OBJECT-ORIENTED LANGUAGE AND THEORY

4. SOME TECHNIQUES IN CLASS BUILDING

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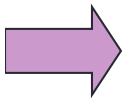
Goals

- Understand notions, roles and techniques for overloading methods and overloading constructors
- Object member, class member
- How to pass arguments of functions

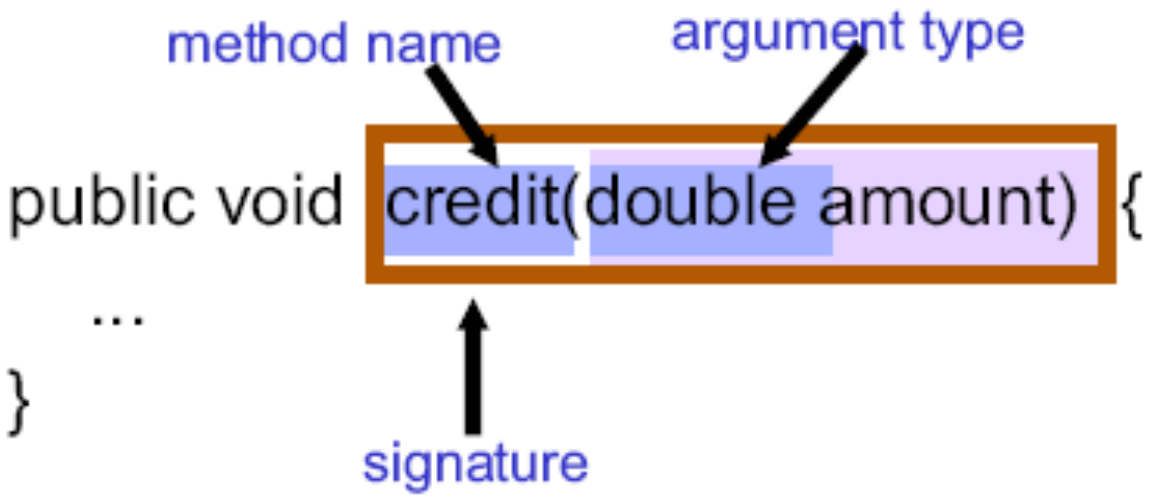
Outline



1. Method overloading
2. Classifier and constant members
3. Passing arguments to methods

Method recalls

- Each method has it own signature
- A method signature is composed of:
  - Method's name
  - Number of arguments and their types



1.1. Method overloading

- **Method Overloading:** Methods **in a class** might have the **same name** but **different signatures**:
  - **Numbers of arguments** are different
  - If the numbers of arguments are the same, **types of arguments** must be **different**
- **Advantages:**
  - The same name describes the **same task**
  - Is easier for developers because they don't have to remember **too many method names**. They remember only one with the appropriate arguments.

Method overloading – Example 1

- Method **`println()`** in **`System.out.println()`** has 10 declarations with different arguments: **`boolean`**, **`char[]`**, **`char`**, **`double`**, **`float`**, **`int`**, **`long`**, **`Object`**, **`String`**, and one without argument.
- Do not need to use different names (for example "**`printString`**“ or "**`printDouble`**“) for each data type to be displayed.

Method overloading – Example 2

```
class MyDate {
 int year, month, day;
 public boolean setMonth(int m) { …}
 public boolean setMonth(String s) { …}
}
public class Test{
  public static void main(String args[]){
    MyDate d = new MyDate();
    d.setMonth(9);
    d.setMonth("September");
  }
}
```

Method overloading – More info.

- Methods are considered as **overloading** only if they belong to the **same class**
- Only apply this technique on methods describing the **same kind of task**; do not abuse
- When compiling, compilers rely on number or types of arguments to decide which **appropriate method** to call.

  → If there is no method or more than one method to call, an error will be reported.

Discussion

- Given a following method:

  0. `public double test(String a, int b)`

- Let select overloading methods of the given method 0 from the list below:

  1. `void test(String b, int a)`
  2. `public double test(String a)`
  3. `private int test(int b, String a)`
  4. `private int test(String a, int b)`
  5. `double test(double a, int b)`
  6. `double test(int b)`
  7. `public double test(String a, long b)`

