LESSON IV
Object Initialization and Usage

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Objectives

- Acquaint how to initialize and use objects

Content

- Data initialization and constructor
- Object declaration and initialization
- Object usage

I. Data initialization

- Needs of initialize data before using
- Primitive data type: initialize by assignment operator
- Object (reference data type): initialize by using constructor.

Constructor

- Objects are created through constructors
  - instance variables of an object are initialized in the scope of constructors.
- A class may declare its own constructor or rely on the default constructor provided by the Java environment.
  - The name of constructor is the name of class
  - Constructor is written without return type; the default return type of a class constructor is the same class

Constructor's definition: without parameter

- Fixing the initial values of attributes
- Syntax:

```
modifier class-name() {
    // constructor body
}
```

- Default constructor:
  - constructor without argument.
  - It is automatically provided in the case of no explicit declaration
  - Initialize attributes with the default values of the corresponding data types

- Example

```
public class Account {
    private String owner;
    private long balance;
    public Account() {
        owner = “Noname”;
        balance = 100;
    }
}
```

- If this constructor is not implemented, the java default constructor will initiate attributes with the following values:
  - owner = null (Default value of String type)
  - balance = 0 (Default value of long type)

Constructor’s definition: with parameter

- Parameterizing the initial values of attributes

```
modifier class-name(parameter-list) {
  // constructor body
}
```

- Example

```
public class Account {
    private String owner;
    private long balance;
    public Account(String name, long money) {
        owner = name;
        balance = money;
    }
}
```

II. Object declaration and initialization

```
datatype instance-variable;
instance-variable = new datatype();
```

or

```
datatype instance-variable = new datatype();
```

- Declaration: declare a reference variable
  - Associate a variable name with a **datatype** object
- Instantiation: **new** is a Java operator that creates the object (i.e. creates an instance of class **datatype**)
  - Allocate memory for a **datatype** object
  - Return its address
- Initialization: initialize the new object
  - Call to a constructor

Object initialization

- Syntax

  `datatype instance-variable = new datatype(…);`
- When the object is created, the member variable is assigned to the memory area, and initialized at the same time.
- Implicit initialization:
  - number data type ← 0;
  - reference type ← null
  - boolean ← false

  (see the default values of data types, lecture 2)

III. Object usage

- Using an object implies
  - Accessing (taking or changing) the value of one of its variables
  - Calling one of its methods to perform an action.
- Objects communicates through message passing

  `receiver.message`

  - The dot operator (“.”) is used to send a **`message`** to **`receiver`** object

1. Accessing and changing the value of a variable

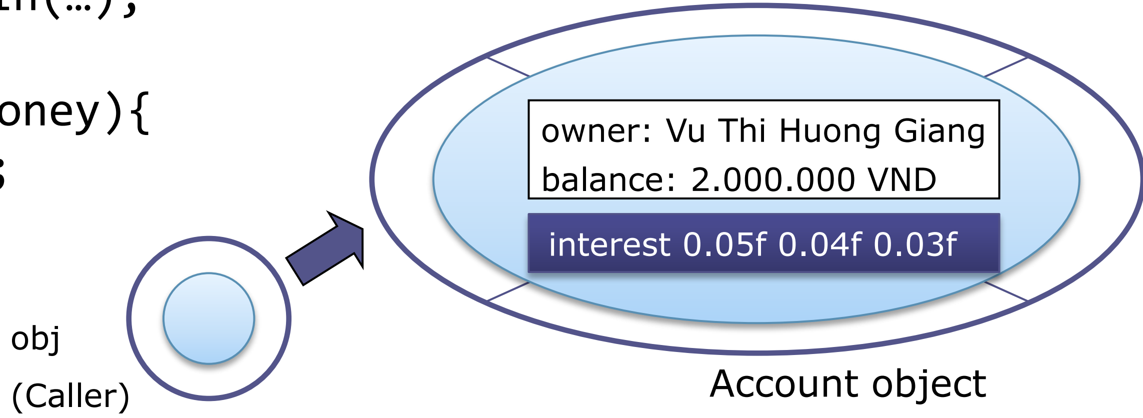
`receiver.member-variable-name;`

- The message is the variable name
- No parameter is used
- No need to use the dot operator inside a class

```
public class Account {
    String name; //Account name
    long balance; //Balance

    void display(){
        System.out.println(…);
    }
    void deposit (long money){
        balance += money;
    }
}
```

```
// Class that uses
// the variable balance
Account obj = new Account();
obj.balance = 100;
```



