Software Process Modeling

Software Design

Session Outcomes

- What is Software design?

- Design Types

- Object Oriented Design
  - Understand System and interactions
  - Design System Architecture
  - Identify main classes and objects
  - Develop Design Models
    - UML
    - SysML
  - Specify Interfaces

Story so far …

- Feasibility study

- Requirement phase
  - Requirements elicitation and analysis
  - Requirements Specification
    - Use case diagrams
    - Activity Diagrams
  - Requirement validation

- Today's lecture : Software Design

Programmer's Approach to Software Engineering

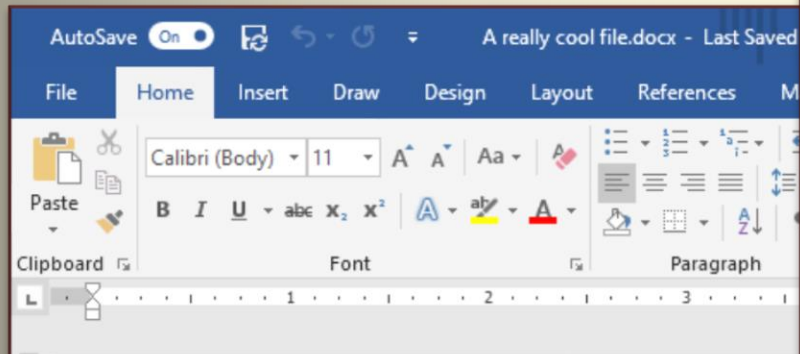Skip requirements engineering and design phases;
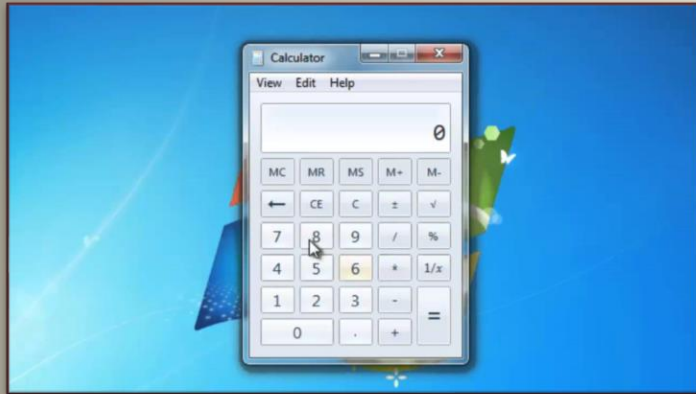
start writing code

Why this programmer's approach?

- Design is a waste of time

- We need to show something to the customer really quickly.

- We are judged by the amount of LOC/month

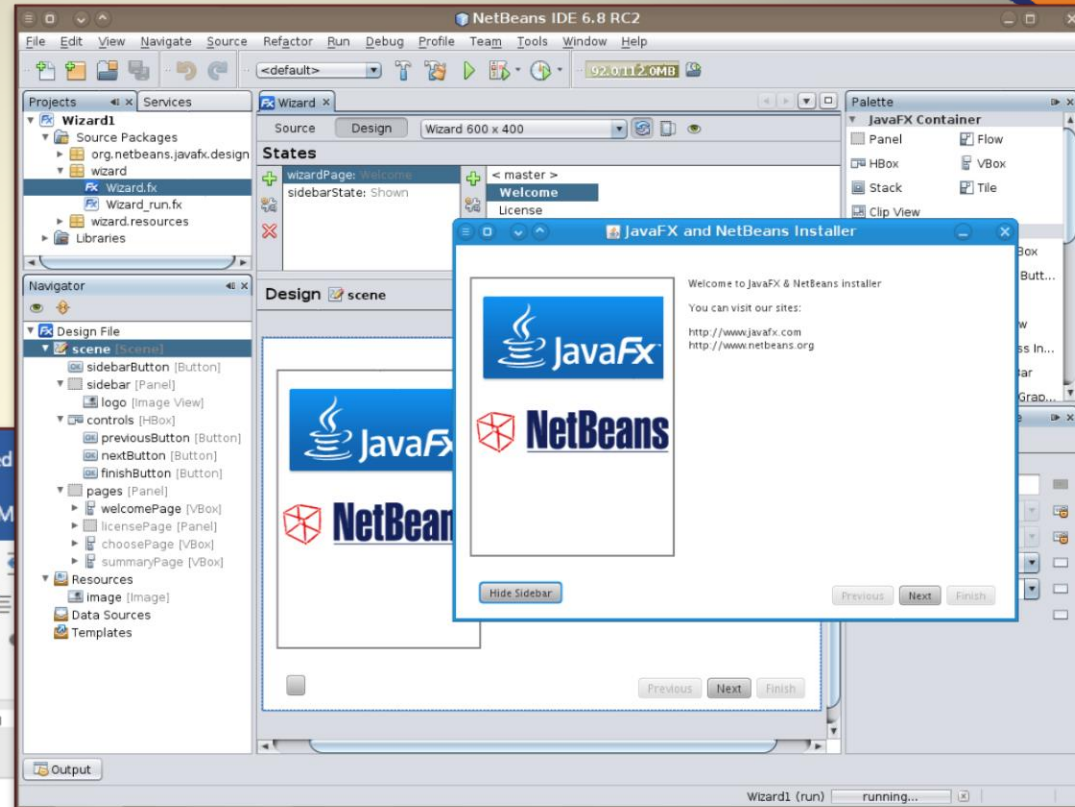- We expect or know that the schedule is too tight

Design of small and large systems

Ref: "Software Architecture and UML" Grady Booch

Design of small and large systems

Importance of design

- Software design is an iterative process through which requirements are translated into a "blueprint" for constructing the software.

  Ref: Software Engineering A Practitioner's approach , R.S. Pressman, 7th Edition

- Design is a highly creative stage in software development where the designer plans

  - how the system or program should meet the customer's requirements
  - how to make system effective and efficient.

    Ref: Software Engineering, I. Sommerville, 10th Edition

Stages of design

- Understand the problem

  - Look at the problem from different angles to discover the design requirements

- Identify one or more solutions

  - Evaluate possible solutions and choose the most appropriate

- Describe solution abstractions

  - Use graphical, formal or other descriptive notations to describe the components of the design

- Repeat process for each identified abstraction until the design is expressed in primitive terms
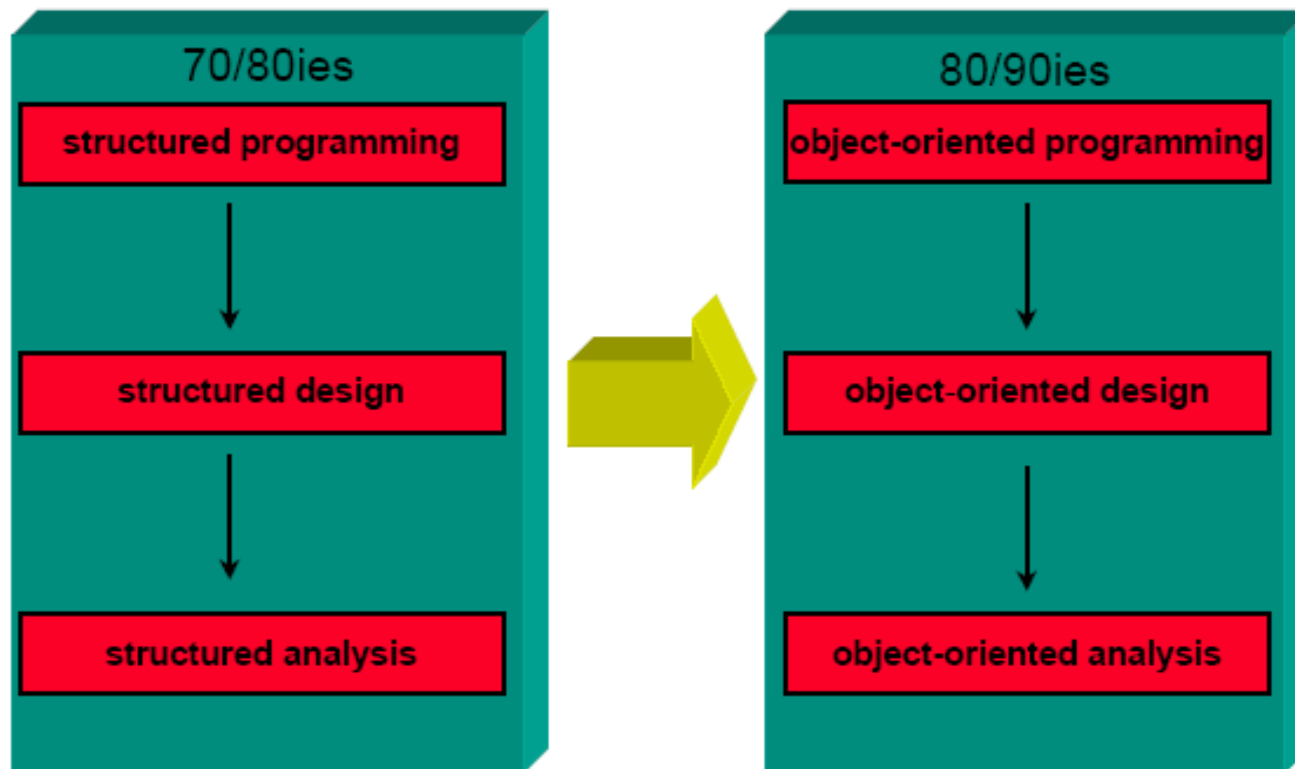
Software Design methods

