THE UNIVERSITY *of* NORTH CAROLINA *at* CHAPEL HILL

COMP 110 Introduction to Programming

Fall 2015

Time: TR 9:30 – 10:45

Room: AR 121 (Hanes Art Center)

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Previous Class

- What did we discuss?

Today

- Assignment3 - extension:
  DUE Fri, 11/6 @ 11:55 PM
- Quiz on Tuesday
- Today – More on Constructors

Summary: Constructor

- A special method with the same name as the class, and no return type
- Called only when an object is created
- It can take parameters to initialize instance variables
- You can define multiple constructors with different parameter lists

Default Constructor

- Constructor that takes no parameters

```
public Pet()
{
    name = “No name yet.”;
    age = 0;
    weight = 0;
}
```

- Java automatically defines a default constructor if you do not define any constructors
  - You have not written a constructor explicitly, but you can still create objects

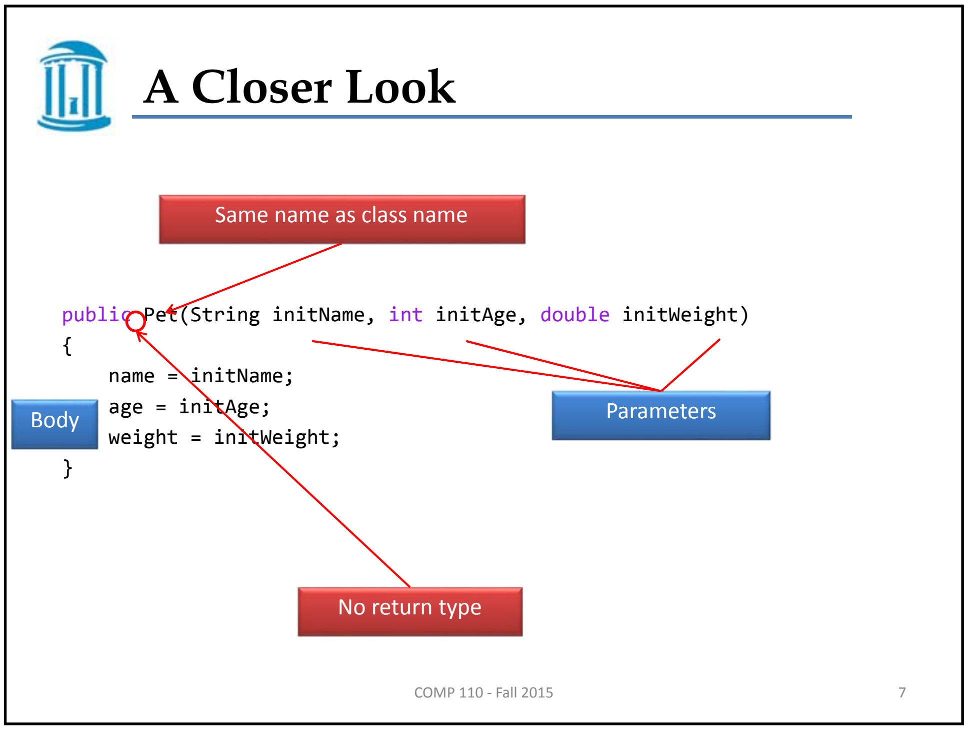
Constructor with Parameters

```
public class Pet
{
    private String name;
    private int age;
    private double weight;

    public Pet(String initName, int initAge, double initWeight)
    {
        name = initName;
        age = initAge;
        weight = initWeight;
    }

    public void setPet(String newName, int newAge, double newWeight)
    {
        name = newName;
        age = newAge;
        weight = newWeight;
    }

}
```



A Closer Look

Same name as class name

```
public Pet(String initName, int initAge, double initWeight)
{
    name = initName;
    age = initAge;
    weight = initWeight;
}
```

