SYSTEM MODELING
Unit Objective

• Gain perspective on how to think about designing a system
• Understand how to model these perspectives using UML
Why Model A System?

Helps clarify the requirements

- Identifies gaps

- Useful tool for understanding how the details really fit in or fit together

Helps in explaining what the system is to do to others

A picture is worth a thousand words
The description or portrayal of someone or something in a particular way or as being of a certain nature: [...] 

- A thing, especially a picture or model, that depicts a likeness or reproduction of someone or something.

- (in some theories of perception) a mental state or concept regarded as corresponding to a thing perceived.

Higher levels help you see the forest for the trees

The devil is often in the details
1. **External**
   - Models the system context or environment

2. **Interaction**
   - Emphasizes how the system interacts with its environment, users, or components

3. **Structural**
   - Models the system’s organization or data

4. **Behavioral**
   - Models the system’s dynamic behavior and how it responds to events
Modeling the External Perspective

Places the system in context

Good for identifying what is part of the system and what is not part of the system

The boundaries are not always clear

Example: a cash register using RFID

- UPC Codes
- Pricing
- Customer Information
- Coupons
- Scanner
- Cash Register
Use Cases (Interaction Models)

1. Name
   1. Actors
   2. Actions
   3. Data
   4. Stimulus
   5. Response
   6. Comments

- Pulls out untagged items
- Rings up untagged items and hands item to customer
Sequence Diagrams

- Models the interactions between actors and system objects
- Time is implied
More Sequence UML Notation

Fragment from previous diagram
Structural Models

Display the internal organization of the system

– Components
– Inter-relationships between components
Class

Inter-relationships between classes

- 1:1
- Optional (e.g. 0)
- 1:Many
  - Bounded
  - Unbounded

- Labels indicate a functional relationship
  - No label means “associated with” or “has”

```plaintext
customer  1  Pays for  1  item
```
Class

Name

Receipt

Date & Time
Cashier
Register ID
Transaction ID
Total
Taxes
Number of Taxable Items
Number of Items
Sub-total
Items

Attributes

Properties
Data

Operations

Methods
Functions

New()
Print()
AddItem()
RemoveItem()
Login()
RegisterSetUp()
Generalization

- More generic as you move up
- More specific as you move down
- More specific inherits attributes and operations from the more general
Aggregation

- Component includes subcomponents
Behavioral Models

Data Driven Models

Specifies the steps taking an input to some output (stimulus->response)

\[ \text{State}_i \rightarrow \text{function} \rightarrow \text{State}_j \]

Sequence diagrams do the same thing
How the system responds to events
- Internal
- External

UML uses state diagrams
System states
Events causing state transitions

Doesn’t focus on the data processing internal to the states

States may decompose into more detailed event diagrams

Simple view of the RFID sensor

- Waiting
  - Do: wait
  - Button pushed
    - Send ping
      - Do: send radio signal
      - Radio signal received
        - Send data
          - Do: post data over IP