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What Is Object-Orientation?



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➤ Modelling Concepts



In This Lecture You Will Learn:

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- ▶ What is meant by a model
- ▶ The distinction between a model and a diagram
- ▶ The UML concept of a model



Modeling

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- ▶ Modeling is a very important activity in software development in that the software engineer usually spends a lot of time developing models with different levels of abstraction before the software system is finally designed and implemented.
- ▶ Models can be an effective communication tool, especially in situations where detailed information is not required.



What is a Model

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- ▶ Like a map, a model represents something else
- ▶ A useful model has the right level of detail and represents only what is important for the task in hand
- ▶ Many things can be modelled: bridges, traffic flow, buildings, economic policy



Why Use a Model?

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- ▶ A model is quicker and easier to build
- ▶ A model can be used in a simulation
- ▶ A model can evolve as we learn
- ▶ We can choose which details to include in a model
- ▶ A model can represent real or imaginary things from any domain



Modeling & Model

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- ▶ Different stakeholders want different level of abstractions.
- ▶ Example – Bus Information System:
 - ▶ A model for the passenger. It can be represented by a straight line with circles on it, showing the bus stop names and possibly the associated fares.
 - ▶ A model for the bus driver. It may be a simplified map showing the route covered by a bus service. Street names and the actual route will also be included to provide more details to the driver.
 - ▶ A model for the planner of bus routes. It may consist of a detailed road map with the actual bus routes. Each bus route is labeled and shown in different colors.

Different Views of Modeling

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- ▶ A model usually provides one or more views, and each view represents a specific aspect of the system. For example, the model for the passenger contains the fare view and the path view.
- ▶ The fare view provides fare information for every stop on a route, while the path view provides the route information, including the associated street names.
- ▶ Models based on different views of a system must be consistent, for example, the three dimensional model of a building must be consistent with the different elevations (models) of the same building.



Different Views of Modeling (cont'd)

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- ▶ Furthermore, a model should be expressed using a suitable notation (language) that can be understood by the stakeholders.
- ▶ In the context of software development, a system can be adequately described by the following three orthogonal views:
 - ▶ a functional view, which covers the transformation of data within the software system;
 - ▶ a static view, which covers the structure of the system and its associated data; and
 - ▶ a dynamic view, which covers the sequence or procedure of a transaction in the software system.

Modelling Organizations

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Organizations are human activity systems.

- ▶ The situation is complex
- ▶ Stakeholders have different views
- ▶ We have to model requirements accurately, completely and unambiguously
- ▶ The model must not prejudice the solution



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What is a Diagram?

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- ▶ Abstract shapes are used to represent things or actions from the real world
- ▶ Diagrams follow rules or standards
- ▶ The standards make sure that different people will interpret the diagram in the same way