- Function oriented software design
- Object oriented software design

Software Design

Object Oriented Design

Object oriented software design

Evolution of OO Development Methods

70/80ies	80/90ies
structured programming	object-oriented programming
structured design	object-oriented design
structured analysis	object-oriented analysis

OOA&D © J.W. Schmidt, F. Matthes, TU Hamburg-Harburg   3.0.2

Object Oriented Design

1. Understand System and interactions
   – Use case Diagrams
   – Activity Diagrams
   – Use case Scenarios
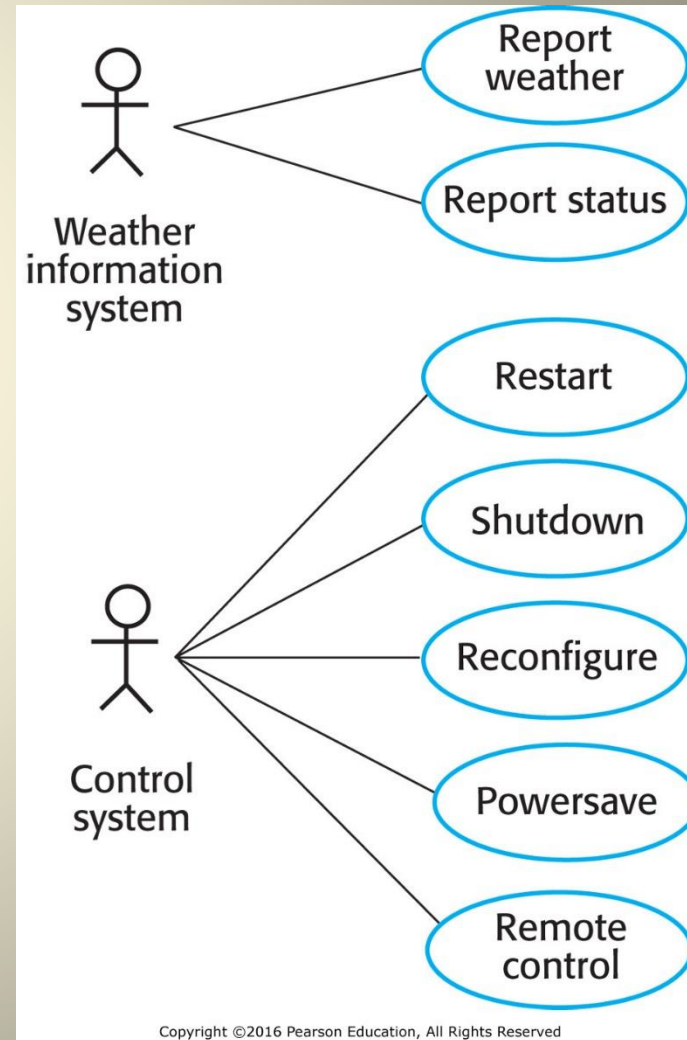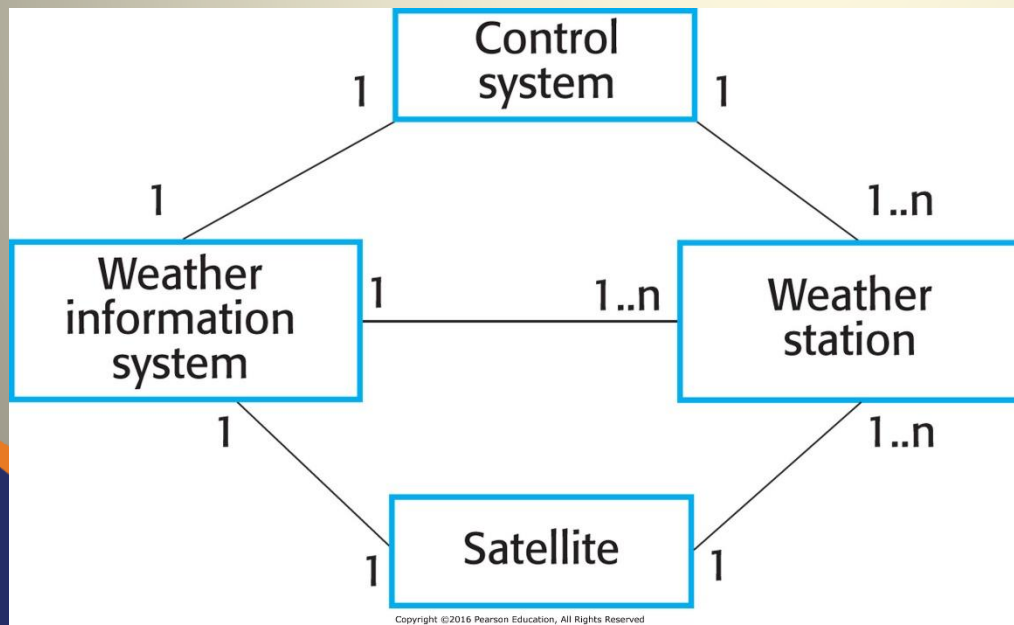
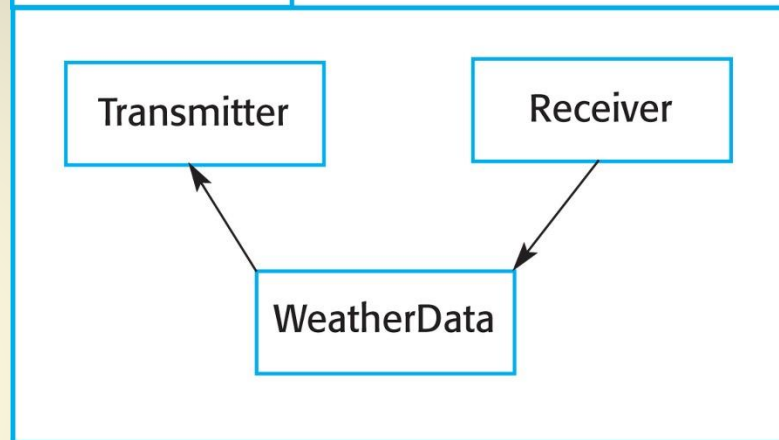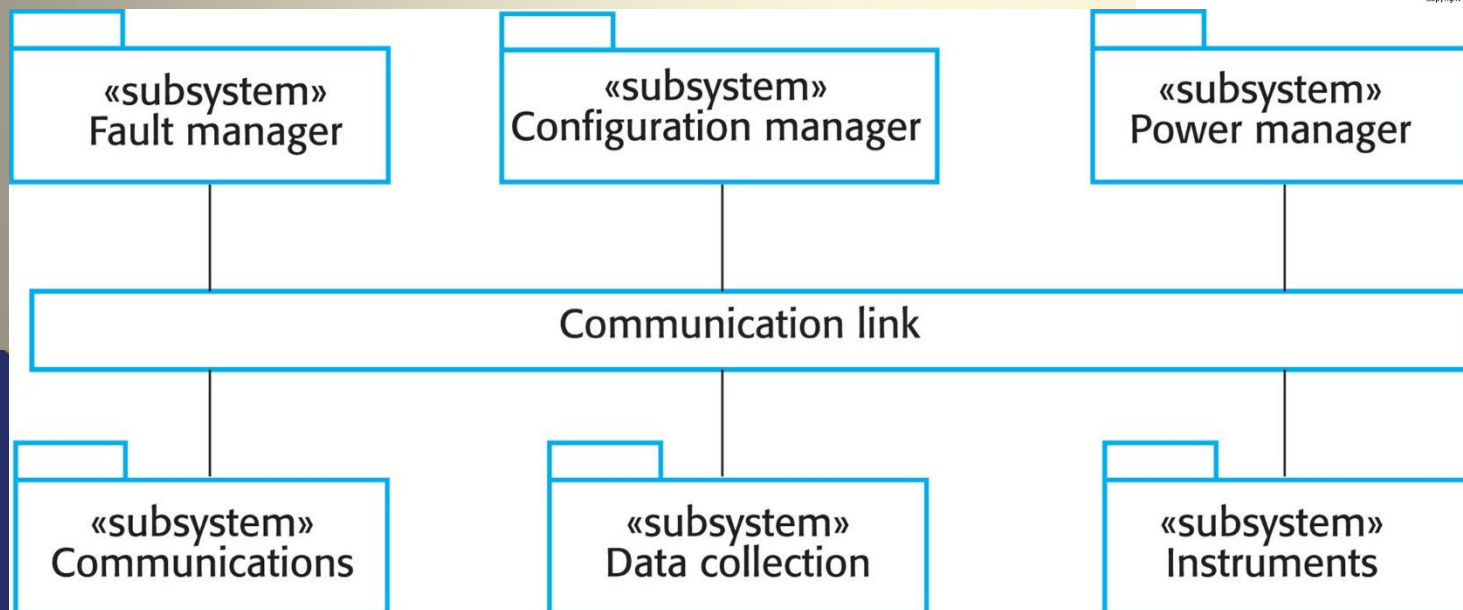# Object Oriented Design