2. Calling methods

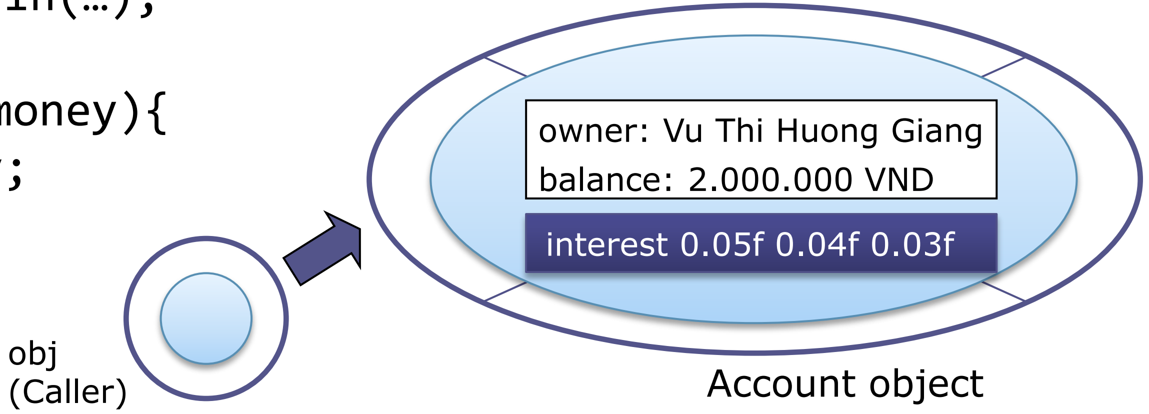
- A method is called through an object
  - The object is its default target

  `receiver.method-name(list-of-parameters)`
  - The message is the method name.
  - The parameters respect the signature of method.

```
public class Account {
    String name; //Account name
    long balance; //Balance

    void display(){
        System.out.println(…);
    }
    void deposit (long money){
        balance += money;
    }
}
```

```
// Class that uses
// methods of Account object
Account obj = new Account();
obj.display();
obj.deposit(1000);
```



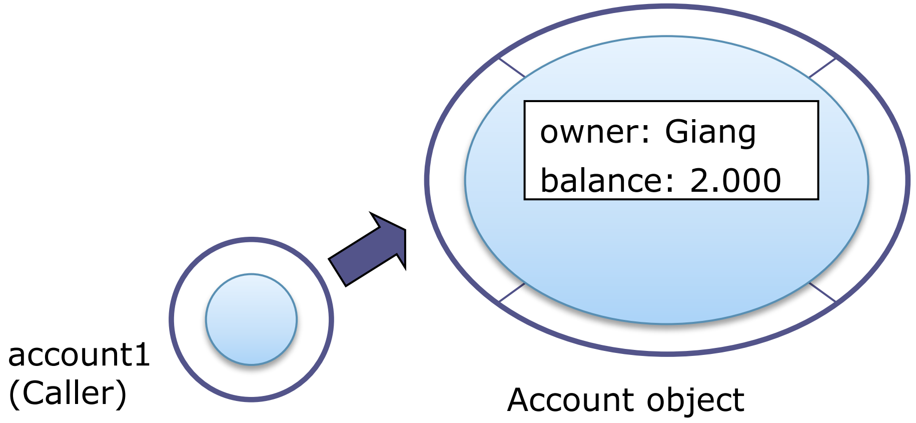
3. Calling constructors

- A constructor can not be called directly
- It can only be called by using the new operator during class instantiation.

```
public class Account {
     // Account name
     private String owner;
     // Account name
     private long balance;

     public Account
        (String name, long money ) {
        owner = name;
        balance = money;
     }
}
```

```
public class AccountUsage {
    public static void main(String[] args) {
        // Object creation
        Account account1 =
            new Account("Giang", 2000);
    }
}
```



Example

```
public class Track {
    // attributes
    private String title;
    // title of the track
    private int time_length;
    // length of time for playback
    private int data_format;
    // encoding format
    private int buffer_size;
    // size of the buffer where data is
    // read from for playback

    // constructor without parameter
    public Track() {
            title = "Notitle";
    }
    public Track(int length, int format, int size) {
            title = "Notitle";
            time_length = length;
            data_format = format;
            buffer_size = size;
    }
    public Track(String name, int length, int format,
    int size) {
            title = name;
            time_length = length;
            data_format = format;
            buffer_size = size;
    }
    public void setLength(int length) {
            time_length = length;
    }
    public void setTitle(String name) {
            title = name;
    }

    // ....

}
```

