Java Programming

Arthur Hoskey, Ph.D.
Farmingdale State College
Computer Systems Department

Today's Lecture

- Classes (continued)

REVIEW - Access Modifiers

- Private member
  - Only visible from inside the object
  - Cannot be seen from "outside"
- Public members
  - Visible from the outside
- Now look at the class definition again:
  - Look for the public members
  - Look for the private members
- For example…

```
public class Car
{
    // Attributes
    private int year;
    private int speed;
    private String color;

    // Behaviors
    public void Accelerate() {
        speed = speed +10;
    }
    public void Decelerate() {
        speed = speed - 10;
    }
}
```

REVIEW - Sample Class Definition

REVIEW - Access Modifiers

- **private** keyword
  - **Used for most instance variables.**
  - `private` variables and methods are accessible only to methods of the class in which they are declared.
  - Declaring instance variables `private` is known as **"data hiding".**
- **public** keyword
  - **Used for most methods.**
  - Public methods are accessible outside the class.

- If the private members cannot be seen from the outside the class then how do we change them?

REVIEW - Access Modifiers

REVIEW - Get and Set Methods

- **Use get/set methods to change private member variables.**
- private instance variables
  - Cannot be accessed directly by clients of the object.
  - Use **set** methods to **change the value.**
  - Use **get** methods to **retrieve the value.**

REVIEW - Get and Set Methods

```
public class Car
{
    // Attributes
    private int year;
    private int speed;
    private String color;

    // Behaviors
    public int GetYear() { return year; }
    public int GetSpeed() { return speed; }
    public String GetColor() { return color; }

    public void SetYear(int newYear) { year = newYear; }
    public void SetSpeed(int newSpeed) { speed = newSpeed; }
    public void SetColor(String newColor) { color = newColor; }

    // Accelerate and Decelerate not shown
}
```

- **Local Variables** - Declared in the body of method. Can only be used within that method.
- **Instance Variables** – Declared in a class declaration but not in a method. Each object of the class has a separate instance of the variable.

```
public class MyClass {
    int x;

    public void myMethod {
        int y;
        y = 10;
        x = 20;
    }

    public void otherMethod() {
        x = 20;

        ~~y = 30;~~
    }
}
```

<u>x is an instance variable</u> (accessible from all methods of the class)

<u>y is a local variable for myMethod</u> (only accessible from inside myMethod)

x can be used in both of these places because member methods have access to all member variables

Y is local to myMethod so it CANNOT be used here (y is out of scope)

REVIEW - Scope of variables

```
public class Car
{
    // Attributes
    private int year;
    private int speed;
    private String color;

    // Behaviors
    Get and set methods not shown

    public void Accelerate() {
        speed = speed +10;
    }
    public void Decelerate() {
        speed = speed - 10;
    }
}
```

Variable Resolution In Member Method

1. **First, look for a local declaration of the variable. If found then use it.**
2. **Second, look for the variable in the class scope.**

No local speed variable so it uses the member variable speed

Are you allowed to declare both a local variable and a class-level variable with the same name???

Variable Resolution

Classes In Memory

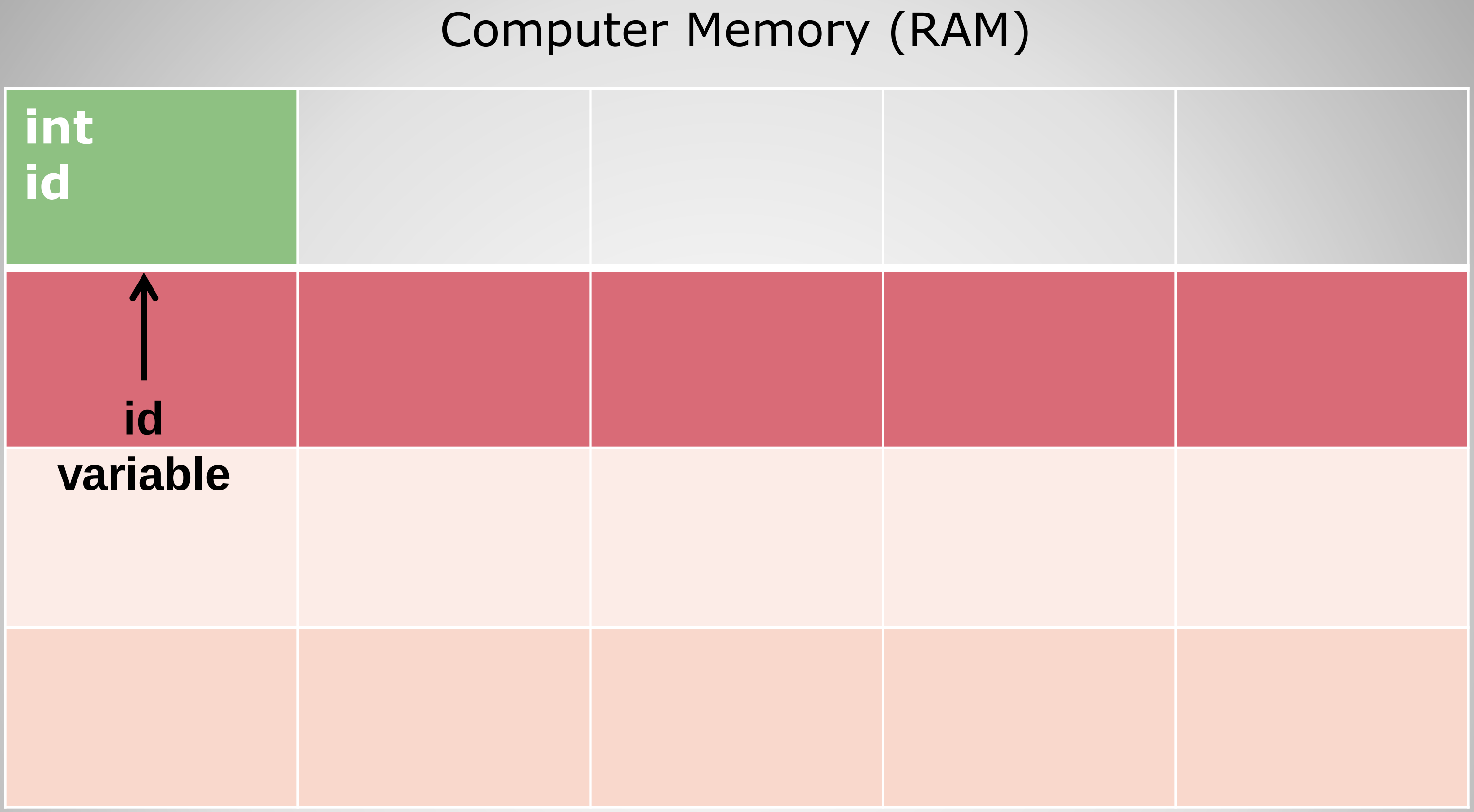
- What will memory allocations (in RAM) look like for the following code?

```
public static void main(String []args) {
    int id;
}
```

main() is the starting point for all Java programs

- Declared one int type variable.

