# Computer Science 2

Lecture 1: Part 2

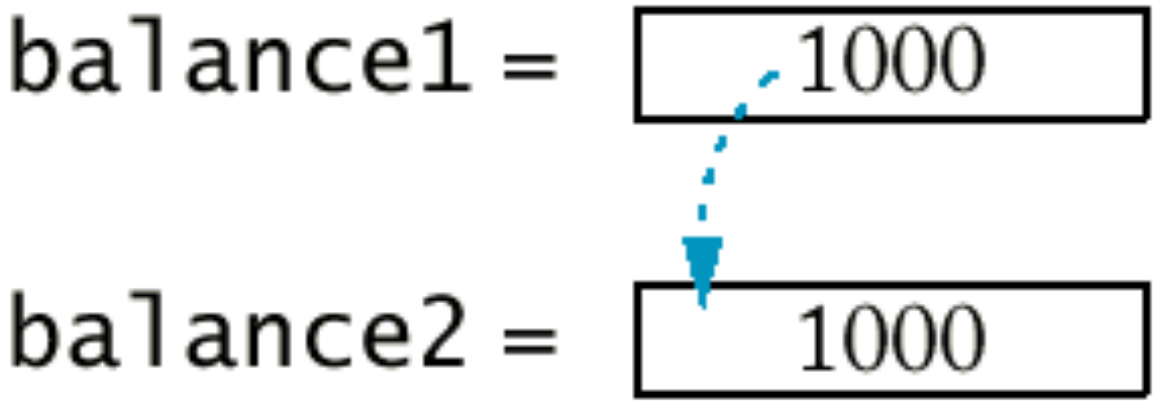
# Non-Reference and Reference Variables, Static Fields, and Static Methods

# Difference between Non-Reference Variables and Reference Variables

- Non-reference variables hold values of the same type;
- Reference variables hold references to objects, not the objects themselves;
- You can see the difference when you copy a variable.

# Copying Numbers

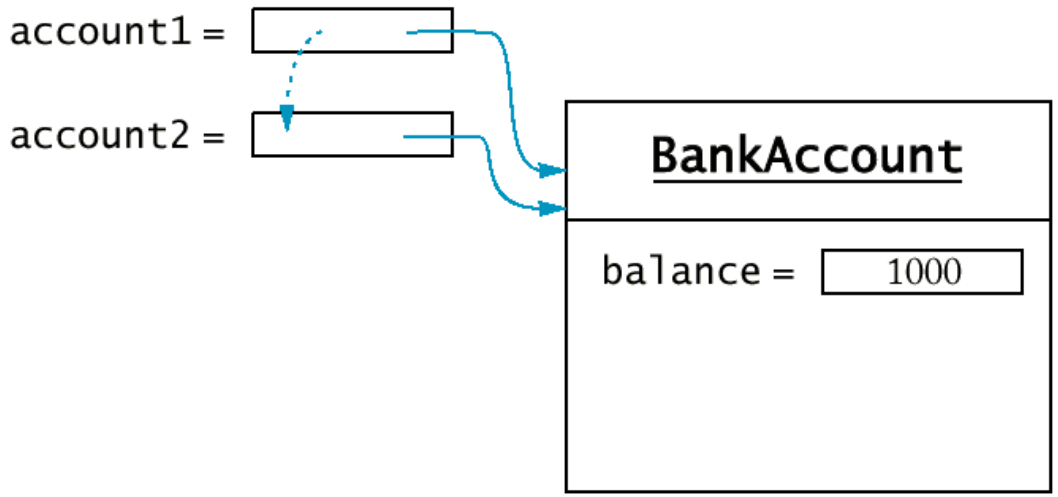
- ```
  double balance1 = 1000;
  double balance2 = balance1;
  balance2 = balance2 + 500;
  ```
- Change in `balance2` does not affect `balance1`


  ```

# Copying Object References

```
BankAccount account1 = new BankAccount(1000);
BankAccount account2 = account1;
account2.deposit(500);
```

- Change through `account2` is also visible through `account1`



# Non-Reference Variables in Method Calls

- The way how the factual values are passed to methods in Java is called ***call-by-value***: for each parameter there is an expression, the expressions are evaluated, and the values of the expressions are passed as actual values.
- Thus, if a variable is passed to a method, the stored value of that variable in the calling method won't be changed.

```
int n = 5;
do(n);
System.out.println(n);
```

```
int n = 5;
do(n + 10);
System.out.println(n);
```

```
static void do(int k)
{ k= k + 10;}
```

# Reference Variables in Method Calls

- If reference variables are passed to a method, the stored values of the variables (references to objects) won't be changed. But, we can use the references inside the method to change the instance fields of the object.