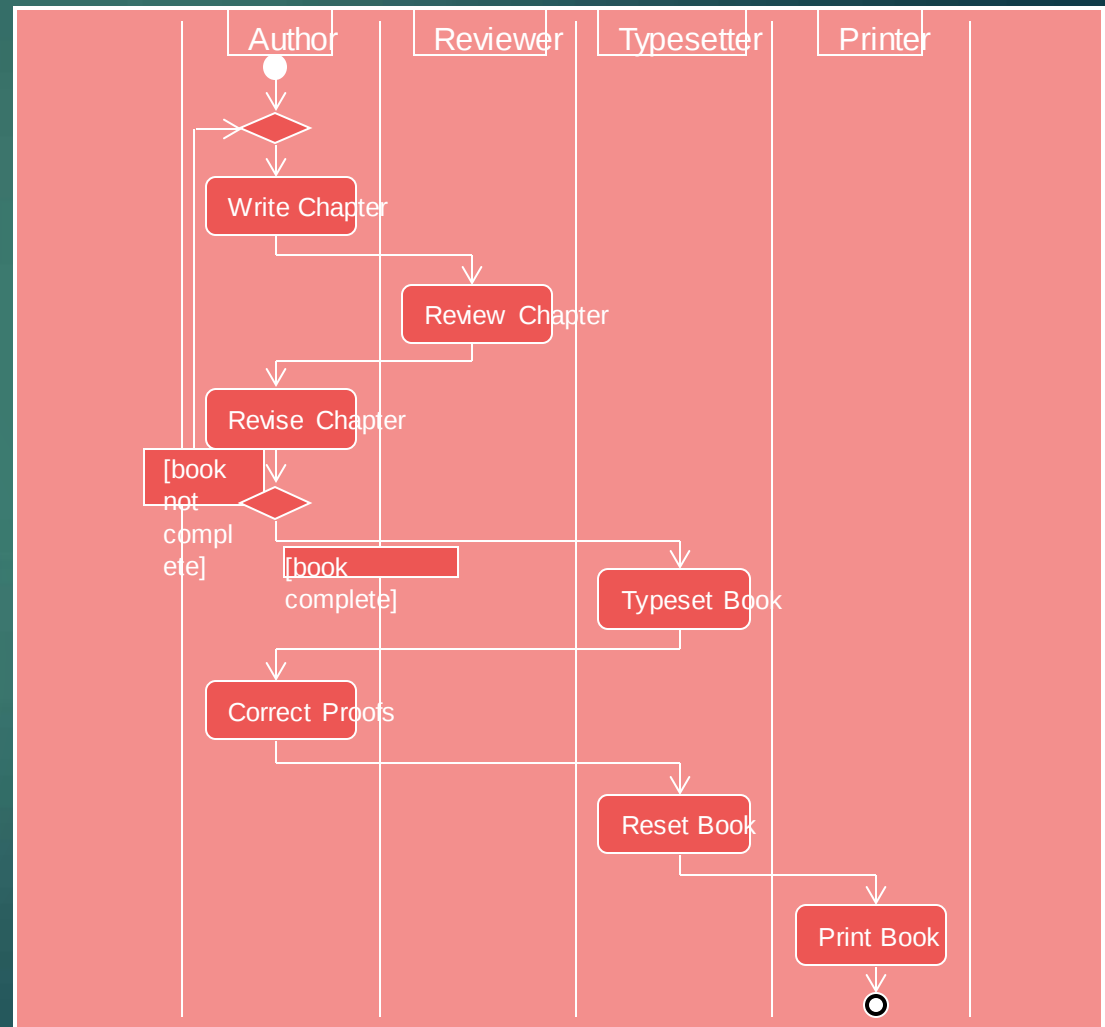


An Example of a Diagram

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- An activity diagram of the tasks involved in producing a book.



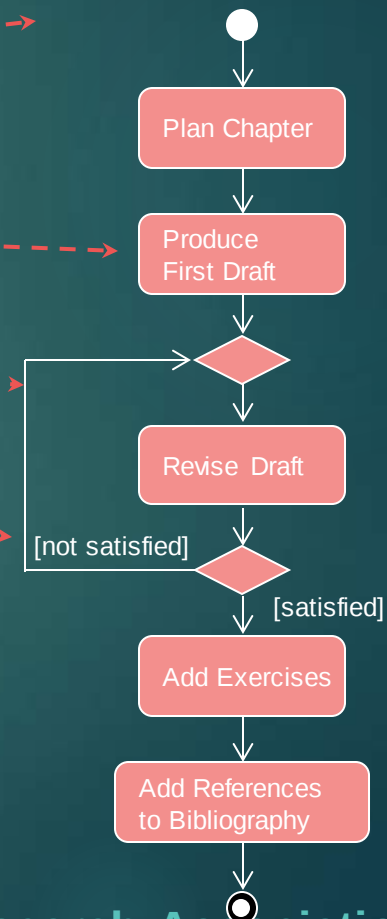
Hiding Detail



Diagrams in UML

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- ▶ UML diagrams consist of:
 - ▶ icons
 - ▶ two-dimensional symbols
 - ▶ paths
 - ▶ Strings
- ▶ UML diagrams are defined in the UML specification.



Diagrams vs Models

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- ▶ A diagram illustrates some aspect of a system.
- ▶ A model provides a complete view of a system at a particular stage and from a particular perspective.
- ▶ A model may consist of a single diagram, but most consist of many related diagrams and supporting data and documentation.