Example

```
public class TrackClassUsage {
     public static void main(String[] args)
        {
          Track track1 = new Track();
          track1.setTitle(“One name");
          track1.setLength(45);
          Track track2 = new Track(
             "Four seasons", 43, 1, 1000);
          Track track3 = new Track(
             “One name", 45, 0, 0);
          Track track4 = track3;
          track2 = new Track(
             “Another name", 0, 0, 1000);
     }
}
```

- Objects are used usually through variables
- Track1 and track3 have the same initial values, but they are not the same object
- Track3 and track4 refer to the same object
- The object ("Four seasons", 43, 1, 1000) is no longer accessible

4. Keyword **this**

- Used inside a method or a constructor to refer to the current object
  - Specify member or method of current object
  - Distinguish the data member with the parameters of member functions (which have the same name)

```
public class Account {
     // instance variable
     private String owner; // Account name
     private long balance; // Balance
     //...
     // value setting method
     public void setAccountInfo(String owner, long balance) {
          this.owner = owner;
          this.balance = balance;
     }
     //...
}
```

Keyword **this**

- Used to call another constructor of own class

```
public class Track {
      private String title; // title of the track
      private int time_length; // the length of time to playback
      private int data_format;
      // the encoding format in which the data (audio, video, text...) is represented
      private int buffer_size;
      // the total size of the buffer where data is read from for playback

      public Track() {
            this(0,0,0);
      }

      public Track(int length, int format, int size) {
            title = "Notitle";
            time_length = length;
            data_format = format;
            buffer_size = size;
      }
}
```

‘this’(argument list) calls another constructor

Keyword **this**

- Used to pass the current object’s reference to other objects

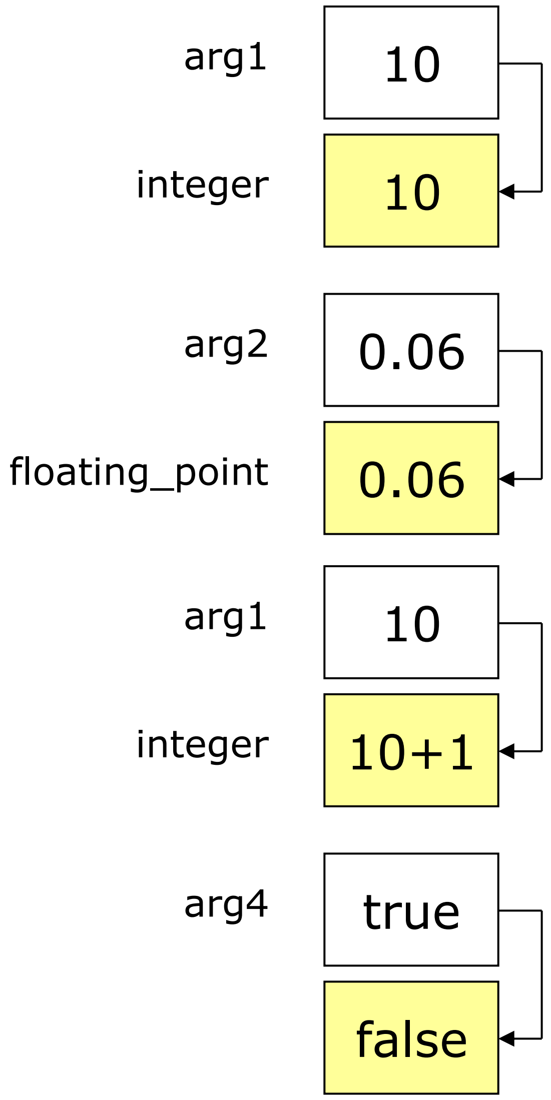
```
public class Track {
     private String title; // title of the track
     private int time_length; // the length of time to playback
     private int data_format;
     // the encoding format in which the data (audio, video, text...) is represented
     private int buffer_size;
     // the total size of the buffer where data is read from for playback
     public Track() {
          this(0,0,0);
     }
     public Track(int length, int format, int size) {
          title = "Notitle";
          time_length = length;
          data_format = format;
          buffer_size = size;
          RecordException re = new RecordException(this);
     }
}
```