Body

Parameters

No return type

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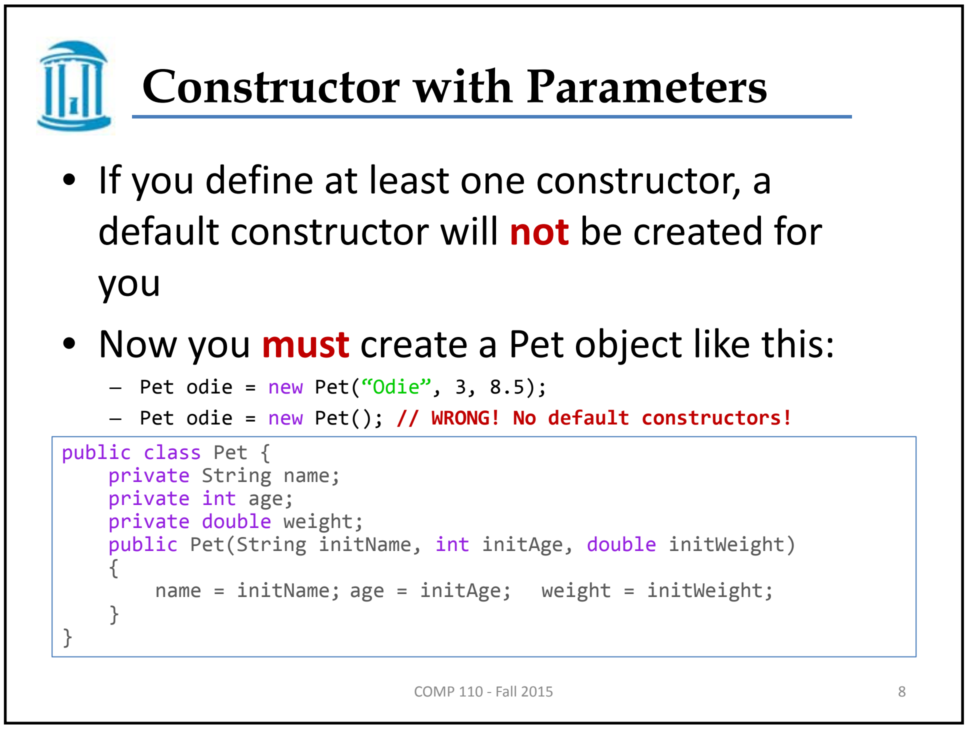

Constructor with Parameters

- If you define at least one constructor, a default constructor will **not** be created for you
- Now you **must** create a Pet object like this:
  - `Pet odie = new Pet("Odie", 3, 8.5);`
  - `Pet odie = new Pet(); // WRONG! No default constructors!`

```
public class Pet {
    private String name;
    private int age;
    private double weight;
    public Pet(String initName, int initAge, double initWeight)
    {
        name = initName; age = initAge;   weight = initWeight;
    }
}
```

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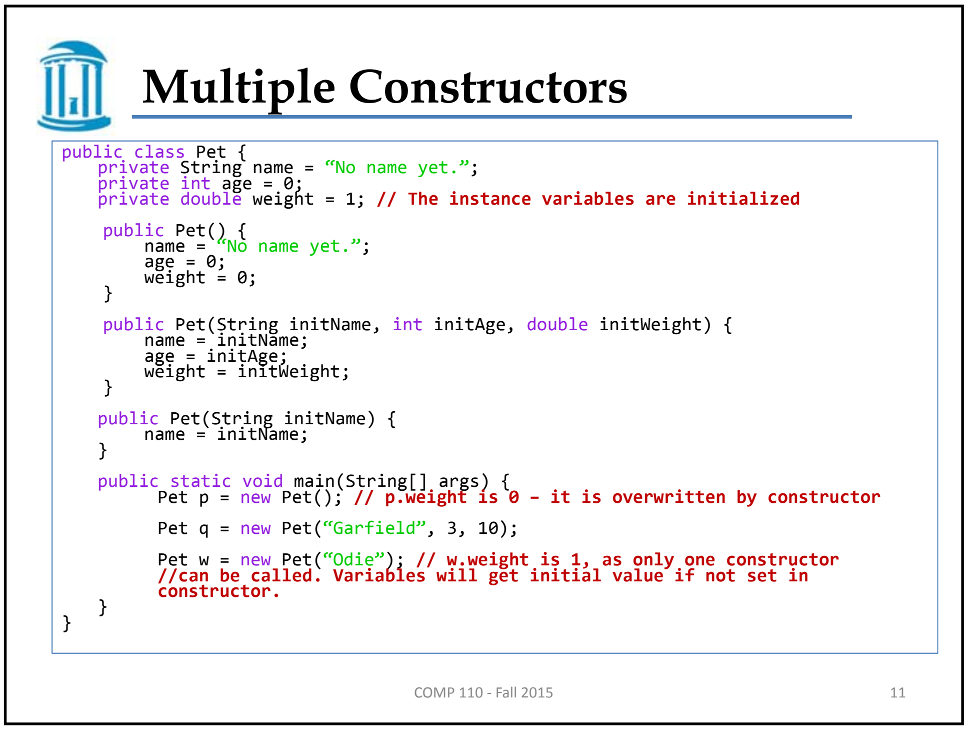
Multiple Constructors