Discussion

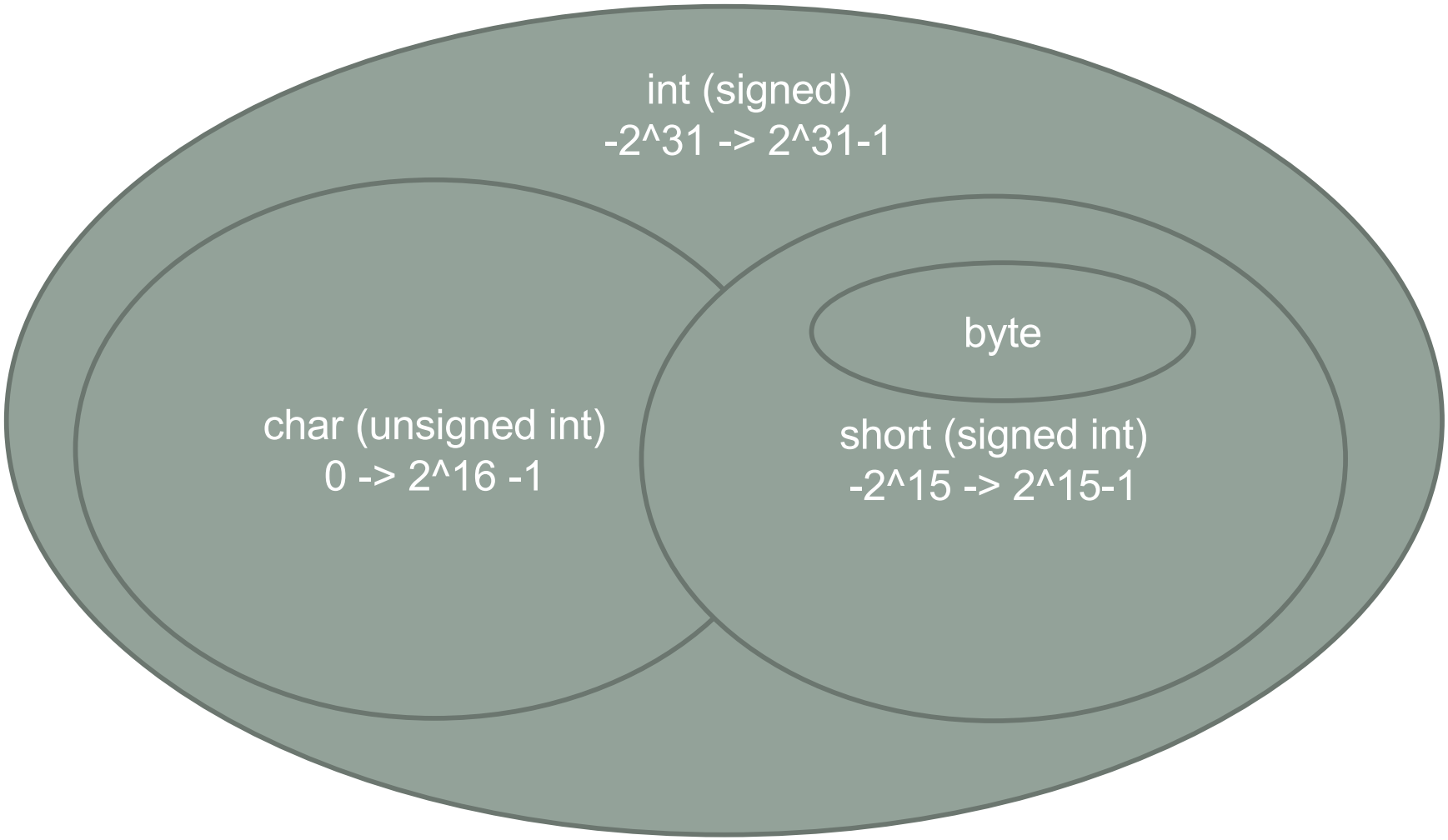
```
void prt(String s) { System.out.println(s); }
void f1(char x) { prt("f1(char)"); }
void f1(byte x) { prt("f1(byte)"); }
void f1(short x) { prt("f1(short)"); }
void f1(int x) { prt("f1(int)"); }
void f1(long x) { prt("f1(long)"); }
void f1(float x) { prt("f1(float)"); }
void f1(double x) { prt("f1(double)"); }
```

- What will happens if we do as follows:
  - `f1(5);`
  - `char x='a'; f1(x);`
  - `byte y=0; f1(y);`
  - `float z = 0; f1(z);`…

Discussion

```
void prt(String s) { System.out.println(s); }
void f2(short x) { prt("f3(short)"); } => 2 b
void f2(int x) { prt("f3(int)"); }  => 4 b
void f2(long x) { prt("f5(long)"); } => 8 b
void f2(float x) { prt("f5(float)"); }
```

- What will happen if we do as follows:
  - `f2(5);`
  - `char x='a'; f2(x); => 2 b`
  - `byte y=0; f2(y);`
  - `float z = 0; f2(z);`
- What will happen if we call f2(5.5)?


int (signed)
-2^31 -> 2^31-1
byte
char (unsigned int)
0 -> 2^16 -1
short (signed int)
-2^15 -> 2^15-1

1.2. Constructor overloading

- In different contexts => create objects in different ways

→Any number of constructors with different parameters (following constructor overloading principles)

- Constructors are commonly overloaded to allow for different ways of initializing instances

```
BankAccount new_account =
    new BankAccount();

BankAccount known_account =
    new BankAccount(account_number);

BankAccount named_account =
    new BankAccount("My Checking Account");
```

