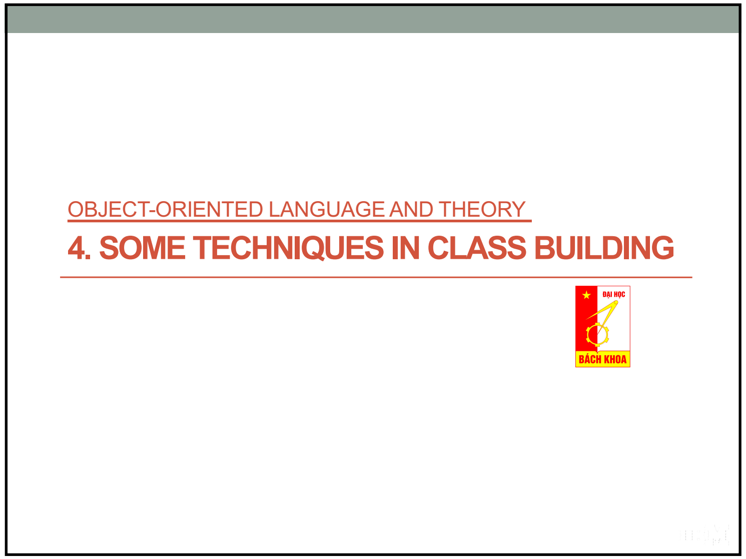
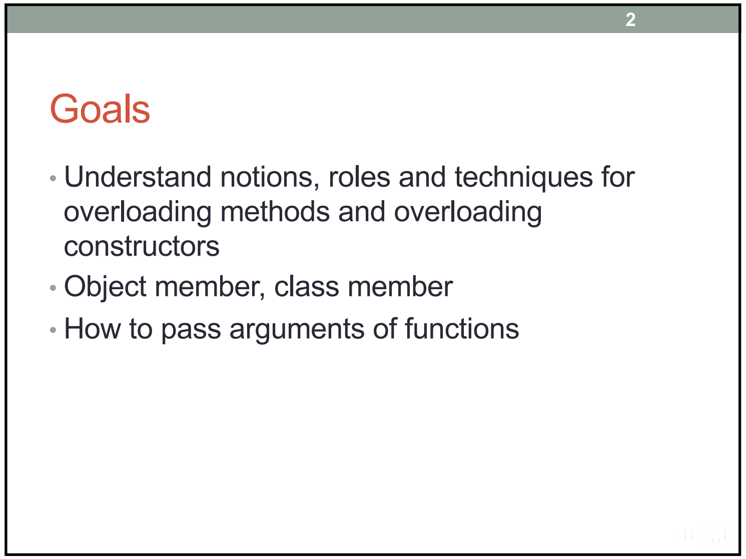


OBJECT-ORIENTED LANGUAGE AND THEORY

4. SOME TECHNIQUES IN CLASS BUILDING

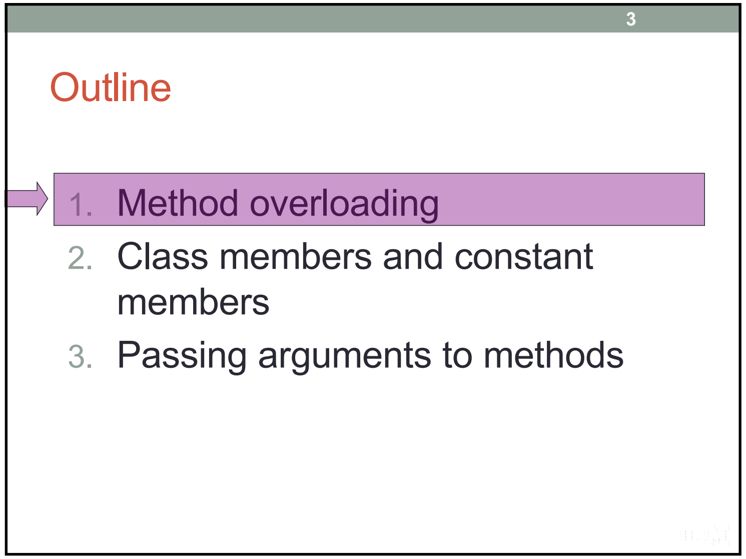
1



Goals

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

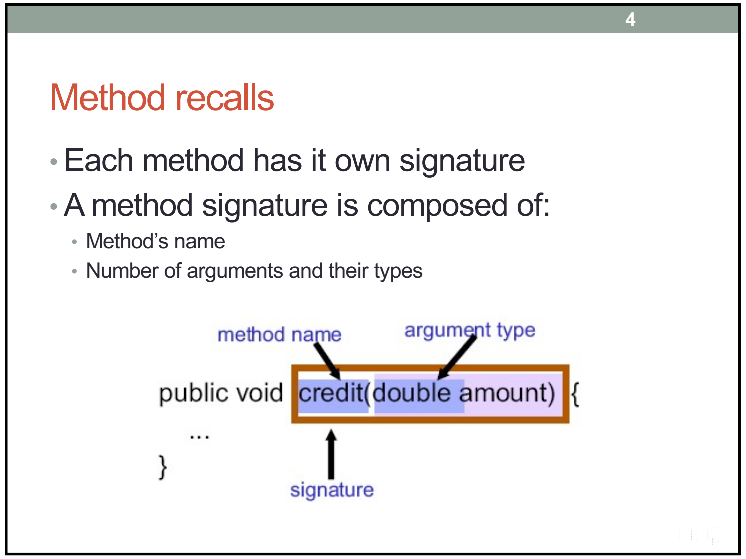
2



Outline

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

3



Method recalls

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

```
public void credit(double amount) {
    ...
}
```

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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.

