Software analysis and design
Module 2: Principles of Visual Modeling

Objectives

- Describe the importance of visual modeling

- Define the four principles of visual modeling

- Explain what the Unified Modeling Language (UML) represents

- Define the type of process that best relates to the UML

Where are we?

- What is modeling?
- Four principles of visual modeling
- The UML
- Process and visual modeling

What is a model?

- A model is a simplification of reality.
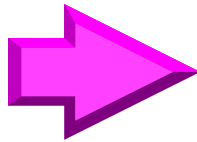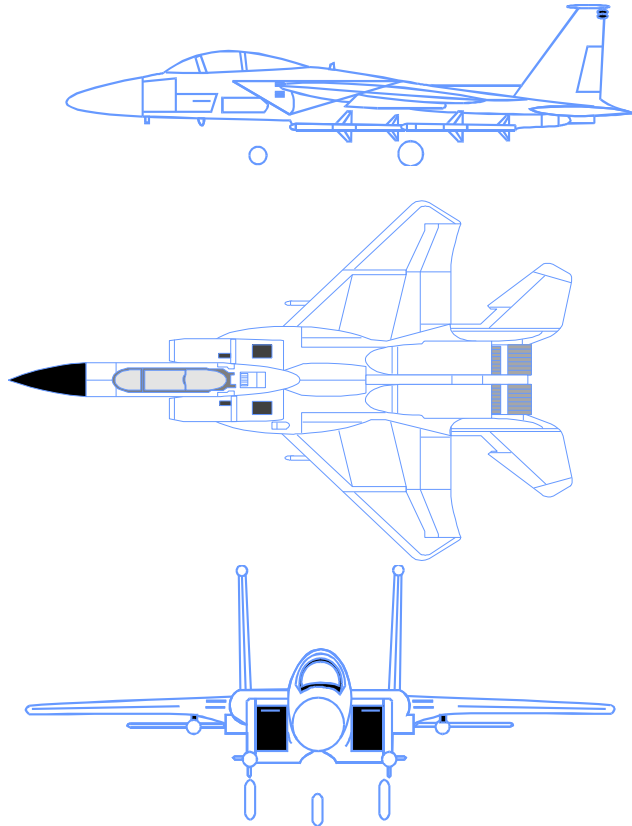
Why model?

- Modeling achieves four aims:
  - Helps you to visualize a system as you want it to be.
  - Permits you to specify the structure or behavior of a system.
  - Gives you a template that guides you in constructing a system.
  - Documents the decisions you have made.
- You build models of complex systems because you cannot comprehend such a system in its entirety.
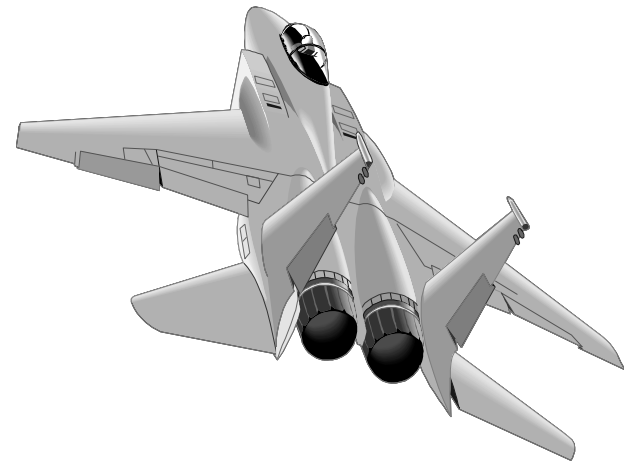- You build models to better understand the system you are developing.

