CS202: Programming Systems

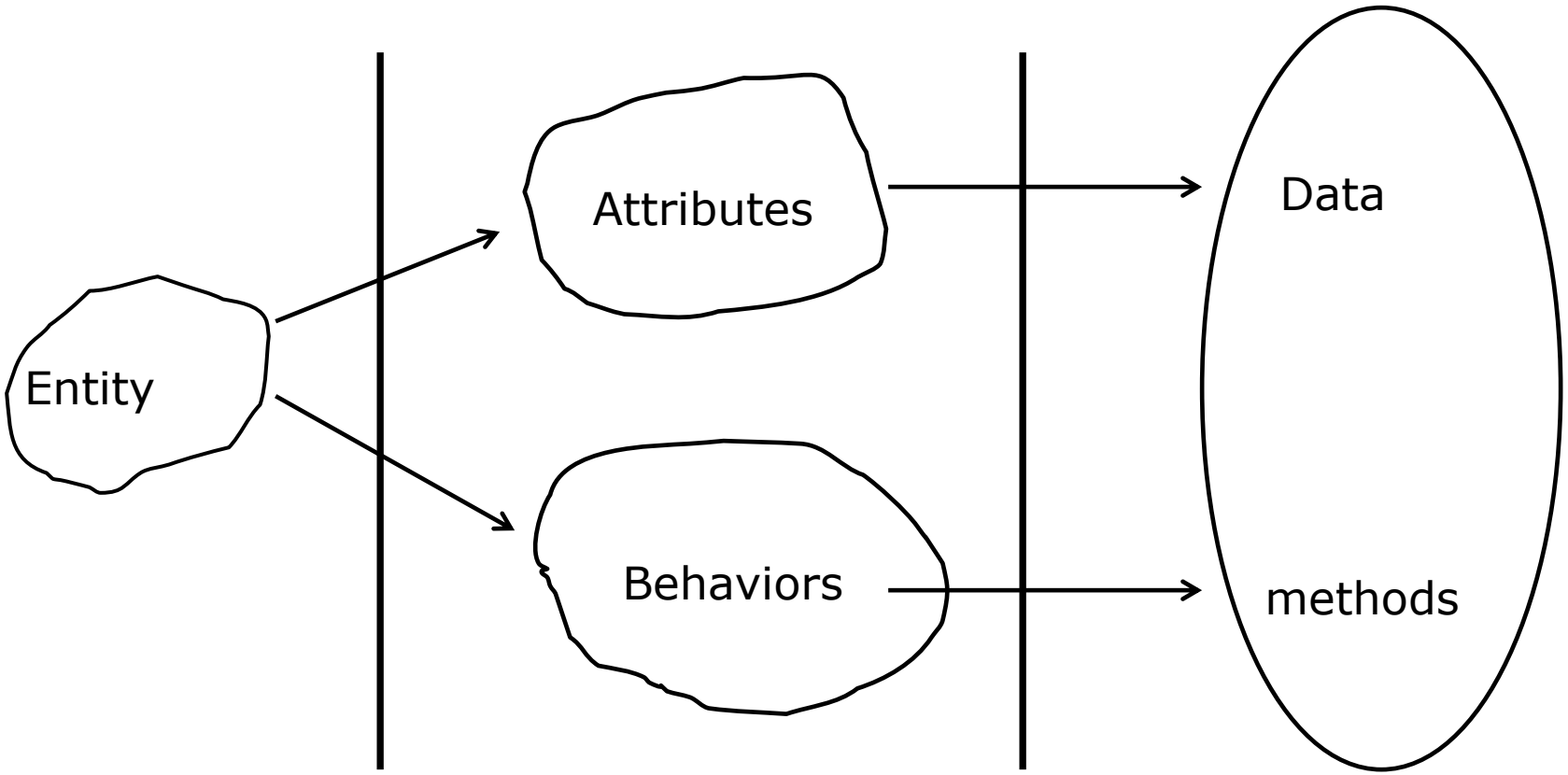
Week 1_3: OO Design

10/2022

Object-oriented design

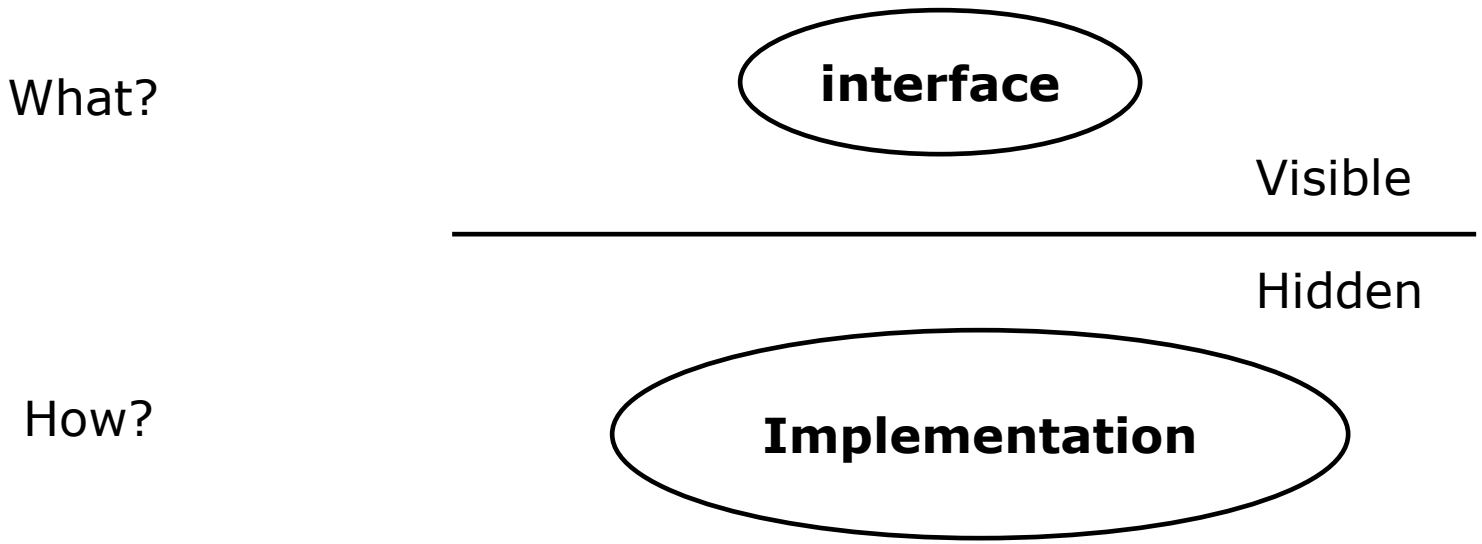
- Abstract Data Types (ADT)
- Divide project into a set of cooperating classes
- Each class has a very specific functionality
