UML

Class Diagrams

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Index

Introduction

Types of Diagrams

In UML, there are two basic categories of diagrams:

- **Structure** diagrams show the static structure of the system being modeled: **class**, *component*, *deployment*, *object* diagrams, ...
- **Behavioral** diagrams show the dynamic behavior between the objects in the system: *activity*, *use case*, *communication*, *state machine*, *sequence* diagrams, ...

Class Diagrams

Class diagrams show the **classes** of the system, their **relationships** (including inheritance, aggregation, and association), and the **operations** and **attributes** of the classes.

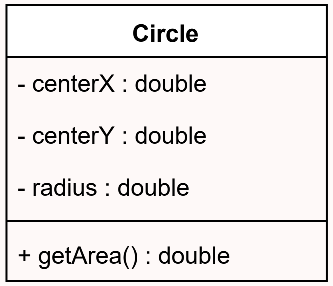
Class diagrams are used for different purposes:

- Conceptual **domain** modeling:
    - Illustrates meaningful conceptual classes in problem domain.
    - Represents real world concepts, not software components.
- Detailed **design** modeling:
    - Represents the concrete software components.

Classes

Class

The UML representation of a class is a **rectangle** containing **three compartments** stacked **vertically**:



Class Attribute List

The **middle** compartment lists each of the **attributes** of the class on a separate line.

Each line uses the following format:

> *name : attribute type*

For example:

> *width : double*

Attribute Default Value

Default values can be specified (**optionally**) in the attribute list section by using the following **notation**:

> *name : attribute type = default value*

For example:

> *width : double = 0*

Class Operations List

The **lowest** compartment lists each of the **operations** of the class on a separate line.

Each line uses the following format:

> *name(parameter list) : type of value returned*

For example:

> *setRadius(radius : double) : void*

Operation Parameters

When an **operation** has **parameters**, they are put inside **parentheses**.

Each parameter uses the **format**:

> *parameter name : parameter type*

They can also have a **optional** "in" or "out" marking specifying if the parameter is an **input** or **output** parameter.

For example:

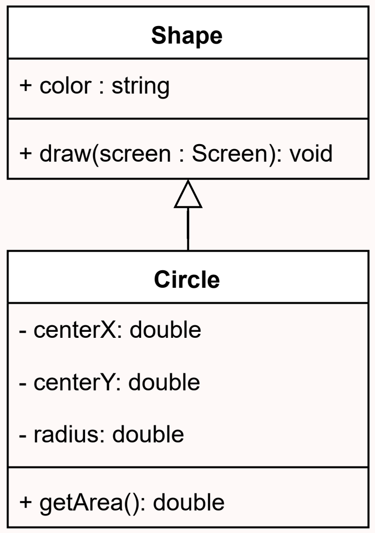
> *setRadius(in radius : double) : void*

Inheritance

Inheritance

The ability of one class (child class) to **inherit** the identical **functionality** of another class (super class), and then **add new functionality** of its own.

Inheritance is indicated by a **solid line** with a **closed**, **unfilled** arrowhead **pointing** at the **super class**.

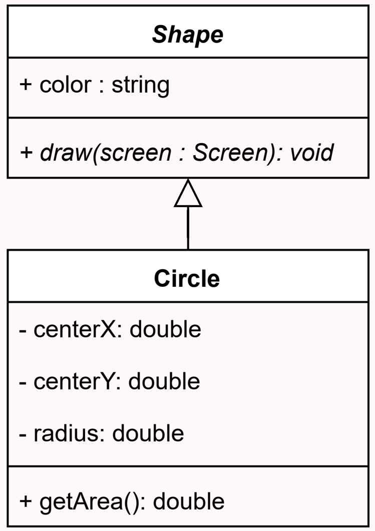


Abstract classes and operations

Abstract operations are operations where the class only provides the operation **signature** and **not it's code**.

Abstract classes are classes that **contain abstract** operations and, therefore, cannot be instantiated.

> *They are **both** represented in italic.*

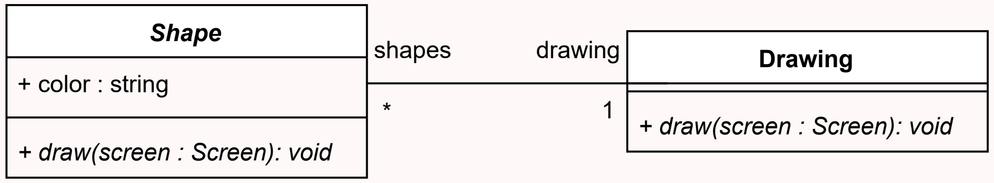


Associations

Bi-directional association

Associations are assumed to be **bi-directional** by default. This means that both classes are aware of each other.