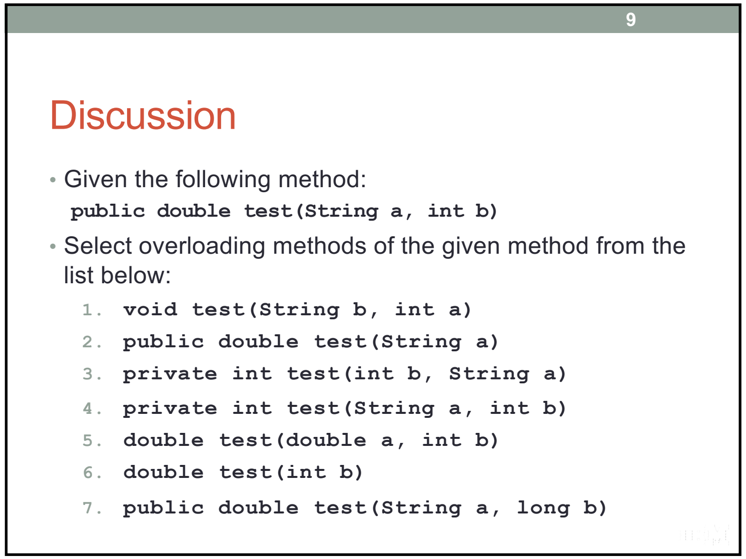
Method overloading – Example 2

```
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.



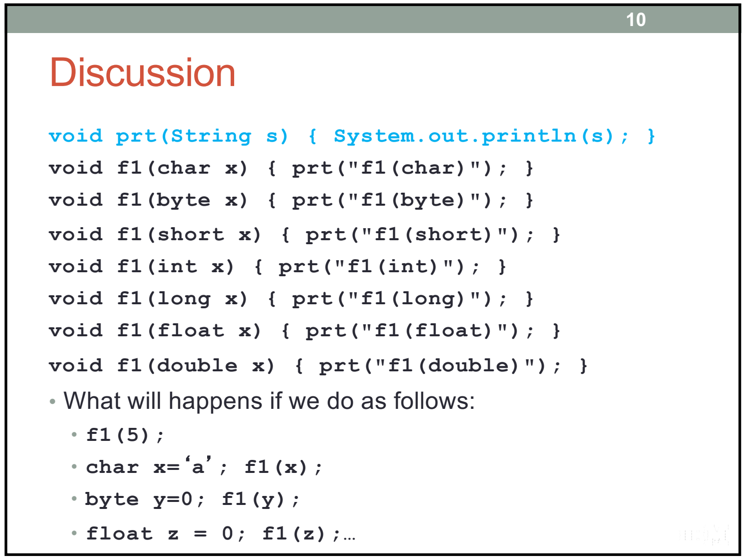
Discussion

- Given the following method:

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

- Select overloading methods of the given method from the list below:

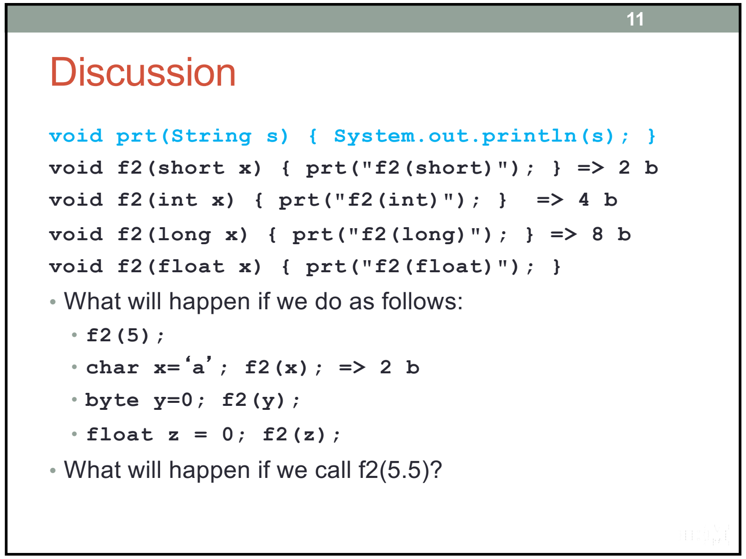
```
1. void test(String b, int a)
2. public double test(String a)
3. private int test(int b, String a)
4. private int test(String a, int b)
5. double test(double a, int b)
6. double test(int b)
7. public double test(String a, long b)
```



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)"); }
```