- Think of a class as similar to a data type
- Class can be used to create instances of objects

Mapping the real world to software



Classes in OO Programming

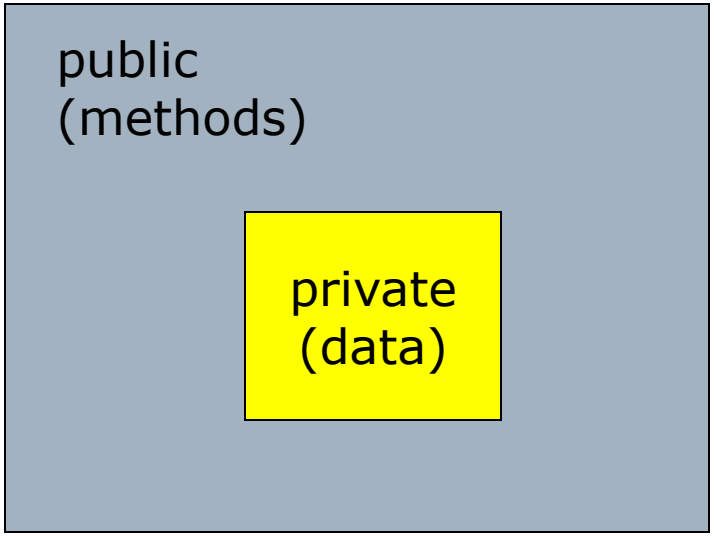
- Separation interface from implementation



