

SE 3140

DESIGN AND MODELLING

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Chap5. Object and class structuring

- ✓ After determining the use cases through use cases modelling,
- ✓ And developing the static model through static modeling of the problem domain,

we shall in this lesson determine the software objects in the system.

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□ Problem Domain and Solution Domain

1 Problem domain

- Defines the environment where the solution will come to work.

2 Solution domain

- Defines the abstract environment where the solution is developed.

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❑ Our focus

- ✓ On **software objects** that model real-world objects in the problem domain.
- ✓ Software objects from use cases and from the static model of the problem domain.

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☐ Where will the objects come from?

- ✓ From the Use cases and
 - ✓ From the static model
- From the problem domain.***

☐ How will it be accomplished?

- ✓ Object structure criteria will be provided then the objects will be categorized using stereotypes.

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Object and Class Structuring criteria

- There is no unique way to decompose a system in to objects – its based on
 - ✓ **The judgement of the analyst and**
 - ✓ **The characteristics of the problem**
- Whether objects are in the same class or in different classes depends on the problem.

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Object and Class Structuring criteria

Example (nature of the problem...)

1. In an automobile catalog, cars, vans and trucks might all be objects of the same class.
 2. In vehicle manufacturer, cars, vans, and trucks might all be objects of different classes.
-  Object and class structuring criteria are provided to assist the designer in structuring a system into objects.

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❑ How to determine the objects in the system

① Object and Class Structuring criteria

➤ The approach use for identifying objects is

- 1. Look for real-world objects in the problem domain**
- 2. Design corresponding software objects that models the real-world.**
- 3. Depict the object interaction in the dynamic model on communication diagrams or sequence diagrams.**

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❑ Modeling application Classes and Objects

- Before dynamic modeling, its necessary to determine what classes is needed to realize each use case.
- **Identification of classes and objects** are assisted by **applying object and class structuring criteria, providing guidance on structuring an application into objects.**

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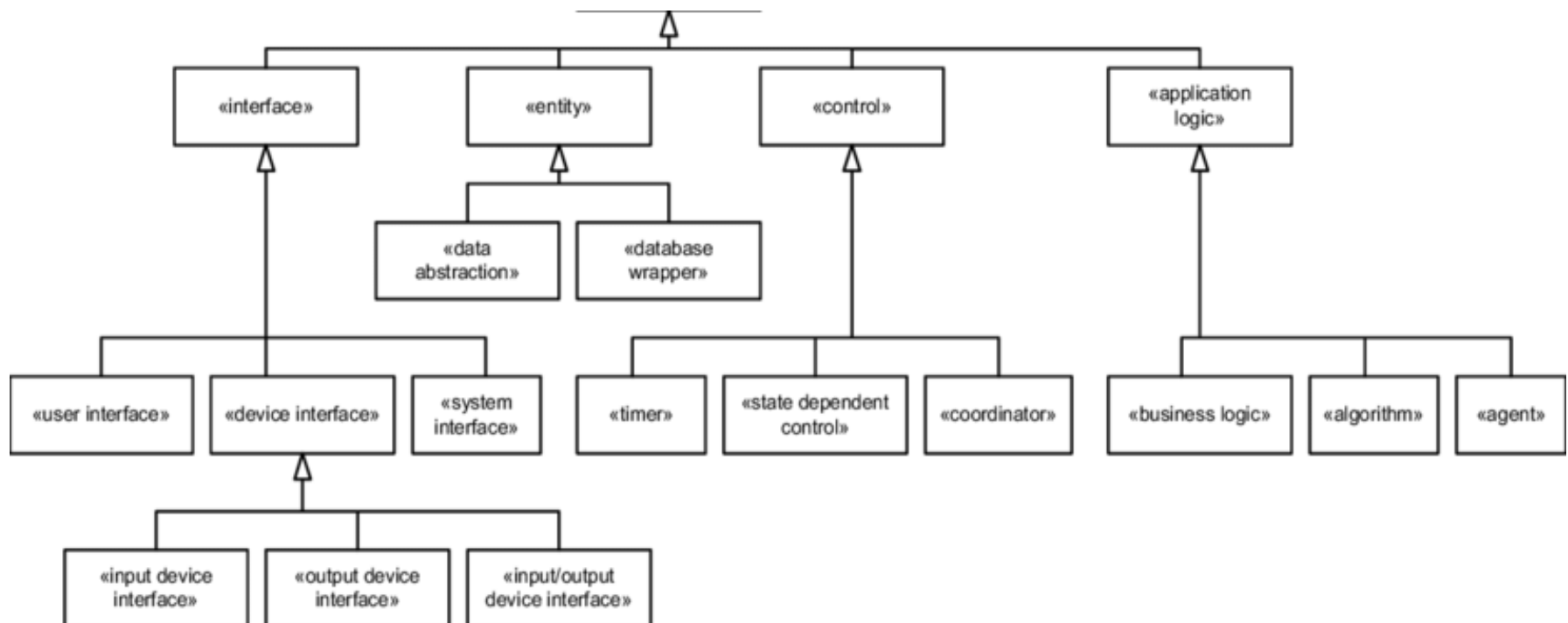
❑ Modeling application Classes and Objects(1)