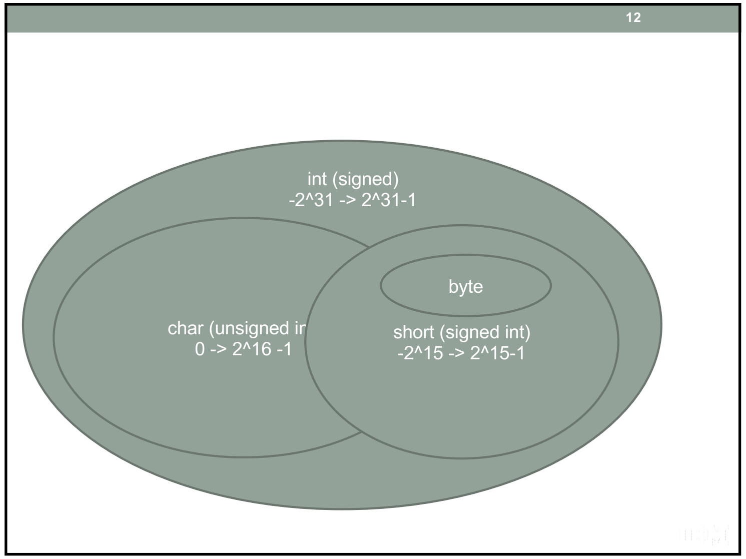
- What will happens if we do as follows:
  - `f1(5);`
  - `char x=‘a’; f1(x);`
  - `byte y=0; f1(y);`
  - `float z = 0; f1(z);…`



Discussion

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



Example

```
class MyClass {
   public void myMethod(int a, long b) {
   }
   public void myMethod(long a, int b) { // overloading
   }
}

public class Test {
   public static void main(String args[]) {
      MyClass m = new MyClass();
      m.myMethod();      // error as there are no matched methods
      m.myMethod(9, 10);        // error as two methods are matched
   }
}
```

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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");
```

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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);
   }
}
```

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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`

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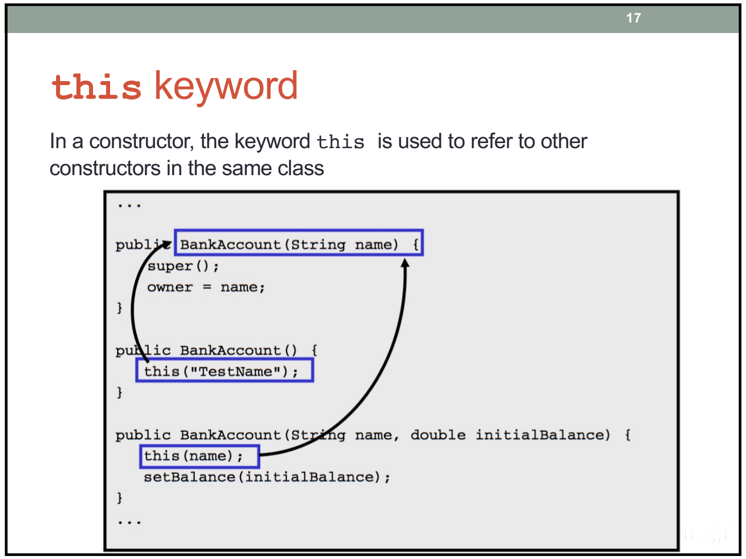

this keyword

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

```
...

public BankAccount(String name) {
    super();
    owner = name;
}

public BankAccount() {
   this("TestName");
}

public BankAccount(String name, double initialBalance) {
   this(name);
   setBalance(initialBalance);
}
...
```

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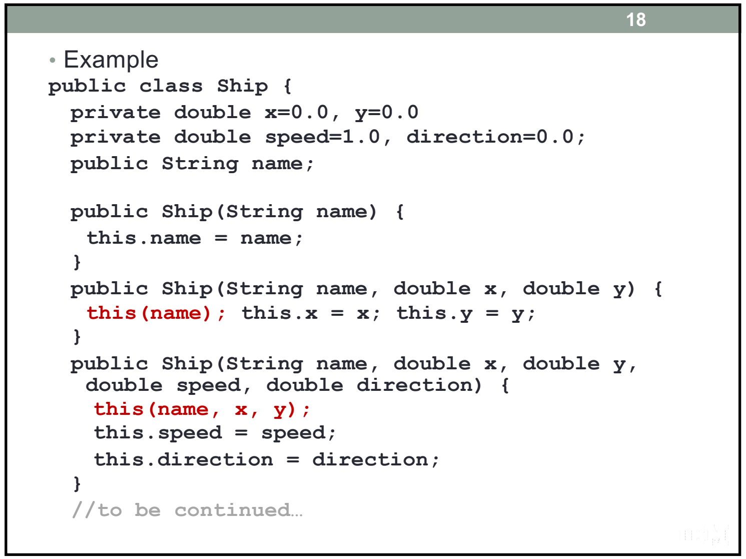