The importance of Modeling

Less important   **More important**
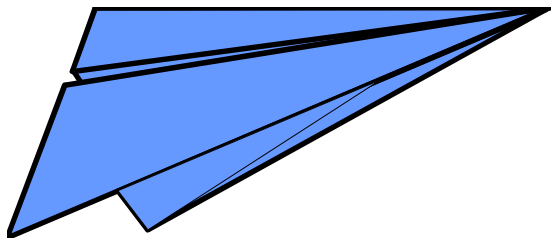
Paper Airplane   **Fighter Jet**

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

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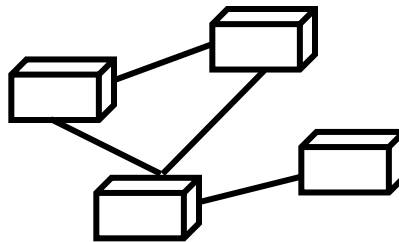
Four principles of modeling

- The model you create influences how the problem is attacked.

- Every model may be expressed at different levels of precision.

- The best models are connected to reality.

- No single model is sufficient.
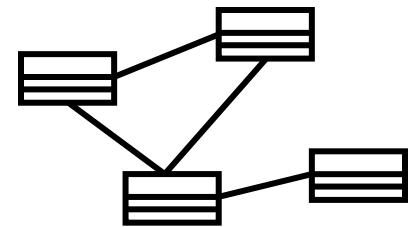
Principle 1: The choice of model is important

- The models you create profoundly influence how a problem is attacked and how a solution is shaped.
  - In software, the models you choose greatly affect your world view.
  - Each world view leads to a different kind of system.
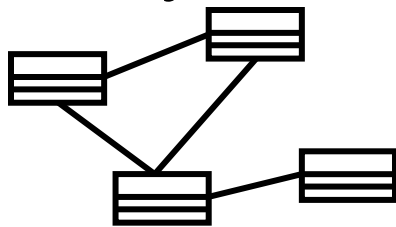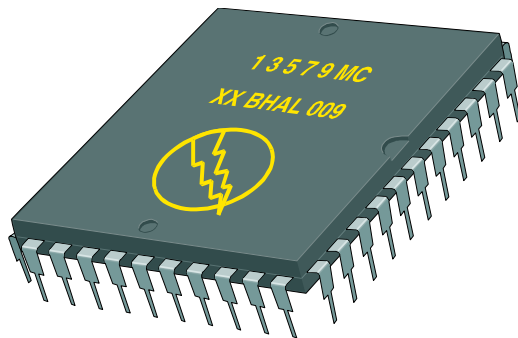

Process Model

Deployment Model

Design Model

Principle 2: Levels of precision may differ

- Every model may be expressed at different levels of precision.
  - The best kinds of models let you choose your degree of detail, depending on:
    - Who is viewing the model.
    - Why they need to view it.

View for customers
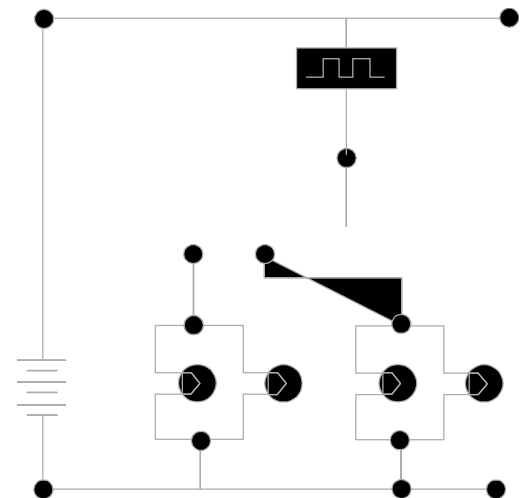
View for designer

Principle 3: The Best Models Are Connected to Reality

- All models simplify reality.

- A good model reflects potentially fatal characteristics.

Principle 4: No single model is sufficient

- No single model is sufficient. Every non-trivial system is best approached through a small set of nearly independent models.
  - Create models that can be built and studied separately, but are still interrelated.

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What is the UML?

- The UML is a language for
  - Visualizing   trực quan hóa
  - Specifying   đặc tả
  - Constructing   cấu trúc
  - Documenting   tài liệu

  the artifacts of a software-intensive system.

The UML Is a Language for Visualizing

- Communicating conceptual models to others is prone to error unless everyone involved speaks the same language.