Variables In Memory (RAM)



Showing a simplified view of memory here but will go into more detail later in the semester

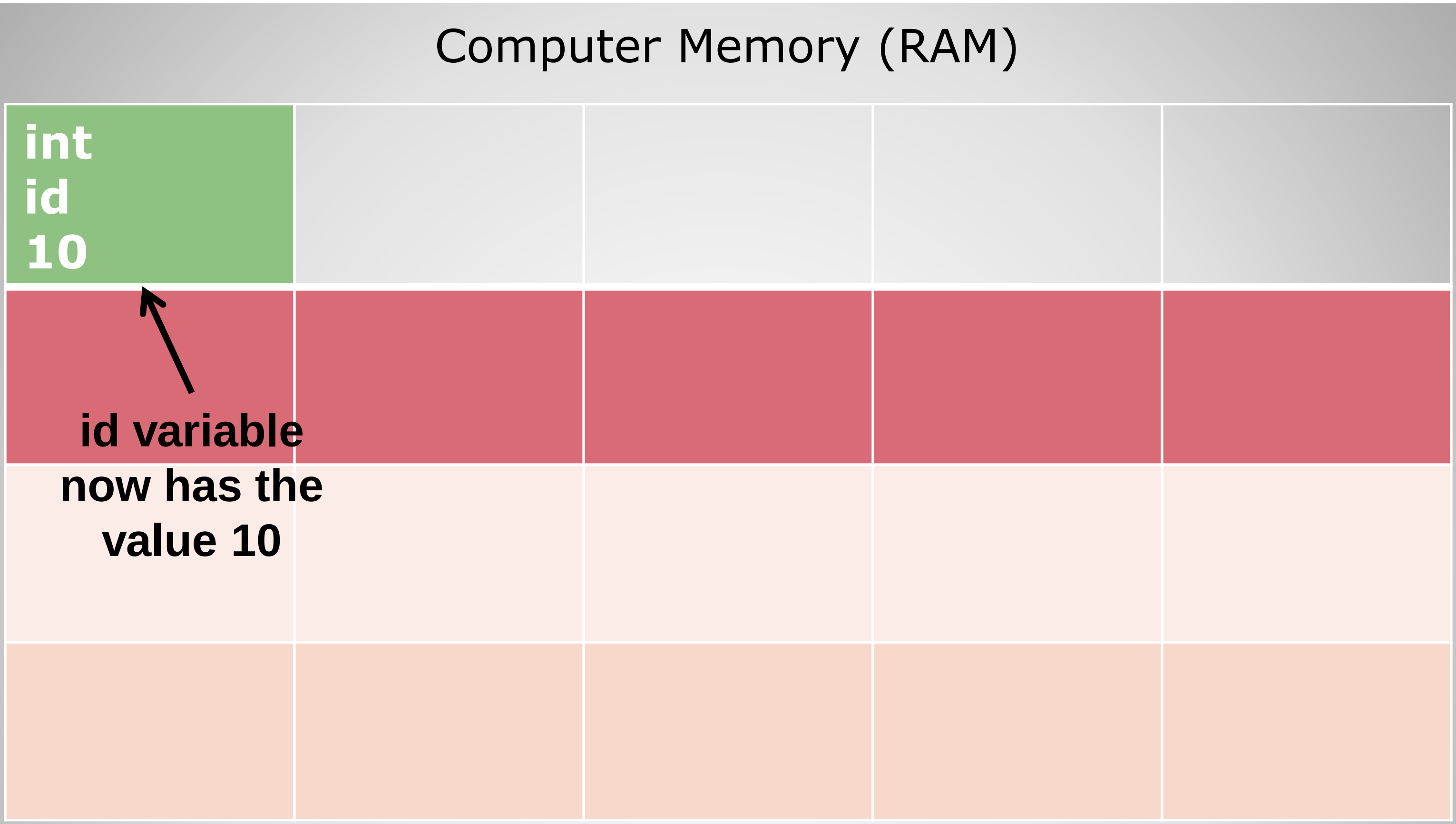
int takes up 4 bytes in memory

Classes In Memory

- What will memory allocations (in RAM) look like for the following code?

```
public static void main(String []args) {
    int id;
    id = 10;
}
```

Declare variable and assign value



Variables In Memory (RAM)

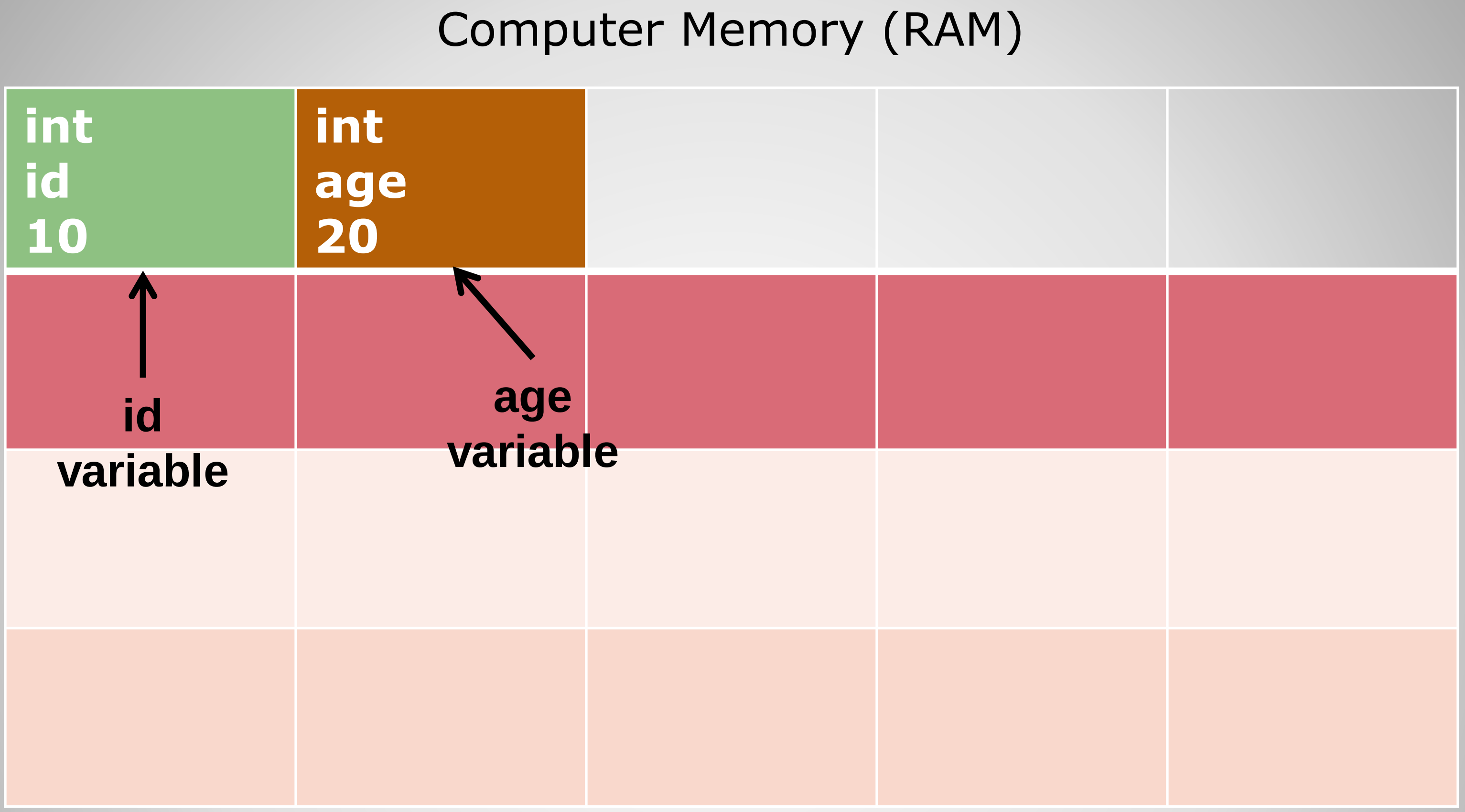
- What will memory allocations look like for the following code?

```
public static void main(String []args) {
    int id = 10;          // Declare and initialize
    int age = 20;         // Declare and initialize
}
```

- Declared two int type variables.