```
BankAccount myAccount = new BankAccount ();
System.out.print(myAccount.getBalance());// prints 0.0
changeObject(myAccount);
System.out.print(myAccount.getBalance());// prints 0.05
```

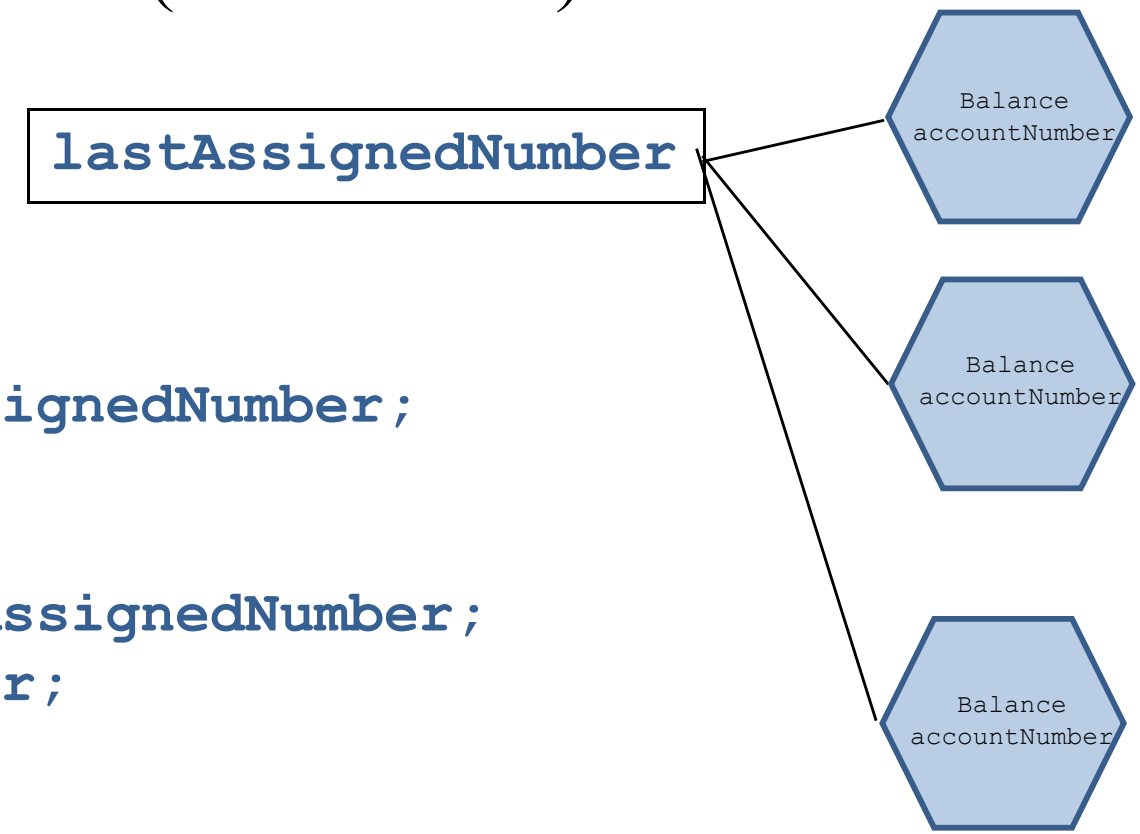
```
static void changeObject(BankAccount b)
{ p.deposit(0.05);}
```

# Static Fields

- **Static (Class) fields** belongs to the class, not to any object of the class;
- Static fields can be considered as fields that belong to all the objects of the class (black board)!

```
public class BankAccount
{  public BankAccount()
   {  balance = 0;
    lastAssignedNumber++;
    accountNumber = lastAssignedNumber;
   }