- There are things about a software system you can't understand unless you build models.

- An explicit model facilitates communication.

The UML Is a Language for Specifying

- The UML builds models that are precise, unambiguous, and complete.

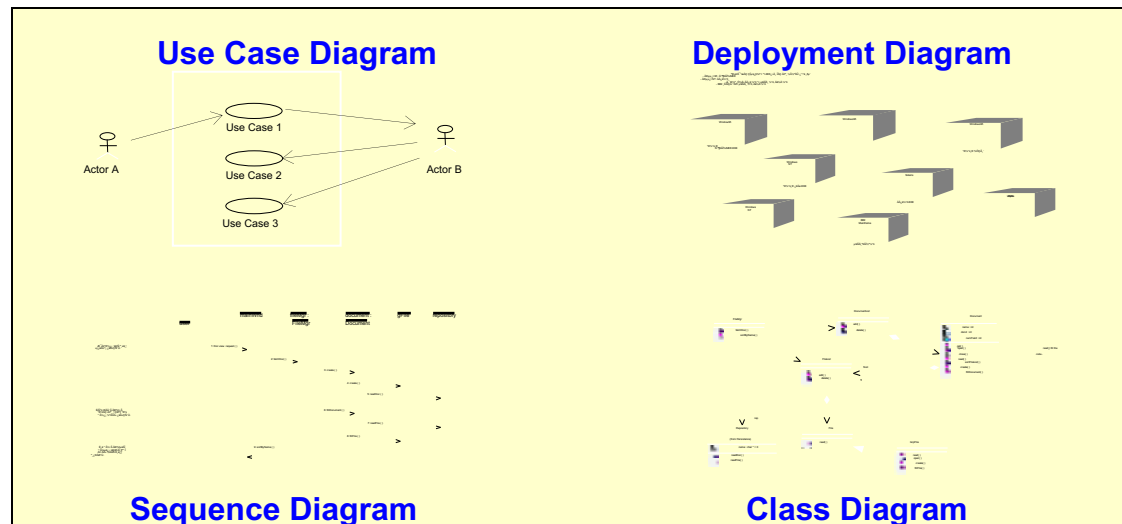# The UML Is a Language for Constructing

- UML models can be directly connected to a variety of programming languages.
  - Maps to Java, C++, Visual Basic, and so on