Example

```
public class BankAccount{
  private String owner;
  private double balance;
  public BankAccount(){owner = “noname”;}
  public BankAccount(String o, double b){
   owner = o; balance = b;
  }
}
public class Test{
  public static void main(String args[]){
    BankAccount acc1 = new BankAccount();
    BankAccount acc2 =
                  new BankAccount(“Thuy”, 100);
  }
}
```

this keyword

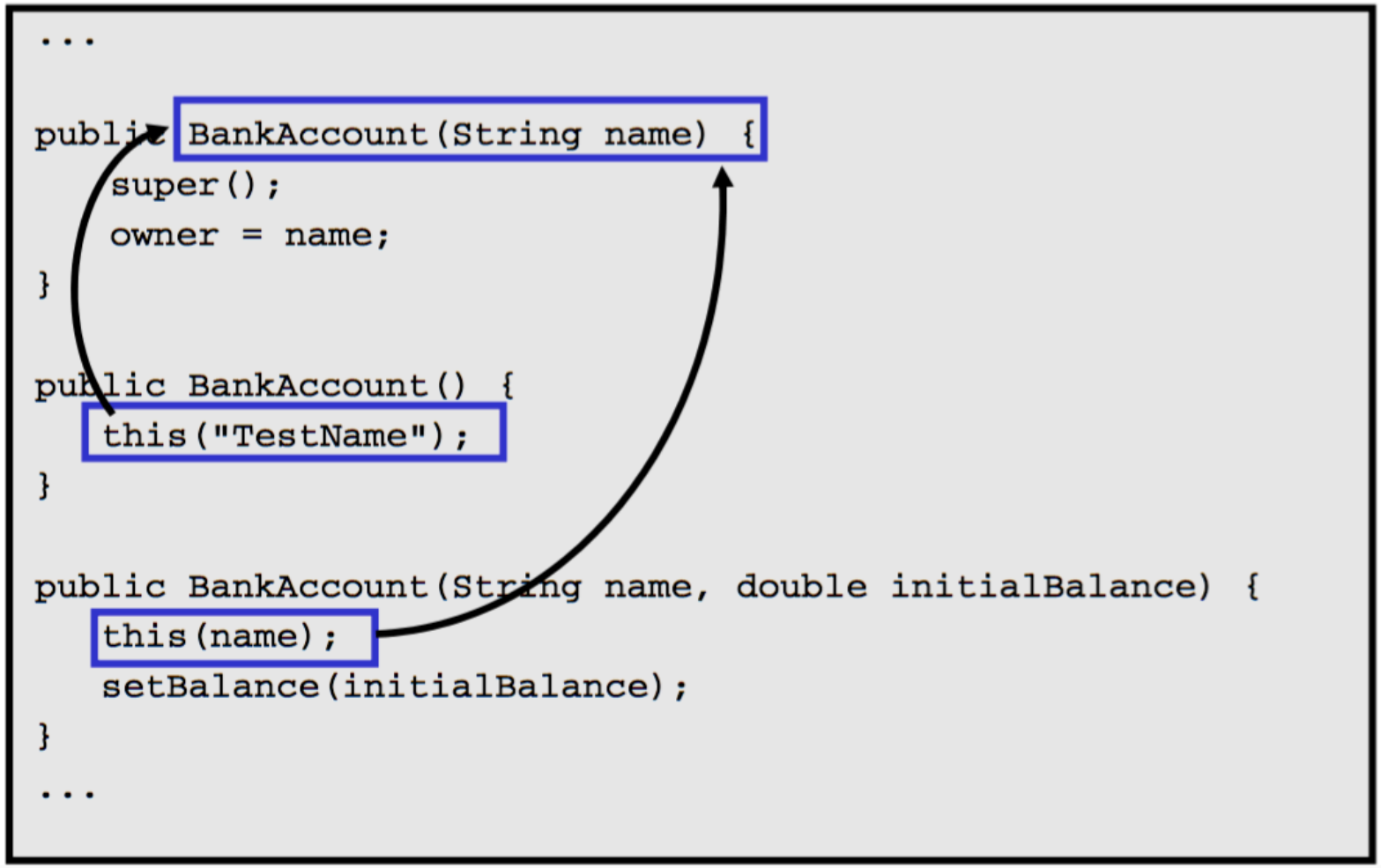
- "this" refers to the **current object**, it is used **inside the class** of the object that it refers to.
- It uses attributes or methods of object through "." operator, for example:

```
public class BankAccount{
  private String owner;
  public void setOwner(String owner){
    this.owner = owner;
  }
  public BankAccount() { this.setOwner("noname"); }
  …
  }
```

- Call another constructor of the class:
  - `this(parameters);` `//first statement in another constructor`

`this` keyword

In a constructor, the keyword `this` is used to refer to other constructors in the same class