Structure of a class

- A class models an entity in real world
- A class represents all members of a group of objects
- A class provides a public interface and a private implementation
- Hiding the data and “algorithm” from the user

Structure of a class



class

Designing process

- Identifying classes
- Identifying behaviors
  - Decide whether behavior is accomplised by a single class or through the collaboration of a number of "related" classes
  - Static behavior: behavior always exists
  - Dynamic behavior: depending of when/how a behavior is invoked, it might or might not be legal

Identifying classes

- Abbott and Booch:
  - use nouns, pronouns, noun phrases to identify objects and classes
  - Note: not all nouns are really going to relate to objects
- Coad and Yourdon:
  - identify individual or group "things" in the system/problem
- Ross: common object categories: people, places, things, organizations, concepts, events

Class

- A class should:
  - be a real-world entity
  - be important to the discussion of the requirements
  - have a crisply defined boundary
  - make sense; (i.e. can identify the attributes and behaviors)
  - closely related

Object

- An “object” is an **instance of a class**
  - Just like a “variable” is an instance of a specific data type
- We can zero or more variables (or objects) in our programs

Class and object

- A class is a blueprint for an object.
- When you instantiate an object, you use a class as the basis for how the object is built.
- A class can be thought of as a sort of higher-level data type. For example:

```
myClass myObject;
```

Class and object

- Each object has its own attributes and behaviours .
- A class defines the attributes and behaviours that all objects created with this class will possess.

- Classes are pieces of code.
- Objects are created from classes,

Class declaration in C++

```
class  <Name of the class>
{
     public:
          <public attributes and methods>
     private:
          <private attributes and methods>
};
```

Scope

- private: only visible to methods of the class itself.
- public: can be use from inside of the class or any client outside

An example

```
class  Date
{
   public:
      Date();
      Date(int iNewDay, int iNewMonth, int iNewYear);
      void moveDays(int k); //move k days
      int compare(const Date& anotherDate);
      ...
   private:
      int    iDay, iMonth, iYear;
};
```

Scope resolution operator ::

- Tell the compiler the method or attribute belongs to a certain object

  For example:

```
void Date::moveDays(int k)
{
}
```

Separation declaration from definition

```
//keep in 1 file
class  Date
{
   public:
        void moveDays(int k);

   private:
        ...
};

void Date::moveDays(int k)
{
  //...
}
```

```
// header file .h
class  Date
{
   public:
        void moveDays(int k);
   private:
        ...
};

// implementation file .cpp
void Date::moveDays(int k)
{
       return iDay;
}
```

How to use the **`Date`** class

```
int main()
{
    Date today(4, 10, 2021);
    Date tomorrow, someDay;

    //can I do this?
    cout << today.iMonth;
    //how about this?
    today.moveDays(5);
    ...
}
```

Encapsulation and data hiding

- Encapsulation:
  - A C++ class provides a mechanism for packaging data and the operations that may be performed on that data into a single entity
- Information Hiding
  - A C++ class provides a mechanism for specifying access

Taxonomy of member functions

- The types of member functions may be classified in a number of ways. A common taxonomy:
  - **Constructor:** an operation that creates a new instance of a class
  - **Mutator:** an operation that changes the state of of the data members of an object
  - **Observer:** an operation that reports the state of the data members (aka Accessors, Getters)
  - **Iterator:** an operation that allows processing of all the components of a data structure sequentially

Exercises

- List member functions of the following class:
  - `Fraction` with `numerator` and `denominator`