5. Argument-passing

- Parameter: a variable receiving value at the time the method is called
- Argument: a value passed to the method when it is called
- Two ways of how the arguments are passed to methods:
  - Parameters of primitive type: by value
    - a method receives a copie of the original value;
  - Parameters of reference type: by reference
    - a method receives the memory address of the original value, not the value itself

Passing arguments by value

```
public class PassingByValueUsage {
     static int integer;
     static float floating_point;
     char character;
     boolean logic;
     public static void
        TestPrimitiveParam(int arg1,
        float arg2, char arg3,
        boolean arg4) {
          //passing by value
          //new values can be seen
          //outside the enclosed method
          integer = arg1;
          floating_point = arg2;
          // legal assignment
          // new values can not be seen
          // outside the enclosed method
          arg1 += arg1;
          arg4 = false;
     }
```



Passing arguments by value

```
public class PassingByValueUsage {
     static int integer;
     static float floating_point;
     char character;
     boolean logic;
     public static void
        TestPrimitiveParam(int arg1,
        float arg2, char arg3,
        boolean arg4) {
          //passing by value
          //new values can be seen
          //outside the enclosed method
          integer = arg1;
          floating_point = arg2;
          // legal assignment
          // new values can not be seen
          // outside the enclosed method
          arg3 += arg3;
          arg4 = false;
     }
```

```
     public static void main(String[] args) {
          int arg1= 10;
          float arg2 = 0.06f;
          char arg3 = 'a';
          boolean arg4 = true;
          System.out.println(
            PassingByValueUsage.integer + “ “ +
            PassingByValueUsage.floating_point);
          System.out.println(arg1 + " " + arg2 +
            " " + arg3 + " " + arg4);

          TestPrimitiveParam(
            arg1, arg2, arg3, arg4);

          System.out.println(
            PassingByValueUsage.integer + “ “ +
            PassingByValueUsage.floating_point);
          System.out.println(arg1 + " " +  arg2
            + " " + arg3 + " " + arg4);
     }
}
```

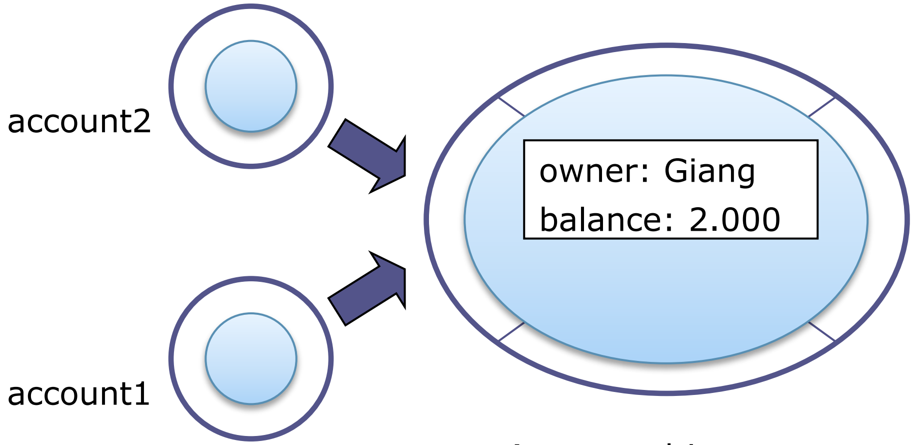
Passing arguments by object reference

```
public class Account {
     // Account name
     private String owner;
     // Account name
     private long balance;

     public Account
        (String name, long money ) {
        owner = name;
        balance = money;
     }
}
```

```
public class AccountUsage {
    public long checkAccountBalance
        (Account acc){
        return tmp = acc.getBalance();
    }

    public static void main(String[] args) {
        // Object creation
        Account account1 =
            new Account("Giang", 2000);
        Account account2 = account1;
        long blc =
            checkAccountBalance(account2);
    }
}
```



Account object

account1 and account2
refer to the same object

5. Array of objects

- Declaration: like primitive values
- Objects in the array will be initialized with `null`.
- Example:

```
Employee emp1 = new Employee(123456);
Employee emp2;
emp2 = emp1;
Department dept[] = new Department[100];
Test[] t = {new Test(1),new Test(2)};
```