- Example

```
public class Ship {
  private double x=0.0, y=0.0
  private double speed=1.0, direction=0.0;
  public String name;

  public Ship(String name) {
    this.name = name;
  }
  public Ship(String name, double x, double y) {
    this(name); this.x = x; this.y = y;
  }
  public Ship(String name, double x, double y,
    double speed, double direction) {
     this(name, x, y);
     this.speed = speed;
     this.direction = direction;
  }
  //to be continued…
```

```
  //(cont.)
  private double degreeToRadian(double degrees) {
    return(degrees * Math.PI / 180.0);
  }
  public void move() {
     move(1);
  }
  public void move(int steps) {
     double angle = degreesToRadians(direction);
     x = x + (double)steps*speed*Math.cos(angle);
      y = y + (double)steps*speed*Math.sin(angle);
  }
  public void printLocation() {
     System.out.println(name + " is at ("
                                + x + "," + y + ").");
  }
} //end of Ship class
```

Outline

1. Method overloading
2. Classifier and constant members
3. Passing arguments to methods

2.1. Constant members

- An attribute/method that can not change its values/content during the usage.
- Declaration syntax:

```
access_modifier final data_type
        CONSTANT_VARIABLE = value;
```

- For example:

```
final double PI = 3.141592653589793;
public final int VAL_THREE = 39;
private final int[] A = { 1, 2, 3, 4, 5, 6 };
```

2.1. Constant members (2)

- Typically, constants associated with a class are declared as **`static final`** fields for easy access
  - A common convention is to use only uppercase letters in their names

```
public class MyDate {
    public static final long SECONDS_PER_YEAR =
        31536000;
    …
}
…
long years = MyDate.getMillisSinceEpoch() /
    (1000*MyDate.SECONDS_PER_YEAR);
```

javax.swing

Class JOptionPane

ERROR_MESSAGE

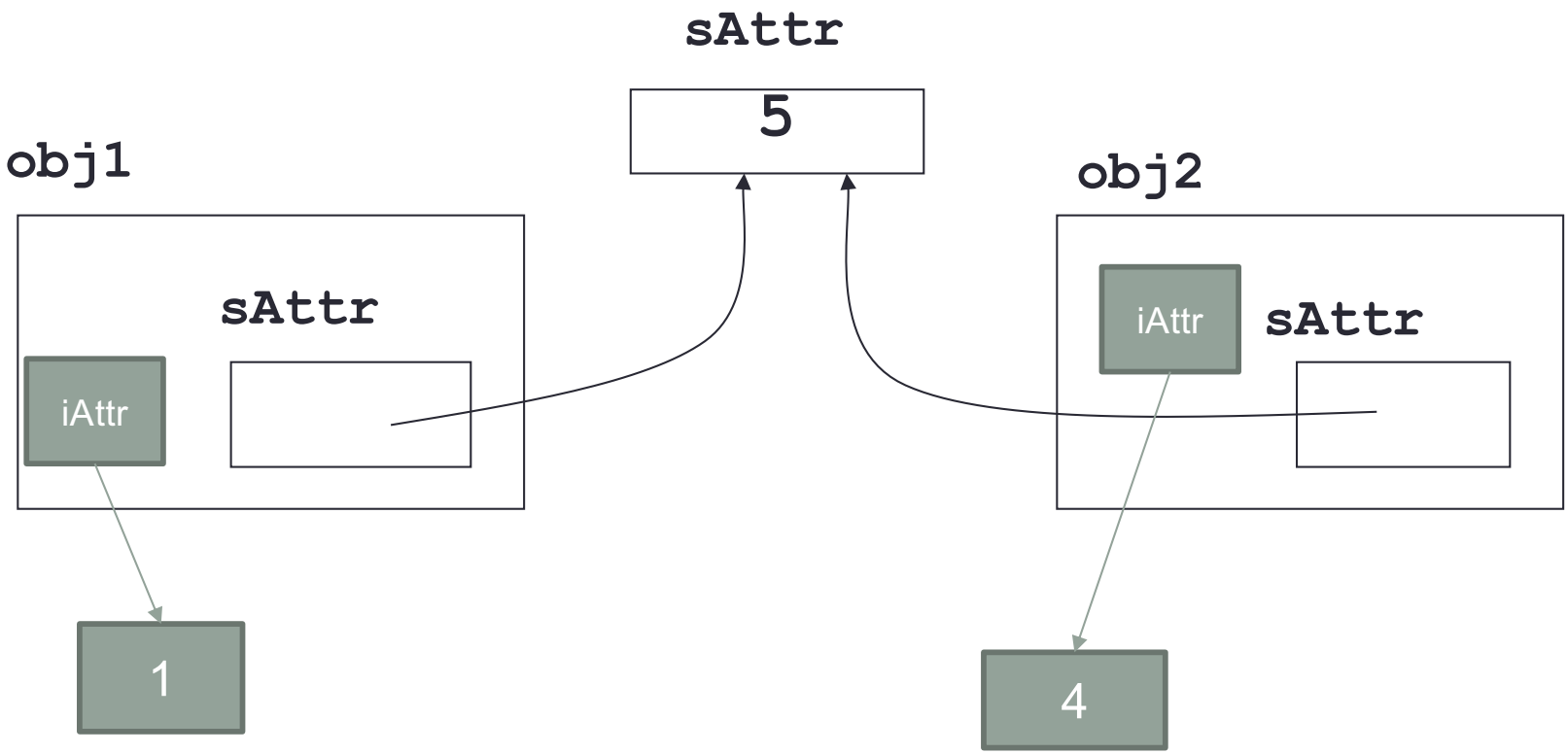
```
public static final int ERROR_MESSAGE
```