2. Design System Architecture

  – Subsystems and communication between the subsystems.
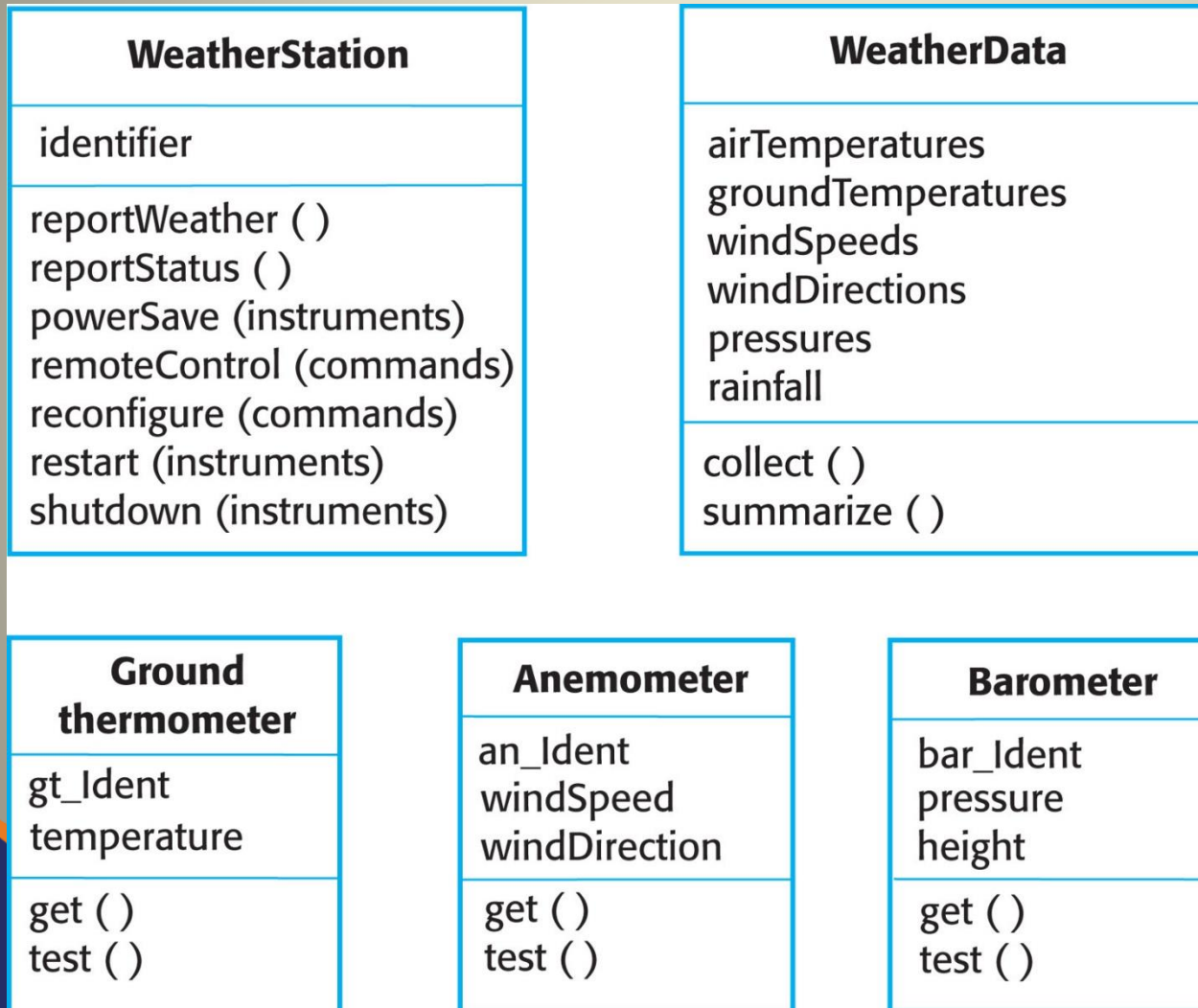

Data collection

- Faculty of Computing

Object Oriented Design

3. Identify main classes and objects

WeatherStation
identifier
reportWeather ( )   reportStatus ( )   powerSave (instruments)   remoteControl (commands)   reconfigure (commands)   restart (instruments)   shutdown (instruments)

WeatherData
airTemperatures   groundTemperatures   windSpeeds   windDirections   pressures   rainfall
collect ( )   summarize ( )

Ground thermometer
gt_Ident   temperature
get ( )   test ( )

Anemometer
an_Ident   windSpeed   windDirection
get ( )   test ( )

Barometer
bar_Ident   pressure   height
get ( )   test ( )

Activity

- What are the CRC cards you identified for the Library system?
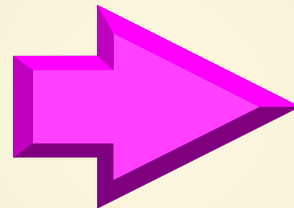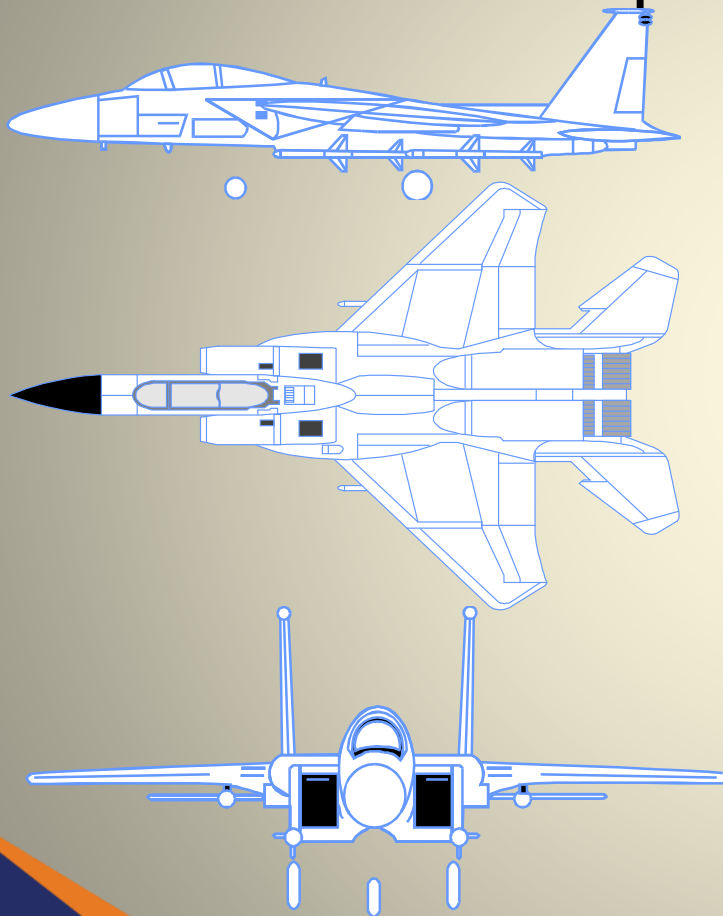
Object Oriented Design

4. Develop Design Models

  – Describing a system at a high level of abstraction

  – Design Model types

    • Structural models

    • Dynamic models

  – Is it necessary to model software systems?