- You can have several constructors per class
  - They all have the same name, just different parameters
    - Remember that the name is **the same as the class name**
  - The methods (with the same name) will be called according to its parameters

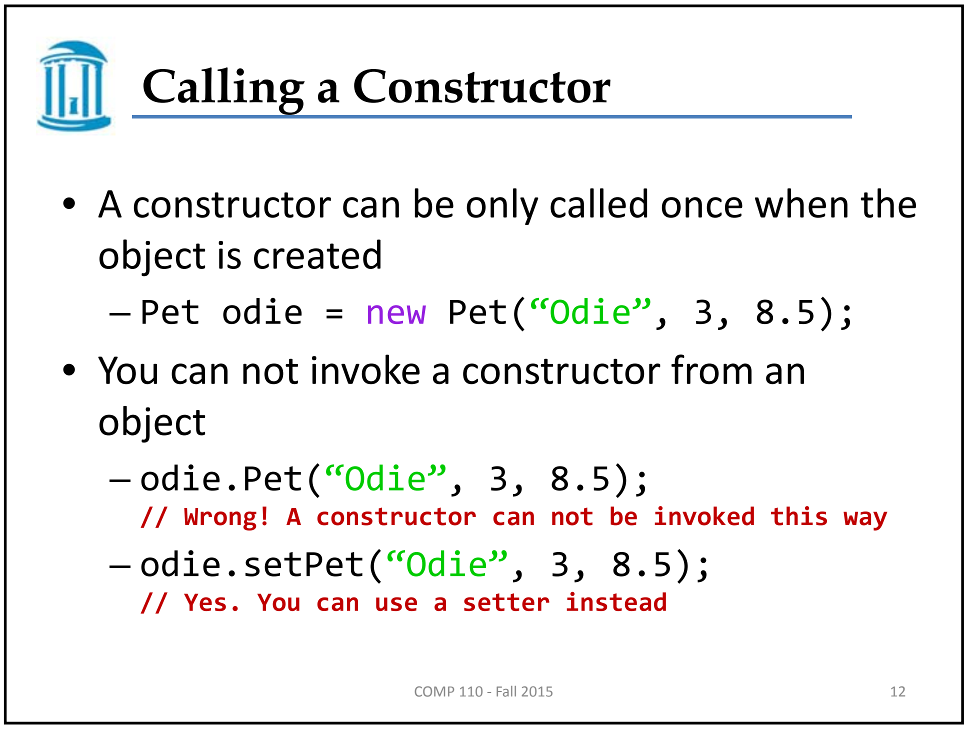
Multiple Constructors

```
public class Pet {
    private String name;
    private int age;
    private double weight;

    public Pet() {
        name = “No name yet.”;
        age = 0;
        weight = 0;
    }

    public Pet(String initName, int initAge, double initWeight) {
        name = initName;
        age = initAge;
        weight = initWeight;
    }

         public static void main(String[] args)      {
                  Pet p = new Pet();
                  Pet q = new Pet(“Garfield”, 3, 10);
         }
}
```



Multiple Constructors

```
public class Pet {
    private String name = “No name yet.”;
    private int age = 0;
    private double weight = 1; // The instance variables are initialized

     public Pet() {
         name = “No name yet.”;
         age = 0;
         weight = 0;
     }

     public Pet(String initName, int initAge, double initWeight) {
         name = initName;
         age = initAge;
         weight = initWeight;
     }

    public Pet(String initName) {
         name = initName;
    }

    public static void main(String[] args) {
          Pet p = new Pet(); // p.weight is 0 – it is overwritten by constructor

          Pet q = new Pet(“Garfield”, 3, 10);

          Pet w = new Pet(“Odie”); // w.weight is 1, as only one constructor
          //can be called. Variables will get initial value if not set in
          constructor.
    }
}
```