  - Tables in a RDBMS or persistent store in an OODBMS
  - Permits forward engineering   tiến: từ biểu đồ sinh ra mã
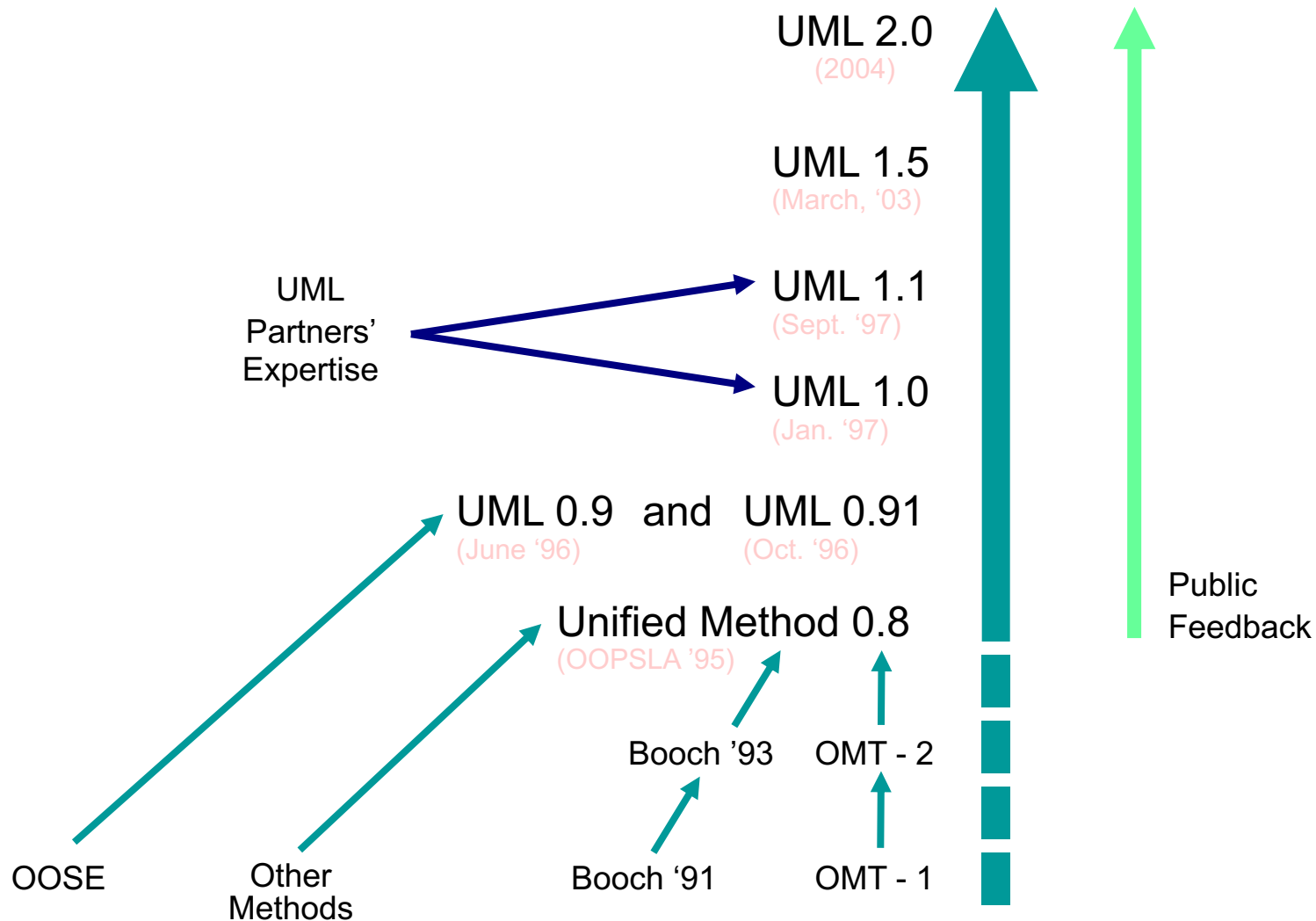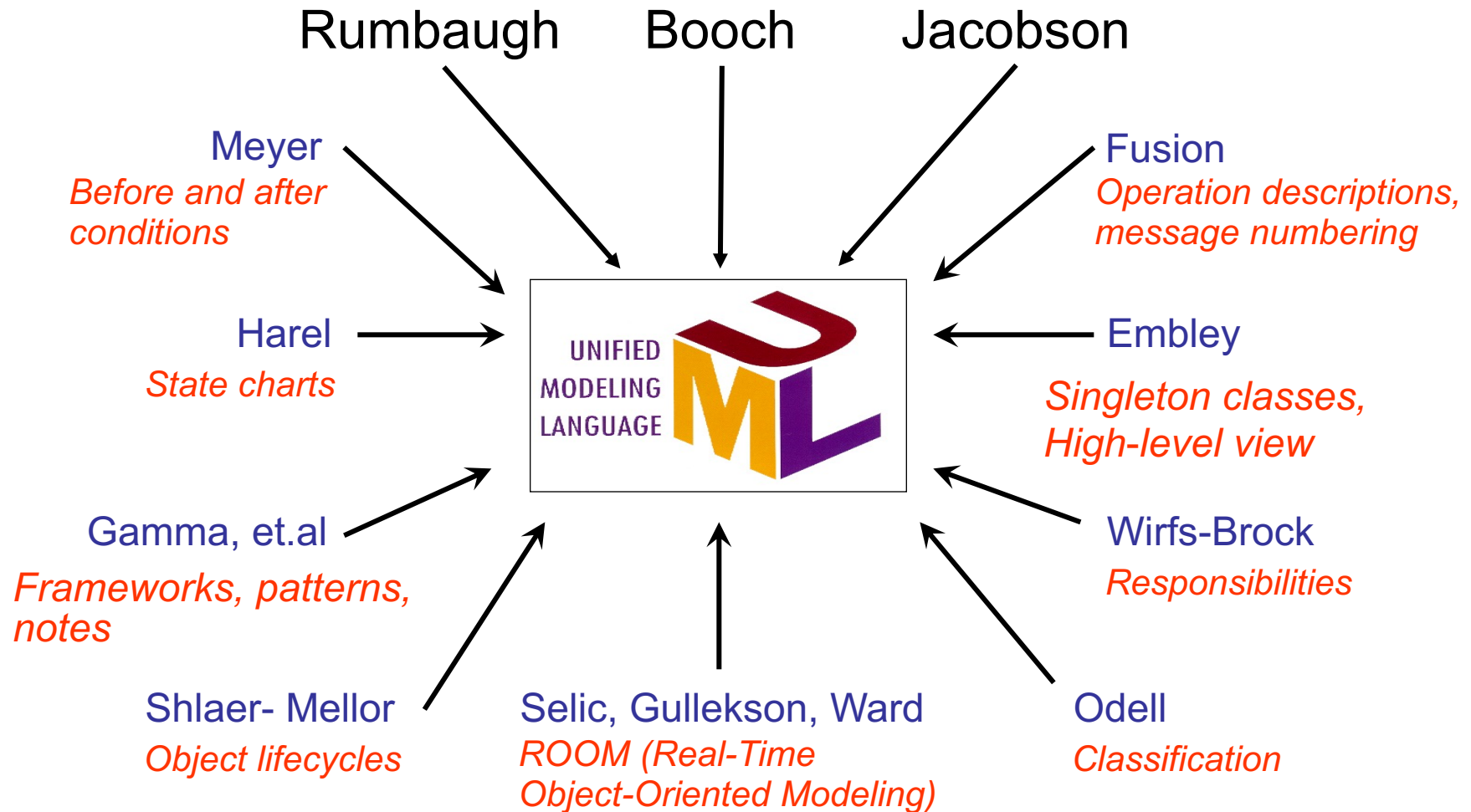 - Permits reverse engineering   lùi: từ mã sinh ra biểu đồ