What Is a Model?

- A model is a simplification of reality.

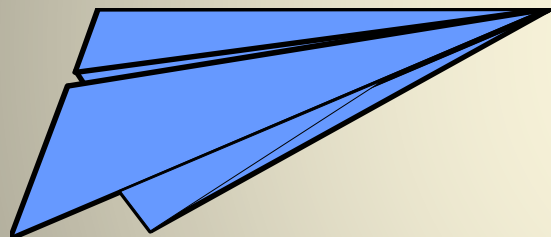Ref: Fundamentals of Visual Modeling with UML

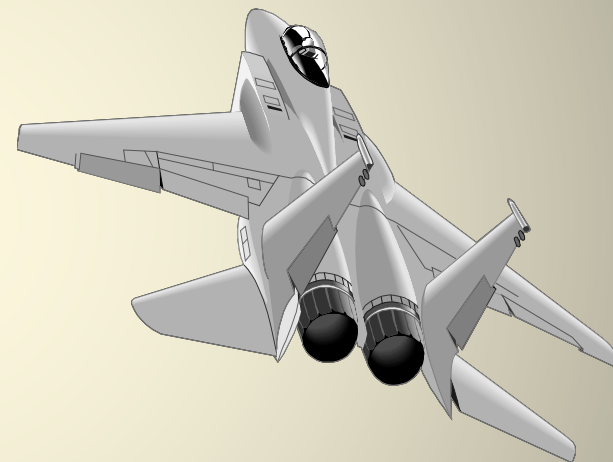# The Importance of Modeling

Less Important   More Important

Paper Airplane   Fighter Jet

Ref: Fundamentals of Visual Modeling with UML

Software Teams Often Do Not Model

- Many software teams build applications approaching the problem like they were building paper airplanes
  - Start coding from project requirements
  - Work longer hours and create more code
  - Lacks any planned architecture
  - Doomed to failure

- Modeling is a common thread to successful projects.

Ref: Fundamentals of Visual Modeling with UML

Why Do We Model?

- Modeling achieves **four aims**:
  - Helps us to **visualize** a system as we want it to be.
  - Permits us to **specify** the structure or behavior of a system.
  - Gives us a template that guides us in **construct**ing a system.
  - **Document**s the decisions we have made.
- We build models of complex systems because we cannot comprehend such a system in its entirety.
- We build models to better understand the system we are developing.

Ref: Fundamentals of Visual Modeling with UML

Object Oriented Design

4. Develop Design Models

- Design Model types

  - Structural models

  - Dynamic models

- Modeling Languages

  - UML

  - SysML

  - Refer https://modeling-languages.com/#
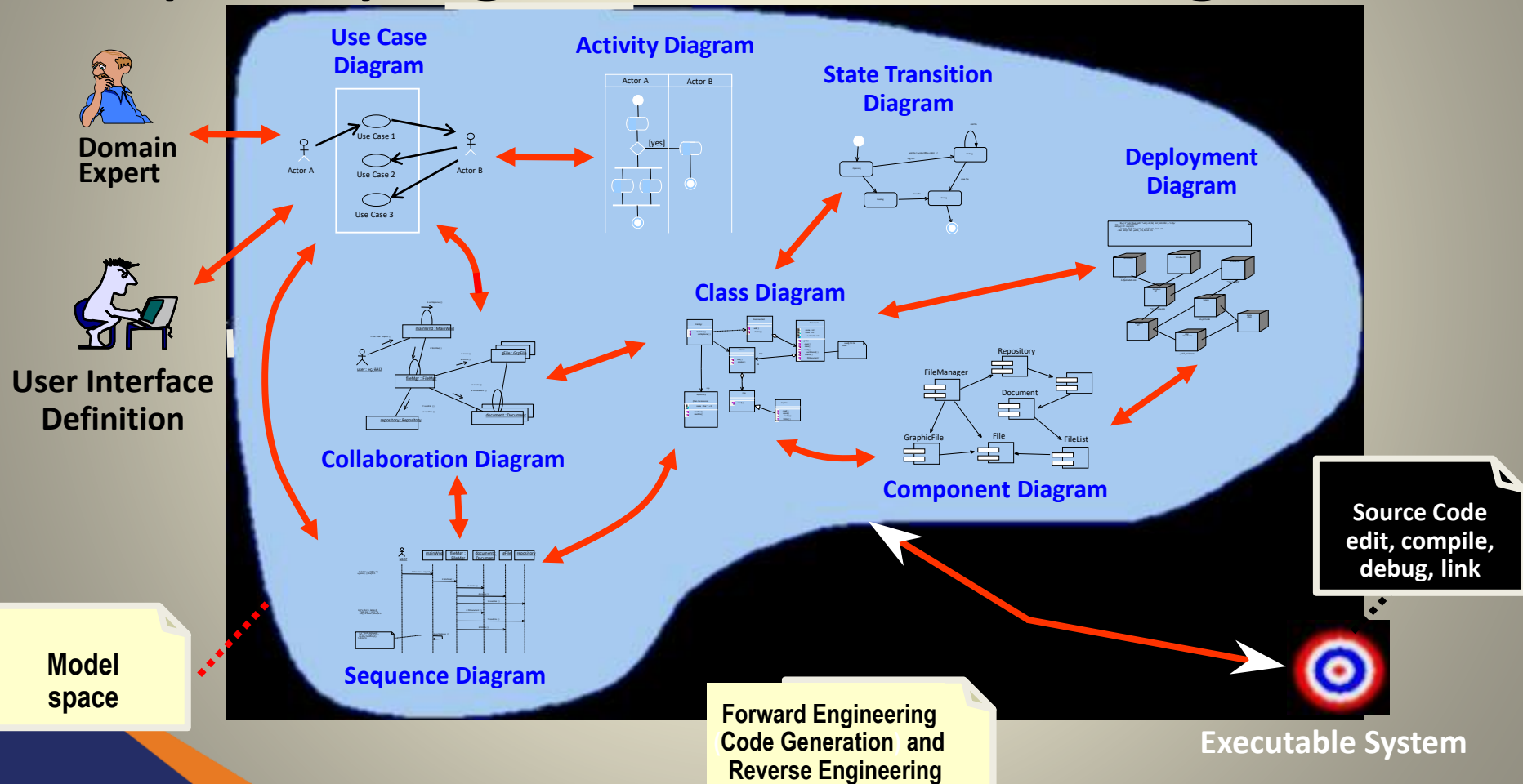
What Is the UML?

- The UML is a language for
  - Visualizing
  - Specifying
  - Constructing
  - Documenting

  the artifacts of a software-intensive system.