2.2. Classifier members

- Members may belong to either of the following:
  - The whole class (class variables and methods, indicated by the keyword **`static`** in Java)
  - Individual objects (instance variables and methods)
- Static attributes and methods belong to the class
  - Changing a value in one object of that class changes the value for all of the objects
- Static methods and fields can be accessed without instantiating the class
  - Static methods and fields are declared using the static keyword

Static parts: are shared between all objects

- sAttr: static (class/classifier scope)
- iAttr: instance (object/instance scope)



Instance member vs. Classifier member

- Attributes/methods can only be accessed via objects
- Each object has it own copy of an object's attribute
- **Values** of an attribute of different objects are different.

- Attributes/methods can be accessed through class
- All objects have the same copy of class attributes
- **Values** of a class attribute of different objects are the same.

Static members in Java

- Regular members are members of objects
- Class members are declared as **static**
- Syntax for declaring static member:

  `access_modifier static data_type varName;`
- Example:

```
public class MyDate {
    public static long getMillisSinceEpoch() {
        …
    }
    public String getMonth(){
                long ms = getMillisSinceEpoch();
    }
}
…
long millis = MyDate.getMillisSinceEpoch();
```

MyDate date1 = new MyDate();
date1.getMonth(); date1.getMillisSinceEpoch();

Example: Class JOptionPane in javax.swing

- Attributes

Field Summary	
static int	CANCEL_OPTION Return value from class method if CANCEL is chosen
static int	CLOSED_OPTION Return value from class method if user closes window CANCEL_OPTION or NO_OPTION.
static int	DEFAULT_OPTION Type used for showConfirmDialog.
static int	ERROR_MESSAGE Used for error messages.

static int	WARNING_MESSAGE Used for warning messages.
static int	YES_NO_CANCEL_OPTION Type used for showConfirmDialog.
static int	YES_NO_OPTION Type used for showConfirmDialog.
static int	YES_OPTION Return value from class method if YES is chosen.

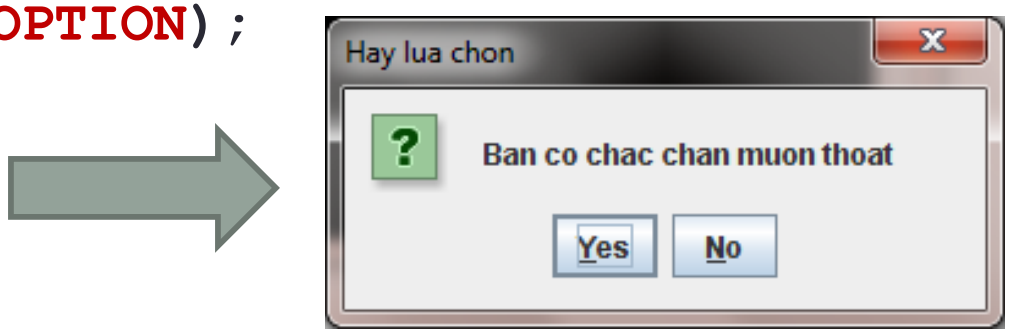
- Methods:

static void	showMessageDialog(Component parentComponent, Object message) Brings up an information-message dialog titled "Message".
static void	showMessageDialog(Component parentComponent, Object message, String title, int messageType) Brings up a dialog that displays a message using a default icon determined by the messageType parameter.
static void	showMessageDialog(Component parentComponent, Object message, String title, int messageType, Brings up a dialog displaying a message, specifying all parameters

Example – using static attributes and methods in class JOptionPane

```
JOptionPane.showMessageDialog(null,"Ban da thao tac
 loi", "Thong bao loi", JOptionPane.ERROR_MESSAGE);
```


```
JOptionPane.showConfirmDialog(null,"Ban co chac chan
 muon thoat?", "Hay lua chon",
 JOptionPane.YES_NO_OPTION);
```



Example – using static attributes and methods in class JOptionPane (2)

