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Lesson 08 – Static Fields and Methods

MISTI

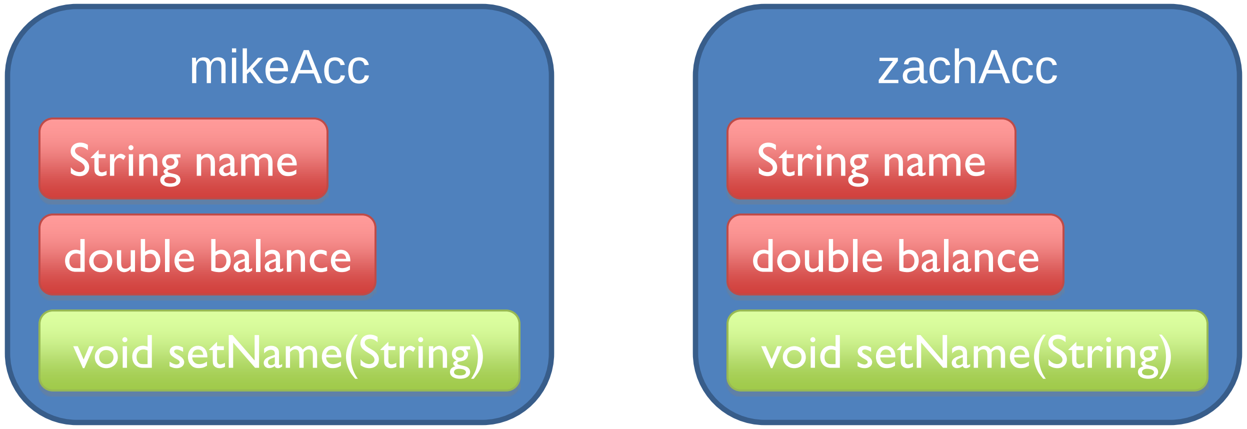
What You Know So Far

- Each object has its own copy of methods and fields:

```
class BankAccount {
  private String name;
  private double balance;
  public void withdraw(double amount)
}

BankAccount mikeAcc = new BankAccount(“Mike”, 100);
BankAccount zachAcc = new BankAccount(“Zach”, 20);
```

Instance Fields and Methods

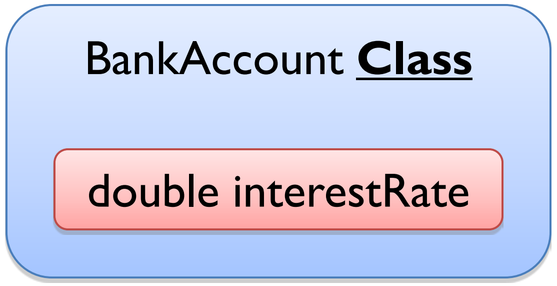
- Each object has its own copy of methods and fields:



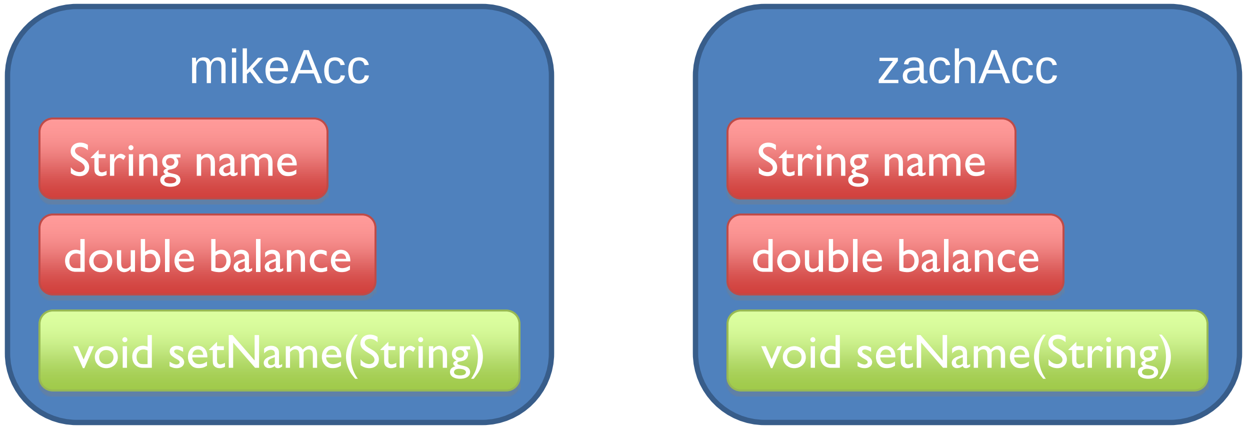
Instance Fields and Methods

```
BankAccount mikeAcc = new BankAccount(“Mike”, 100);
BankAccount zachAcc = new BankAccount(“Zach”, 20);

System.out.println(mikeAcc.getBalance()); //100
System.out.println(zachAcc.getBalance()); //20

zachAcc.withdraw(19);

System.out.println(mikeAcc.getBalance()); //100
System.out.println(zachAcc.getBalance()); //1
```