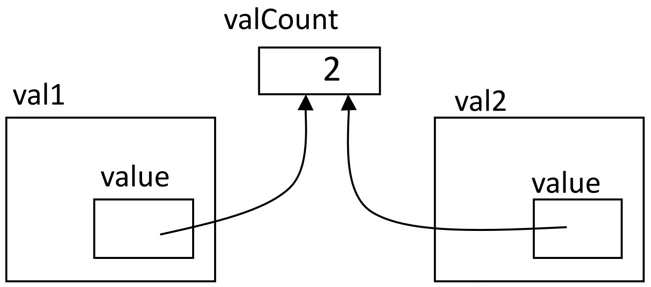
6. Static members

- Class variable: declared with the **`static`** keyword
- Memory space for a class variable is created when the class is first referenced
- It holds the same value for all objects instantiated from this class → changing the value of a static variable in one object changes it for all others
- Declaration format:

```
[access-modifier] static data-type
    member-variable-name;
```

- Reference format:

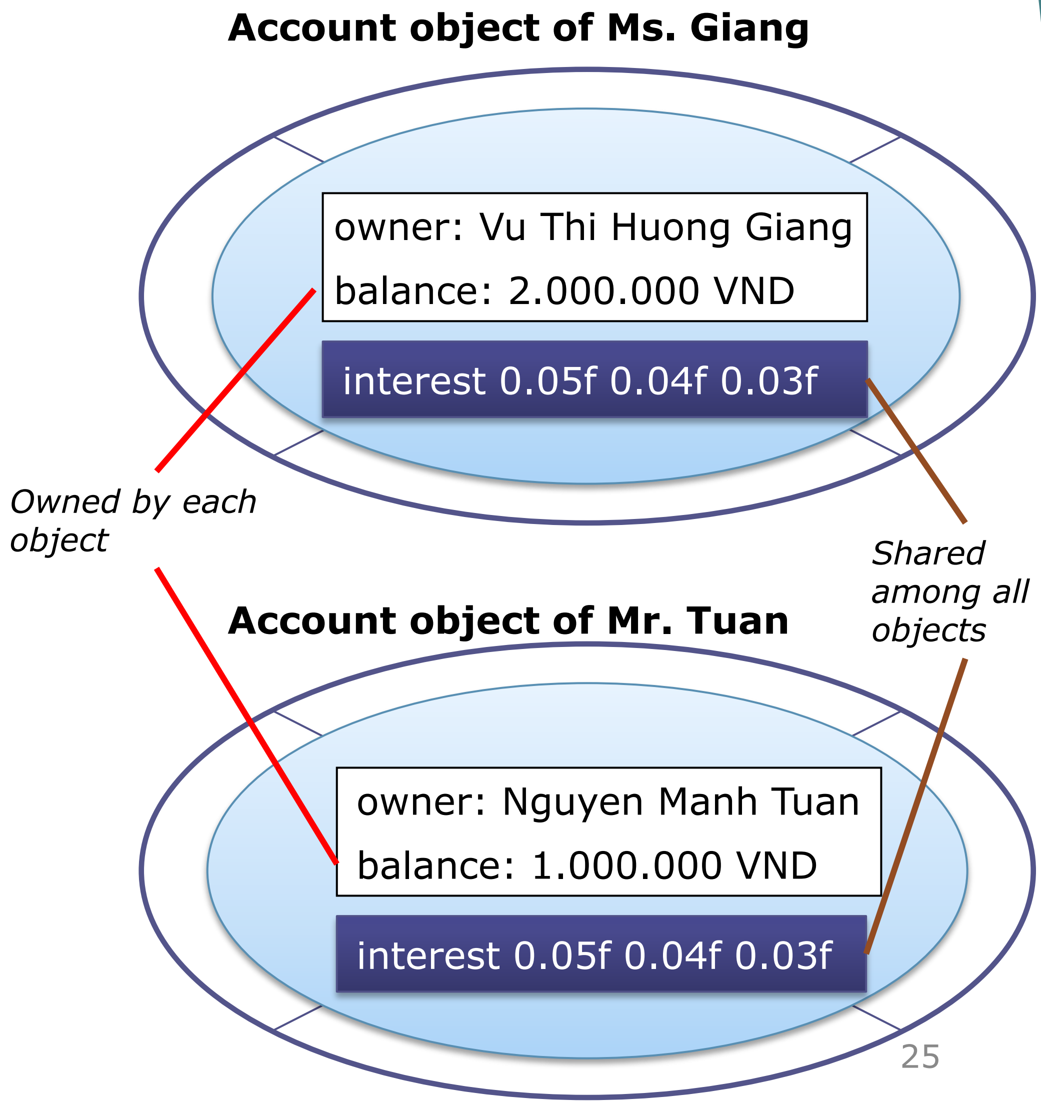
```
class-name.member-variable-name;
object-name.member-variable-name;
```



