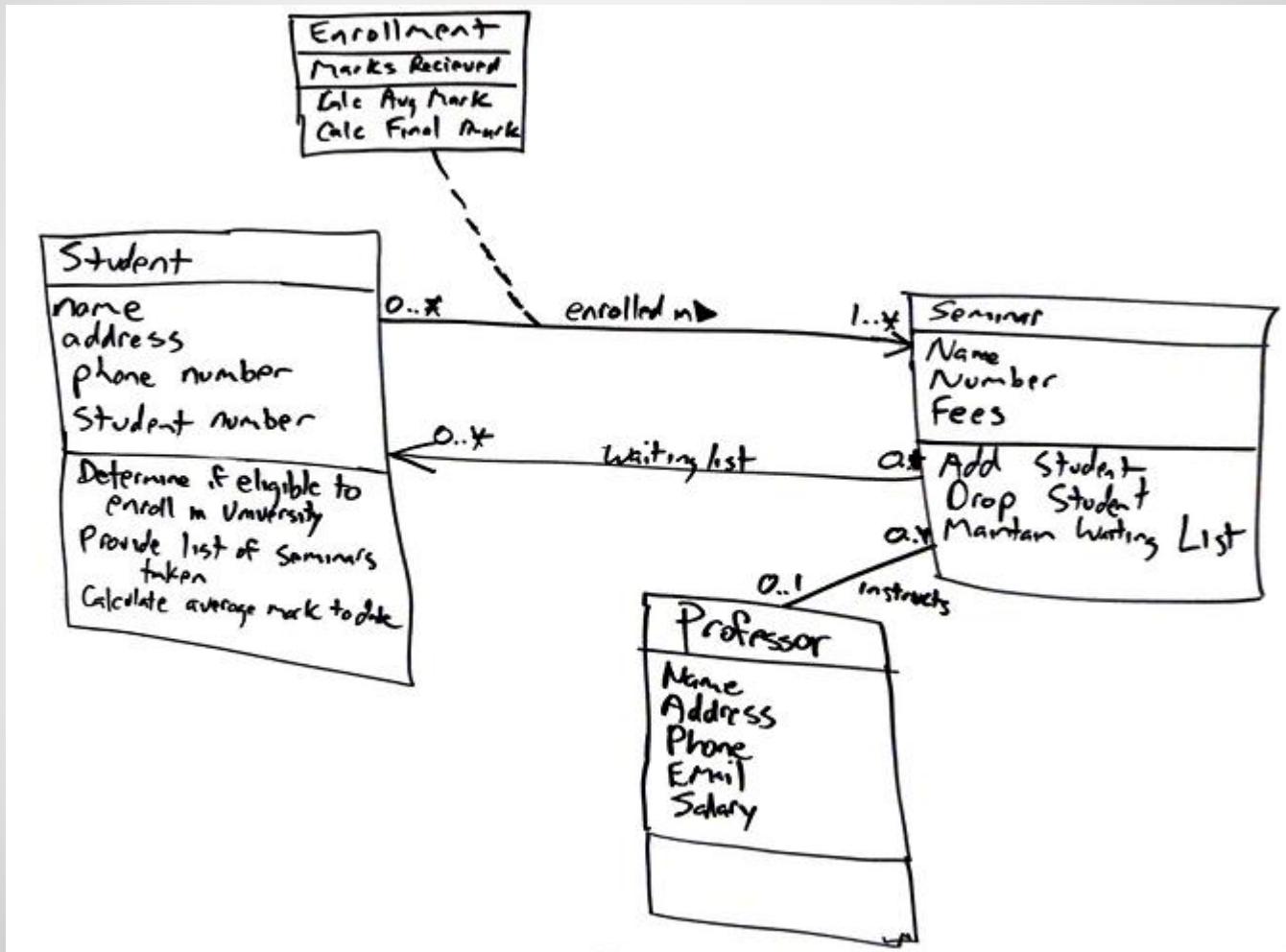
Example: HMM



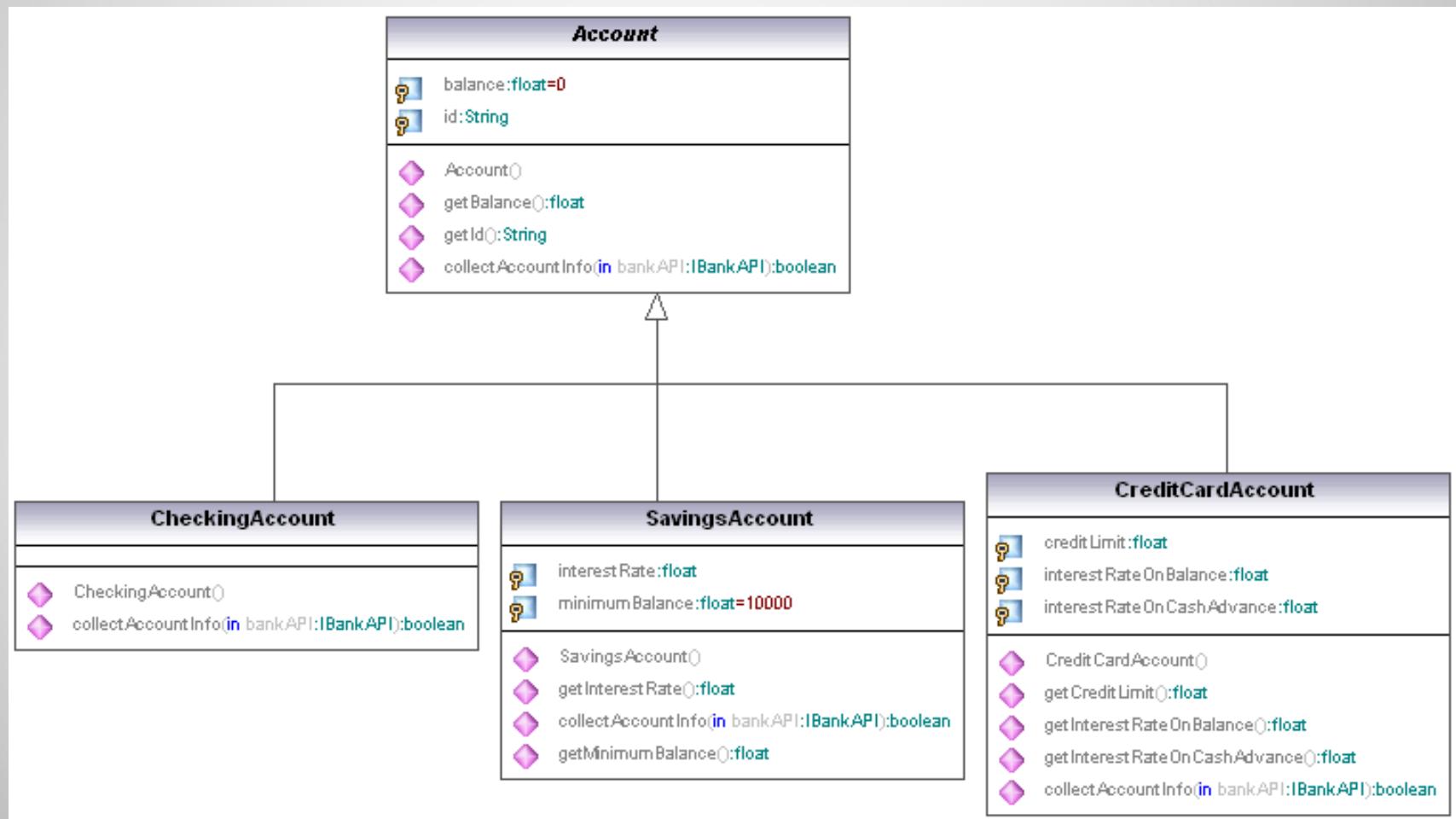
Examples – UML Class Diagrams



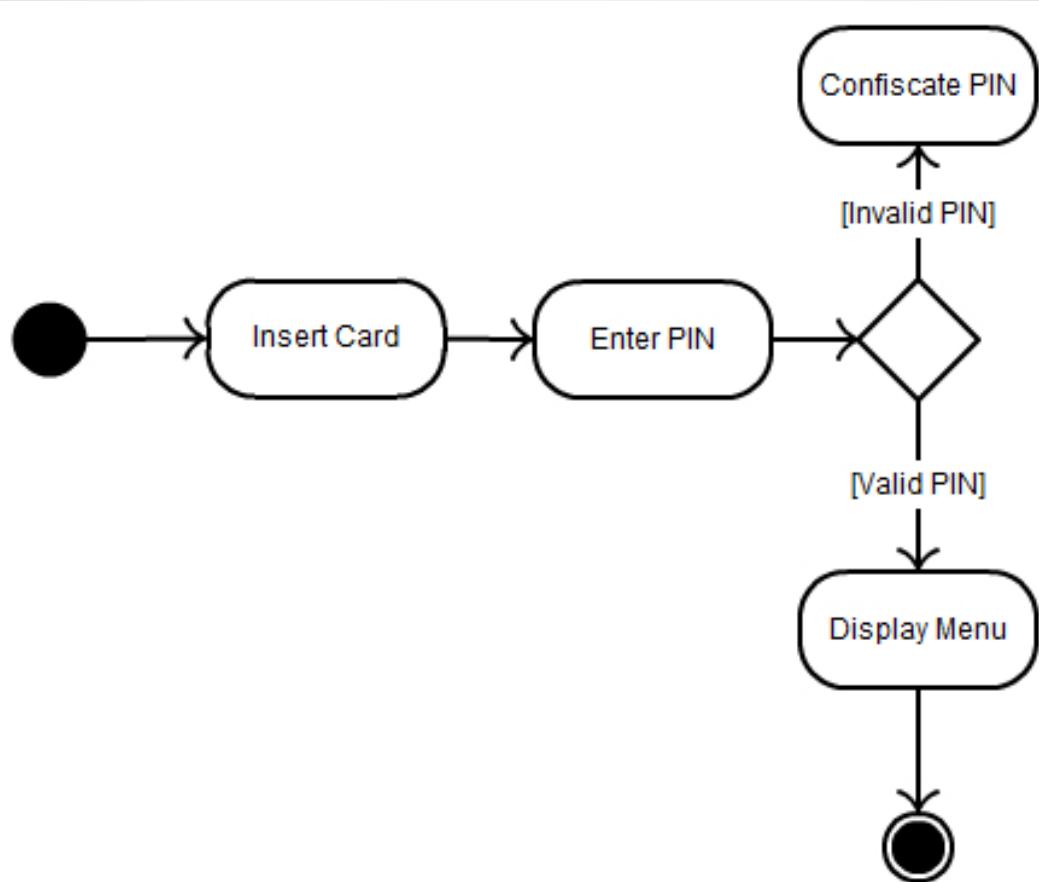
Examples – UML Class Diagrams



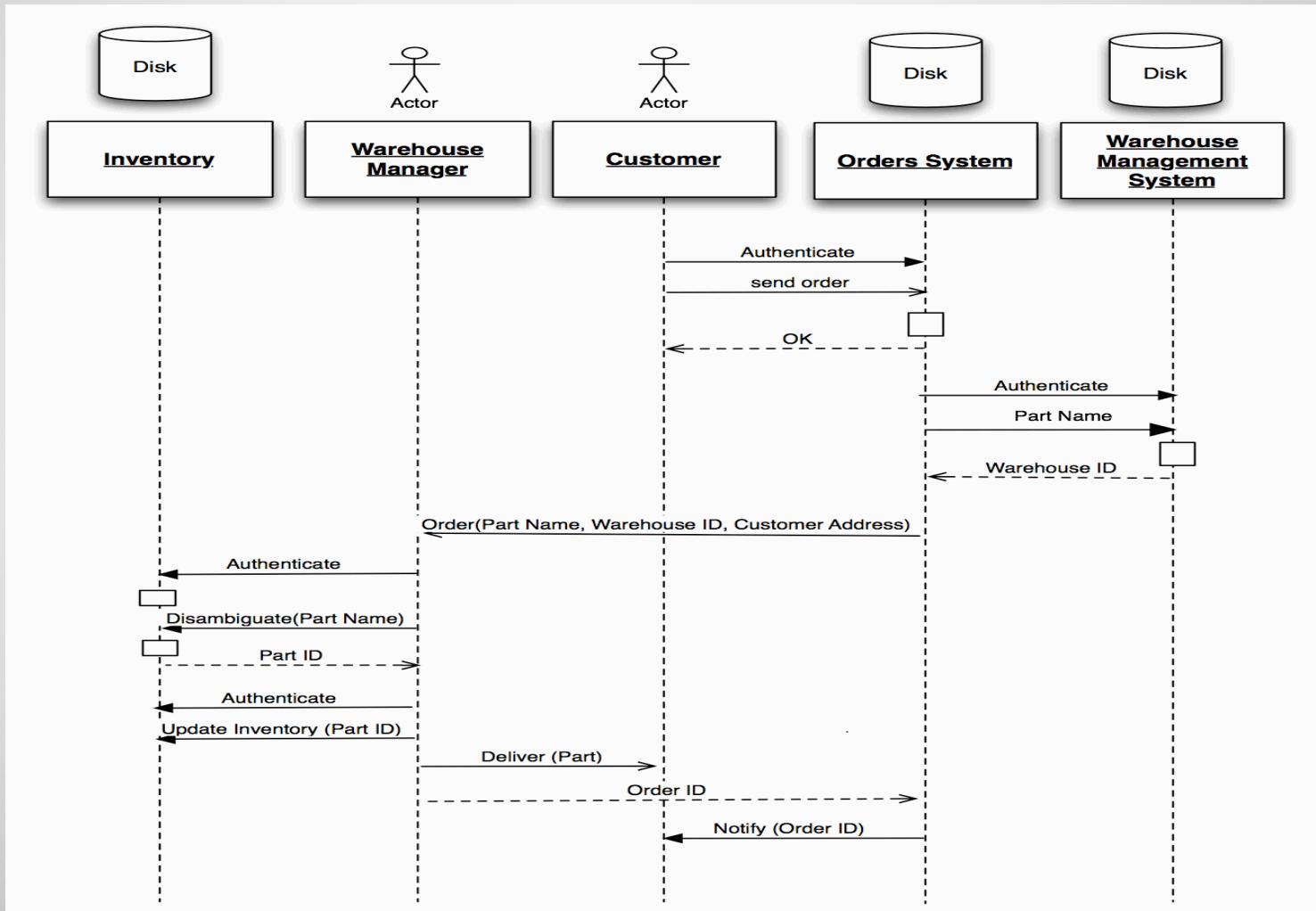
Examples – UML Class Diagrams



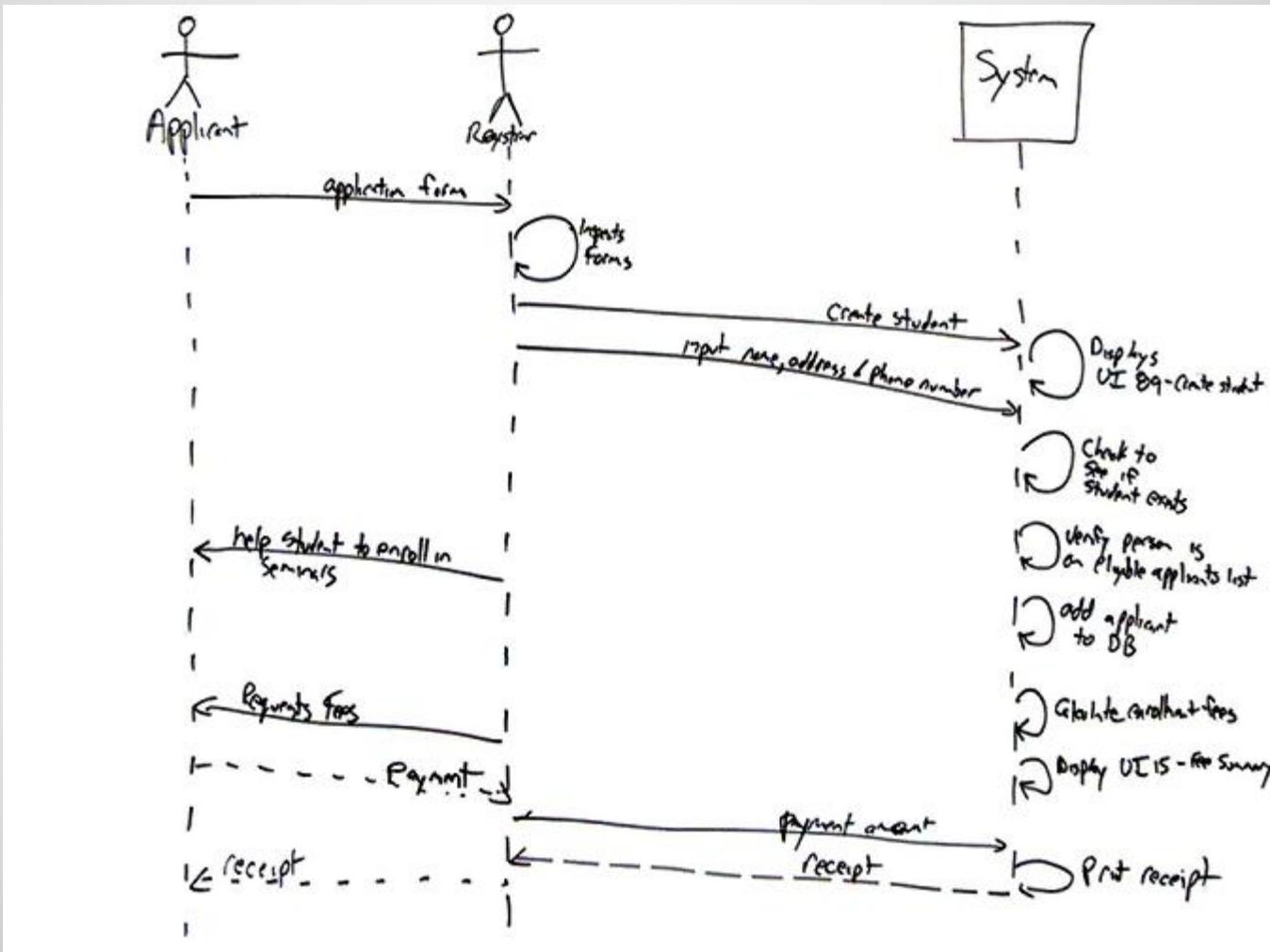
Examples – UML Activity Diagrams



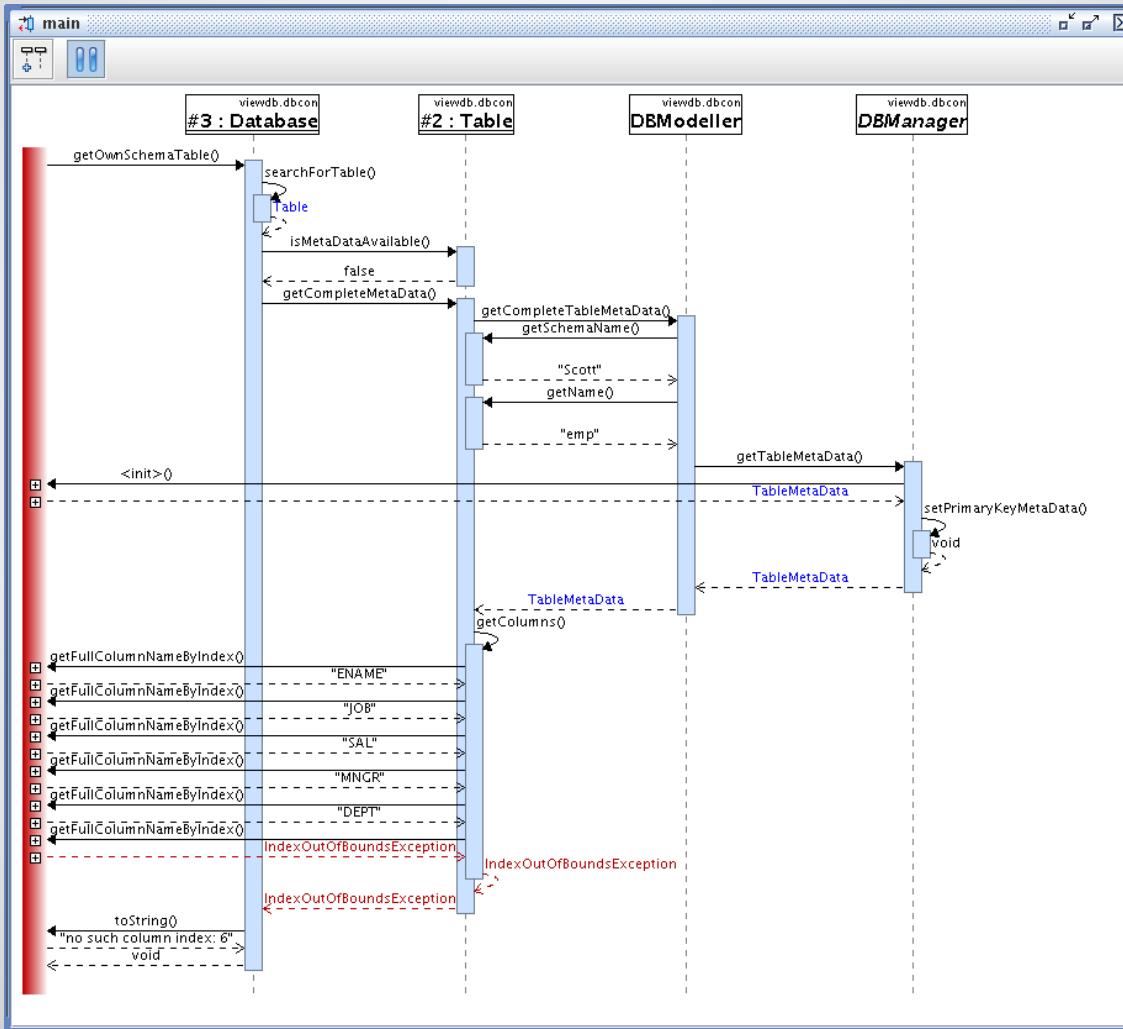