Classes In Memory

Classes In Memory



If you make a change to the id variable will it effect the age variable?

- Assume the previous definition of the Car class.
- What will memory allocations (in RAM) look like for the following code?

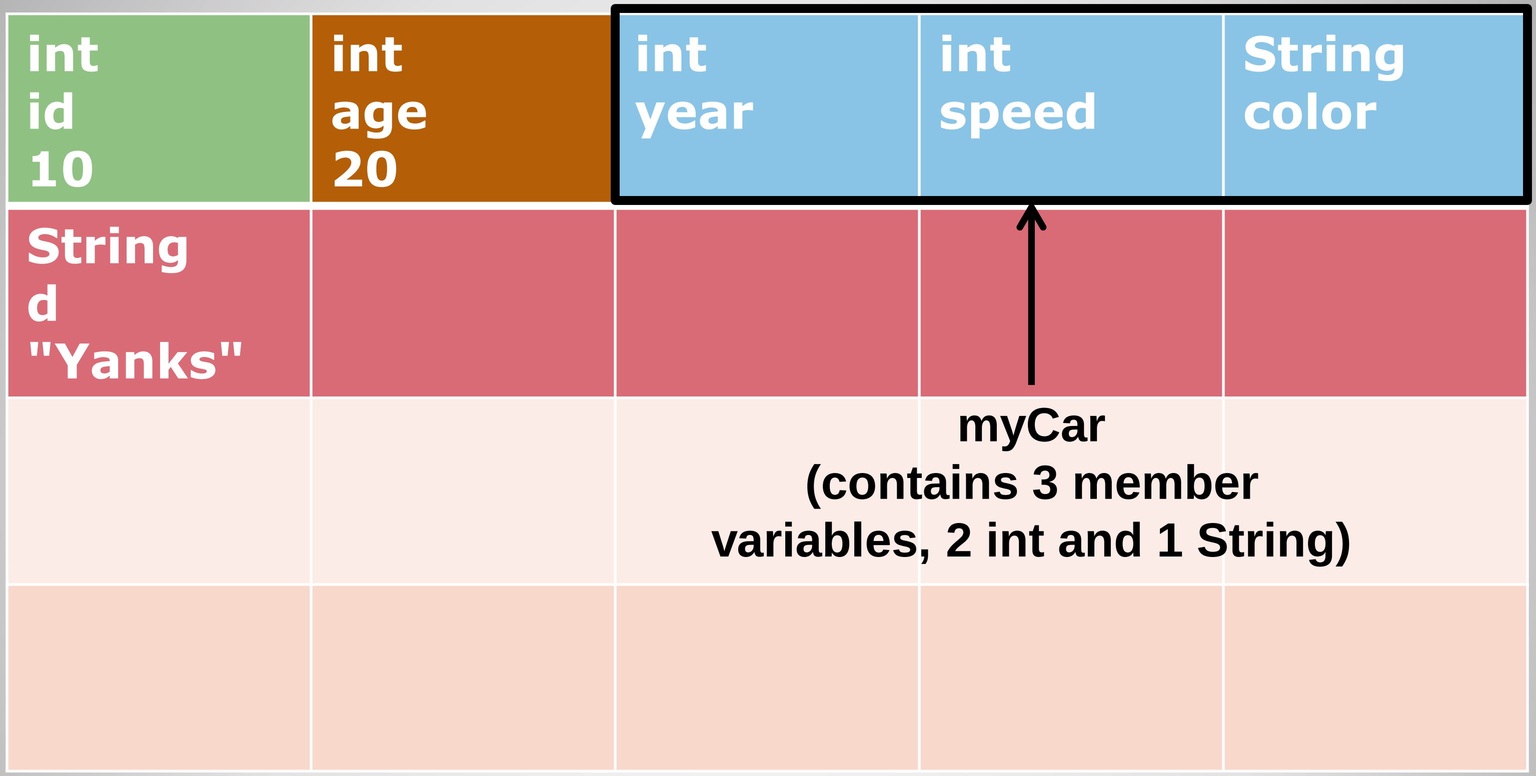
```
public static void main(String []args) {
    int id = 10;
    int age = 20;
    String d = "Yanks";

    Car myCar; // Declaring a variable of type Car

    myCar = new Car();  // Call new to create instance
}
```

Is there a memory leak??

Classes In Memory

Classes In Memory

Computer Memory (RAM)



This is a simplified view of what is happening with classes in memory

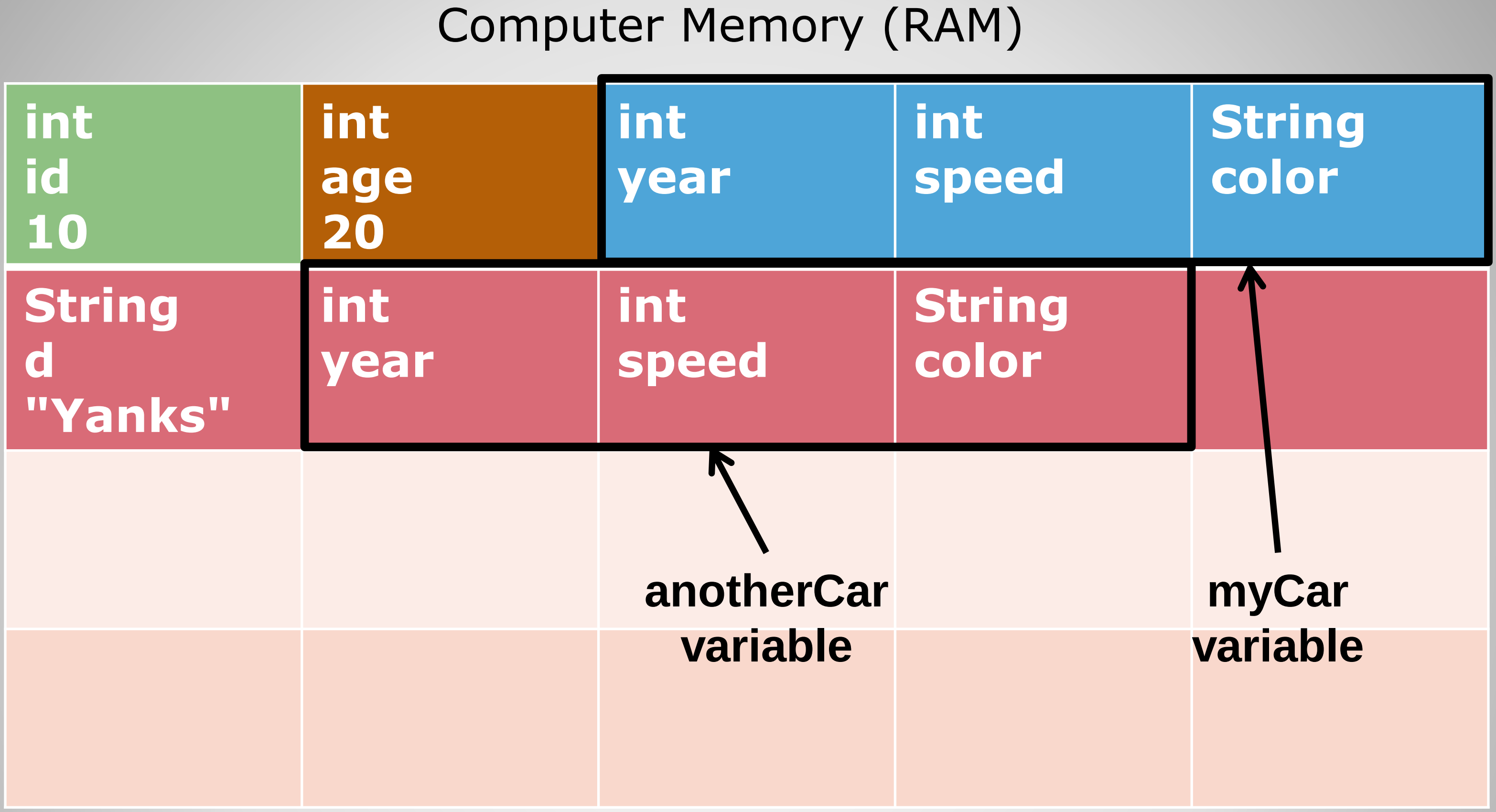
Classes In Memory

- What will memory look like if we declare and create another instance of the car class?