- Example

```
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…
```

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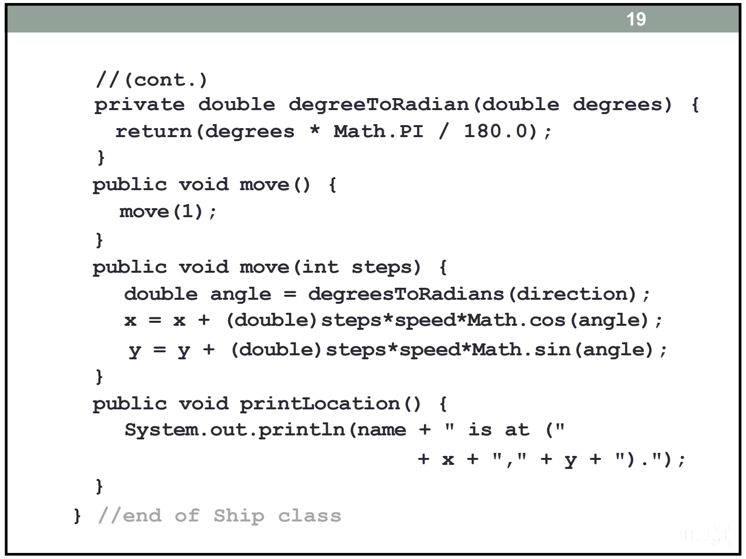

```
  //(cont.)
  private double degreeToRadian(double degrees) {
    return(degrees * Math.PI / 180.0);
  }
  public void move() {
    move(1);
  }
  public void move(int steps) {
     double angle = degreesToRadians(direction);
     x = x + (double)steps*speed*Math.cos(angle);
     y = y + (double)steps*speed*Math.sin(angle);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

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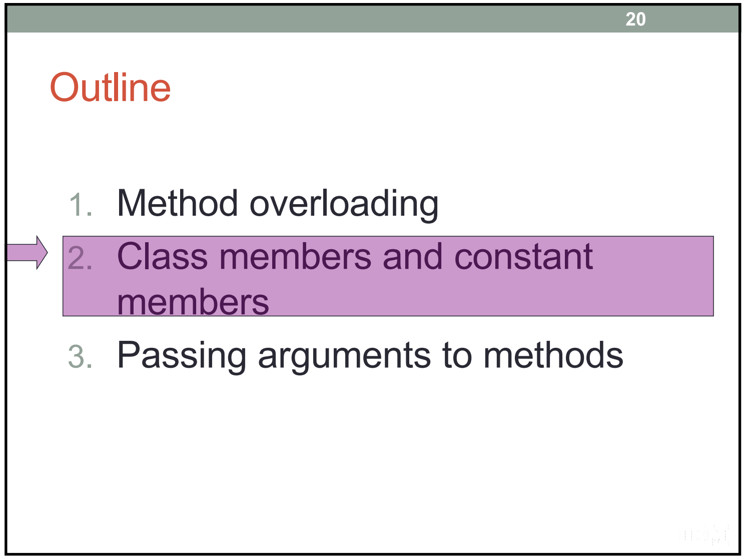

Outline

1. Method overloading
2. Class members and constant members
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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;
```

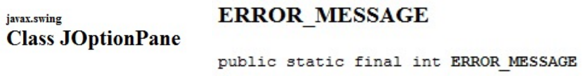
- For example:

```
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

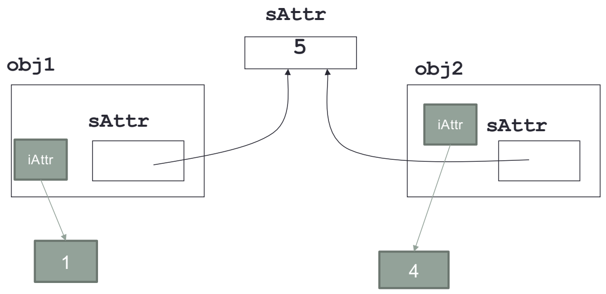
public static final int **ERROR_MESSAGE**

2.2. Class 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 scope)
- iAttr: instance (object/instance scope)



Instance member vs. Class member

Instance 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.

Class member

- 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;
```

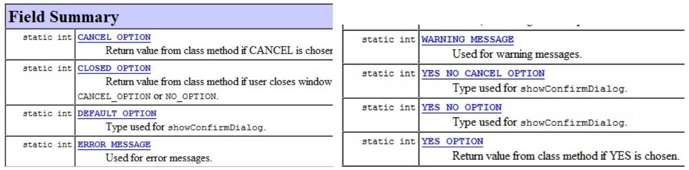
- Example:

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

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

Example: Class JOptionPane in javax.swing

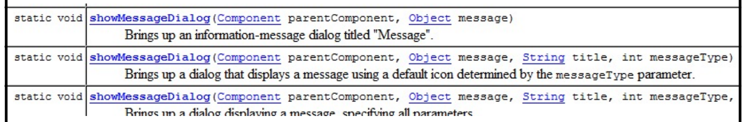
- Attributes



Field Summary

static int	CANCEL_OPTION Return value from class method if CANCEL is choser
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.

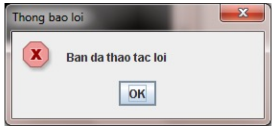
- Methods:



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

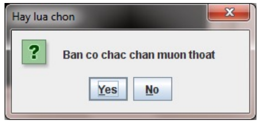
```
JOptionPane.showMessageDialog(null,”Ban da thao tac
 loi", "Thong bao loi", JOptionPane.ERROR_MESSAGE);
```



Thong bao loi

Ban da thao tac loi

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

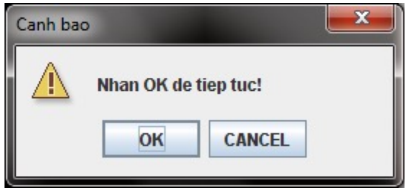


Hay lua chon

Ban co chac chan muon thoat

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]);
```



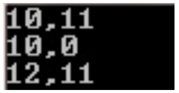
Nhan OK de tiep tuc!

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);
 }
}
```

