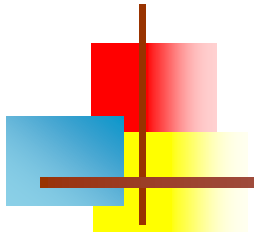
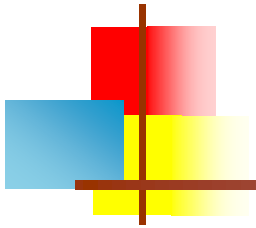
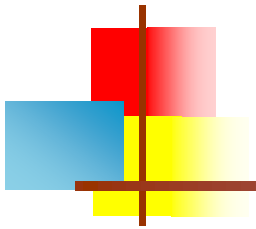


Class Structure



Classes

- A class describes a set of objects
- The objects are called instances of the class
- A class describes:
  - Fields (instance variables)that hold the data for each object
  - Constructors that tell how to create a new object of this class
  - Methods that describe the actions the object can perform
- In addition, a class can have data and methods of its own (not part of the objects)
  - For example, it can keep a count of the number of objects it has created
  - Such data and methods are called static
  - We are avoiding static data and methods for the time being

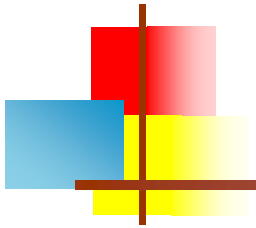


Defining a class

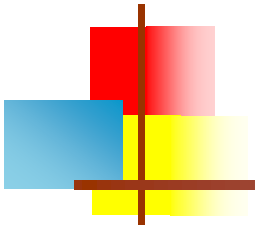
- Here is the simplest syntax for defining a class:

```
class ClassName {
    // the fields (variables) of the object
    // the constructors for the object
    // the methods of the object
}
```

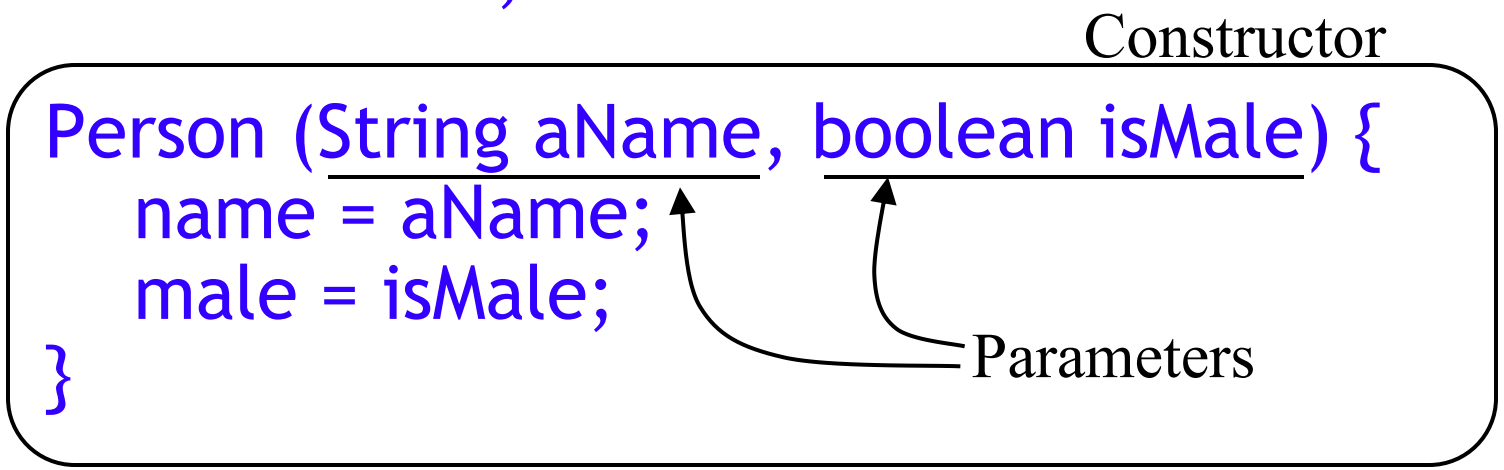
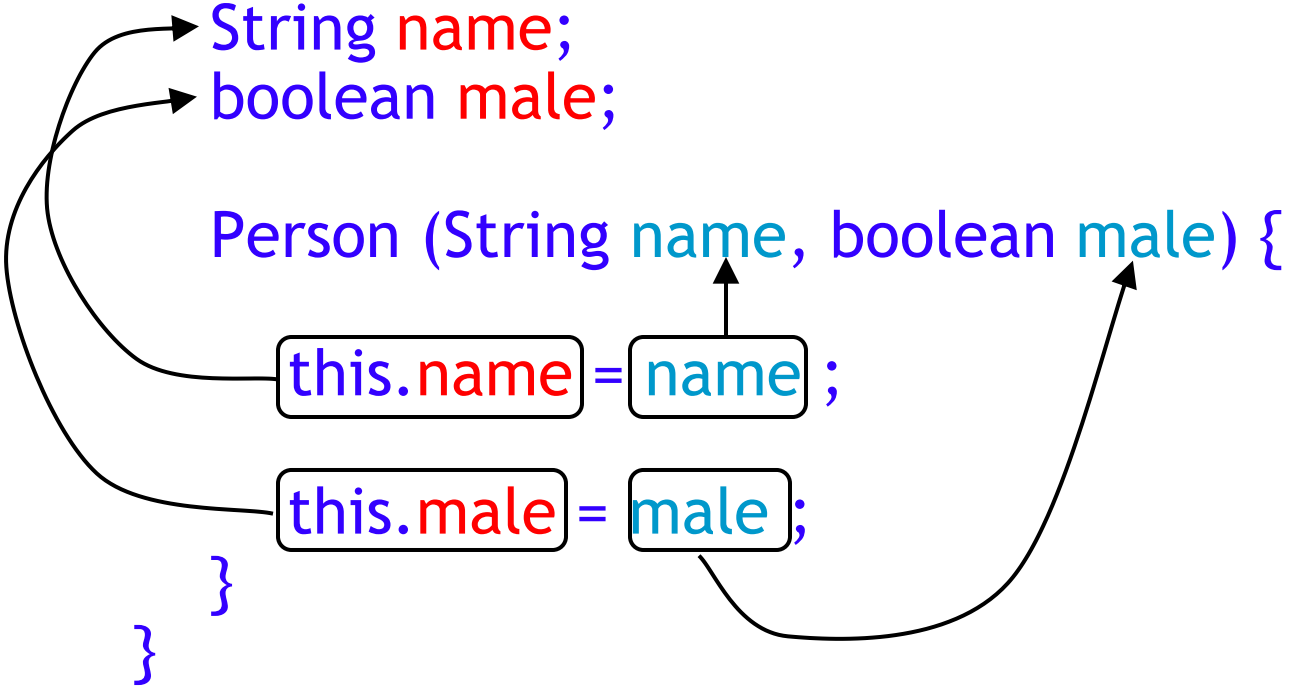
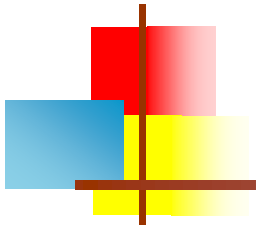
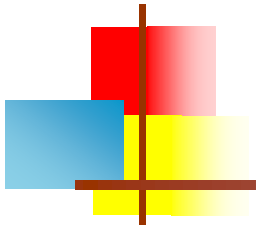
- You can put public, protected, or private before the word class
- Things in a class can be in any order (I recommend the above order)