- Assume the previous definition of the Car class.
- What will memory allocations (in RAM) look like for the following code:

```
public static void main(String[] args)
{
    int id = 10;
    int age = 20;
    String d = "Yanks";
    Car myCar;
    Car anotherCar; // Different car object

    myCar = new Car();
    anotherCar= new Car();
}
```

Classes In Memory



<u>EVERY</u> instance of Car has its own full set of the member variables!!!

Classes In Memory

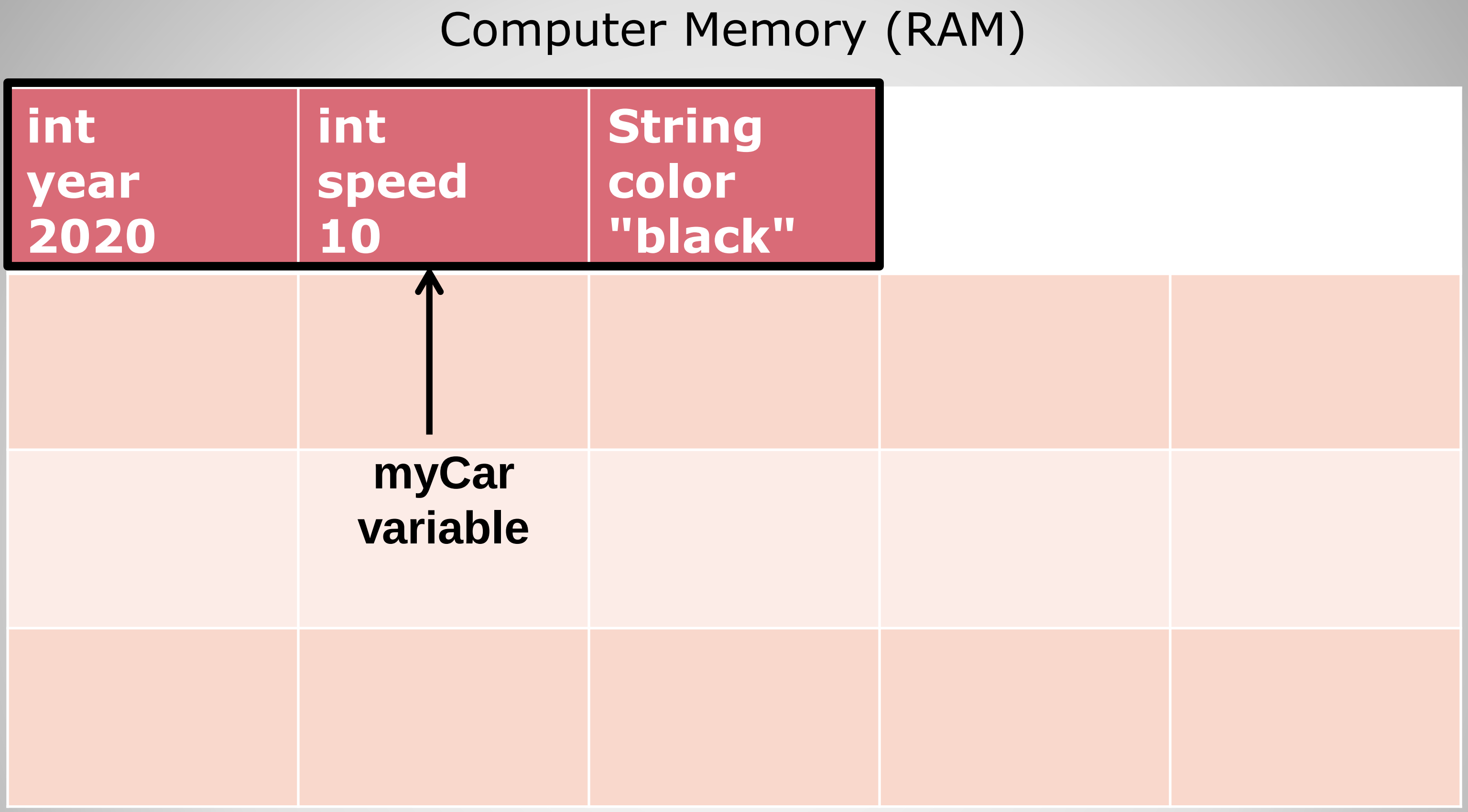
Access Modifiers

- How do we use the Car class in code?

```
public static void main(String[] args)
{
      Car myCar;

      myCar = new Car();

      myCar.SetSpeed(10);
      myCar.SetYear(2020);
      myCar.SetColor("black");
}
```

What does memory look like AFTER running this line?

Classes In Memory



If you change the year member variable will it effect the speed member variable?

Classes In Memory

```
public static void main(String[] args)
{
    Car myCar;

    myCar = new Car();

    SetSpeed(10);
    myCar.SetYear(2020);
    myCar.SetColor("black");
}
```

What is wrong with this code???

Classes In Memory

```
public static void main(String[] args)
{
    Car myCar;

    myCar = new Car();

    SetSpeed(10); // Incorrect
    myCar.SetYear(2020);
    myCar.SetColor("black");
}
```

What is wrong with this code???