Static variable

```
class Account {
// Member variable
String name; // Account name
long balance; // Balance
static float interest;//Deposit rate
}
class AccountClassUsage{
 public static void main(String[] args) {
       Account.interest=0.05f;
       Account giang= new Account();
       Acount tuan = new Account();
       giang.interest=0.04f;
       tuan.interest=0.03f;
 }
}
```

→ **Static variable cannot be used within a non-static method.**


Account object of Ms. Giang
owner: Vu Thi Huong Giang
balance: 2.000.000 VND
interest 0.05f 0.04f 0.03f
Owned by each object
Shared among all objects
Account object of Mr. Tuan
owner: Nguyen Manh Tuan
balance: 1.000.000 VND
interest 0.05f 0.04f 0.03f

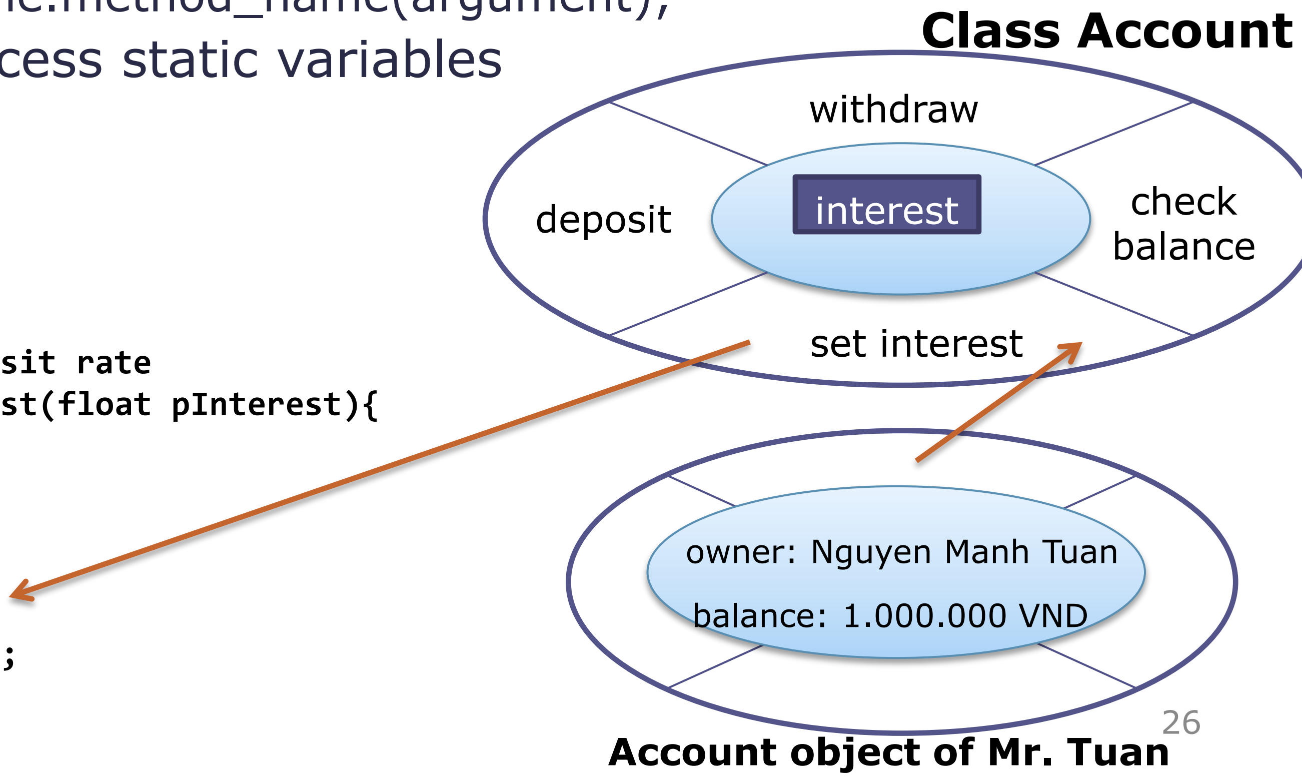
Static method

`static return-type name(parameter-list) { … }`

- Several restrictions:
  - can only call static methods
    - Class name.method_name(argument);
    - Object name.method_name(argument);
  - must only access static variables

```
class Account {
// Member variable
..
static float interest;//Deposit rate
public static void setInterest(float pInterest){
    interest = pInterest;
}
}

Account.setInterest(0.05f);
Account tuan = new Account();
tuan.setInterest(0.04f);
```