- Out of the above, **SPM** and **SE** modules specially focus on using *UML as a language for specifying and documenting*.
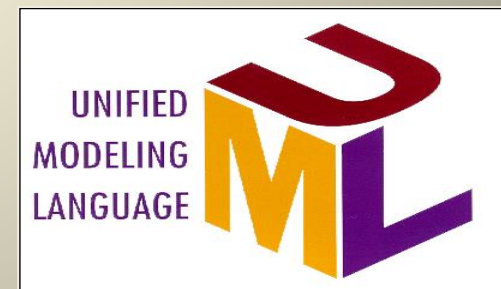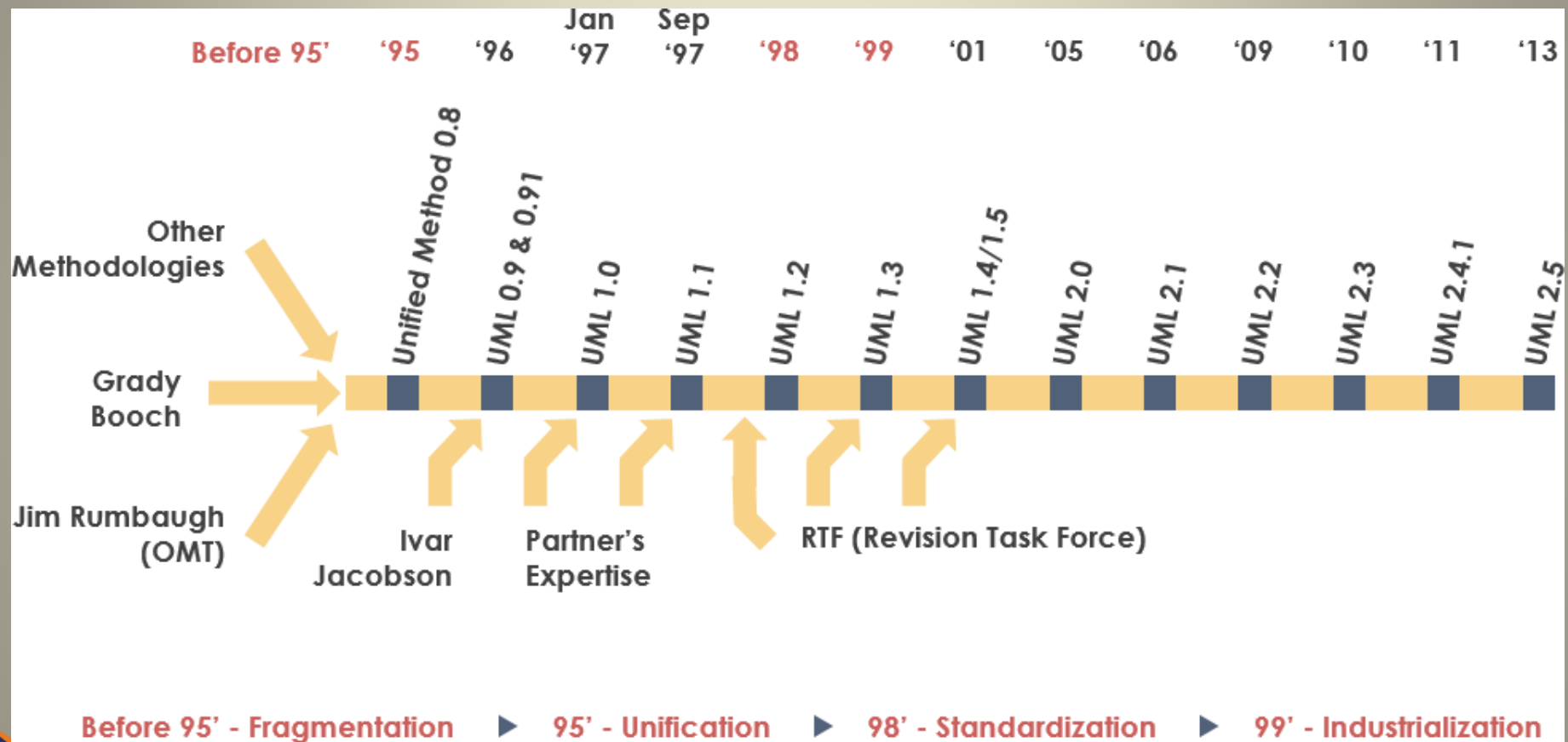
Ref: Fundamentals of Visual Modeling with UML

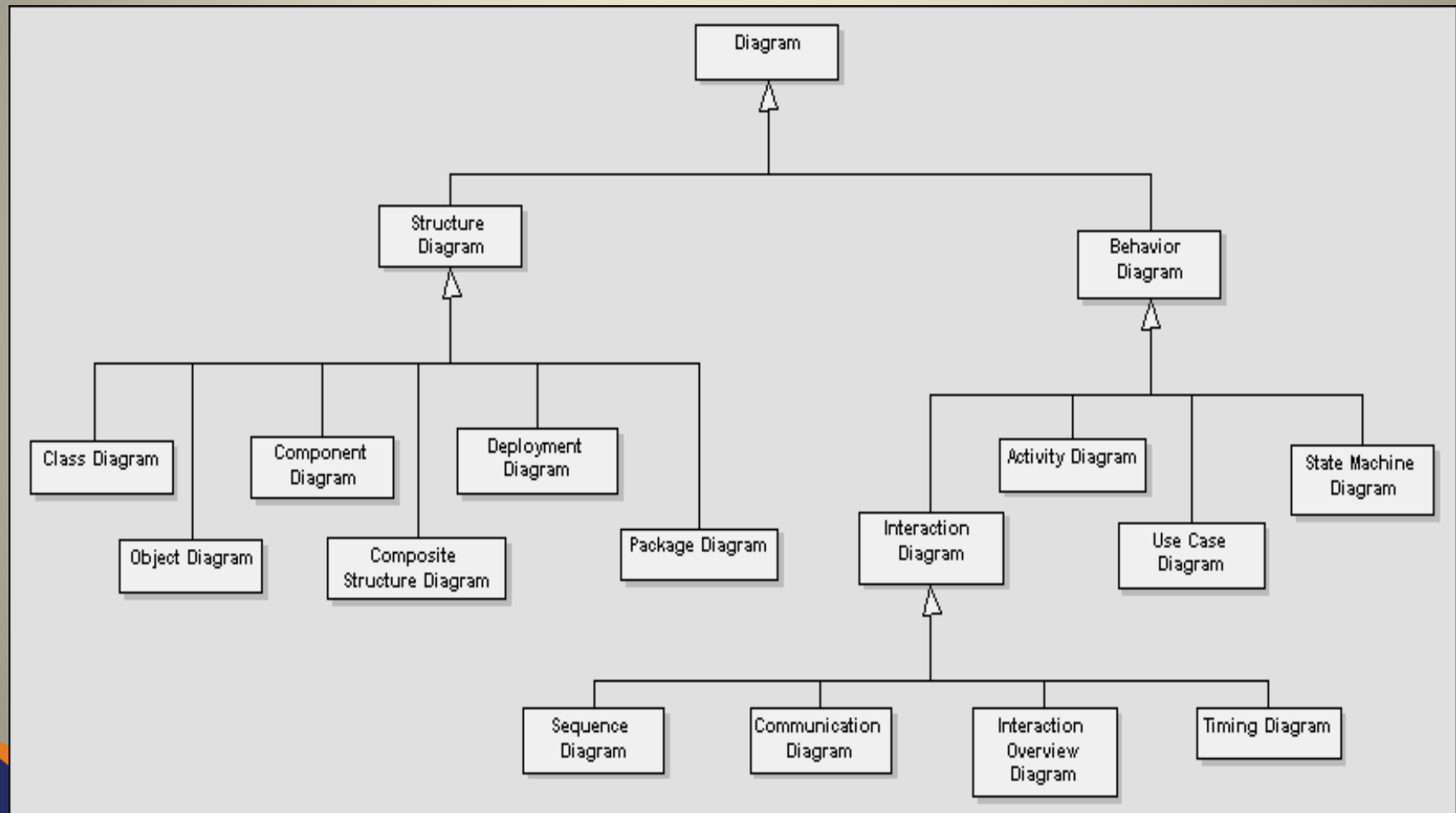# The UML Is a Language for Specifying and Documenting

Ref: Fundamentals of Visual Modeling with UML

UML - History

UML 2 Structure

Types of UML diagrams

- There are different types of UML diagram, each with slightly different syntax rules:
    - use cases- Covered in RE
    - activity diagrams- Covered in RE
    - class diagrams. – Cover in OOC
    - sequence diagrams.
    - collaboration diagrams.
    - state diagrams
    - component diagrams.
    - deployment diagrams.

Covers in SE in the next semester

SLIIT - Faculty of Computing

Design

- When you use UML to develop a design, you will normally develop two kinds of design models:

  1. Structural models :

     - describe the static structure of the system using objects, classes and their relationships.