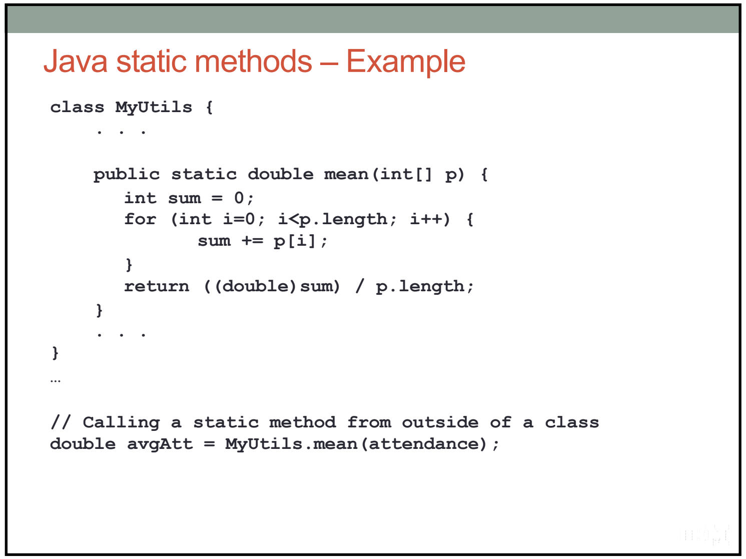


```
10,11
10,0
12,11
```

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 {
    . . .

    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);
```

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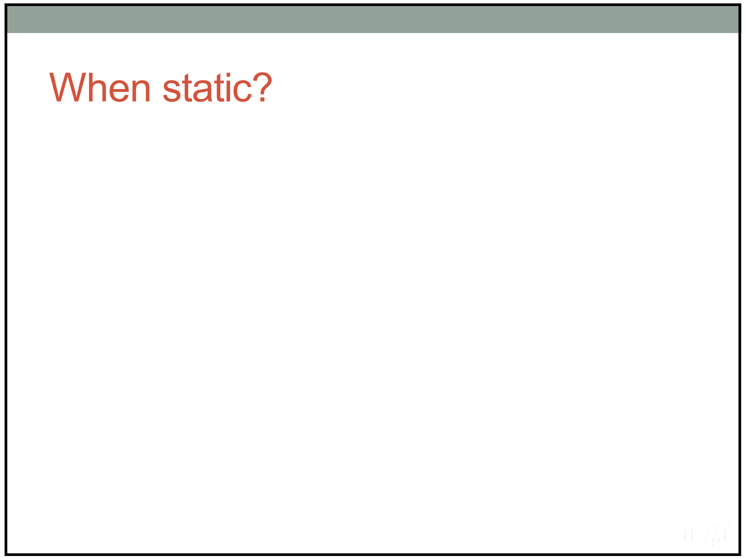

When static?

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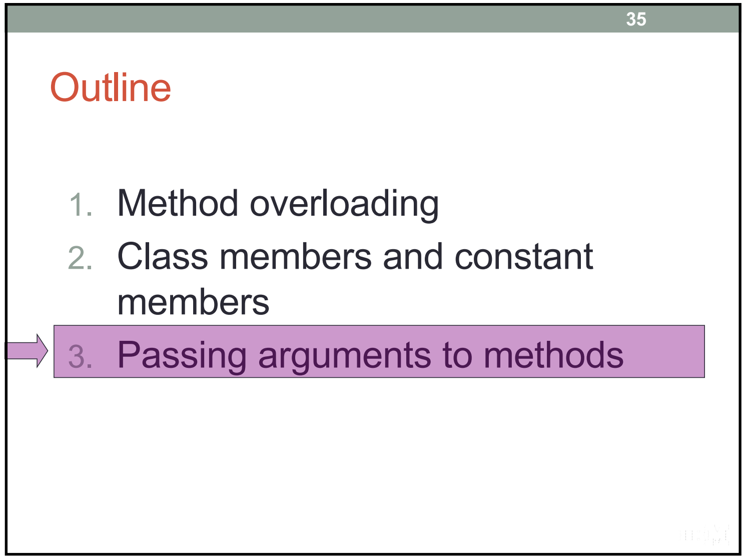

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Outline

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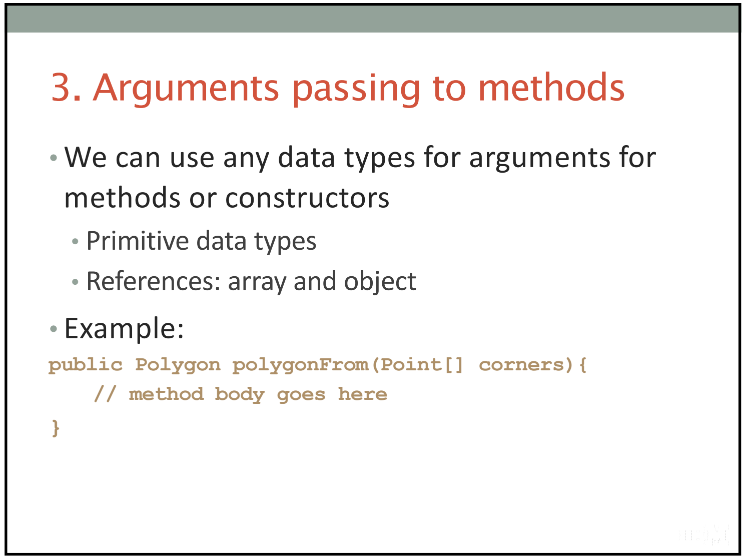

3. Arguments passing to methods

- 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
}
```

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3.1. Passing by values

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

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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

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Discussion:

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

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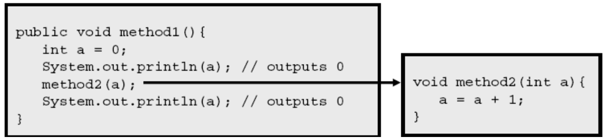
a. With value-based data type

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



```
public void method1(){
   int a = 0;
   System.out.println(a); // outputs 0
   method2(a);
   System.out.println(a); // outputs 0
}
```

```
void method2(int a){
   a = a + 1;
}
```

- Is this swap method correct?