Examples of Models

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- ▶ Requirements Model
 - ▶ complete view of requirements
 - ▶ may include other models, such as a Use Case Model
 - ▶ includes textual description as well as sets of diagrams

Examples of Models

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- ▶ Behavioural Model
 - ▶ shows how the system responds to events in the outside world and the passage of time
 - ▶ an initial model may just use Communication Diagrams
 - ▶ a later model will include Sequence Diagrams and State Machines

Models in UML

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- ▶ A system is the overall thing that is being modelled
- ▶ A subsystem is a part of a system consisting of related elements
- ▶ A model is an abstraction of a system or subsystem from a particular perspective
- ▶ A model is complete and consistent at the chosen level of abstraction

Models in UML

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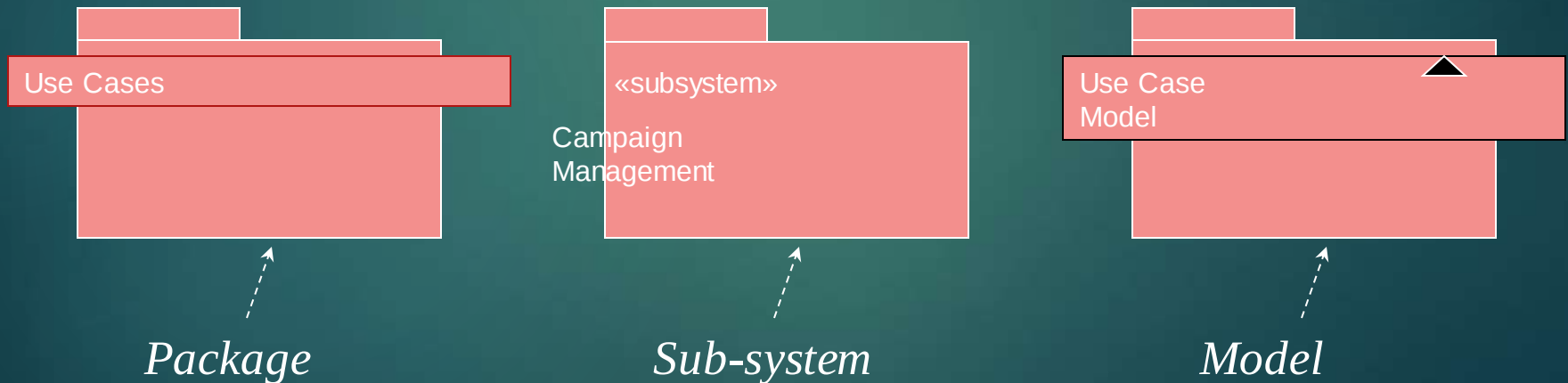
- ▶ Different models present different views of the system, for example:
 - ▶ use case view
 - ▶ design view
 - ▶ process view
 - ▶ implementation view
 - ▶ deployment view

(Booch et al., 1999)

Packages, Sub-systems and Models

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- ▶ UML has notation for showing subsystems and models, and also for packages, which are a mechanism for organising models (e.g. in CASE tools)



Developing Models

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- ▶ During the life of a project using an iterative life cycle, models change along the dimensions of:
 - ▶ abstraction—they become more concrete
 - ▶ formality—they become more formally specified
 - ▶ level of detail—additional detail is added as understanding improves



Development of the Use Case Model

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Iteration 1

Obvious use cases.
Simple use case descriptions.



Iteration 2

Additional use cases.
Simple use case descriptions.
Prototypes.



Iteration 3

Structured use cases.
Structured use case descriptions.
Prototypes.



References

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- ▶ Booch, Rumbaugh and Jacobson (1999)

- ▶ Bennett, Skelton and Lunn (2005)

(For full bibliographic details, see Bennett, McRobb and Farmer)

- ▶ Object-Oriented Technology - From Diagram to Code with Visual Paradigm for UML, Curtis H.K. Tsang, Clarence S.W. Lau and Y.K. Leung, McGraw-Hill Education (Asia), 2005



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