Examples – UML Sequence Diagram



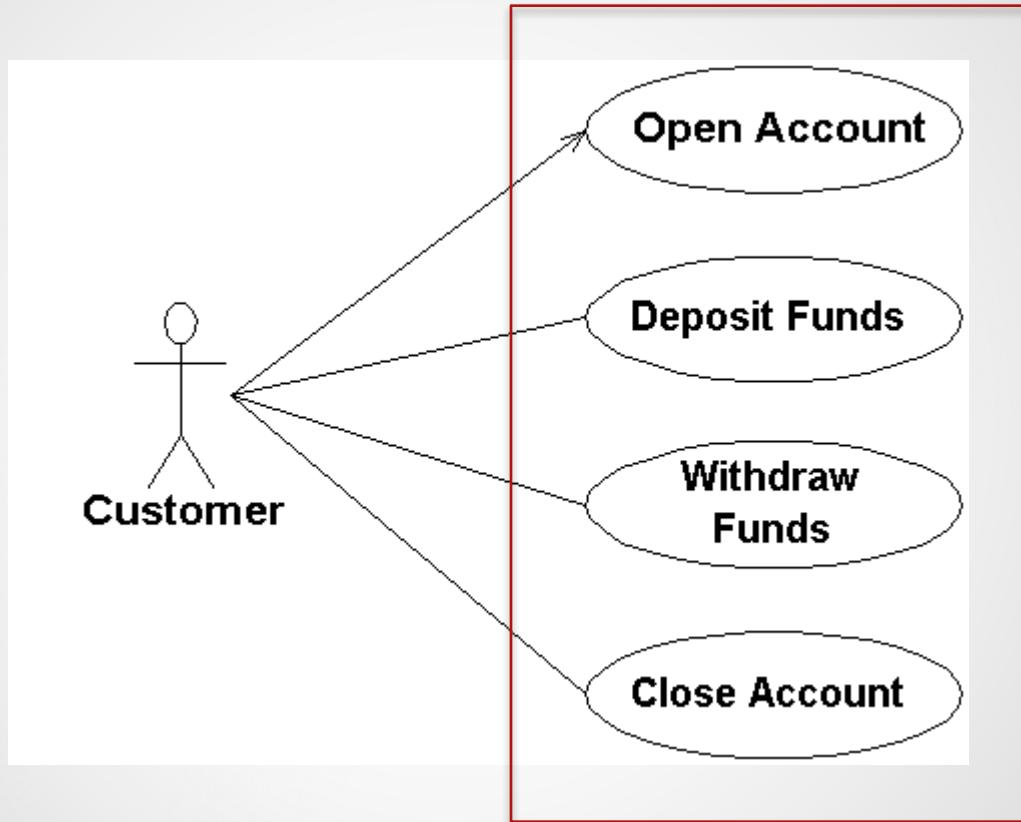
Examples – UML Sequence Diagrams



Examples – UML Sequence Diagrams



Examples - UML Use Case Diagrams



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Other Diagrams - User Interface Mockups

The image contains two hand-drawn wireframe mockups of user interfaces.

Left Mockup: Student Information

This screen shows student details:

- Student Number: 789-567-234
- First Name: Scott
- Middle: William
- Surname: Ambler
- Salutation: Mr. □
- Date First Enrls: June 14 2003

A section titled "Seminars:" displays a table of course enrollments:

Seminar	Term	Mark	Status
CSC 100 Intro to CSC	Fall 2003	A+	Passed
CSC 200 Intro to AM	Fall 2003	A	Passed
CSC 203 Advanced AM	Spring 2004	-	Enrolled

Buttons at the bottom include Add..., Drop..., Transcript, and Close.

Right Mockup: Add a Seminar

This screen allows adding a seminar:

- Seminar Number: CSC #
- Name: Agile XP

A Search button is present. Below is a Results table:

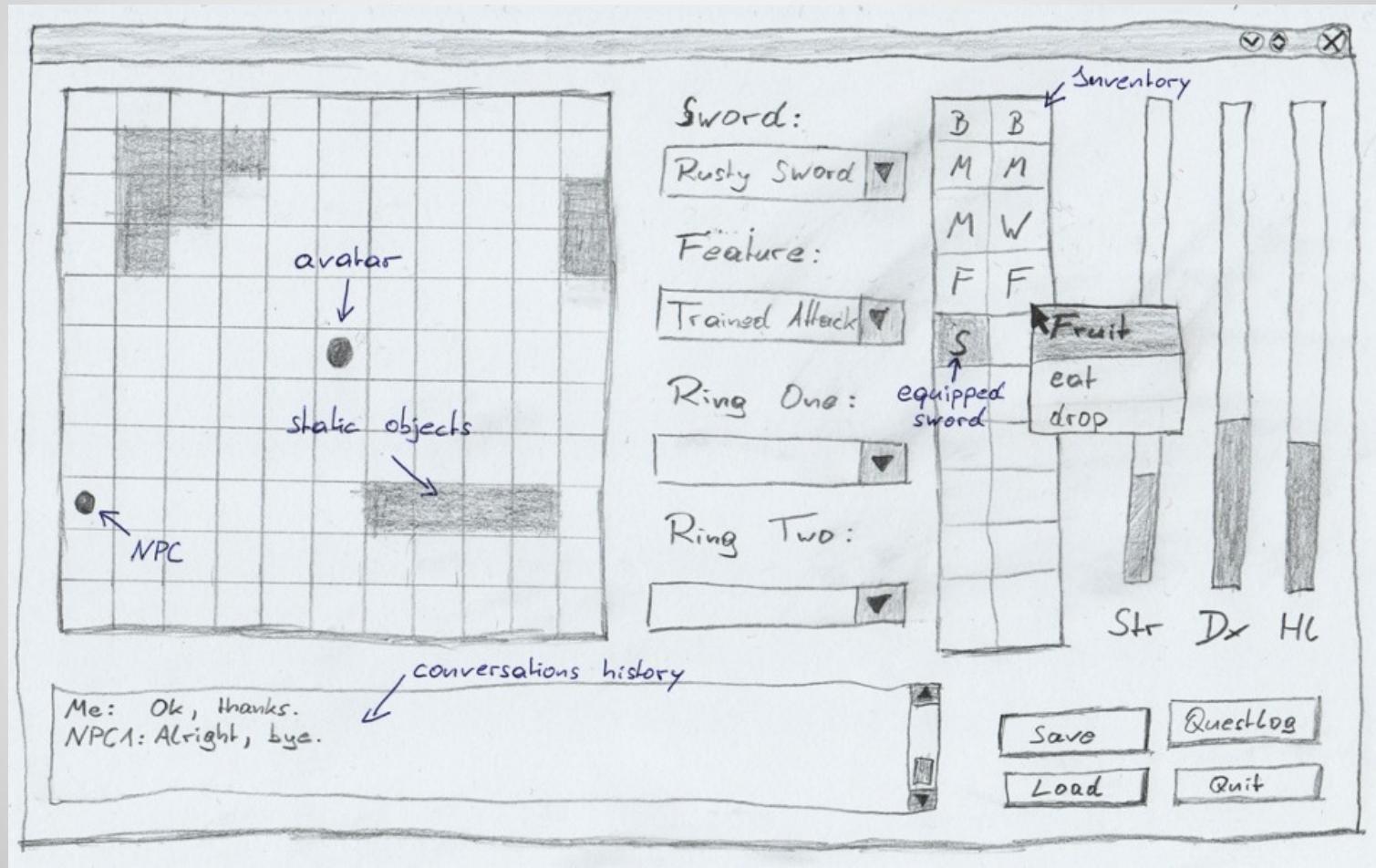
Seminar	Term	Seats Avail	Professor
CSC 250 Agile Techniques	Fall 2004	4	Smith, J.
CSC 300 Agile EVP	Spring 2005	17	Jones, S.
CSC 310 Agile Database techniques	Spring 2004	0	Johnson, K.