Shared Fields



- What if we wanted to make a field shared among all objects of a class?



Static Fields

- A given class will only have one copy of each of its static fields
  - This will be shared among all the objects.

- Each static field exists even if **no** objects of the class have been created.

- Use the word **`static`** to declare a static field.

Static Fields

- Only one instance of a static field data for the entire class, not one per instance.

- "static" is a historic keyword from C/C++

Static Fields Example

```
class BankAccount {
  public static double interestRate = 0.02;
}

BankAccount mikeAcc = new BankAccount(“Mike”, 100);
BankAccount zachAcc = new BankAccount(“Zach”, 20);

System.out.println(mikeAcc.interestRate); //0.02
System.out.println(BankAccount.interestRate); //0.02

mikeAcc.interestRate = 0.05;
System.out.println(zachAcc.interestRate); //0.05
```

Counting Objects Created

```
public class BankAccount {
  private static int numAccounts = 0;

  public BankAccount(String name, double balance)
  {
   numAccounts++;
  }
}
```

Unique ID for Objects

```
public class BankAccount {
  private static int nextAccountNum = 0;
  private int accountNum;

  public BankAccount(String name,
                         double balance)
  {
     accountNum = nextAccountNum++;
  }
}
```

Array of All Objects Created

```
public class BankAccount {
  private static BankAccount[] accounts =
     new BankAccount[100];
  private static int nextAccountNum = 0;

  public BankAccount(String name,
                              double balance) {
    accounts[nextAccountNum++] = this;
  }
}
```

What would happen if we deleted this static modifier?

Array of All Objects Created

```
public class BankAccount {
  private BankAccount[] accounts =
     new BankAccount[100];
  private static int nextAccountNum = 0;

  public BankAccount(String name,
                     double balance) {
    accounts[nextAccountNum++] = this;
  }
}
```

More Static Field Examples

Constants used by a class:

- Usually used with `final` keyword

- Only need to have one per class; don’t need one in each object:

```
public static final double TEMP_CONVERT = 1.8;
```

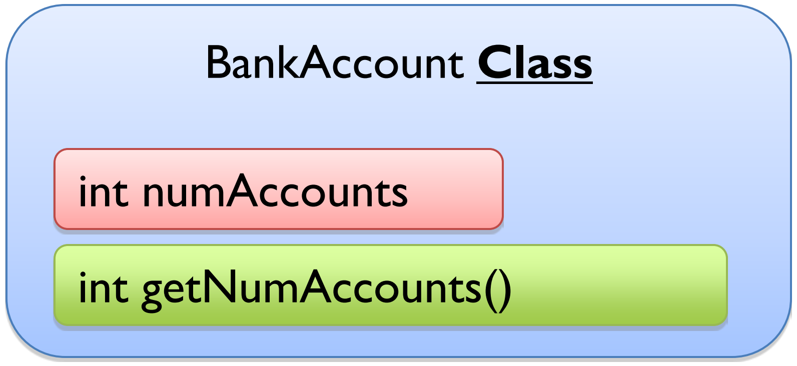
- If variable TEMP_CONVERT is in class Temperature, it is invoked by:

```
double t = Temperature.TEMP_CONVERT * temp;
```