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

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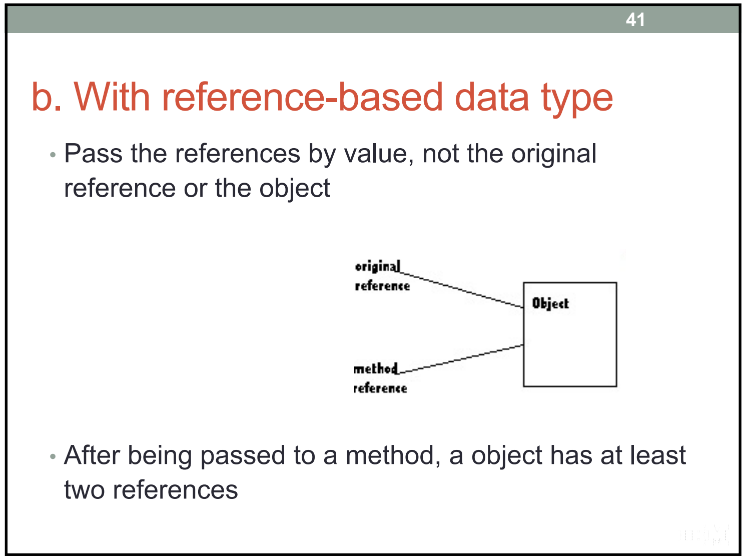

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b. With reference-based data type

- 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

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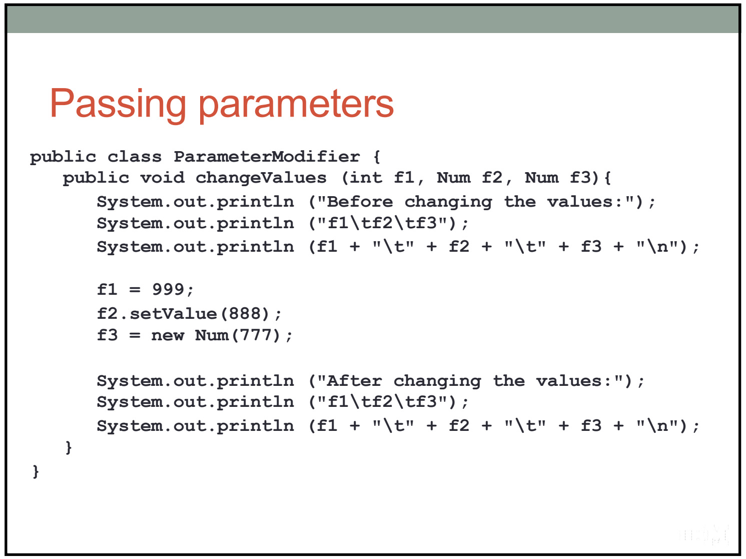

Passing parameters

```
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");
   }
}
```

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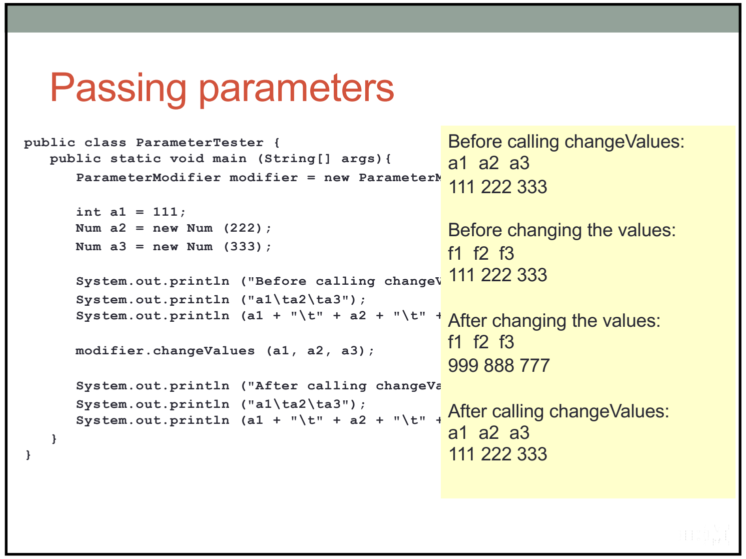

Passing parameters

```
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
111 222 333
```