A large callout box provides course descriptions for CSC 310:

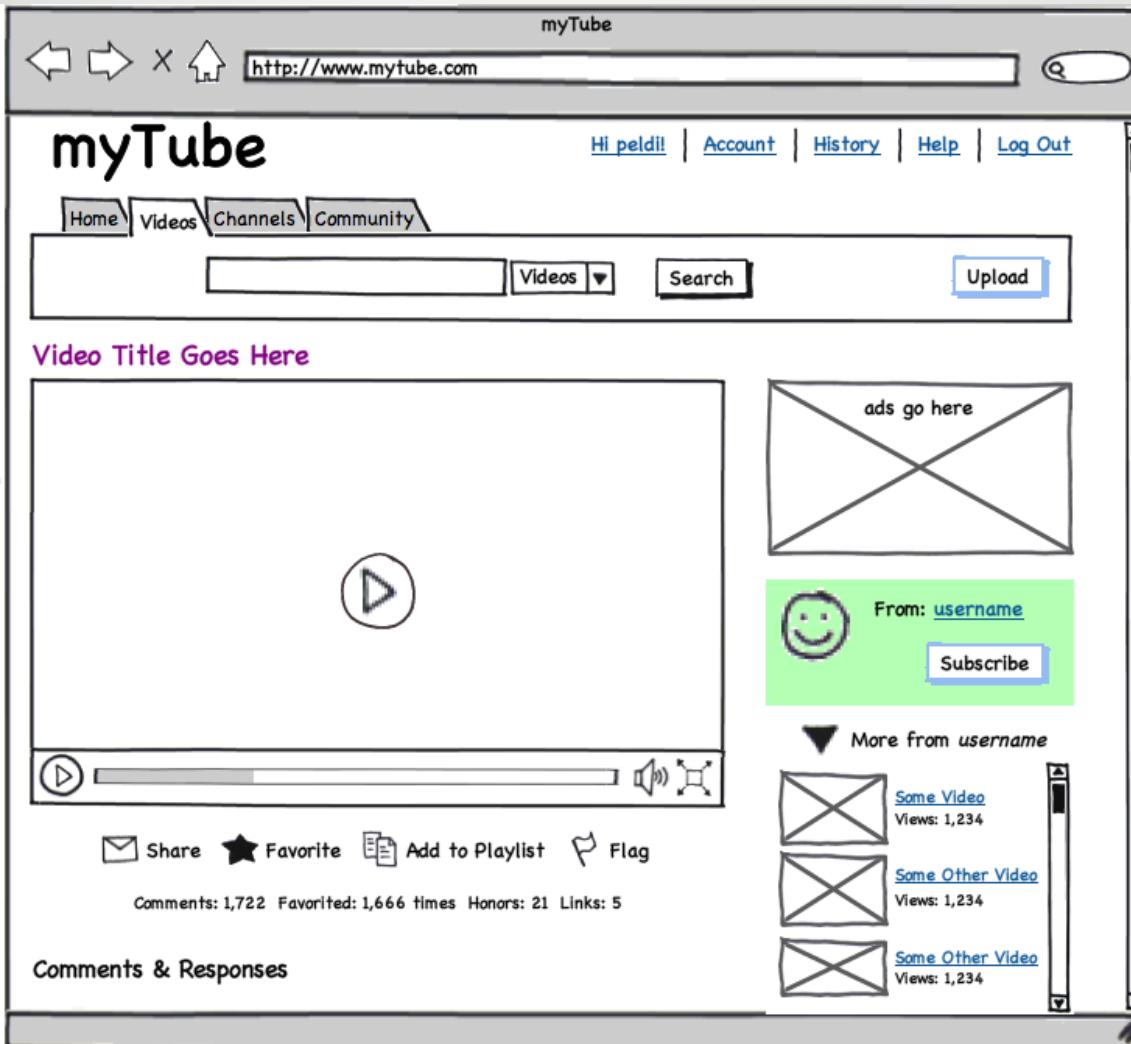
Course description:
CSC 310 Agile Database Techniques
This course describes evolutionary development strategies for data oriented development. See www.agiledb.org for details.

At the bottom, it says: This course currently has 39 people waitlisted.

Other Diagrams - User Interface Mockups



Other Diagrams - User Interface Mockups



[balsamiq]

Other Diagrams – Pseudo Code

Begin

Until each cell contains exactly one machine, **Do**

Identify machines n_1 and n_2 such that d_{n_1, n_2} is the minimum.

Assign n_1 and n_2 to two different and empty cells.

Discard machines n_1 and n_2 from the unassigned machines set.

If only one cell is remaining **then**

Assign n_1 to this cell

Discard machine n_1 from the unassigned machines set.

End Until

Until unassigned machines set becomes empty, **Do**

Identify machines n_1 and n_2 such that d_{n_1, n_2} is the maximum

Assign n_1 and n_2 to the same cell

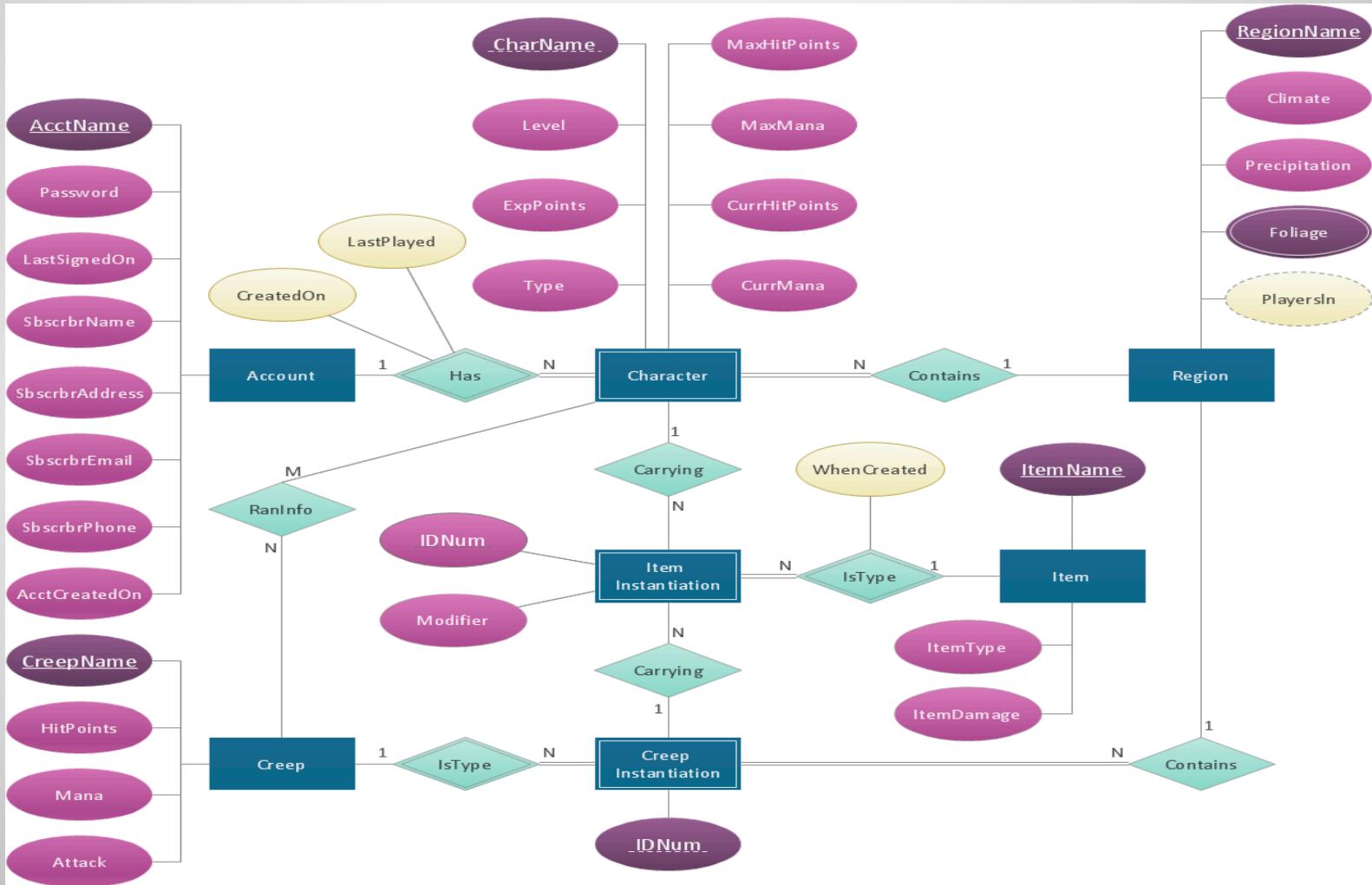
End Until

Read V (* interactively from the user *)

