

Advanced Programming

CSE 201

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(Semester: Monsoon 2025)

Week 2 - Classes and Objects – Basics

Classes and Objects.

- *Defining your own class:*

```
class ClassName
{
    field1
    field2
    . . .
    constructor1
    constructor2
    . . .
    method1
    method2
    . . .
}
```

```
class Employee
{
    // instance fields
    private String name;
    private double salary;
    private LocalDate hireDay;

    // constructor
    public Employee(String n, double s, int year, int month, int day)
    {
        name = n;
        salary = s;
        hireDay = LocalDate.of(year, month, day);
    }

    // a method
    public String getName()
    {
        return name;
    }

    // more methods
    . . .
}
```

Classes and Objects.

- *Defining your own class:*

-

- *Array of objects:*

-

```
Employee[] staff = new Employee[3];
```

```
staff[0] = new Employee("Carl Cracker", . . .);
```

```
staff[1] = new Employee("Harry Hacker", . . .);
```

```
staff[2] = new Employee("Tony Tester", . . .);
```

Class with `main()` method should *ideally* be different from the class whose objects it uses.

Classes and Objects.

```
import java.time.*;

/**
 * This program tests the Employee class.
 * @version 1.13 2018-04-10
 * @author Cay Horstmann
 */
public class EmployeeTest
{
    public static void main(String[] args)
    {
        // fill the staff array with three Employee objects
        Employee[] staff = new Employee[3];

        staff[0] = new Employee("Carl Cracker", 75000, 1987, 12, 15);
        staff[1] = new Employee("Harry Hacker", 50000, 1989, 10, 1);
        staff[2] = new Employee("Tony Tester", 40000, 1990, 3, 15);

        // raise everyone's salary by 5%
        for (Employee e : staff)
            e.raiseSalary(5);

        // print out information about all Employee objects
        for (Employee e : staff)
            System.out.println("name=" + e.getName() + ",salary=" + e.getSalary() + ",hireDay="
                               + e.getHireDay());
    }
}

class Employee
{
    private String name;
    private double salary;
    private LocalDate hireDay;

    public Employee(String n, double s, int year, int month, int day)
    {
        name = n;
        salary = s;
        hireDay = LocalDate.of(year, month, day);
    }

    public String getName()
    {
        return name;
    }
}
```

Private/Public Methods and Variables

- – *Unlike C/C++ all methods and variables are public.*
- – *To make a class visible to the JVM and other files you must declare it as public.*
- – *All public classes need their respective files.*
- – *Non-public (private) class need not have their own files.*

Private/Public Methods and Variables

- **Final keyword**
 - – *WORM* type field (define and initialize in the beginning and use as many times as you like without reassining or changing it).
- – Can be used for normal variable as well as class object variables.
- **Private keyword**
 - – Private keyword for class members - cannot be accessed through objects. Can only be accessed by class methods.

Static Methods and Variables

- **Static keyword**
- – *Philosophy: Have a single instance of a class object, variable, method etc.*
- – *Class variable with 'static' keyword - Can be used without the class object only with the class name only.*
- – *Only one variable shared across all objects of the class.*

Static Methods and Variables

- **Static constants**
- *static final*

```
public class Math
{
    . . .
    public static final double PI = 3.14159265358979323846;
    . . .
}
```


Constructors and Constructor Overloading

- – Called when the class object is created.
- – Explicit constructor vs implicit.
- *Implicit: Default when there are no explicit constructors.*
- *Explicit: Function with same name as class and no return values. Can have any number of arguments.*
- – *Constructor overloading: Multiple constructors with the same name, differing only wrt the args.*

Initializations

- – *Constructor(s).*
- – *Value initialization at declaration time.*
- – *Value initialization block.*

```
class Employee
{
    private static int nextId;

    private int id;
    private String name;
    private double salary;

    // object initialization block
    {
```

- – *no need before*
- *initialization.*

```
        id = nextId;
        nextId++;
    }

    public Employee(String n, double s)
    {
        name = n;
        salary = s;
    }

    public Employee()
    {
        name = "";
        salary = 0;
    }
    . . .
}
```

Packages and Imports

- Collection of classes - package.
- – Packaged in a directory.
- – Packages are clustered in a directory structure.
- – Classes with same name can reside inside their respective packages. No conflict.
- – Classname can be a fully qualified classname:
 - `java.time.LocalDate`
 - OR
 - Implicit based on the imported packages:
 - `import java.time.*;`
 - `LocalDate today = LocalDate.now();`

What is Memory?