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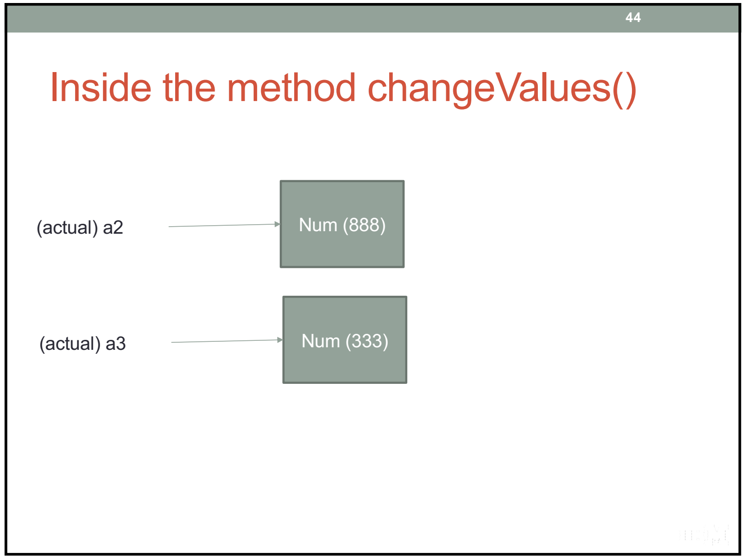

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Inside the method changeValues()

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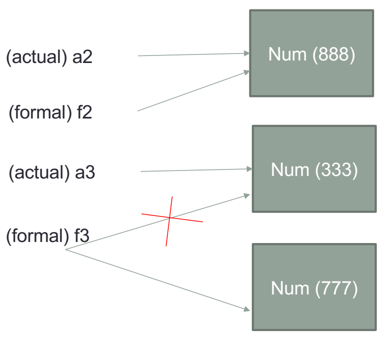
Inside the method changeValues()



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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);
  }
}
```

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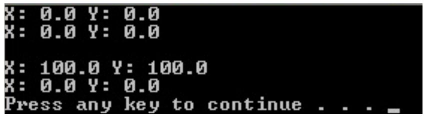
```
public class Test {
 public static void tricky(Point arg1, Point arg2) {
  arg1.setX(100); arg1.setY(100);
  Point temp = arg1;
  arg1 = arg2; arg2 = temp;
 }
 public static void main(String [] args) {
  Point pnt1 = new Point(0,0);
  Point pnt2 = new Point(0,0);
  pnt1.printPoint(); pnt2.printPoint();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

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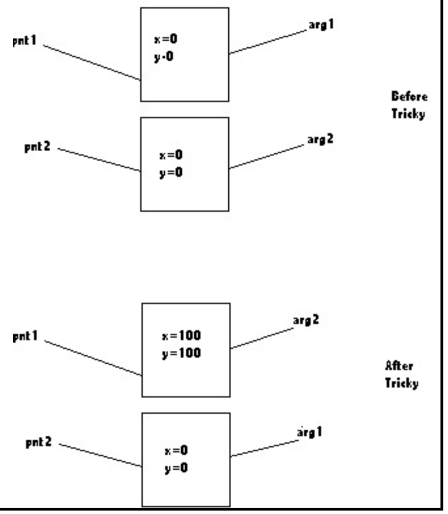
- Only the method references are swap, not the original references



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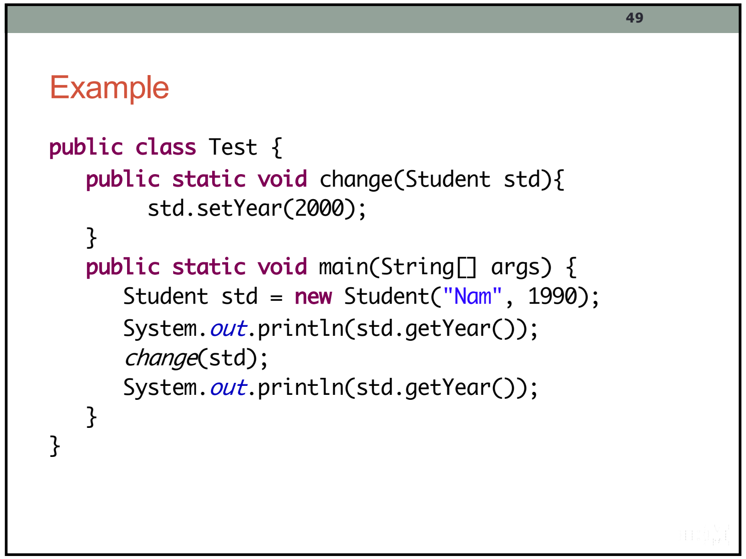

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Example

```
public class Test {
   public static void change(Student std){
        std.setYear(2000);
   }
   public static void main(String[] args) {
      Student std = new Student("Nam", 1990);
      System.out.println(std.getYear());
      change(std);
      System.out.println(std.getYear());
   }
}
```

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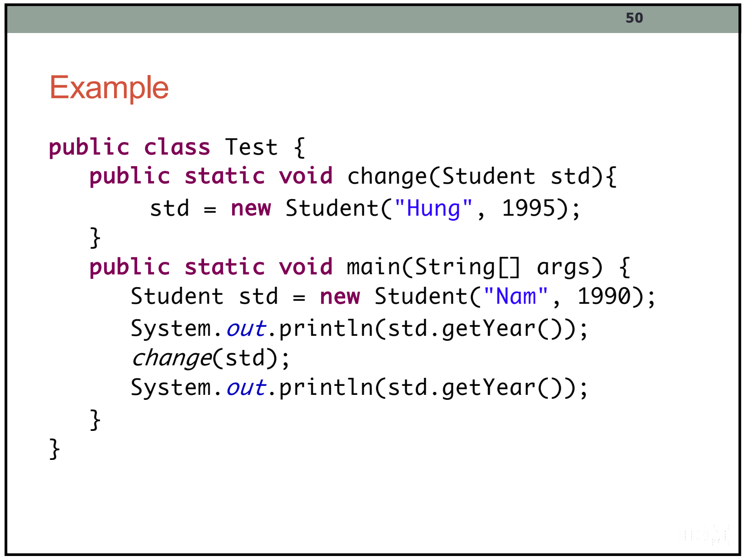