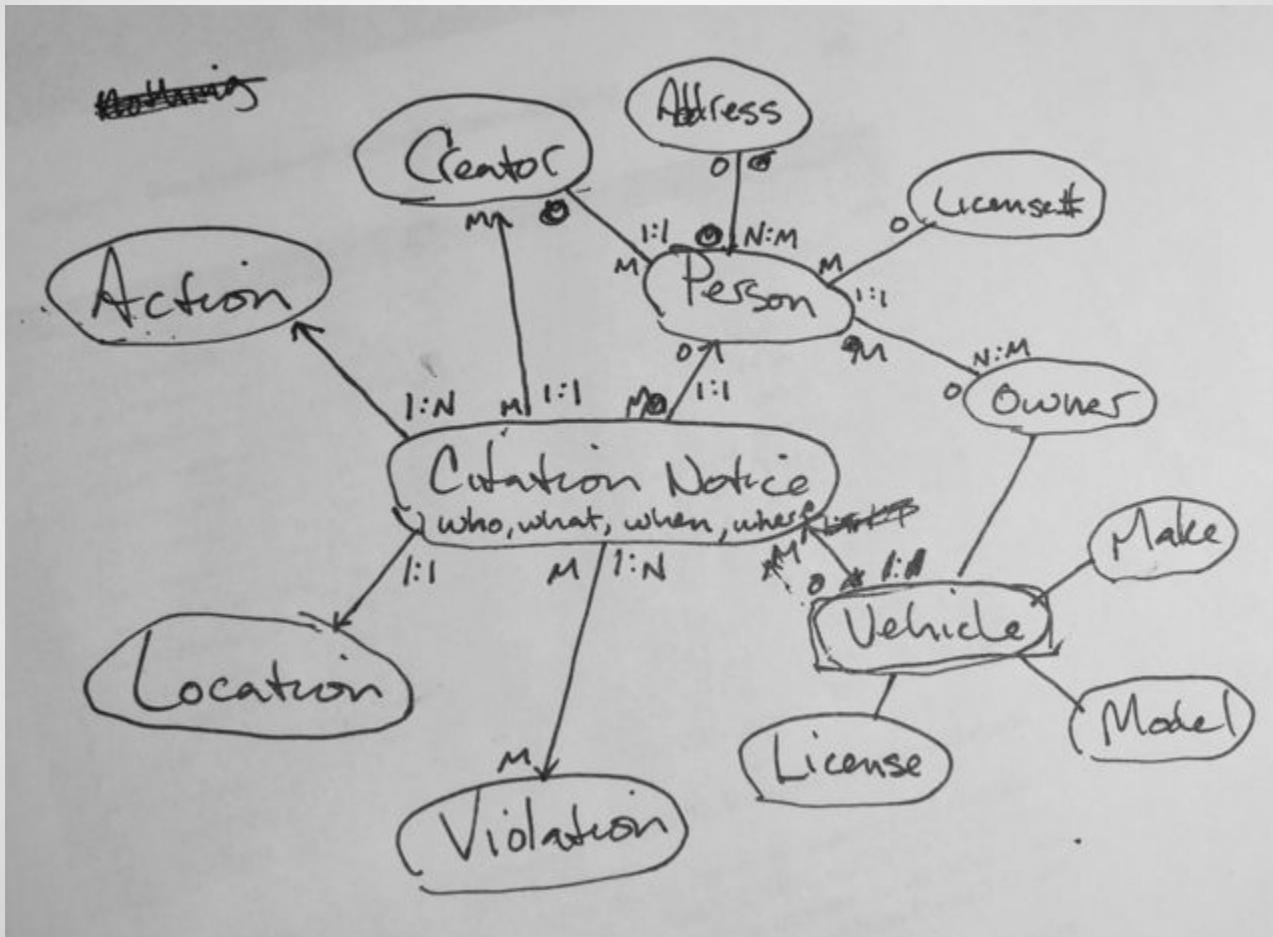
Add $V\%$ dummy individual machines to each cell, such that the C cell sizes are equal

End

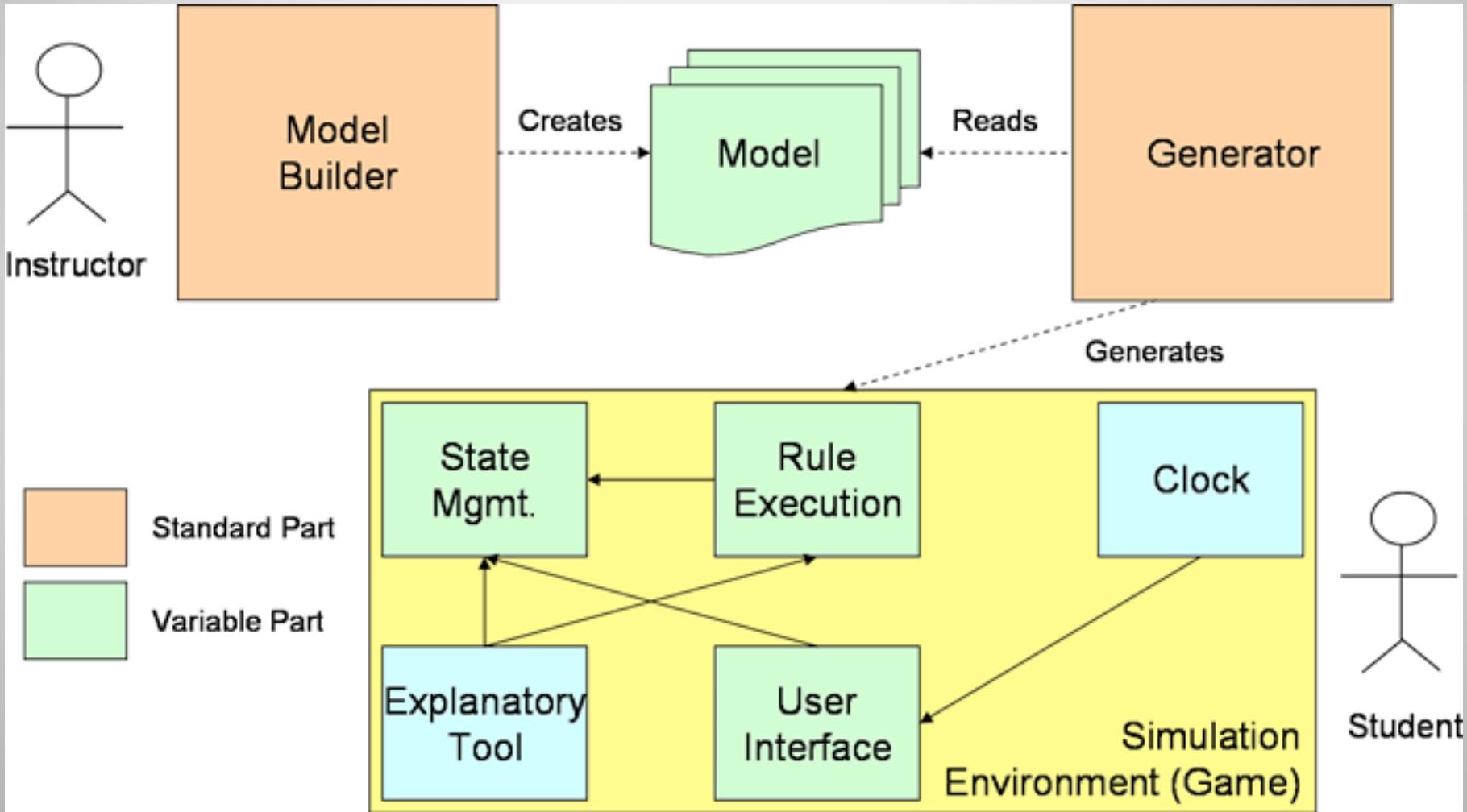
Other Diagrams – Entity Relationship Diagram