ANSWER

You must call the member method with respect to an instance variable

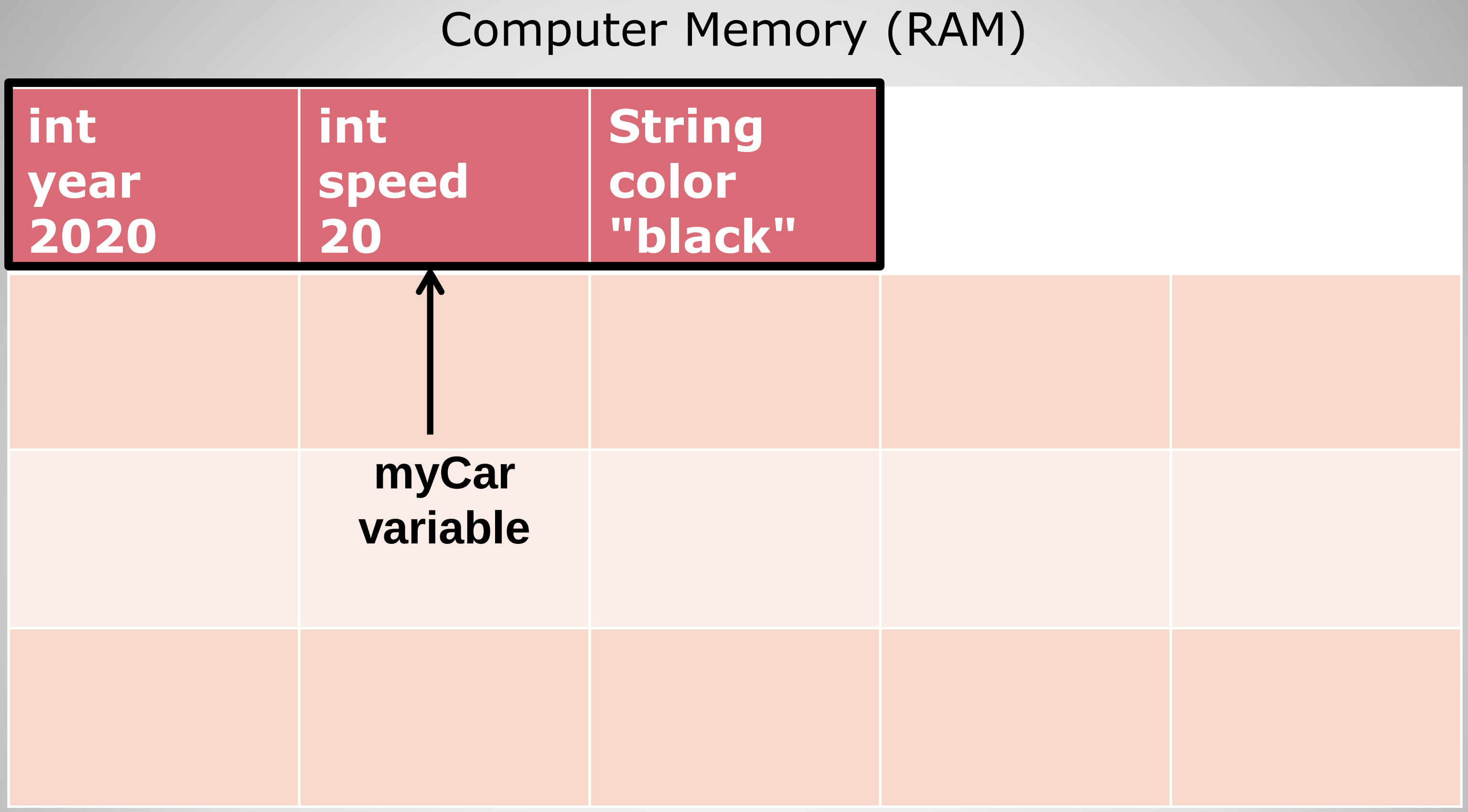
Classes In Memory

```
public static void main(String[] args)
{
	Car myCar;

	myCar = new Car();

	myCar.SetSpeed(10);
	myCar.SetYear(2020);
	myCar.SetColor("black");

	myCar.Accelerate();
}
```

What does memory look like AFTER running this line?

Classes In Memory

Classes In Memory



The speed member variable now has the value 20

```
public static void main(String[] args)
{
	Car myCar, anotherCar;

	myCar = new Car();
	anotherCar = new Car();

	myCar.SetSpeed(10);
	myCar.SetYear(2020);
	myCar.SetColor("black");

	anotherCar.SetSpeed(20);
	anotherCar.SetYear(2022);
	anotherCar.SetColor("red");
}
```

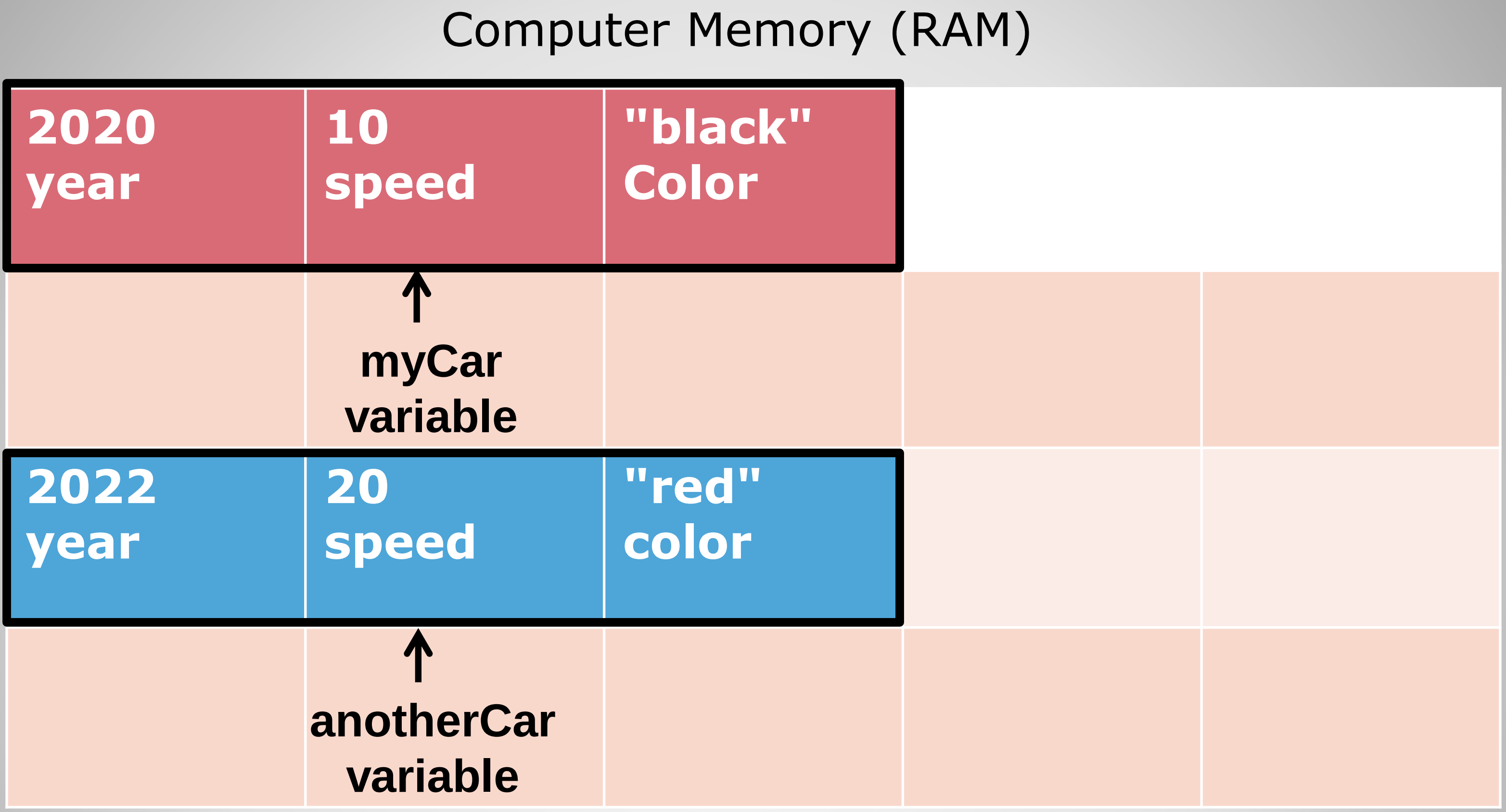
Must call new for every instance

Must call member methods with respect to a given instance

What does memory look like AFTER running this line?

Classes In Memory

Classes In Memory



Each instance of the Car class has its own section of memory.