Calling a Constructor

- A constructor can be only called once when the object is created
  - `Pet odie = new Pet(“Odie”, 3, 8.5);`
- You can not invoke a constructor from an object
  - `odie.Pet(“Odie”, 3, 8.5);`
    `// Wrong! A constructor can not be invoked this way`
  - `odie.setPet(“Odie”, 3, 8.5);`
    `// Yes. You can use a setter instead`

Calling a Setter from the Constructor

```
public class Pet
{
    private String name;
    private int age;
    private double weight;

    public Pet(String initName, int initAge, double initWeight)
    {
        setPet(initName, initAge, initWeight);
    }

    public void setPet(String newName, int newAge, double newWeight)
    {
        name = newName;
        age = newAge;
        weight = newWeight;
    }
}
```

Initialization and Setting Instance Variables

- Initialization values give values to instance variables that are the same (or commonly the same) for all objects
- Constructors give values to instance variables that should be decided for each object
- Setters give values to instance variables that can be changed over time
  - If a value is never going to be changed, no setter is needed

Example: Initialize, Construct and Set

```
public class Pet {
    private String name;
    private int age = 0;
    // Age is always 0 (assuming newly-born pets are registered immediately)
    private double weight;

    public Pet(String initName, double initWeight){
        name = initName;
        weight = initWeight;
                // Name is given when registering, and can not be changed
    }

    public void setPetWeight(double newWeight) {
        weight = newWeight;
        // Weight changes every time you weigh your pet
    }

    public void setPetAge(double newAge) {
        age = newAge;
        // Surely age can change, too
    }
}
```

Static Variables

- Static variables are shared by all objects of a class
- Only one instance of the variable exists
- It can be accessed by all instances of the class

```
public double gpa;
public static double highestGPA = 0.0;
public void setGPA(double newGPA) {
        if (newGPA > Student.highestGPA) {
                Student.highestGPA = newGPA;
        }
        gpa = newGPA;
}
```

Static Variables

- Static variables also called *class variables*
  - Contrast with *instance variables*
- Do not confuse class variables with variables of a class type
- Both static variables and instance variables are sometimes called *fields* or *data members*

Final Static Variables

- Variables declared **`static final`** are considered constants – value cannot be changed

```
public static final MAX_CLASS_YEAR = 6;
```

- Now, this won't work

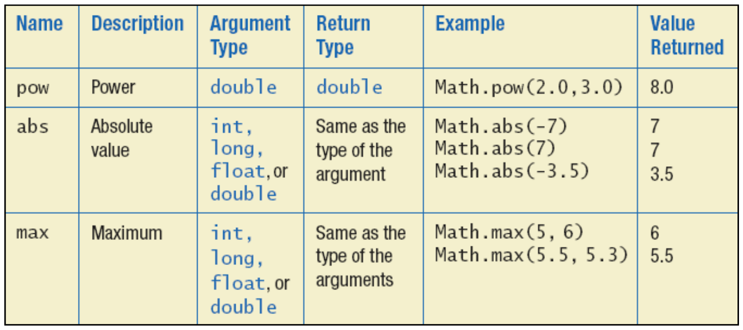
```
public static void main(String[] args) {
    …
    Student.MAX_CLASS_YEAR = 12;
    …
}
```

Static Methods

- Some methods may have no relation to any type of object
- Example
  - Compute max of two integers
  - Convert character from upper- to lower case
- Static method declared in a class
  - Can be invoked without using an object
  - Instead use the class name

The `Math` Class

- Provides many standard mathematical methods
  - Automatically provided, no import needed
- Example methods, figure 6.3a



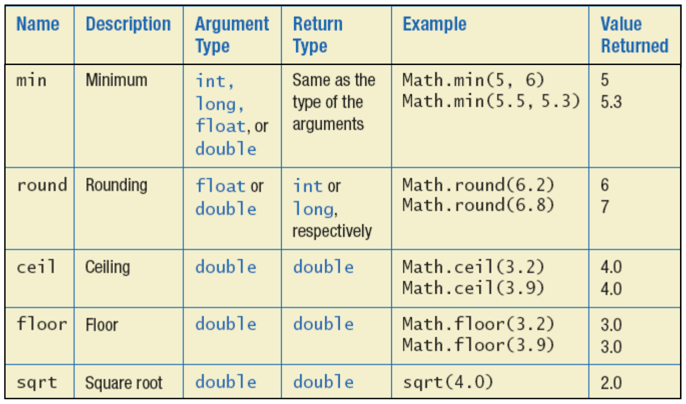
Name	Description	Argument Type	Return Type	Example	Value Returned
`pow`	Power	`double`	`double`	`Math.pow(2.0,3.0)`	8.0