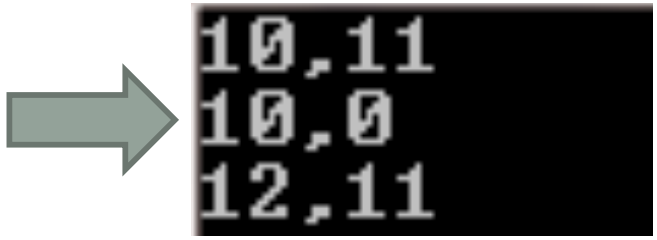
```
Object[] options = { "OK", "CANCEL" };
JOptionPane.showOptionDialog(null,"Nhan OK de tiep tuc",
  "Canh bao", JOptionPane.DEFAULT_OPTION,
  JOptionPane.WARNING_MESSAGE,null,options,options[0]);
```

Static member (2)

- Modifying value of a **`static`** member in an object will modify the value of this member in all other objects of the class.
- **`Static`** methods can access only **`static`** attributes and can call **`static`** methods in the same class.

Example 1

```
class TestStatic{
 public static int iStatic;
 public int iNonStatic;
}
public class TestS {
 public static void main(String[] args) {
  TestStatic obj1 = new TestStatic();
  obj1.iStatic = 10; obj1.iNonStatic = 11;
  System.out.println(obj1.iStatic+","+obj1.iNonStatic);
  TestStatic obj2 = new TestStatic();
 System.out.println(obj2.iStatic+","+obj2.iNonStatic);
 obj2.iStatic = 12;
  System.out.println(obj1.iStatic+","+obj1.iNonStatic);
 }
}
```



Example 2

```
public class Demo {
 int i = 0;
 void increase(){ i++; }
 public static void main(String[] args) {
    increase();
    System.out.println("Gia tri cua i la" + i);
 }
}
```

non-static method increase() cannot be referenced from a static contex
non-static variable i cannot be referenced from a static context

Java static methods – Example

```
class MyUtils {
     . . .
     //====================== mean
     public static double mean(int[] p) {
               int sum = 0;
        for (int i=0; i<p.length; i++) {
                  sum += p[i];
               }
               return ((double)sum) / p.length;
     }
     . . .
}
…

// Calling a static method from outside of a class
double avgAtt = MyUtils.mean(attendance);
```

When static?

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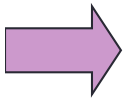


3. Arguments passing to methods

- We can use any data types for arguments for methods or constructors
  - Primitive data types
  - References: array and object
- Example:

```
public Polygon polygonFrom(Point[] corners){
    // method body goes here
  }
```

3.1. Variable arguments

- An arbitrary number of arguments, called *varargs*
- Syntax in Java:
  - **`methodName(data_type... parameterName)`**
- Example
  - Declaration:

```
public PrintStream printf(String format,
                          Object... args)
```

  - Usage:

```
System.out.printf ("%s: %d, %s\n",
        name, idnum, address);
System.out.printf ("%s: %d, %s, %s, %s\n",
        name, idnum, address, phone, email);
```

- Example

```
public Polygon polygonFrom(Point... corners) {
  int numberOfSides = corners.length;
  double squareOfSide1, lengthOfSide1;
  squareOfSide1 = (corners[1].x - corners[0].x)
          *(corners[1].x - corners[0].x)
          +(corners[1].y - corners[0].y)
          *(corners[1].y - corners[0].y) ;
  lengthOfSide1 = Math.sqrt(squareOfSide1);
  //create & return a polygon connecting the Points
}
```

- **`corners`** is considered as an array
- You can pass an array or a sequence of arguments

3.2. Passing by values

- C++
  - Passing values, pointers
- Java
  - Passing values

Java: Pass-by-value for all types of data

- Java passes all arguments to a method in form of pass-by-value: Passing value/copy of the real argument
  - For arguments of value-based data types (primitive data types): passing value/copy of primitive data type argument
  - For argument of reference-based data types (array and object): passing value/copy of original reference.

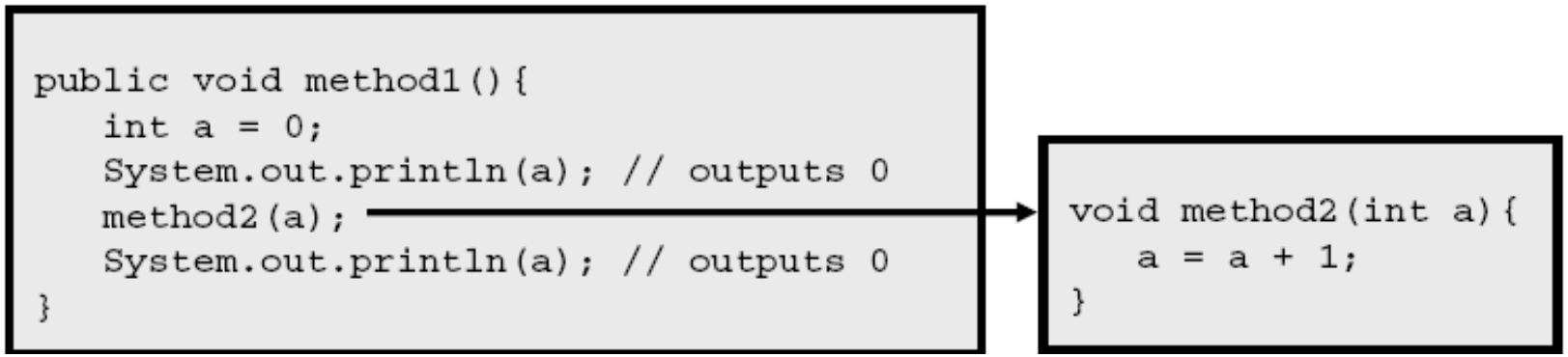
→ Modifying formal arguments does not effect the real arguments