Calling a Method

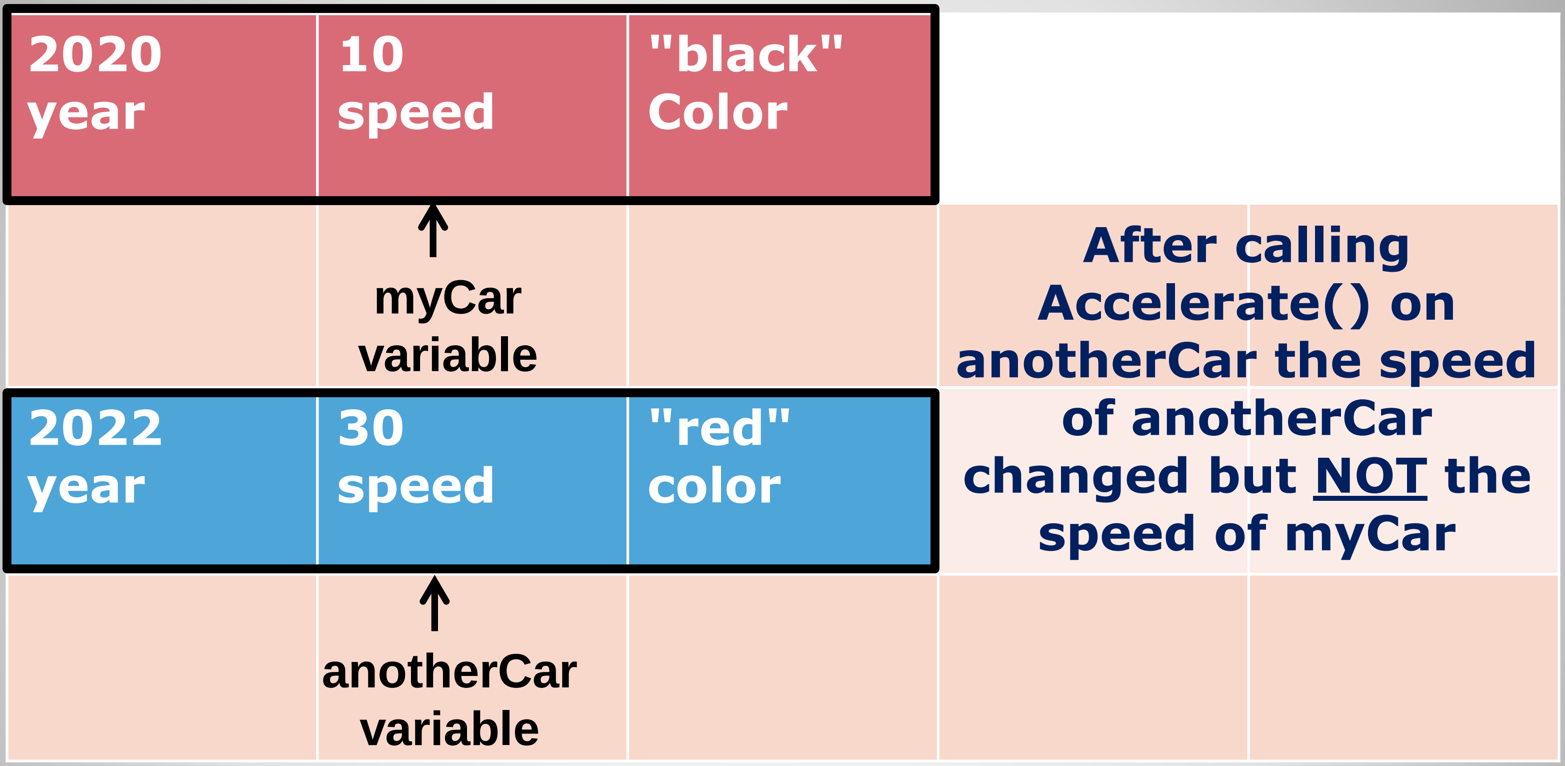
- If we call the Accelerate() method on the anotherCar instance what will memory look like?
- For example…

```
public static void main(String[] args)
{
	Car myCar, anotherCar;

	myCar = new Car();
	anotherCar = new Car();

	myCar.SetSpeed(10);
	myCar.SetYear(2020);
	myCar.SetColor("black");

	anotherCar.SetSpeed(20);
	anotherCar.SetYear(2022);
	anotherCar.SetColor("red");

	anotherCar.Accelerate();
}
```

Call Accelerate() on the anotherCar instance

Calling a Method

Computer Memory (RAM)


2020
year
10
speed
"black"
Color
myCar
variable
2022
year
30
speed
"red"
color
anotherCar
variable
After calling Accelerate() on anotherCar the speed of anotherCar changed but NOT the speed of myCar

If you make a change to one instance it does NOT effect any other instance.

Calling A Method

Constructors

- How do we initialize an object?
- A special method called a constructor is used to initialize an instance of an object.
- The constructor gets called when the "new" method runs.
- For example…

Constructors

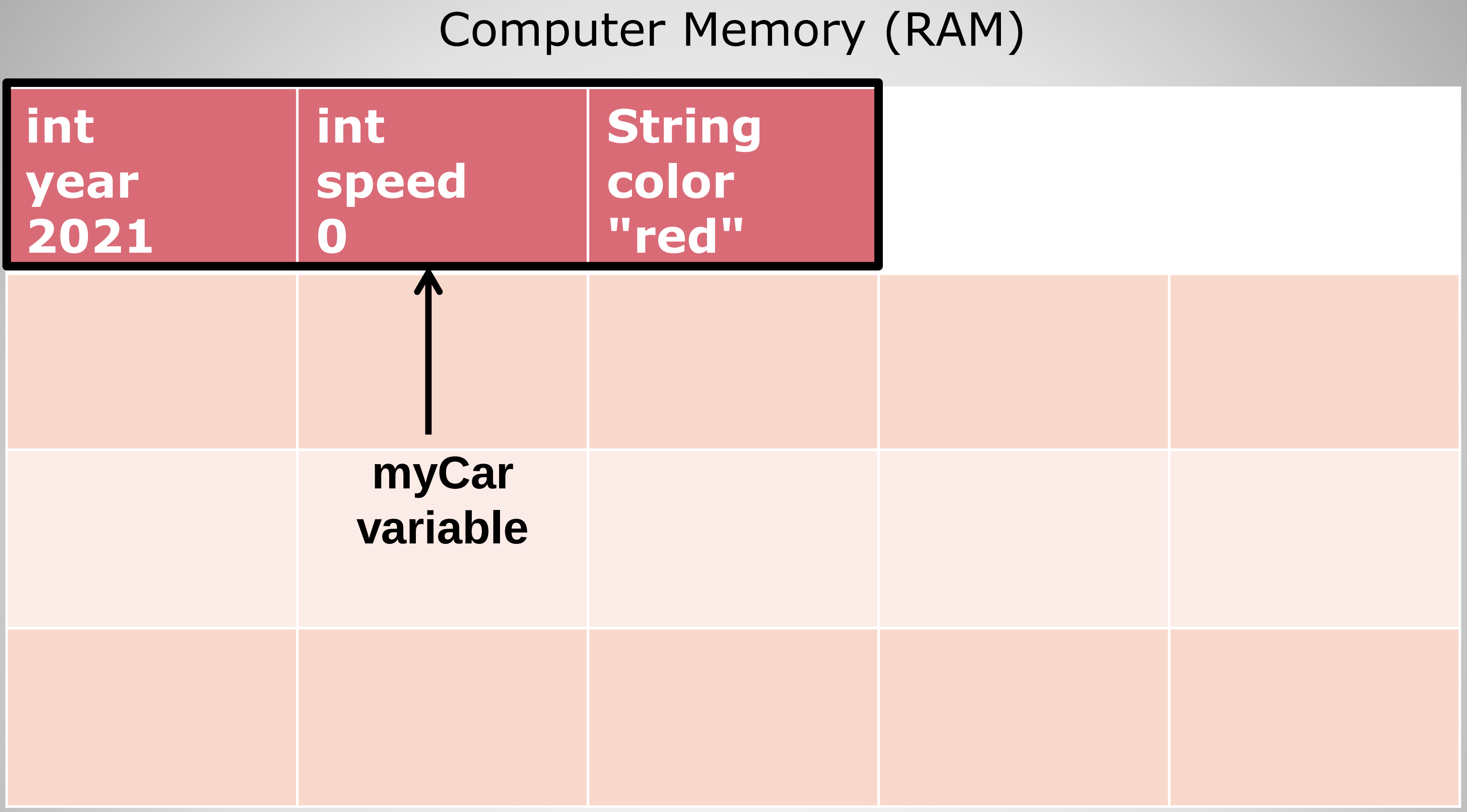
Car class contains a constructor

```
public class Car
{
    // Attributes
    private int year;
    private int speed;
    private String color;

    // Behaviors
    Get/Set and Accelerate and Decelerate methods not shown

    // Default Constructor – Takes no parameters
    public Car() {
        year = 2021;
        speed = 0;
        color = "Red";
    }
}
```

```
public static void main(String[] args)
{
        Car myCar;

        // New instance using a default
        // constructor
        myCar = new Car();
}
```