Example

```
public class VariableLengthArgumentUsage {
    public static double average( double... numbers ) {
        double total = 0.0;
        for ( double d : numbers )
          total += d;
        return total / numbers.length;
    }
    public static void main(String[] args) {
        double d[] = {10.0, 20.0, 30.0, 40.0, 50.0};
        System.out.printf("Mean value of this array is");
        System.out.printf(" %.1f\n", average(d[0], d[1], d[2],
          d[3], d[4]));
    }
}
```

Quiz 1 – variable and method declaration

- Declare the class Media describing media products such as book, that has following attributes and operations
  - Title
  - Category
  - Price
  - Show the title, price, category of a media product

Quiz 1 – solution

```
public class Media {
    String title;
    String category;
    float cost;

    public void displayInfo(){
        System.out.println("Title: " + title + "\nCategory: " + category
        + "\nPrice: " + cost);
    }

}
```

Quiz 1 – constructor

- Create a default constructor and a constructor with 3 parameters
- Create a Media object and display its information

Quiz – static variable and static method

2. In the class Media:
   - Declare the product distributor as a static variable
   - Declare and implement the static method that allows changing the distributor of all media products.
3. In the class Media:
   - Declare and implement a method for displaying information about a concrete media product. Explain which attributes can be displayed by this method and why.
   - Declare and implement a method with variable-length argument for displaying all information about a concrete media product.
4. Write a program that
   - calls the static method using the class name
   - calls an instance of the method with/without variable-length argument

Quiz 2 - Solution

```
public class Media {
    private String title;
    private String category;
    private float cost;

    static String distributor;

    // ... implementation of methods as in the solution of Quiz 1

    public static void setDistributor(String dist) {
          distributor = dist;
    }
}
```

Quiz 3 - Solution

```
public void displayInstanceInfo() {
    System.out.println("Information about a
    concrete media product: ");
    System.out.println("Title: "+ title);
    System.out.println("Category:" +
    category);
    System.out.println("Price:" + cost);
    // can not access to static variable
}

public static void displayStaticInfo() {
    System.out.println("Distributor: " +
    distributor);
    // can not access to instance variable
}
```

```
public static void displayInstanceInfo
    (String... values) {

    System.out.println("Information
    about the media product: ");

    for ( String v : values )
          System.out.print(v);
}
```

Quiz 4 - solution

```
public class MediaClassUsage {
    public static void main(String[] args) {
        // static reference of variable
        System.out.println("Distributor: " + Media.distributor);
        // create a concrete media product
        Media media = new Media();
        media.setTitle("Vivaldi: The Four Seasons");
        media.setCategory("CD"); media.setCost((float) 14.38);
        media.setDistributor("Amazon");
        // static method call
        Media.displayStaticInfo();
        // call of instance method without variable-length args
        media.displayInstanceInfo();
        // call of instance method with variable-length args
        media.displayInstanceInfo("Title: ", media.getTitle(), "\n",
          "Category: ", media.getCategory(),"\n",
          "Price: ", Float.toString(media.getCost()),"\n",
          "Distributor: ", media.distributor);
    }
}
```

Quiz

1. How to get the changed value inside a method ?
    1. Return the value that was changed.
2. Consider the Track class (slide 15). Modify and complete operations of setting/getting all of its attributes with the this keyword.
3. Implement a program for testing these operations and showing the results.
4. Consider the Track class. Implement different overloaded constructors (with and without parameters) for creating the Track objects in different ways.
5. Implement a program for testing these operations and showing the results.

Review

- Data must be initialized before used
- Constructor is used to create objects
- Object must be declared and initialized before used
- Object usage :
  - All objects are allocated and accessed through reference variables
  - this: refers to the current object
  - argument passing: by value and by reference