The UML Is a Language for Documenting

- The UML addresses documentation of system architecture, requirements, tests, project planning, and release management.

Use Case Diagram

Deployment Diagram

Sequence Diagram

Class Diagram

History of the UML

Inputs to the UML

Rumbaugh   Booch   Jacobson

Meyer
Before and after conditions

Fusion
Operation descriptions, message numbering

UNIFIED MODELING LANGUAGE

Harel
State charts

Embley
Singleton classes, High-level view

Gamma, et.al
Frameworks, patterns, notes

Wirfs-Brock
Responsibilities

Shlaer- Mellor
Object lifecycles

Selic, Gullekson, Ward
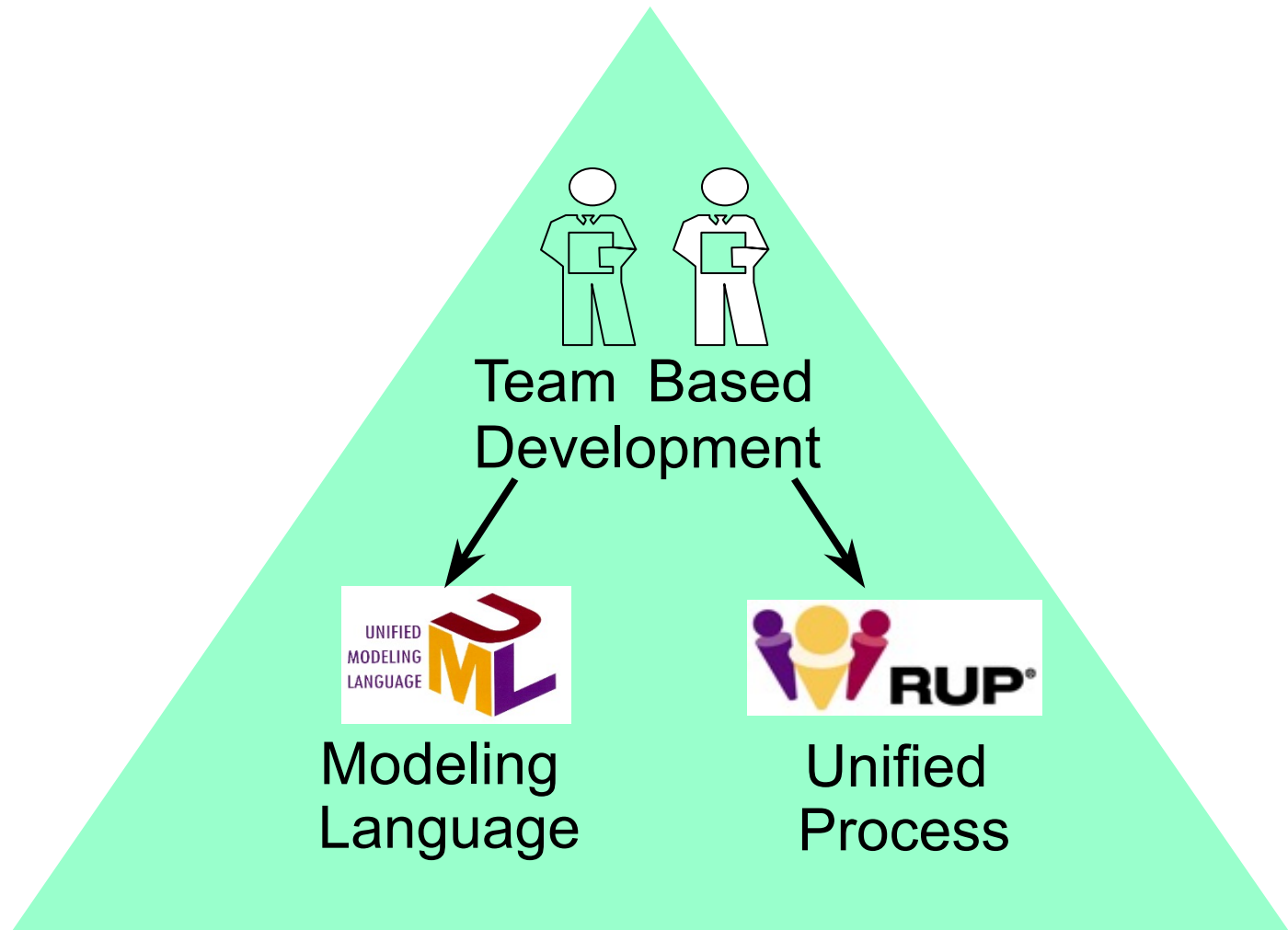*ROOM (Real-Time Object-Oriented Modeling)*

Odell
Classification

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A Language Is Not Enough to Build a System

Team Based Development

Modeling Language

Unified Process

What Type of Process Most Benefits the UML?

- The UML is largely process independent. A process fully benefits from the UML when the process is:
  - Use-case driven — quy trình hướng ca sử dụng
  - Architecture centric — quy trình lấy kiến trúc làm trung tâm
  - Iterative and incremental — quy trình lặp và tăng dần

A Use-Case Driven Process

quy trình hướng ca sử dụng

- Use cases defined for a system are the basis for the entire development process.

- Benefits of use cases:

  - Concise, simple, and understandable by a wide range of stakeholders.