Defining fields

- An object's data is stored in fields (also called instance variables)
- The fields describe the state of the object
- Fields are defined with ordinary variable declarations:
  - ```
    String name;
    Double health;
    int age = 0;
    ```
- Instance variables are available *throughout the entire class* that declares them
    ```



Defining constructors

- A constructor is code to create an object
  - You *can* do other work in a constructor, but you *shouldn't*
- The syntax for a constructor is:

```
ClassName(parameters) {
    …code…
}
```

- The *ClassName* has to be the same as the class that the constructor occurs in
- The *parameters* are a comma-separated list of variable *declarations*

Example constructor I

```
public class Person {
    String name;
    int age;
    boolean male;

    Person (String aName, boolean isMale) {
        name = aName;
        male = isMale;
    }

}
```



Example constructor II

- Most constructors just set instance variables:
  - public class Person {





Defining a method

- A method has the syntax:

```
return-type  method-name(parameters) {
    method-variables
    code
}
```

- Example:

```
boolean isAdult(int age) {
    int magicAge = 21;
    return age >= magicAge;
}
```

- Example:

```
double average(int a, int b) {
    return (a + b) / 2.0;
}
```



Methods may have local variables

- A method may have local (method) variables
- Formal parameters are a kind of local variable
  - ```
    int add(int m, int n) {
        int sum = m + n;
        return sum;
    }
    ```
- m, n, and sum are all local variables
  - The scope of m, n, and sum is the method
  - These variables can *only* be used in the method, *nowhere else*
  - The *names* can be re-used elsewhere, for *other* variables
    ```