     - Important relationships that may be documented at this stage are generalization (inheritance), aggregation, dependency, and composition relationships. (class diagram relationships in OOC)

Ref: Software Engineering, I. Sommerville, 10th Edition

Structural models Example
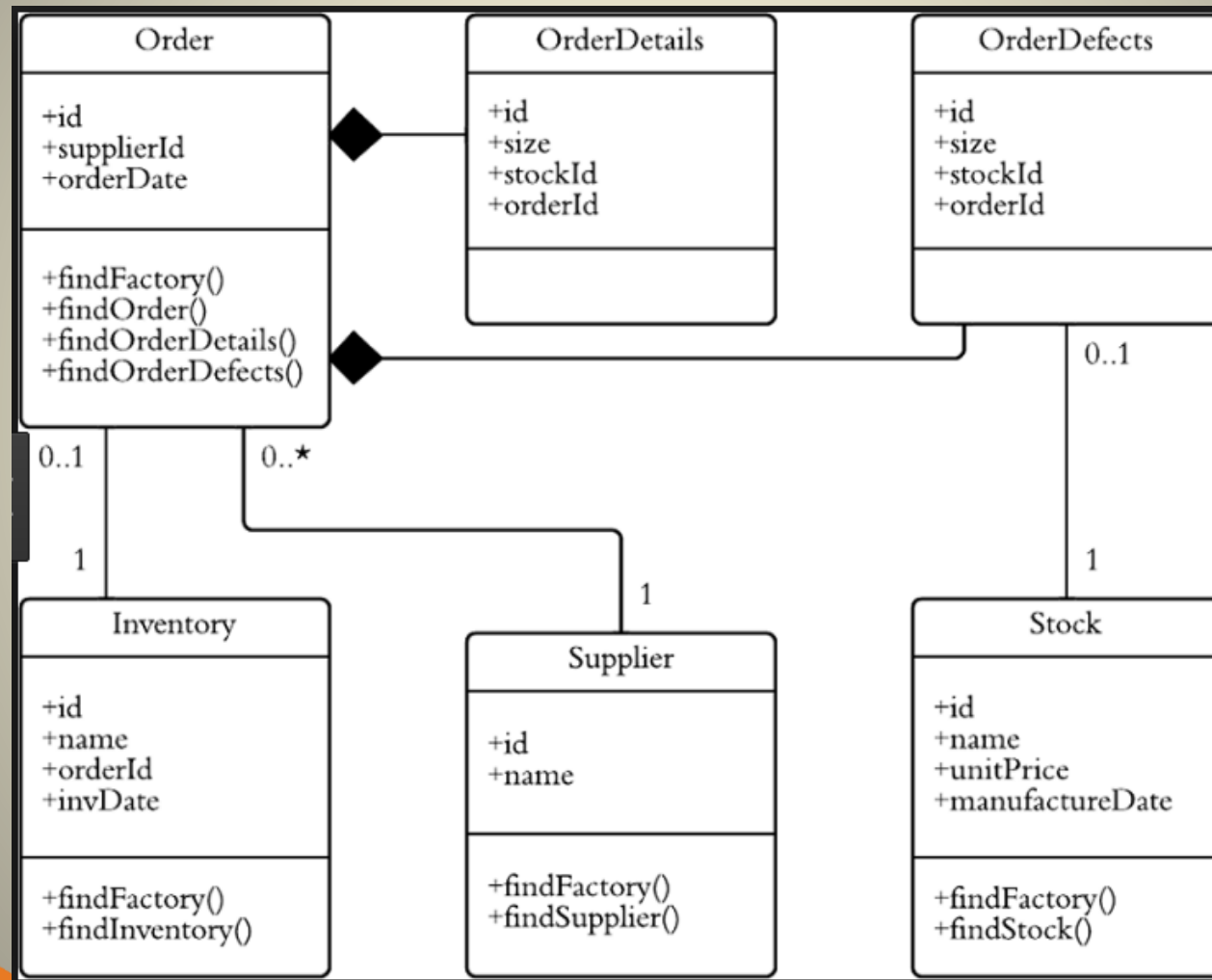
Design

2. Dynamic models :

- Describes the dynamic structure of the system and shows the interactions between the system objects.

- Interactions that may be documented include the sequence of service requests made by objects and the state changes that are triggered by these object interactions. (You will learn them in SE next semester)

Ref: Software Engineering, I. Sommerville, 10th Edition
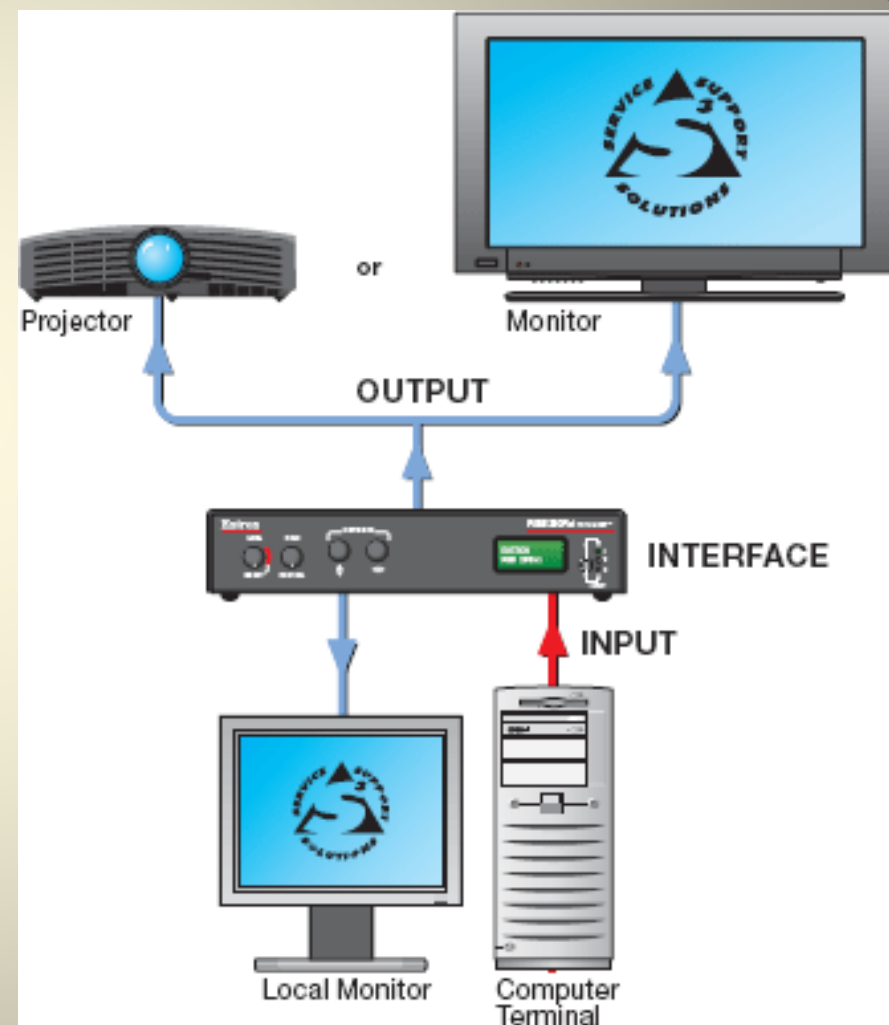
Dynamic models Example
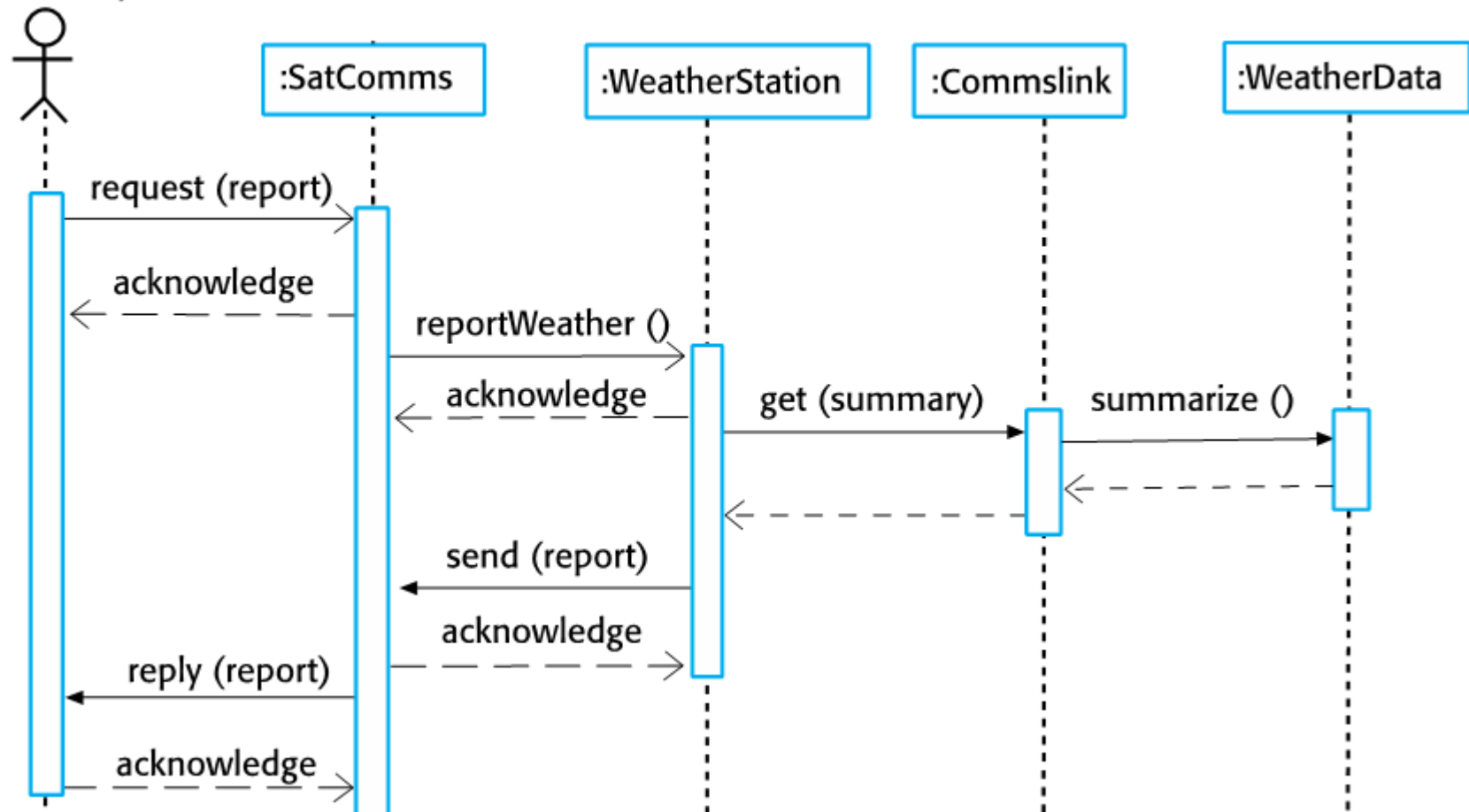
Ref: Software Engineering, I. Sommerville, 10th Edition