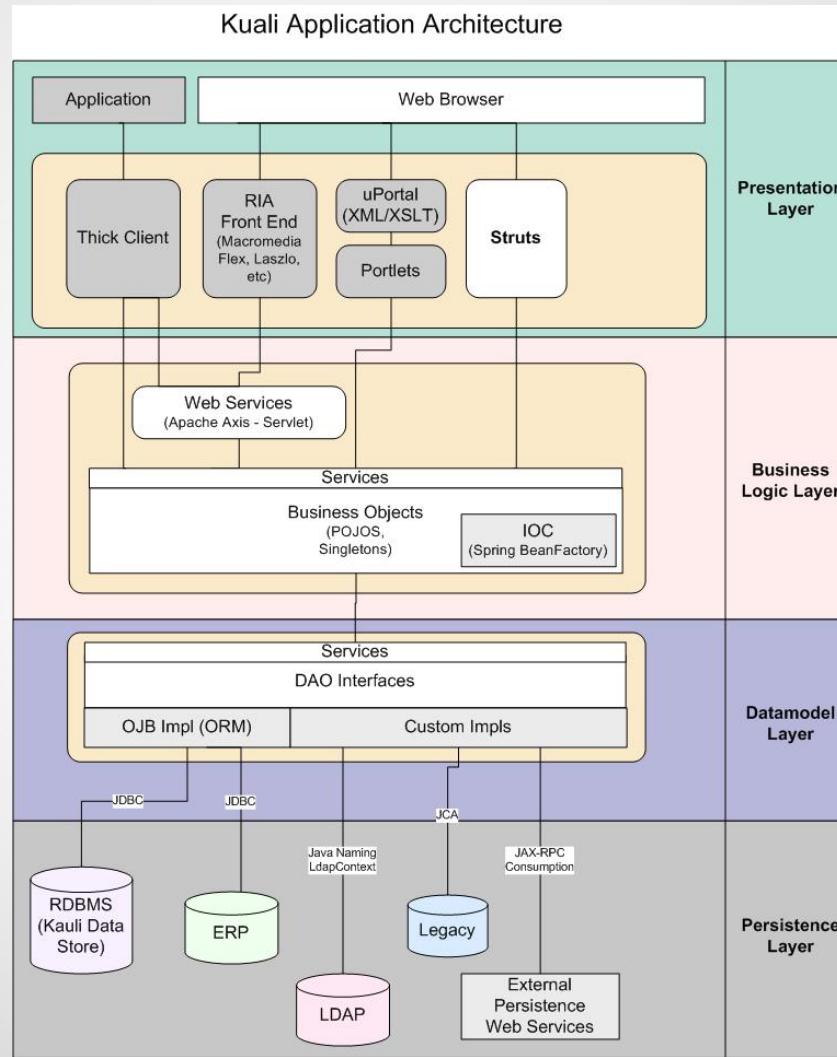
Other Diagrams – Entity Relationship Diagrams