Discussion:

- What will happen if:
  - We modify the internal state of object parameters inside a method?
  - We modify the reference to an object?

a. With value-based date type

- Primitive values can not be changed when being passed as a parameter

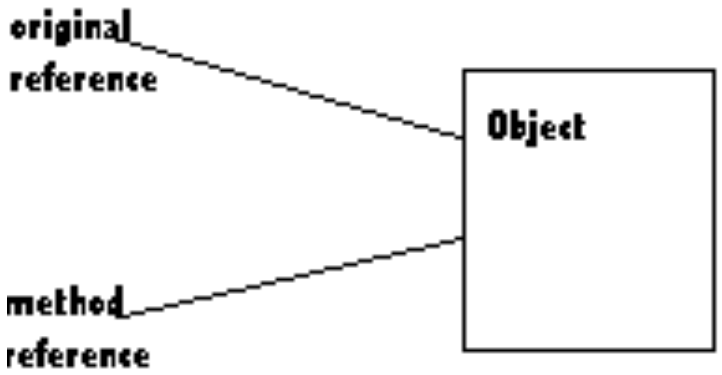


- Is this swap method correct?

```
public void swap(int var1, int var2) {
  int temp = var1;
  var1 = var2;
  var2 = temp;
}
```

b. With reference-based data type

- Pass the references by value, not the original reference or the object



- After being passed to a method, a object has at least two references

Passing parameters

```
public class ParameterModifier
{
   public void changeValues (int f1, Num f2, Num f3)
   {
      System.out.println ("Before changing the values:");
      System.out.println ("f1\tf2\tf3");
      System.out.println (f1 + "\t" + f2 + "\t" + f3 + "\n");

      f1 = 999;
      f2.setValue(888);
      f3 = new Num (777);

      System.out.println ("After changing the values:");
      System.out.println ("f1\tf2\tf3");
      System.out.println (f1 + "\t" + f2 + "\t" + f3 + "\n");
   }
}
```

Passing parameters

```
public class ParameterTester
{
   public static void main (String[] args)
   {
      ParameterModifier modifier = new ParameterM

      int a1 = 111;
      Num a2 = new Num (222);
      Num a3 = new Num (333);

      System.out.println ("Before calling changeV
      System.out.println ("a1\ta2\ta3");
      System.out.println (a1 + "\t" + a2 + "\t" +

      modifier.changeValues (a1, a2, a3);

      System.out.println ("After calling changeVa
      System.out.println ("a1\ta2\ta3");
      System.out.println (a1 + "\t" + a2 + "\t" +
   }
}
```

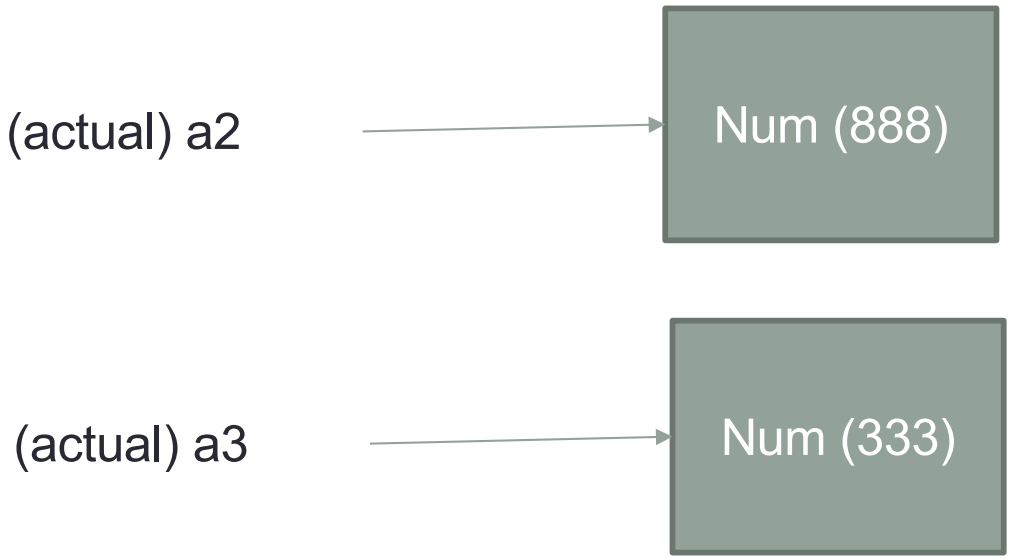
Before calling changeValues:
a1 a2 a3
111 222 333