Object Oriented Design

5. Specify Interfaces

- Interfaces can be
    - devices
    - software

- The collection of all the inputs and outputs of a system defines its *interface*.
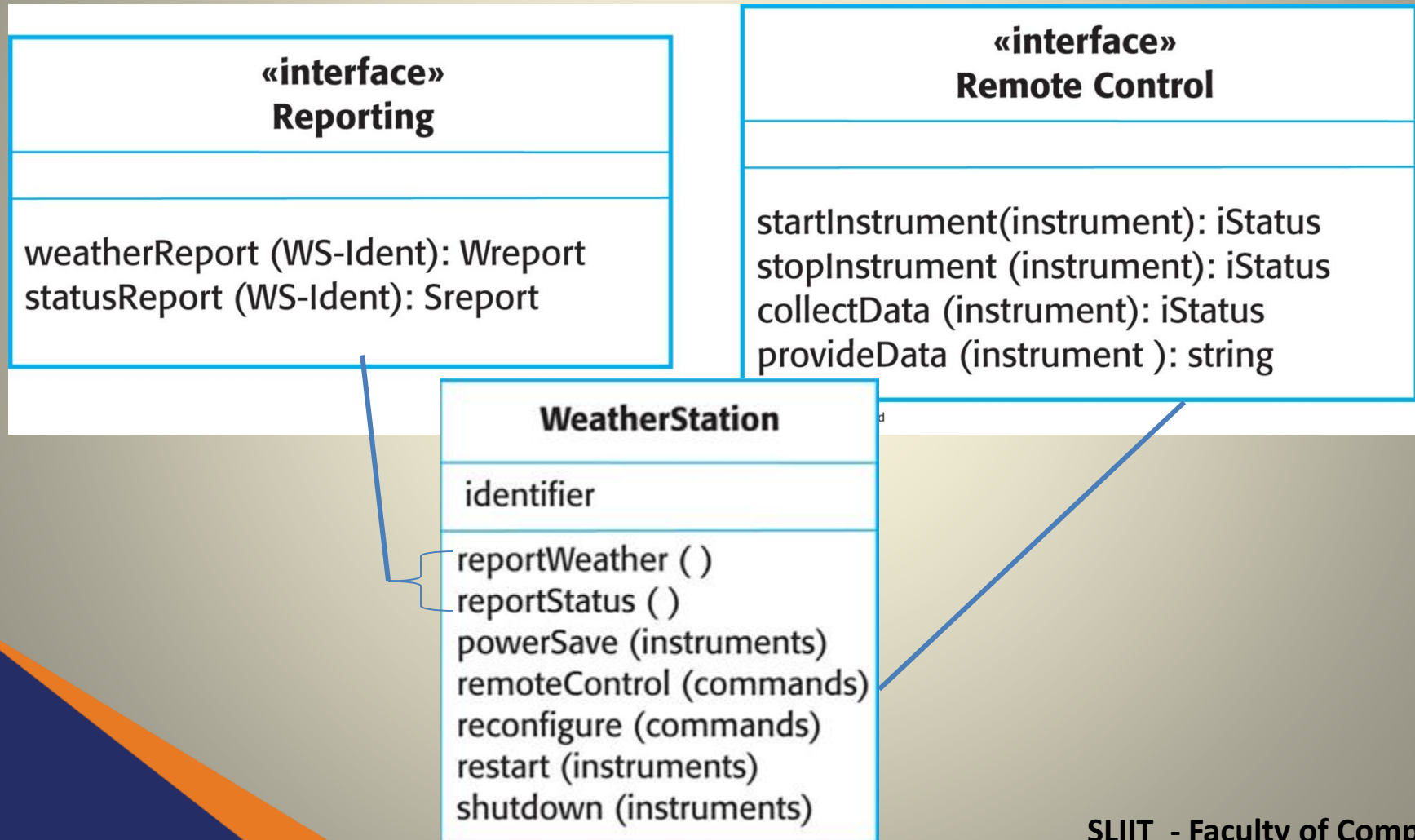
Activity

- Draw a wireframe for the SLIIT Library System

Object Oriented Design

Interfaces

«interface»
Reporting

weatherReport (WS-Ident): Wreport
statusReport (WS-Ident): Sreport

«interface»
Remote Control

startInstrument(instrument): iStatus
stopInstrument (instrument): iStatus
collectData (instrument): iStatus
provideData (instrument): string