- **Identification of classes and objects**
 - ✓ Here, software classes and objects are categorized by the roles they play in the application.
- 1 **Classes are categorized in order to group together classes with similar characteristics.**

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□ Modeling application Classes and Objects(2)

■ Classification of application classes by stereotype



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❑ Modeling application Classes and Objects(2 condit...)

❖ What is a stereotype?

- ✓ A well-formed mechanism for expressing user-definable extensions, refinements or redefinitions of elements of the language without (directly) modifying the meta-model of the language.

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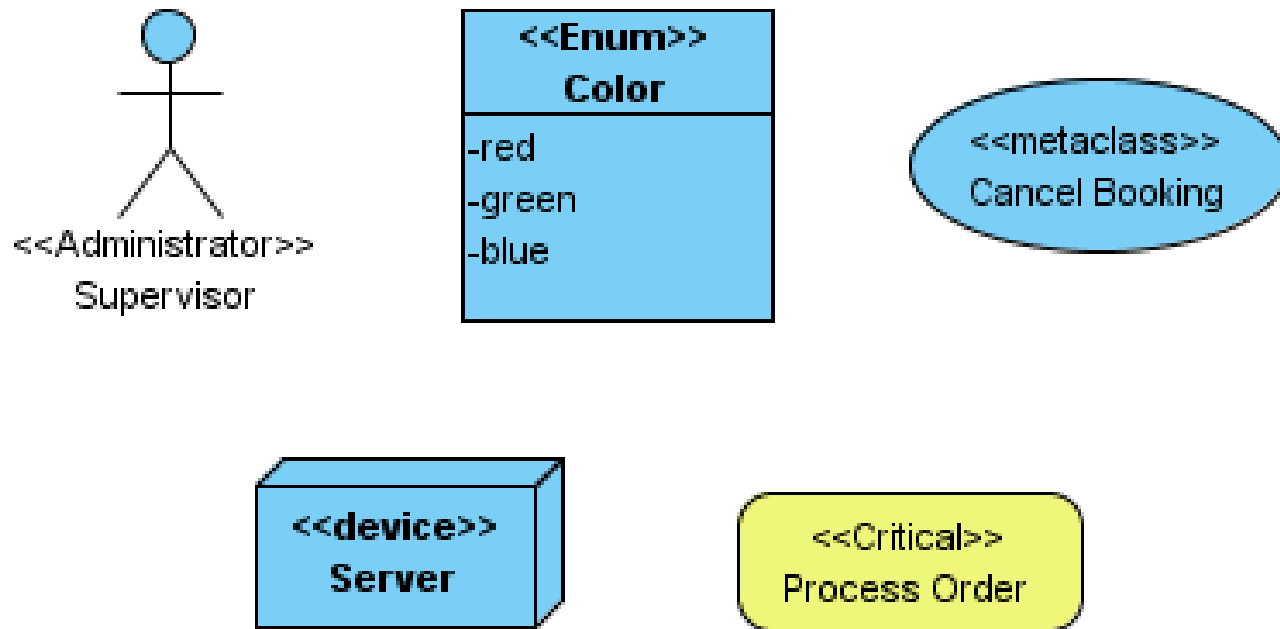
❑ Modeling application Classes and Objects(2 cond...

❖ What is a stereotype(1)?

- ✓ By applying appropriate stereotypes in your model, you can make the specification model comprehensible.

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- ❑ Modeling application Classes and Objects(2 condit...)
- ❖ UML stereotype example in modeling an online shopping system with use case diagram.



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- ❑ **Modeling application Classes and Objects(2 condit...)**
- ❖ **UML stereotype notation**
 - Class stereotypes can be shown with keywords in guillemets

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❑ Modeling application Classes and Objects(3)

■ Identification of classes and objects

2

Object has the same stereotype as the class because an object is an instance of a class.

Meaning the categorization above applies to both classes and objects.

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❑ Object and class structuring categories(1)

- Categorization of objects and classes according to the roles they play in the application.
- They are four object and classes structuring categories
 - ① Boundary objects
 - ② Entity objects
 - ③ Control objects
 - ④ Application logic objects

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❑ Object and class structuring categories(2)

- ① Boundary objects ② Entity objects**
- ③ Control objects ④ Application logic objects**

- ✓ Most applications will have objects from each of the four categories.
- ✓ Depending on the application, some will have less while some a greater number of classes in one or other category.