This call to new will call the default constructor

Constructors



Memory After Default Constructor Runs

- Default constructor
- Takes no parameters
- Assigns starting values to attributes
- If you do not define ***any*** constructors then a default constructor is created automatically by the compiler behind the scenes.
- This automatically created default constructor initializes all attributes to their default values (for example, int → 0).

Constructors

```
public class Car
{
    // Attributes
    private int year;
    private int speed;
    private String color;

    // Behaviors
    // Get/Set go here…
    // Accelerate goes here…
    // Decelerate goes here…
}
```

This Car class does NOT contain a constructor

There are *__NO__* *__consturctors__* defined so the compiler will create a default one *__automatically__*

Constructors

```
public static void main(String[] args)
{
	Car myCar;

	// New instance
	myCar = new Car();
}
```

New calls the automatically generated default constructor for the class

Constructors

- Constructors with parameters
- You can initialize attributes to any value by passing in data to the constructor.
- Use a parameter for every value that you want to be able to initialize from outside the class.
- For example…

Constructors

```
public class Car
{
    // Attributes
    private int year;
    private int speed;
    private String color;

    // Behaviors
    Get/Set and Accelerate and Decelerate methods not shown

    // Constructor
    public Car(int newYear, int newSpeed, String newColor) {
        year = newYear;
        speed = newSpeed;
        color = newColor;
    }
}
```

Sets all the values

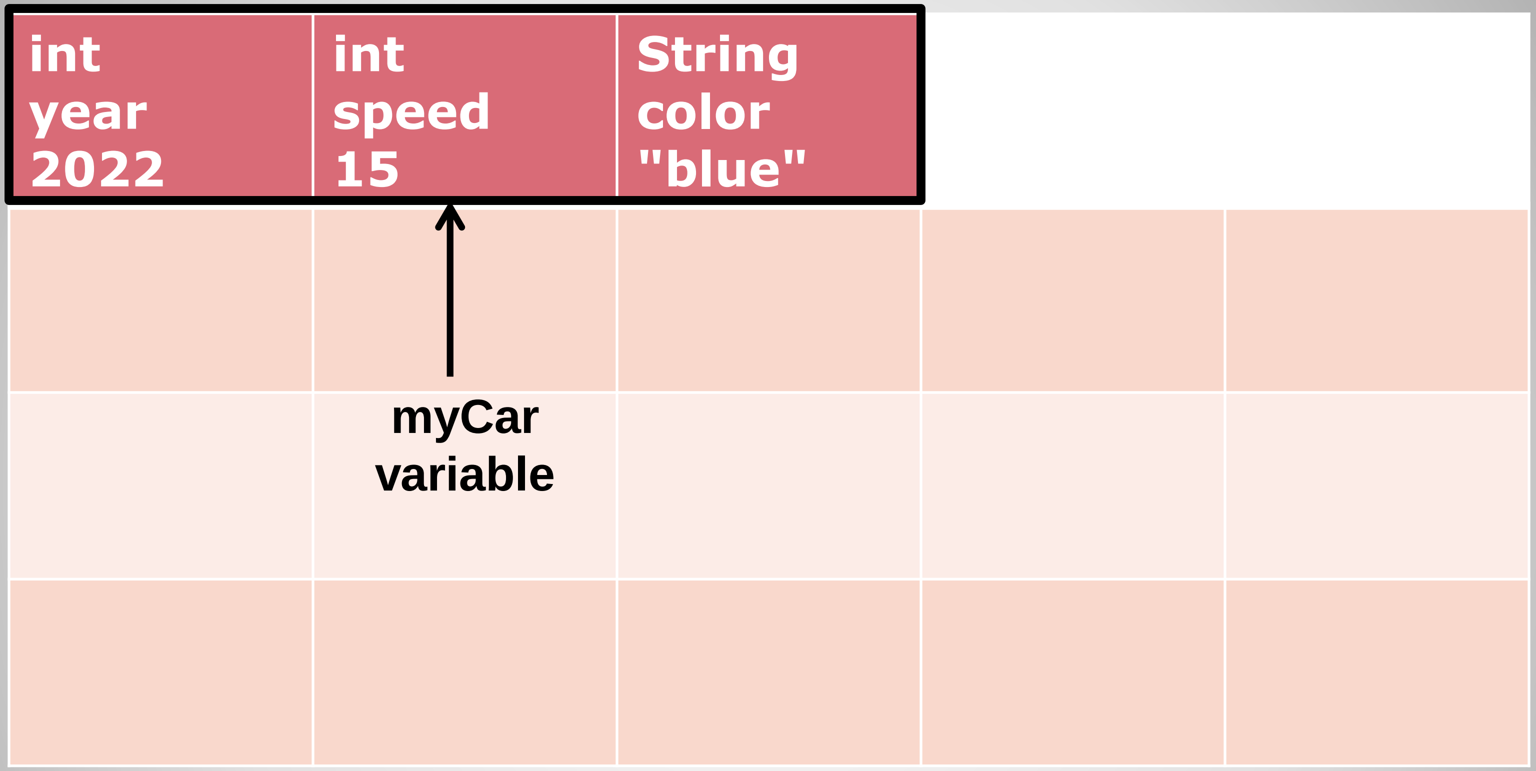
Constructors

```
public static void main(String[] args)
{
    Car myCar;

    // New instance using a constructor
    myCar = new Car(2022, 15, "blue");
}
```

New calls the constructor for the class. Parameters are passed in to the constructor like a method call.