A bi-directional association is indicated by a **solid line** between the two classes.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shapes
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Drawing
+ *draw(screen : Screen): void*

At either end of the line, you place a **role** name and a **multiplicity** value.

Multiplicity

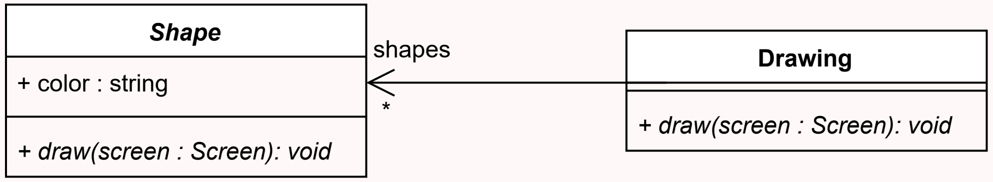
Some examples of possible **multiplicities**:

Multiplicity	Shorthand	Cardinality
0..0	0	Collection must be empty
0..1		No instances or one instance
1..1	1	Exactly one instance
0..*	*	Zero or more instances
1..*		At least one instance
5..5	5	Exactly 5 instances
m..n		At least m but no more than n instances

Uni-directional association

In a uni-directional association, **two classes** are **related**, but **only one** class **knows** that the relationship exists.

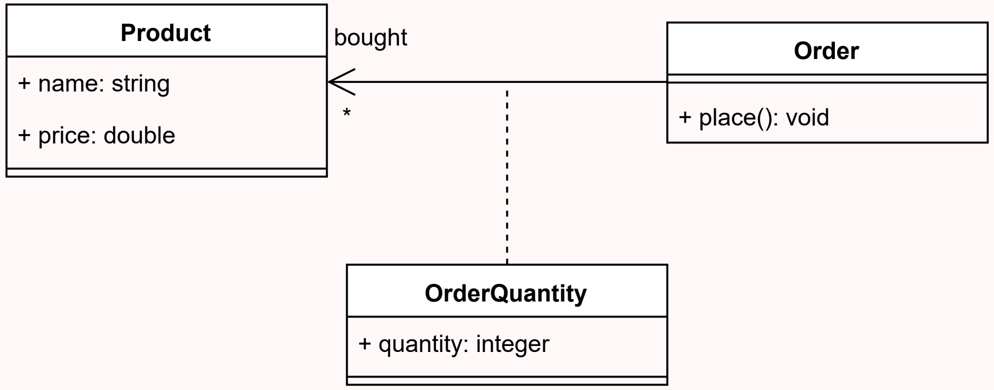
A uni-directional association is drawn as a **solid line** with an **open arrowhead** pointing to the **known** class.



Association Class

An **association class** includes **information** about a **relationship**.

It is represented like a **normal class** but has a **dotted line connecting** it to the **association**.

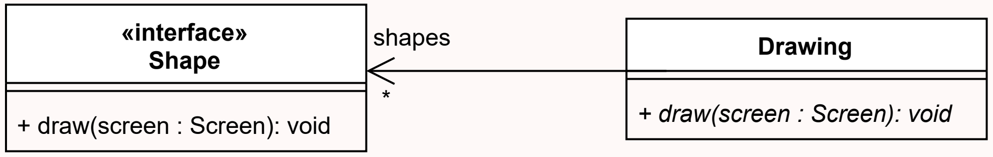


Interfaces

Interface

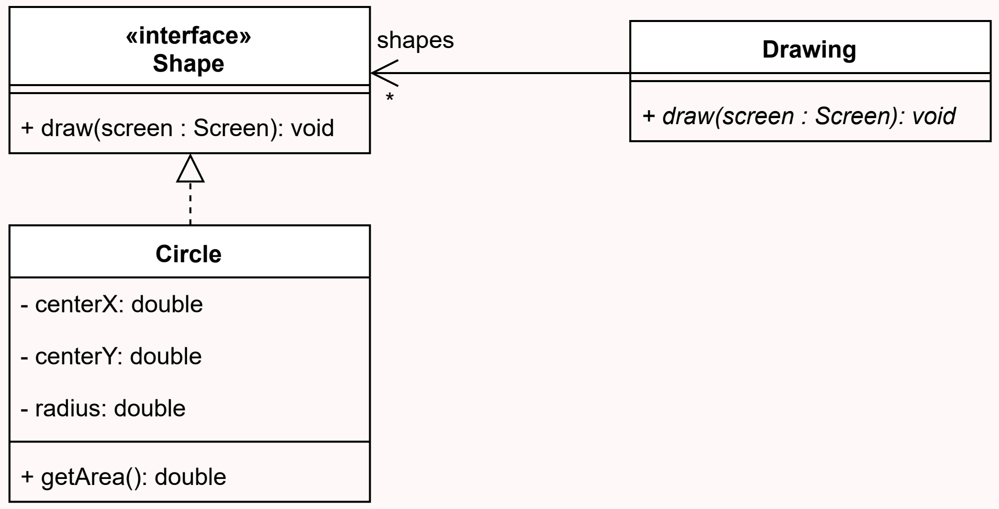
- An interface is a **description** of the **actions** that an object **can do**.
- The **combination** of all **public methods** and **properties** of an **object**.
- Interfaces can also be seen as **contracts** that other classes must fulfil.