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❑ Object and class structuring categories(4)

✓ Information-intensive systems vs real-time system

① In information-intensive system

- It will have several entity classes , which is why static modeling is so vital for these systems.

② Real-time systems

- They are likely to have several devices I/O boundary classes to interface to interface to the various sensors and actuators.

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❑ Object and class structuring categories(5)

✓ **The four main object and class structuring categories**

① Entity Object

- Software object , in many cases , its persistent and provides access to information its stores.
- It is a passive class, it does not initiate interactions on its own and may participate in many different use case realizations.

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❑ Object and class structuring categories(6)

✓ The four main object and class structuring categories

② Boundary object

- Software object that interfaces to and communicates with the external ***environment***.
- It lies on the periphery of a system, but within it.
- It interacts with actors outside the system as well as objects of all three kinds of analysis classes within the system.

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❑ Object and class structuring categories(6)

✓ The four main object and class structuring categories

② Boundary object

■ Further categorized as

i. User interaction object

ii. Proxy object

iii. Device I/O boundary object

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❑ Object and class structuring categories(7)

✓ The four main object and class structuring categories

② Boundary object

i. User interaction object

- Software object that interacts with the interfaces to a human user

Example:

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❑ Object and class structuring categories(8)

✓ The four main object and class structuring categories

② Boundary object

ii. Proxy object

- Software object that interfaces to and communicates with an external system or subsystem.

Example:

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❑ Object and class structuring categories(8)

✓ The four main object and class structuring categories

② Boundary object

iii. Device I/O boundary object

- Software object that receives input from and/or outputs to a hardware I/O device.

Example:

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❑ Object and class structuring categories(9)

✓ The four main object and class structuring categories

③ Control object

- Software object that provides the overall coordination for a collection of objects.

we may have

I. Coordinator objects

II. State-dependent control objects

III. Timer objects

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❑ Object and class structuring categories(10)

✓ The four main object and class structuring categories

④ Application logic object

- Software objects that contains the details of the application logic.
- *Use where there is need to hide the application logic from the data and use to make the application logic independent from the data.*

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❑ Object and class structuring categories(11)

✓ The four main object and class structuring categories

④ Application logic object

- In Information system – application logic object are usually ***business logic objects***.
- In real-time , scientific applications, they are usually ***algorithm objects***.

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❑ Object and class structuring categories(12)

✓ The four main object and class structuring categories

④ Application logic object

- Another category is **service objects** which provide services for client objects, usually in service-oriented applications.

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❑ Object and class structuring categories(13)

- ✓ In most cases , the category each object fits in is obvious.
- ✓ In some cases, an object may satisfy more than one of the criteria. In such cases, allocate the object to the category it seems to fit best.

Example:

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❑ External classes and software boundary classes(1)

✓ What are external classes?

- Classes that are outside the software system and that interact to the system.

✓ What are boundary classes?

- Classes inside the system that interface to and communicate with the external classes.

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❑ External classes and software boundary classes(2)

✓ How do you determine the boundary classes?

- Identify the external classes to which they are connected which will help identify some of the classes in the system itself such as boundary classes.
- They are usually one to one association between the external class and the internal boundary class with which they communicate.

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❑ External classes and software boundary classes(3)

✓ External classes interface to software

boundary classes.

1. *An external user class* interfaces to and interacts with a user interaction class.
2. *An external system class* interfaces to and communicate with a proxy class
3. *An external device class* provides inputs to and/or receives output from a device I/O boundary class.

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❑ External classes and software boundary classes(4)

- ✓ External classes interface to software boundary classes.

3. An external device class may be

- a) **An external input device** class that provides input to an input class
- b) **An external output device** class that receives output from an output class

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❑ External classes and software boundary classes(5)

- ✓ External classes interface to software boundary classes.

3. An external device class may be

c). **An external I/O device** that provides input to and receives output from an I/O class

d). **An external timer class** signals to a software timer class.

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❑ External classes and software boundary classes(5)

- ✓ External classes interface to software boundary classes.

3. An external device class may be

c). **An external I/O device** that provides input to and receives output from an I/O class

d). **An external timer class** signals to a software timer class.

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- ❑ **External classes and software boundary classes(6)**
 - ✓ **External classes interface to software boundary classes.**
 - An external device class represents an I/O device type.
 - An external I/O device object represents a specific I/O device that is an instance of the device type.