  private static int lastAssignedNumber;
  private int accountNumber;
  private double balance;
}
```



# Static Fields

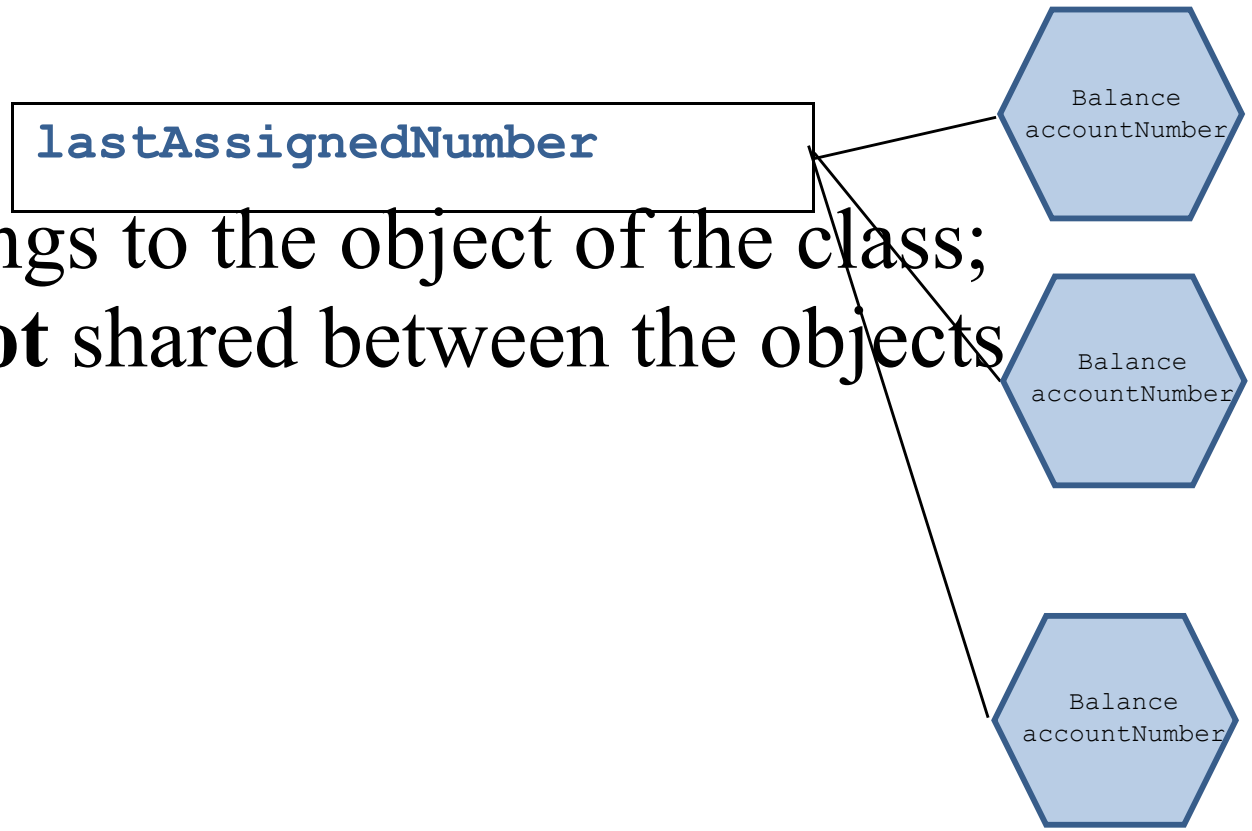
- There are three ways to initialize a static field:
  - Do nothing (the default value is assigned);
  - Use an explicit initializer;
  - Use a static initialization block.

```
public class BankAccount
{   …….
   static
   {     lastAssignedNumber = 0;
   }
   private static int lastAssignedNumber;
   private int accountNumber;
   private double balance;
}
```

# Static and Instance Fields

**Static (Class) fields** belongs to the class, not to any object of the class;

Static fields can be considered as fields that belong to all the objects of the class (black board)!




**Instance fields** belongs to the object of the class;

Instance fields are **not** shared between the objects of the class!

# Static Methods

**Static (Class) methods** are those methods that do not have an implicit parameter; i.e., they do not operate on objects;

To define a static method, use the keyword **`static`**;

To call a static method, use the name of the class and the name of the method:

```
<Class Name>.<Method Name>(<parameter List>)
```

Example: **Math.sqrt(4.5);**

# Example

```
public class Numeric
{  public static boolean equal(double x, double y)
   {
      final double EPSILON = 1E-14;
      if (x == 0) return Math.abs(y) <= EPSILON;
      if (y == 0) return Math.abs(x) <= EPSILON;
      return Math.abs(x - y) /
             Math.max(Math.abs(x), Math.abs(y))
             <= EPSILON;
   }
}
```

*Too many static methods are a sign of too little OO!*

# Static and Instance Fields and Methods

Rules:

- Instance and static fields can be used from non-static methods;
- Static fields can be used from static methods;
- **Instance fields cannot be used from static methods.**

# Static and Instance Fields, and Static and Instance Methods

```
public class BankAccountS
{  public BankAccountS()
   {    lastAssignedNumber++;
    accountNumber = lastAssignedNumber;
   }
   public void withdraw(double amount)
   {  balance = balance - amount; }
   public static int getNumberAccounts()
   {  return lastAssignedNumber; }
    ……
   private static int lastAssignedNumber = 0;
   private int accountNumber;
   private double balance = 0;
}
```

# Concepts Covered in the Lecture

- Comparison of Non-Reference and Reference Variables.
- Static Fields
- Static Methods