Before changing the values:
f1 f2 f3
111 222 333

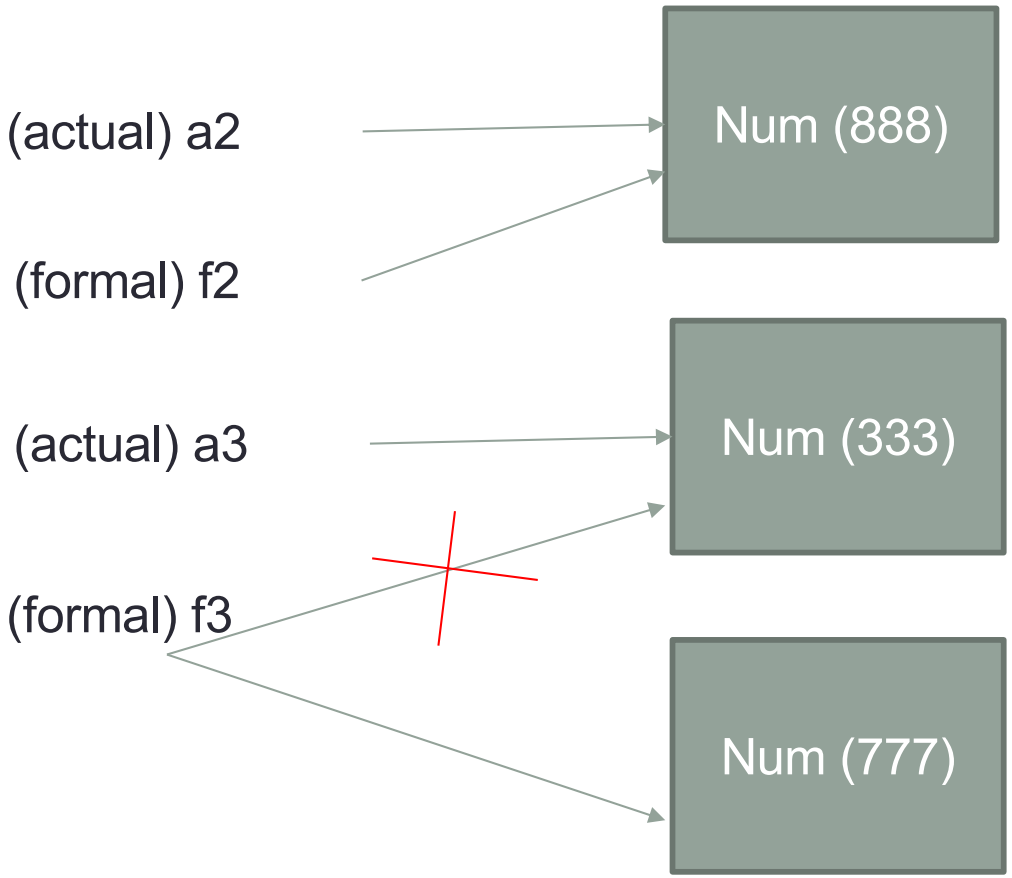
After changing the values:
f1 f2 f3
999 888 777

After calling changeValues:
a1 a2 a3
111 888 333

Inside the method changeValues()



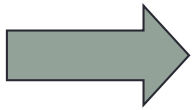
Inside the method changeValues()



For example

```
public class Point {
  private double x;
  private double y;
  public Point() { }
  public Point(double x, double y) {
      this.x = x; this.y = y;
  }
  public void setX(double x) { this.x = x; }
  public void setY(double y) { this.y = y; }
  public void printPoint() {
      System.out.println("X: " + x + " Y: " + y);
  }
}
```

```
public class Test {
 public static void tricky(Point arg1, Point arg2) {
  arg1.setX(100); arg1.setY(100);
  Point temp = arg1;
  arg1 = arg2; arg2 = temp;
 }
 public static void main(String [] args) {
  Point pnt1 = new Point(0,0);
  Point pnt2 = new Point(0,0);
  pnt1.printPoint(); pnt2.printPoint();
  System.out.println(); tricky(pnt1, pnt2);
  pnt1.printPoint(); pnt2.printPoint();
 }
}
```



```
X: 0.0 Y: 0.0
X: 0.0 Y: 0.0

X: 100.0 Y: 100.0
X: 0.0 Y: 0.0
Press any key to continue . . .
```

- Only the method references are swap, not the original references