  - Help synchronize the content of different models.
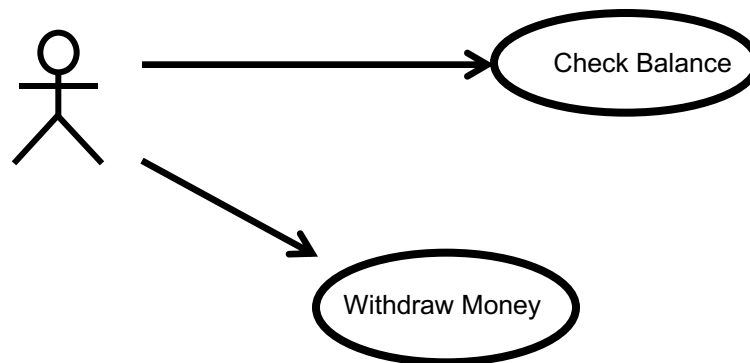
An Architecture-Centric Process

lấy kiến trúc làm trung tâm

- A system's architecture is used as a primary artifact for conceptualizing, constructing, managing, and evolving the system under development.

- Benefits:
  - Intellectual control over a project to manage its complexity and to maintain system integrity.
  - Effective basis for large-scale reuse.
  - A basis for project management.
  - Assistance in component-based development.

An Iterative and Incremental Process

quy trình lặp và tăng dần

- Critical risks are resolved before making large investments.

- Initial iterations enable early user feedback.

- Testing and integration are continuous.

- Objective milestones focus on the short term.

- Progress is measured by assessing implementations.

- Partial implementations can be deployed

Iterative Development

Iteration 1   Iteration 2   Iteration 3

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T I M E
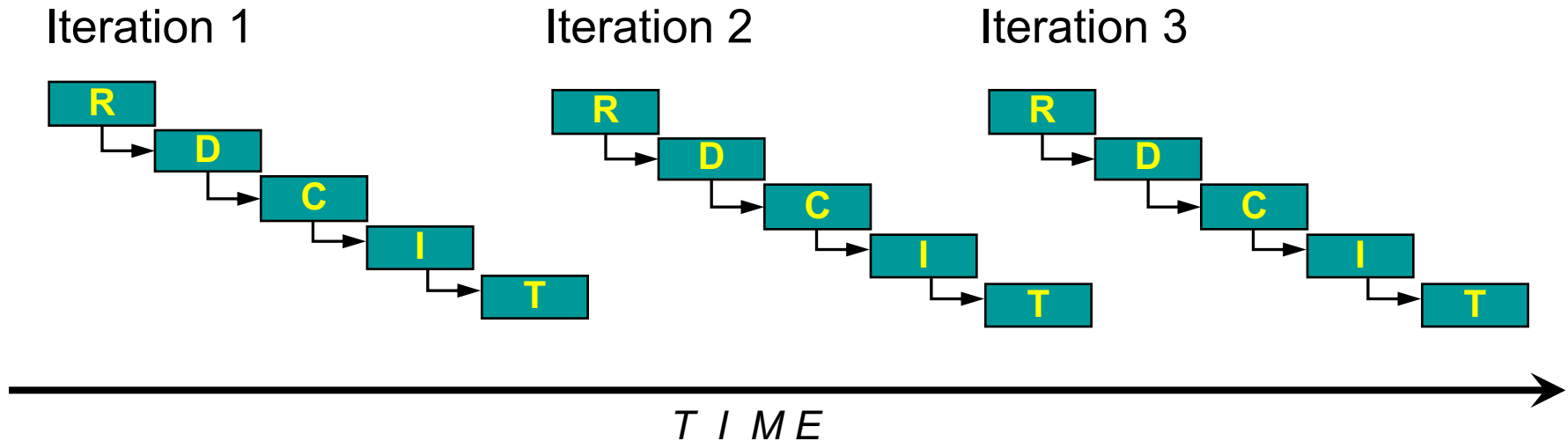
- Earliest iterations address greatest risks.
- Each iteration produces an executable release, an additional increment of the system.
- Each iteration includes integration and test.

Review

- What is a model?
- What are the four principles of modeling? Describe each one.
- What is the UML? Describe each of its four benefits.
- What process characteristics best fit the UML? Describe each characteristic.
- What is an iteration?