- Memory (system memory, not disk or other peripheral devices) is the hardware in which computers store information, both temporary and permanent
- Think of memory as a list of slots; each slot holds information (e.g., a local `int` variable, or a reference to an instance of a class)
- Here, two references are stored in memory: one to a `Dog` instance, and one to a `DogGroomer` instance

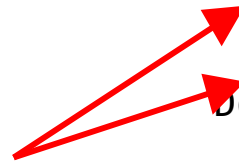
//Elsewhere in the program

```
Petshop petSmart = new Petshop();
```

```
public class PetShop {
```

```
    public PetShop() {  
        this.testGroomer();  
    }
```

```
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new  
        DogGroomer();  
        groomer.groom(django);  
    }
```



Objects as Parameters: Under the Hood (1/6)

```
public class PetShop {  
  
    public PetShop() {  
        this.testGroomer();  
    }  
  
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new DogGroomer();  
        groomer.groom(django);  
    }  
}
```

```
public class DogGroomer {  
  
    public DogGroomer() {  
        // this is the constructor!  
    }  
  
    public void groom(Dog shaggyDog) {  
        // code that grooms shaggyDog goes here  
    }  
}
```

Somewhere in memory...



Objects as Parameters: Under the Hood (2/6)

```
public class PetShop {
```

```
    public PetShop() {  
        this.testGroomer();  
    }
```

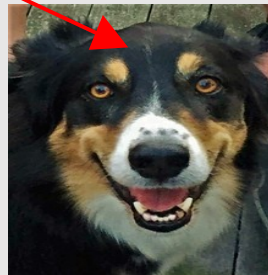
```
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new DogGroomer();  
        groomer.groom(django);  
    }
```

```
public class DogGroomer {
```

```
    public DogGroomer() {  
        // this is the constructor!  
    }
```

```
    public void groom(Dog shaggyDog) {  
        // code that grooms shaggyDog goes here!  
    }  
}
```

Somewhere in memory...



When we instantiate a

Dog , he's stored somewhere in memory. Our

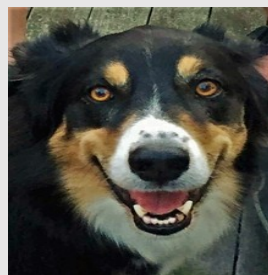
PetShop will use the

Objects as Parameters: Under the Hood (3/6)

```
public class PetShop {  
  
    public PetShop() {  
        this.testGroomer();  
    }  
  
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new DogGroomer();  
        groomer.groom(django);  
    }  
}
```

```
public class DogGroomer {  
  
    public DogGroomer() {  
        // this is the constructor!  
    }  
  
    public void groom(Dog shaggyDog) {  
        // code that grooms shaggyDog goes here!  
    }  
}
```

Somewhere in memory...



The same goes for the

DogGroomer

—we store a particular

DogGroomer

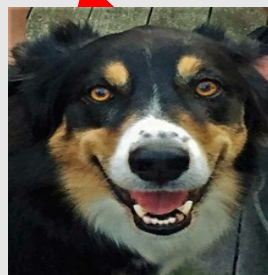
somewhere in

Objects as Parameters: Under the Hood (4/6)

```
public class PetShop {  
  
    public PetShop() {  
        this.testGroomer();  
    }  
  
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new DogGroomer();  
        groomer.groom(django);  
    }  
}
```

```
public class DogGroomer {  
  
    public DogGroomer() {  
        // this is the constructor!  
    }  
  
    public void groom(Dog shaggyDog) {  
        // code that grooms shaggyDog goes here!  
    }  
}
```

Somewhere in memory...



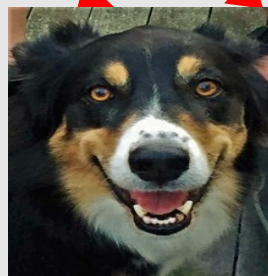
We call the `groom` method on our `DogGroomer`, `groomer.groom(django)`. We need to tell her which `Dog` to

Objects as Parameters: Under the Hood (5/6)

```
public class PetShop {  
  
    public PetShop() {  
        this.testGroomer();  
    }  
  
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new DogGroomer();  
        groomer.groom(django);  
    }  
}
```

```
public class DogGroomer {  
  
    public DogGroomer() {  
        // this is the constructor!  
    }  
  
    public void groom(Dog shaggyDog) {  
        // code that grooms shaggyDog goes here!  
    }  
}
```

Somewhere in memory...