In UML, an interface is depicted just like a **class** but with a **«interface» keyword**.



Implementation

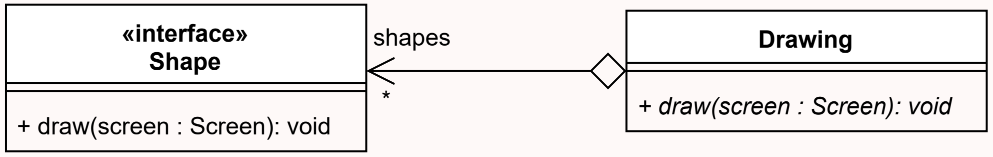
A class can **declare** that it **implements** a certain **interface** in a very similar way to inheritance (but with the line **dotted** and not solid).



Aggregation

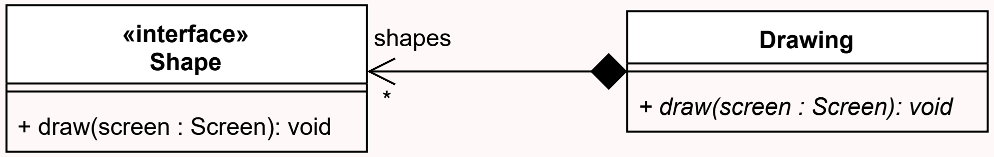
Aggregation

- Aggregation is a special type of **association** used to model a "**whole** to its **parts**" relationship.
- An association with an **aggregation relationship** indicates that **one** class is a **part** of **another** class.
- In an aggregation relationship, the **child** class instance can **outlive** its **parent** class.
- To represent an aggregation we use an **unfilled diamond** shape on the **parent**'s association **end**.



Composition

- The **composition aggregation** relationship is another, **stronger**, form of the aggregation relationship.
- In an **composition aggregation** relationship, the **child** class instance **cannot outlive** its **parent** class.
- To represent a composition aggregation we use an **filled diamond** shape on the **parent**'s association **end**.

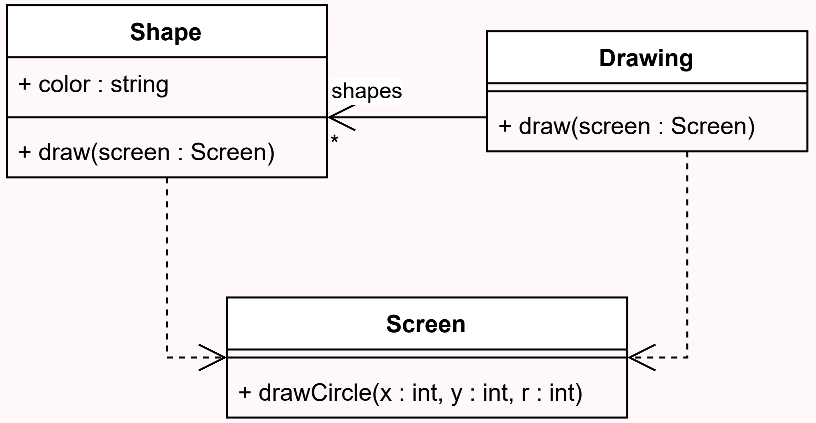


Dependency

Dependency

Represents a **dependency** between two elements of a UML diagram (e.g., classes).

Important when we want to show that **changes** to an element **may impact** another one; even when there is no association (as in an attribute referencing the other class) between them.


Shape
+ color : string
+ draw(screen : Screen)
shapes
*
Drawing
+ draw(screen : Screen)
Screen
+ drawCircle(x : int, y : int, r : int)