`abs`	Absolute value	`int`, `long`, `float`, or `double`	Same as the type of the argument	`Math.abs(-7)`
				`Math.abs(7)`
				`Math.abs(-3.5)`
					7
					7
					3.5

`max`	Maximum	`int`, `long`, `float`, or `double`	Same as the type of the arguments	`Math.max(5, 6)`
				`Math.max(5.5, 5.3)`
					6
					5.5

The Math Class

- Example methods



Name	Description	Argument Type	Return Type	Example	Value Returned

`min`	Minimum	`int`, `long`, `float`, or `double`	Same as the type of the arguments	`Math.min(5, 6)`
				`Math.min(5.5, 5.3)`
					5
					5.3

`round`	Rounding	`float` or `double`	`int` or `long`, respectively	`Math.round(6.2)`
				`Math.round(6.8)`
					6
					7

`ceil`	Ceiling	`double`	`double`	`Math.ceil(3.2)`
				`Math.ceil(3.9)`
					4.0
					4.0

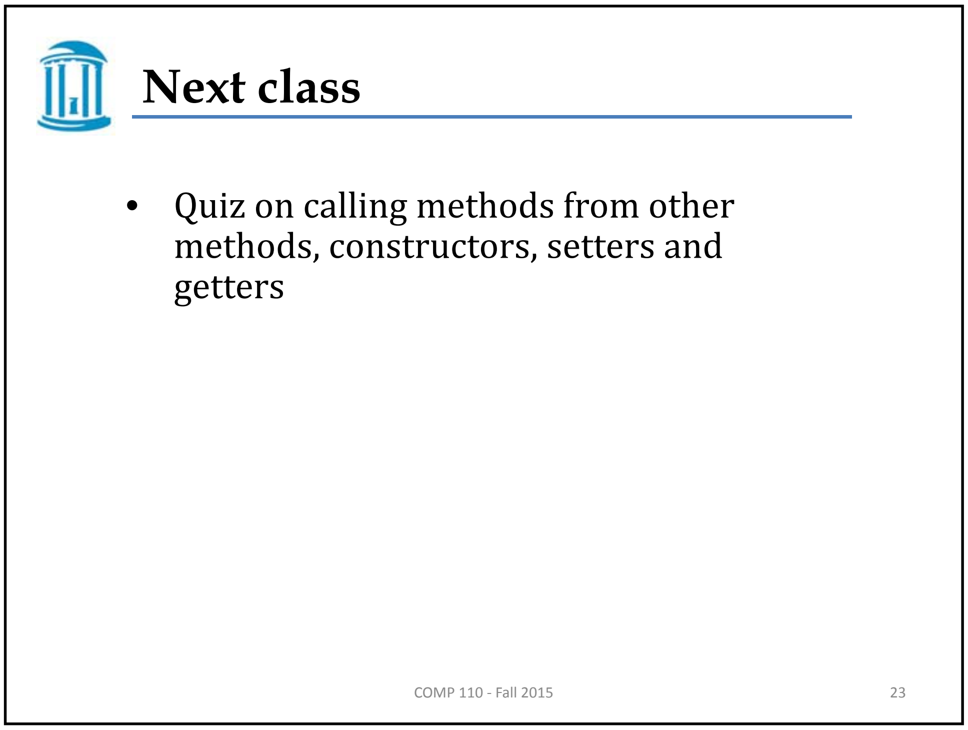
`floor`	Floor	`double`	`double`	`Math.floor(3.2)`
				`Math.floor(3.9)`
					3.0
					3.0

`sqrt`	Square root	`double`	`double`	`sqrt(4.0)`	2.0

Random Numbers

- **`Math.random()`** returns a random double that is greater than or equal to zero and less than 1
- Java also has a **Random** class to generate random numbers
- Can scale using addition and multiplication; the following simulates rolling a six sided die

```
int die = (int) (6.0 * Math.random()) + 1;
```



Next class

- Quiz on calling methods from other methods, constructors, setters and getters