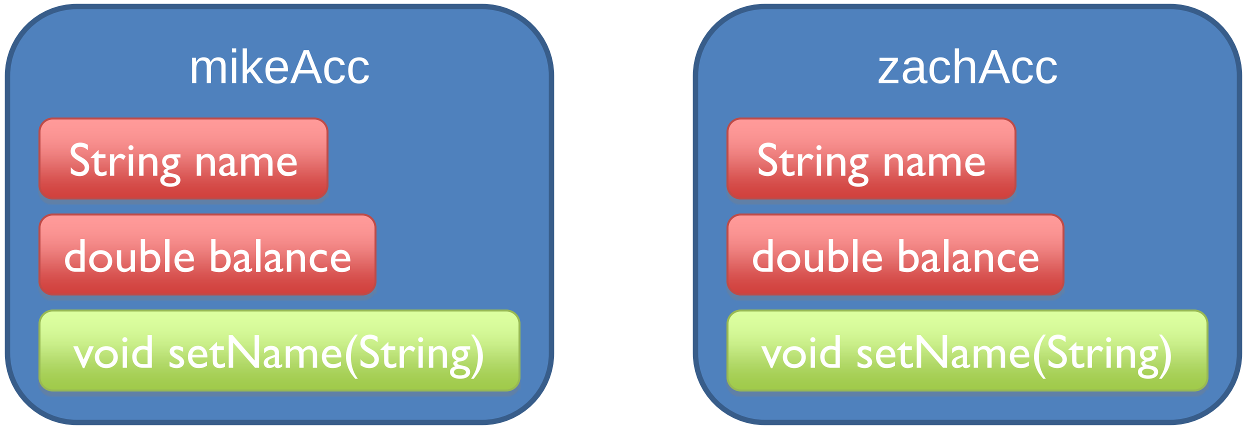
Instance Methods

- These are what you know so far…
- These define the operations you can perform on *objects* of a class.
- Methods typically operate on the instance (non-static) fields of the class.
  - Each object has a “copy” of the method just as it has copies of the fields.

Static / Class Methods



- Static methods are shared by all objects of the class
- One copy for all objects



Static Methods

To define a class method, add the keyword **`static`** to its definition.

```
public class BankAccount {
  private static int numAccounts = 0;

  public static int getNumAccounts() {
   return numAccounts;
  }
}
```

Calling Static Methods

```
public class BankAccount {
   private static int numAccounts = 0;

   public static int getNumAccounts() {
    return numAccounts;
   }
}

BankAccount mikeAcc = new BankAccount(“Mike”, 100);
System.out.println(mikeAccount.getNumAccounts()); //1

BankAccount zachAcc = new BankAccount(“Zach”, 20);
System.out.println(mikeAccount.getNumAccounts()); //2
System.out.println(BankAccount.getNumAccounts()); //2
```

Static Methods

- Static methods do not operate on a specific instance of their class

- Have access only to static fields and methods of the class
  - Cannot access non-static ones

Static Methods Limitations

```
public class BankAccount {
   private static int nextAccountNum = 0;
   private int accountNum;

   public static int getAccountNum() {
     return accountNum;
   }
}
```

Illegal, cannot access non-static field from static method

More Static Methods

- Static methods are also used when you need to define a method on 2 objects.

```
public static BankAccount greaterBalance
     (BankAccount ba1, BankAccount ba2)
{
  if (ba1.balance() >= ba2.balance())
   return ba1;
  else
   return ba2;
}
```

Static Method Examples

- For methods that use only the arguments and therefore do not operate on an object

```
public static double pow(double b, double p)
// Math class, takes b to the p power
```

- For methods that only need static data fields
- We **HAVE TO** use the static key word on the main method in the class that starts the program
  - No objects exist yet for the main method to operate on!

The `final` keyword

- Sometimes you will declare and initialize a variable with a value that will never change.

- To prevent any accidental changes, Java provides you with a way to fix the value of any variable by using the **`final`** keyword when you declare it.

The `final` keyword

- We declared `PI` as

```
public static double PI = 3.14159;
```

but this does not prevent changing its value:

```
MyMath.PI = 999999999;
```

- We use keyword **`final`** to denote a constant:

```
public static final double PI = 3.14159;
```

- Once we declare a variable to be **`final`**, it's value can no longer be changed!

Final References

- Consider this final reference to a `Point`:

```
public static final Point ORIGIN =
                                 new Point(0,0);
```

- This prevents changing the reference `ORIGIN`:

```
      MyMath.ORIGIN = new Point(3, 4);
```

- BUT! You can still call methods on ORIGIN that change the state of ORIGIN.

```
          MyMath.ORIGIN.setX(4);
```