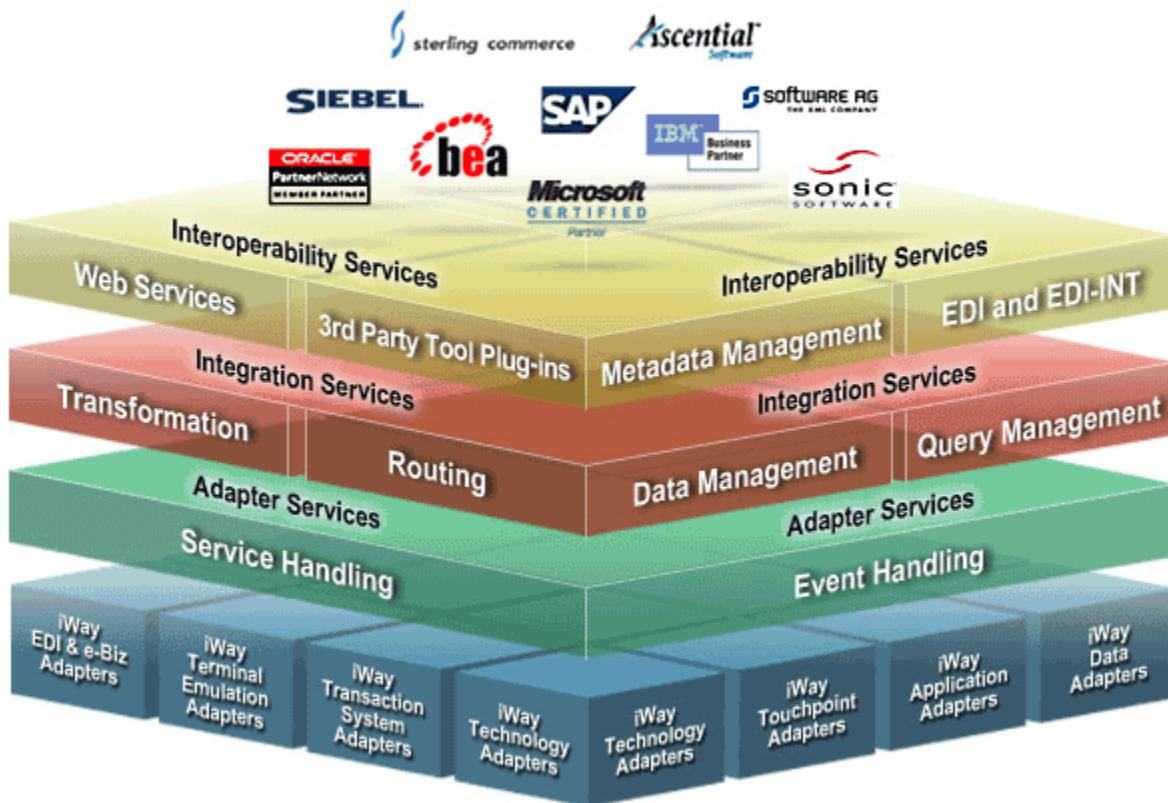
Other Diagrams – Architecture Diagrams



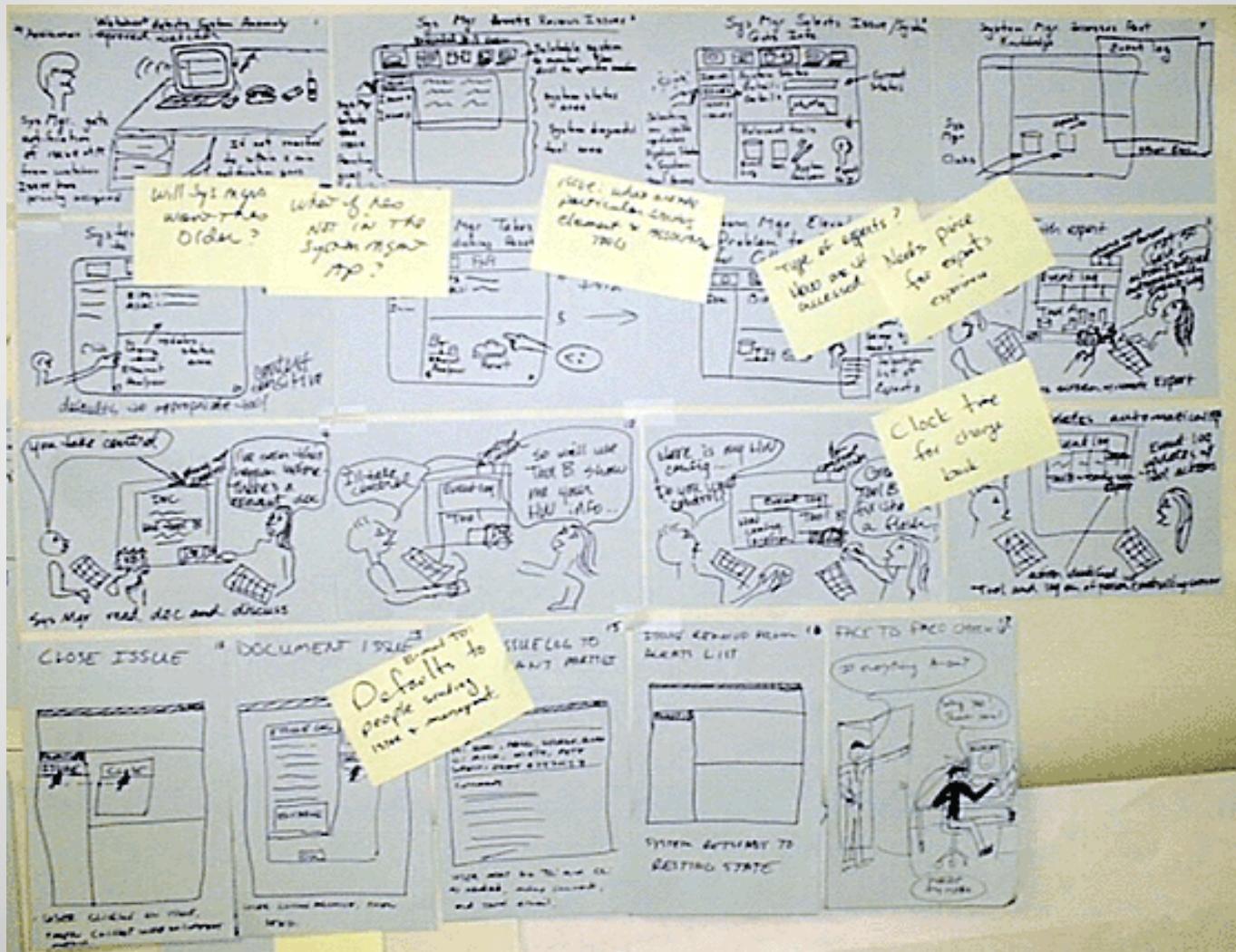
Other Diagrams – Architecture Diagrams



Other Diagrams – Architecture Diagrams



Other Diagrams – Storyboard



Other Diagrams – Storyboard

Monster Belly Storyboards v2.0 July 8, 2009

WHAT CAN WE PICKUP ON THE WAY HOME?
A VEGETARIAN COUPLE ON THE WAY HOME FROM WORK DECIDES ON ASIAN FOOD FOR DINNER. THEY WANT TO ORDER AND PAY FOR THE FOOD WHILE DRIVING. THEY USE THEIR GPS DEVICE TO COMPARE RESTAURANTS BASED ON MENU OPTIONS, PRICE, PROXIMITY AND POPULARITY BEFORE PLACING THEIR ORDER. THEY END UP ORDERING FROM THEIR FAVORITE RESTAURANT AND PAYING WITH THEIR PAYPAL PIN.

This storyboard illustrates a user flow for ordering food using a GPS device. It consists of two rows of seven screenshots each, showing the progression from menu selection to payment confirmation.

- Row 1:**
 - GPS device home screen.
 - GPS device displaying a map with various icons.
 - GPS device displaying a list of categories: Address, Go Home, Favorites, Home, Intersections, Entries, Help/Email, Search, Settings, Tools.
 - GPS device displaying a search interface for "Red Bean Dumplings".
 - GPS device displaying a list of restaurant options: All Food, American, Asian, Barbecue.
 - GPS device displaying a sorting menu: Sort..., Nearest, Most Popular, Least Expensive.
- Row 2:**
 - GPS device displaying a list of restaurant options: PF Chang's, Red Bean Dumplings, etc.
 - GPS device displaying a detailed menu for "Red Bean Dumplings": Three sweet red bean dumplings with plain sauce, \$3.95.
 - GPS device displaying a shopping cart with one item: Red Bean Dumplings, \$3.95.
 - GPS device displaying a confirmation message: Order Confirmed: #ACH196.
 - GPS device displaying a map with a route highlighted.
 - GPS device displaying a payment screen: Enter PayPal PIN.
 - GPS device displaying a payment confirmation: Order Confirmed: #ACH196.

MIDNIGHT DUMPLING CRAVING
AFTER A LONG FLIGHT INTO AUSTIN, AN UNAMED FAMOUS MUSICIAN IS STARVING FOR DUMPLINGS. USING THE GPS IN HIS RENTAL CAR, HE SEARCHES FOR THE BEST AND CLOSEST DUMPLINGS, ORDERS AND PAYS WITH HIS PAYPAL PIN ON THE WAY TO THE RESTAURANT.

This storyboard illustrates a user flow for ordering food using a GPS device during a flight. It consists of two rows of seven screenshots each, showing the progression from menu selection to payment confirmation.

- Row 1:**
 - GPS device home screen.
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 - GPS device displaying a detailed menu for "Red Bean Dumplings": Three sweet red bean dumplings with plain sauce, \$3.95.
 - GPS device displaying a shopping cart with one item: Red Bean Dumplings, \$3.95.
 - GPS device displaying a confirmation message: Order Confirmed: #ACH178.
 - GPS device displaying a map with a route highlighted.
 - GPS device displaying a payment screen: Send order and receipt to my email: myname@domain.com.
 - GPS device displaying a payment confirmation: Order Confirmed: #ACH178.

Theresa Neil July 10, 2009

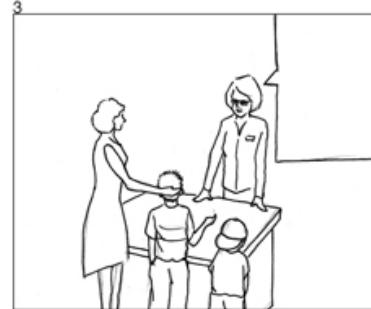
Other Diagrams – Storyboard



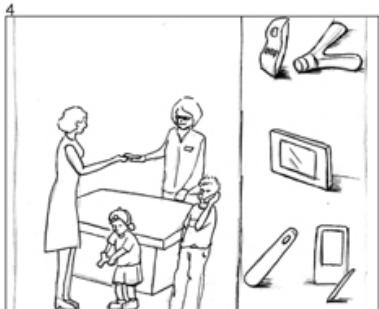
Other Diagrams – Storyboard



Adam, Bryan and their mother enter the museum and go to the exhibit area, where they decide to use the echoVue guide system



The family moves to the table, where a guide is located. The guide informs the family regarding the narrative aspect of the guide system. The guide explains that they are time travelers, from the future, and have been stranded in the present day due to their time machine malfunctioning. They are required to fix the time-map to restore the time-machine's data bank (etc....)



The family is given instruction regarding the six devices that are available in the museum, which include: A collecting device, a listening device, a monitor device, a text device and a divining rod device

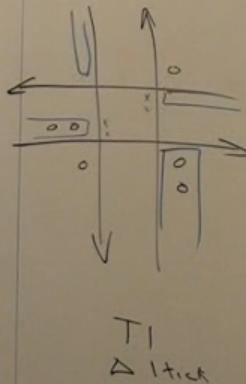


the family goes to the mission table where the two boys look at the table, where the family is told that they are a group of time travelers who come from the future, and who are now stuck in the present day because their time machine has malfunctioned. In order to repair the time machine, they must fix the time-map.



The guide at the table asks the visitors if they can help repair the time-map by first answering a few questions. These questions will ultimately help to understand the visitors age, gender and interests, used to create user models for the adaptive system. This phase provides the members the opportunity to become familiar with the operation of the devices.

Other Diagrams - Sketches



Other Diagrams - Sketches



Other Diagrams - Sketches



What is Software Engineering?

*Software engineering is the process of building a set of related **models** that represent the system-to-be.*

Summary

- Design phase of software engineering
 - The “how” to the “what” of requirements
 - Architecture, functional decomposition, relational database design, OO design/UML, UI design, sketching
- Designs are used iteratively to think, talk, and prescribe
- Every design notation supports an abstraction
- A design diagram is a statement in a language that has a syntax
 - UML diagrams, UI mockups, pseudo code, ER diagrams, architecture diagrams, storyboards, sketches
- Software engineering is the process of building a set of related models that represent the system-to-be.

Next time

- User orientation
- Guest interview
- No discussion tomorrow