Constructors

Computer Memory (RAM)



Memory After Constructor Runs

Data Types

- Java data types are divided into two major categories:
  Primitive and Reference
- Primitive types are the following:
  boolean, byte, char, short, int, long, float, double
- Class instances are reference types
- You must call the "new" operator to instantiate a reference type

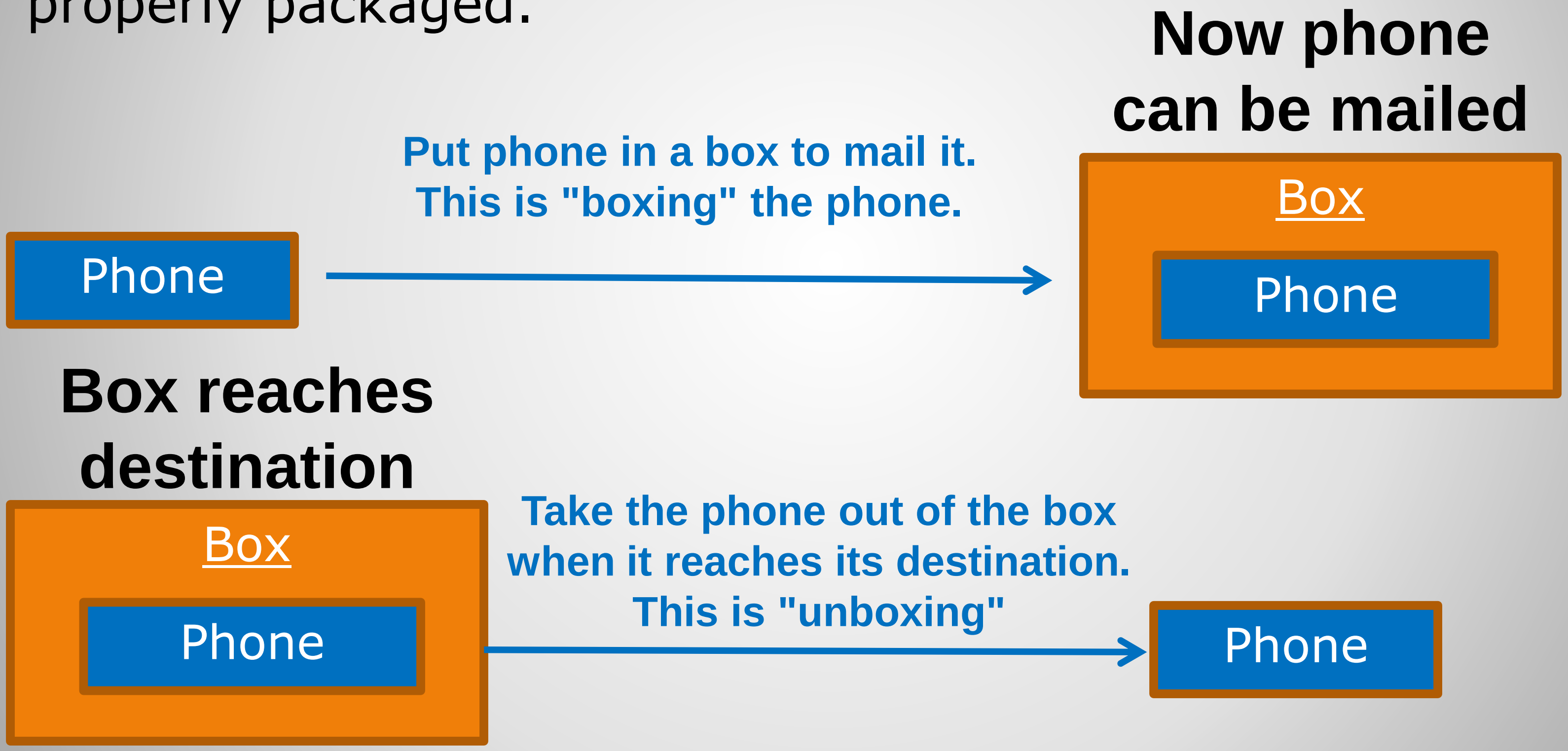
- There are reference versions of the primitive types (wrapper classes).
- These can be used when you need to put a primitive value where a reference value is required.

Primitive Type	**Wrapper Class for Primitive Type**
int	Integer
double	Double
char	Character
byte	Byte
boolean	Boolean
short	Short
long	Long
float	Float

Wrapper Data Types

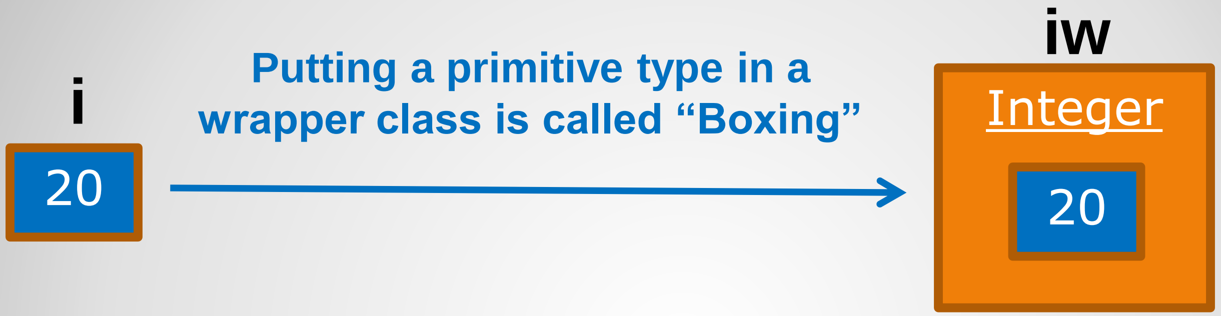
Mailing a Phone

To mail a phone you must put in in a box (or package of some sort). The post office will not mail it unless it is properly packaged.

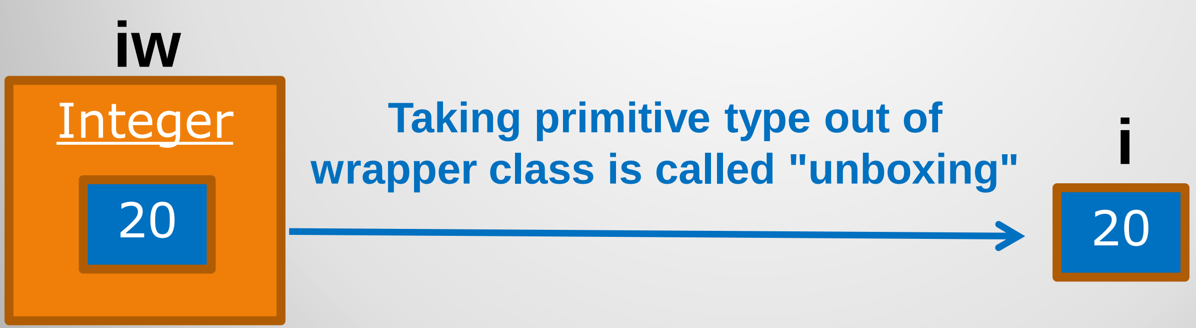

Now phone can be mailed
Put phone in a box to mail it.
This is "boxing" the phone.
Phone
Box
Phone
Box reaches destination
Box
Phone
Take the phone out of the box when it reaches its destination.
This is "unboxing"
Phone

Wrapper Data Types

```
int i = 20;  // Declare the primitive type
Integer iw; // Declare the wrapper instance
iw = new Integer(i);  // Create instance and pass in primitive value
```


iw
i
Putting a primitive type in a wrapper class is called "Boxing"
20
Integer
20

```
int value;
value = iw.intValue(); // Get primitive value from wrapper class
```


iw
Integer
20
Taking primitive type out of wrapper class is called "unboxing"
i
20

Wrapper Data Types

- An inner class is a class defined inside of another class.
- The inner class can be used as a "helper" for the outer class.
- For example…

Inner Classes

Inner Classes

```
public class Car
{
            public  class Helper
            {
                        // Class Helper members here…
            }

            // Class Car members here…
}

public class Main {
    public static void main(String[] args) {

            Car c;
            c = new Car();

            Car.Helper h;
            h = c.new Helper();
}
```

Helper is an inner class. It is defined within Car (it does not have to be named Helper).

Create an instance of the outer class first

Create an instance of the inner class using the outer class instance. Call new with respect to the outer class instance.

End of Slides

- End of Slides