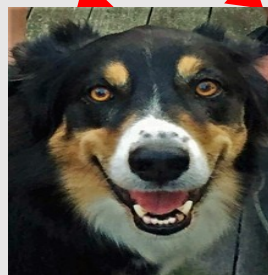


Objects as Parameters: Under the Hood (6/6)

```
public class PetShop {  
  
    public PetShop() {  
        this.testGroomer();  
    }  
  
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new DogGroomer();  
        groomer.groom(django);  
    }  
}
```

```
public class DogGroomer {  
  
    public DogGroomer() {  
        // this is the constructor!  
    }  
  
    public void groom(Dog shaggyDog) {  
        // code that grooms shaggyDog goes here!  
    }  
}
```

Somewhere in memory...

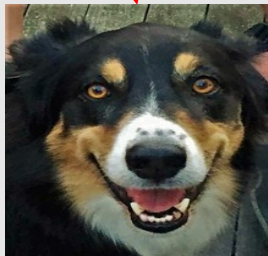


The groom method doesn't really care which

Dog it's told to groom—no matter what another

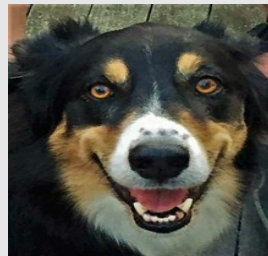
Variable Reassignment: Under the Hood (1/5)

```
public class PetShop {  
  
    /* This is the constructor! */  
    public PetShop() {  
        this.testGroomer();  
    }  
  
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new DogGroomer();  
        groomer.groom(django);  
        django = new Dog();  
        groomer.groom(django);  
    }  
}
```



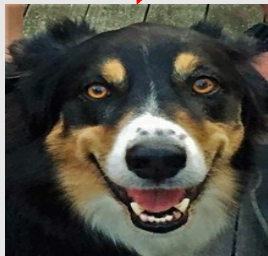
Variable Reassignment: Under the Hood (2/5)

```
public class PetShop {  
  
    /* This is the constructor! */  
    public PetShop() {  
        this.testGroomer();  
    }  
  
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new DogGroomer();  
        groomer.groom(django);  
        django = new Dog();  
        groomer.groom(django);  
    }  
}
```



Variable Reassignment: Under the Hood (3/5)

```
public class PetShop {  
  
    /* This is the constructor! */  
    public PetShop() {  
        this.testGroomer();  
    }  
  
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new DogGroomer();  
        groomer.groom(django);  
        django = new Dog();  
        groomer.groom(django);  
    }  
}
```



Local Variables (1/2)

- All variables we've seen so far have been **local variables**: variables declared *within a method*
- Problem: the **scope** of a local variable (where it is known and can be accessed) is limited to its own method—it cannot be accessed from anywhere else
 - the same is true of method parameters

```
public class PetShop {
```

```
    /* This is the constructor! */
```

```
    public PetShop() {
```

```
        this.testGroomer();
```

```
    }
```

```
    public void testGroomer() {
```

```
        Dog django = new Dog();
```

```
        DogGroomer groomer = new DogGroomer();
```

```
        groomer.groom(django);
```

```
        django = new Dog();
```

```
        groomer.groom(django);
```

```
    }
```

```
}
```

local variables



Local Variables (2/2)

- We created `groomer` and `django` in our `PetShop` 's helper method, but as far as the rest of the class is concerned, they don't exist
- What happens to `django` after the method is executed?
 - "Garbage Collection"

```
public class PetShop {
```

```
    /* This is the constructor! */
```

```
    public PetShop() {
```

```
        this.testGroomer();
```

```
    }
```

```
    public void testGroomer() {
```

```
        Dog django = new Dog();
```

```
        DogGroomer groomer = new DogGroomer();
```

```
        groomer.groom(django);
```

```
        django = new Dog();
```

```
        groomer.groom(django);
```

```
    }
```

```
}
```

local variables



Variable Reassignment: Under the Hood (4/5)

```
public class PetShop {  
  
    /* This is the constructor! */  
    public PetShop() {  
        this.testGroomer();  
    }  
  
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new DogGroomer();  
        groomer.groom(django);  
        django = new Dog();//old ref garbage collected  
        groomer.groom(django);  
    }  
}
```



Variable Reassignment: Under the Hood (5/5)

```
public class PetShop {  
  
    /* This is the constructor! */  
    public PetShop() {  
        this.testGroomer();  
    }  
  
    public void testGroomer() {  
        Dog django = new Dog();  
        DogGroomer groomer = new DogGroomer();  
        groomer.groom(django);  
        django = new Dog();    //old ref garbage collected  
        groomer.groom(django);  
    }  
}
```