WeatherStation

identifier

reportWeather ( )
reportStatus ( )
powerSave (instruments)
remoteControl (commands)
reconfigure (commands)
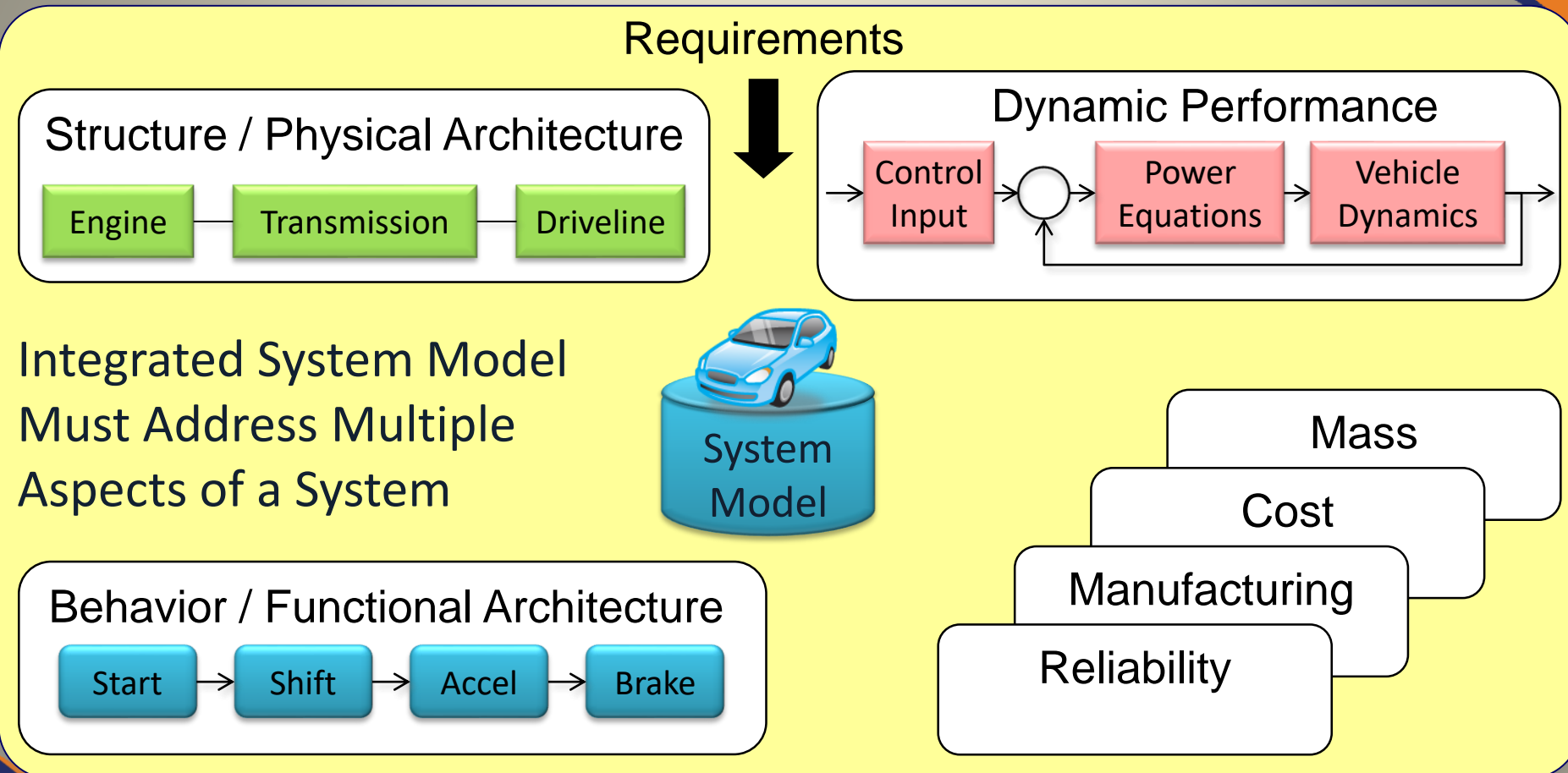restart (instruments)
shutdown (instruments)

SysML

- What is SysML? A graphical modeling language in response to the UML.

  - It is a UML Profile that represents a subset of UML 2 with extensions.

- Supports the specification, analysis, design, verification and validation of systems that include hardware, software, data, personnel, procedures, and facilities.
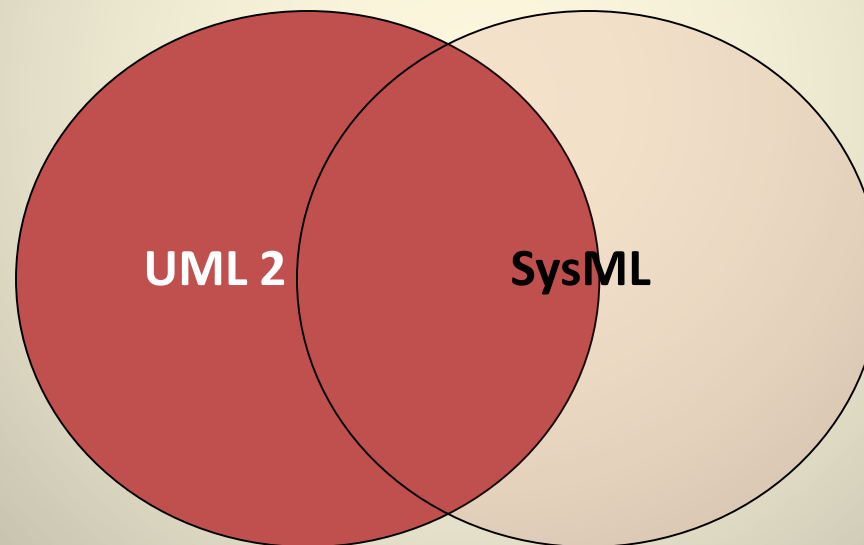
SysML

Marketing
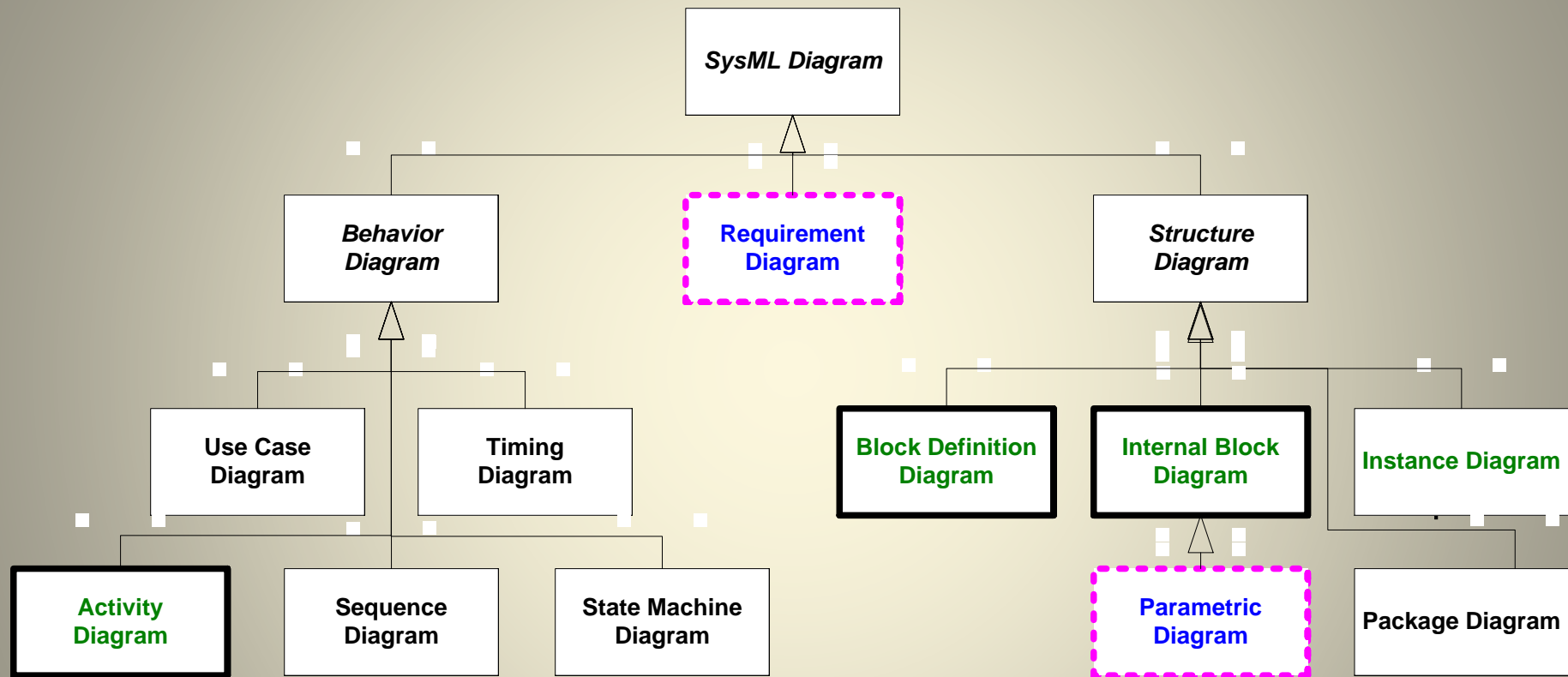
Software

Analysis

Project
Management

System
Model

Manufacturing

CAD

- Power plant
- Transmission
- Brakes
- Chassis
- …

SysML

Relationship shared by the SysML and UML Standards

- # Package hierarchy in SysML

SysML Diagram

Behavior Diagram · Requirement Diagram · Structure Diagram

Use Case Diagram · Timing Diagram

Activity Diagram · Sequence Diagram · State Machine Diagram

Block Definition Diagram · Internal Block Diagram · Instance Diagram

Parametric Diagram · Package Diagram

Legend:
- Same as UML 2
- Modified from UML 2
- New diagram type

References

- Software Engineering – 10th Edition by Ian Sommerville, Chapter 7

- https://modeling-languages.com/#

- http://www.omgsysml.org/

- http://www.omg.org/