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❑ Boundary classes and objects (1)

- ✓ **The three different kinds of boundaries and their characteristics**

1 User Interaction Objects

2 Proxy Objects

3 Device I/O boundary objects

Chap5. Object and class structuring

□ Boundary classes and objects (2)

- ✓ The three different kinds of boundaries and their characteristics

① User Interaction Objects

- It communicates directly with the human user, receiving input from the user and providing output to the user via standard I/O devices (keyboard, visual display, and mouse).

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□ Boundary classes and objects (3)

- ✓ **The three different kinds of boundaries and their characteristics**

1 User Interaction Objects

- The user interface may be a simple command line or a more complex interface such as the GUI object.

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□ Boundary classes and objects (4)

- ✓ The three different kinds of boundaries and their characteristics

② Proxy objects

- It interfaces to and communicates with an external system.
- The local representation of the external system and hides the details of how to communicate with the external system.

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□ Boundary classes and objects (5)

- ✓ The three different kinds of boundaries and their characteristics

③ Device I/O Boundary objects

- It provides the software interface to a hardware I/O device.
- A physical object in the application domain is a real-world object that can be seen and touch.

Chap5. Object and class structuring

□ Boundary classes and objects (6)

- ✓ **The three different kinds of boundaries and their characteristics**

③ Device I/O Boundary objects

- Real world physical object will have a corresponding software object in the system.
- Real world physical objects usually interface to the system via sensors and actuators.

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□ Boundary classes and objects (7)

- ✓ **The three different kinds of boundaries and their characteristics**

3 Device I/O Boundary objects

- Real world physical object provides inputs to the system via sensors or receive outputs from the system via actuators.

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□ Boundary classes and objects (8)

- ✓ The three different kinds of boundaries and their characteristics

③ Device I/O Boundary objects

- An ***input object*** is a device I/O boundary object that receives input from external input device.
- An ***output object*** is a device I/O boundary object that sends output to an external output device.

Chap5. Object and class structuring

□ Boundary classes and objects (9)

- ✓ The three different kinds of boundaries and their characteristics

③ Device I/O Boundary objects

- An *input/output object* is a device I/O boundary object that receives input from and sends output to an external I/O device.

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- ❑ Depicting External classes and boundary classes**
 - ✓ **Determining the scope of the system and how to develop a software system context class diagram shows all the external classes that interface to and communicate with the system.**
 - ✓ **Boundary classes are software classes inside the system that are at the boundary between the system and the external environment.**

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❑ Entity classes and objects

- ✓ Entity objects stores information
- ✓ Entity objects are instances of entity classes, whose attributes and relationships with other entity classes determined during the static modeling.
- ✓ In most system, information encapsulated by entity objects is stored in a file or database

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❑ Entity classes and objects (1)

- ✓ **In many information system applications**
 - Information encapsulated by entity objects is stored in a file or database
- ✓ **In real-time systems**
 - Entity objects are often stored in main memory.

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❑ Control classes and objects(2)

- ✓ Control object provides the overall coordination of the objects that realize a use case.
- ✓ Simple use case does not need a control object while more complex one need
- ✓ A control object may be state-dependent

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❑ Control classes and objects(3)

✓ Control Object types

① **Coordinator objects**

- An overall decision-making object that determines the overall sequencing for a collection of related objects.
- Often required to provide the overall sequencing for execution of a use case.
- It makes overall decisions on when, and in what order , other objects participate in the use case.

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❑ Control classes and objects(4)

✓ Control Object types

① **Coordinator objects**

- It makes its decision based on the input it receives and is not state-dependent.
- An action initiated by this object depends only on the information contained in the incoming message and not on what previously happened in the system.

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❑ Control classes and objects(5)

✓ Control Object types

② *State-dependent control objects*

- Behavior varies in each of its states
- Finite state machine is use to define a state-dependent control object and is depicted by using a statechart.

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❑ Control classes and objects(6)

✓ Control Object types

③ **Timer objects**

- Activated by an external timer – for example a real time clock or operating system clock.
- It either perform some action itself or activates another object to perform the desired action.

Example : **Report timer**,

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❑ Application logic classes and objects(1)

✓ Types of application objects

① ***Business logic objects***

② ***Algorithm objects***

③ ***Service objects***

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❑ Application logic classes and objects(2)

✓ Types of application objects

① **Business logic objects**

- Defines the business-specific application logic for processing a client request.
- The goal is to hide the business rules that could change independently of each other into separate business logic objects.

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❑ Application logic classes and objects(3)

✓ Types of application objects

② *Algorithm objects*

- Encapsulates an algorithm used in the problem domain.
- More seen in real-time scientific and engineering domains.

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❑ Application logic classes and objects(4)

✓ Types of application objects

③ *Service objects*

➤ Provides a service for other objects

➤ Never initiates a request, it response to a service request it might seek the assistance of other service objects.

QUESTIONS



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□ Assignment