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Example

```
public class Test {
   public static void change(Student std){
        std = new Student("Hung", 1995);
   }
   public static void main(String[] args) {
      Student std = new Student("Nam", 1990);
      System.out.println(std.getYear());
      change(std);
      System.out.println(std.getYear());
   }
}
```

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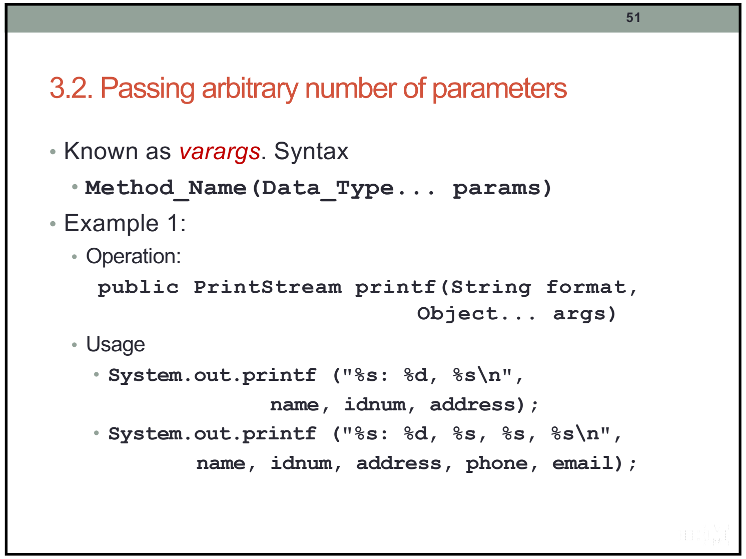

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3.2. Passing arbitrary number of parameters

- Known as *varargs*. Syntax
  - **`Method_Name(Data_Type... params)`**
- Example 1:
  - Operation:

```
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);
```

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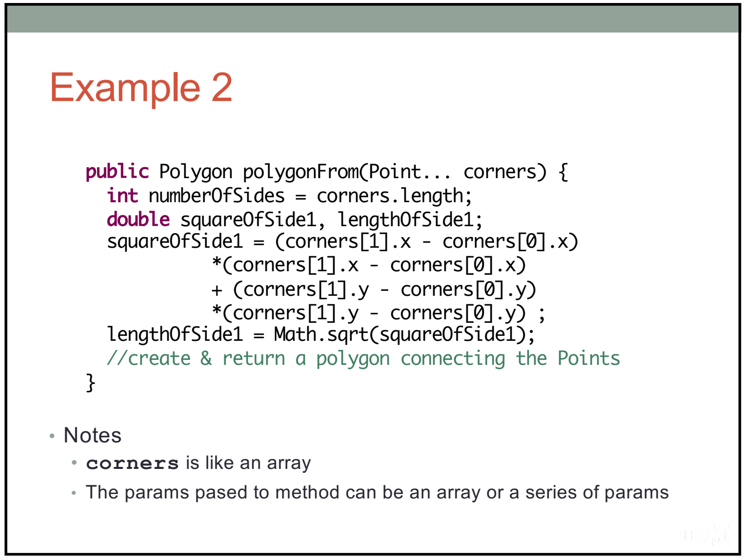

Example 2

```
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
}
```

- Notes
  - **`corners`** is like an array
  - The params pased to method can be an array or a series of params

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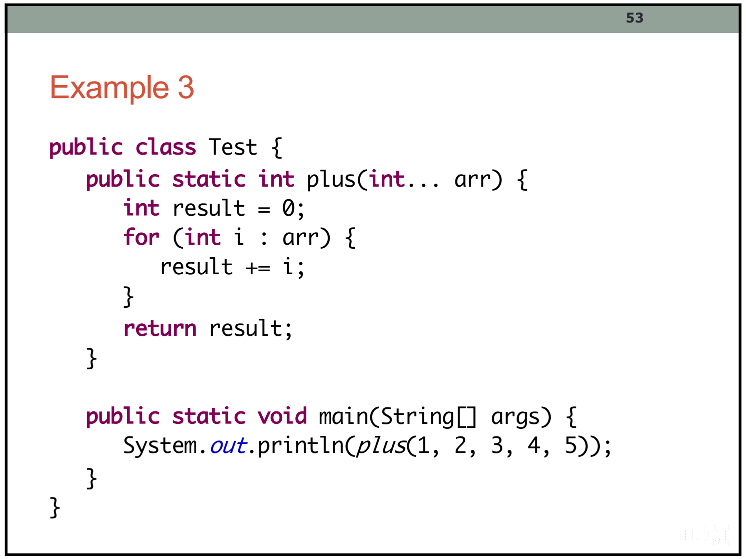

Example 3

```java
public class Test {
   public static int plus(int... arr) {
      int result = 0;
      for (int i : arr) {
         result += i;
      }
      return result;
   }

   public static void main(String[] args) {
      System.out.println(plus(1, 2, 3, 4, 5));
   }
}
```

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