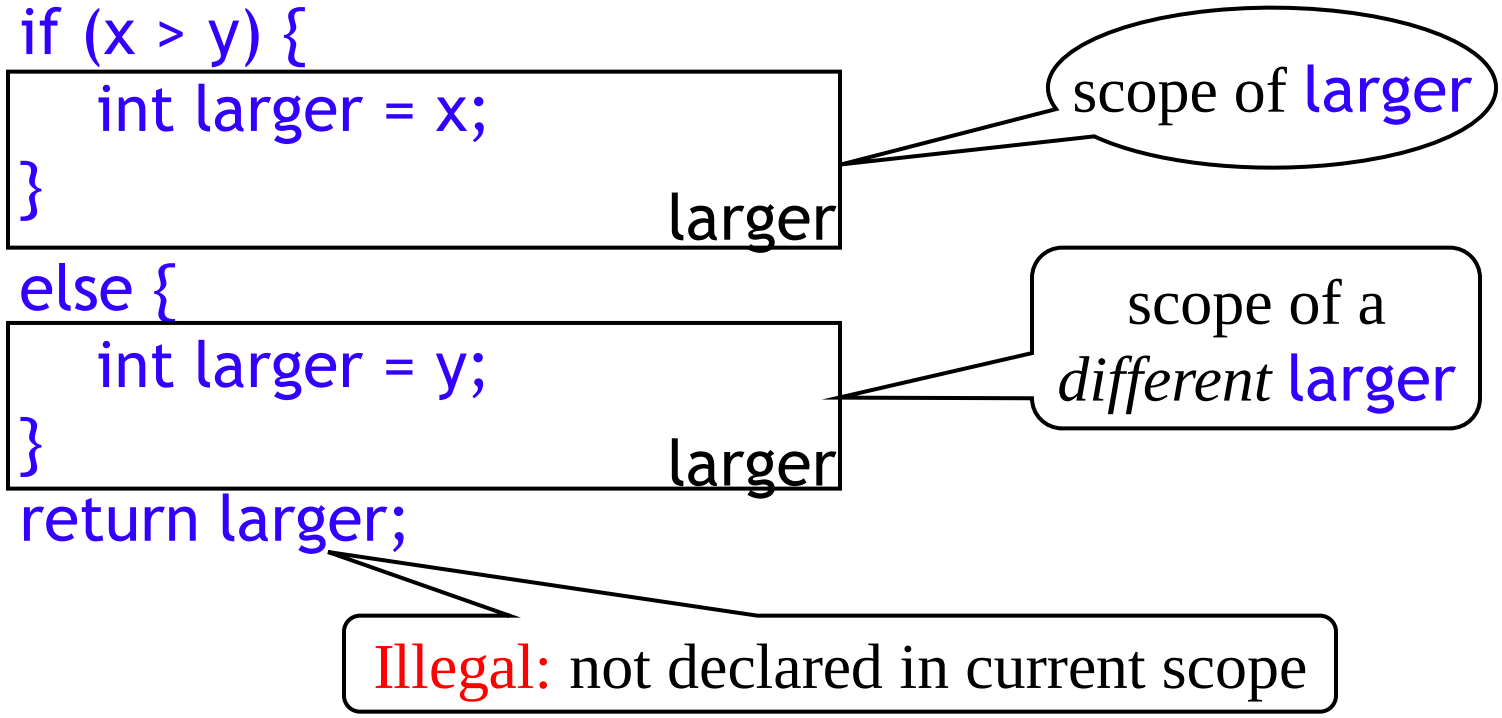
Blocks (== Compound statements)

- Inside a method or constructor, whenever you use braces, you are creating a *block*, or *compound statement*:

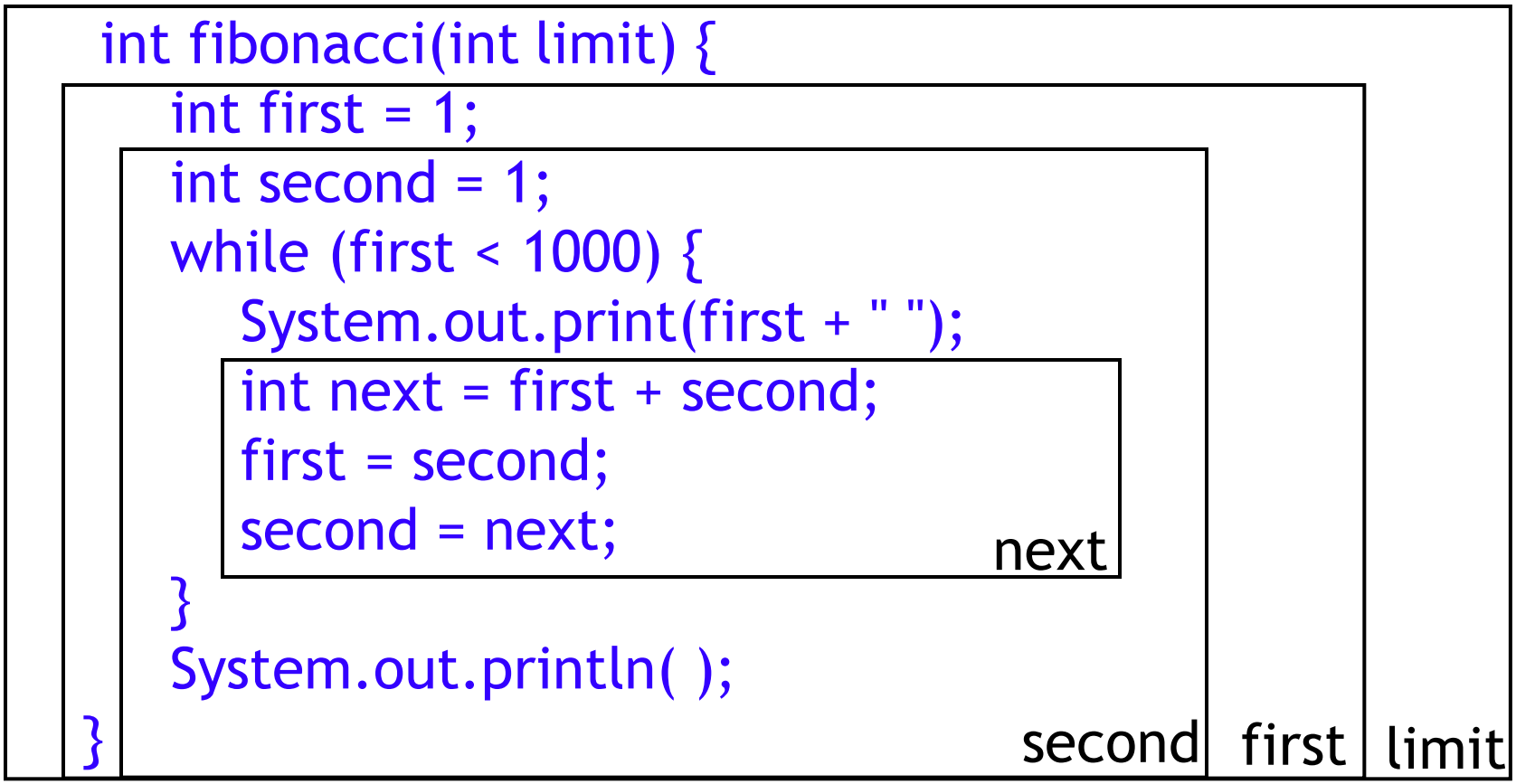
```
int absoluteValue(int n) {
    if (n < 0) {
        return -n;
    }
    else return n;
}
```

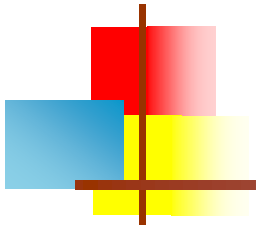
Declarations in a method

- The scope of formal parameters is the entire method
- The scope of a variable in a block starts *where you define it* and extends *to the end of the block*



Nested scopes





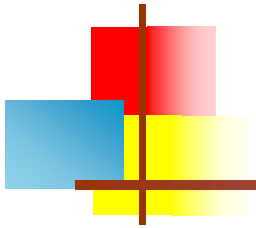
The for loop

- The for loop is a special case
  - You can declare variables in the for statement
  - The scope of those variables is the entire for loop
  - This is true even if the loop is not a block

```
void multiplicationTable() {
    for (int i = 1; i <= 10; i++) {
        for (int j = 1; j <= 10; j++)
            System.out.print("  " + i * j);
        System.out.println();
    }
}
```

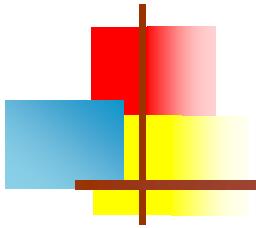
j

i

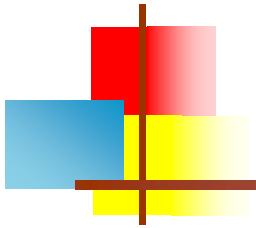
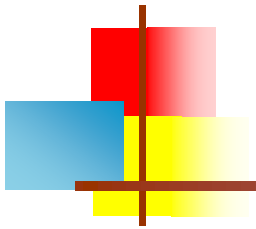


Returning a result from a method

- If a method is to return a result, it must specify the *type* of the result:
  - `boolean isAdult ( ...`
- You must use a `return` statement to exit the method with a result of the correct type:
  - `return age >= magicAge;`



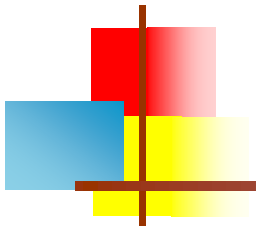
Returning *no* result from a method

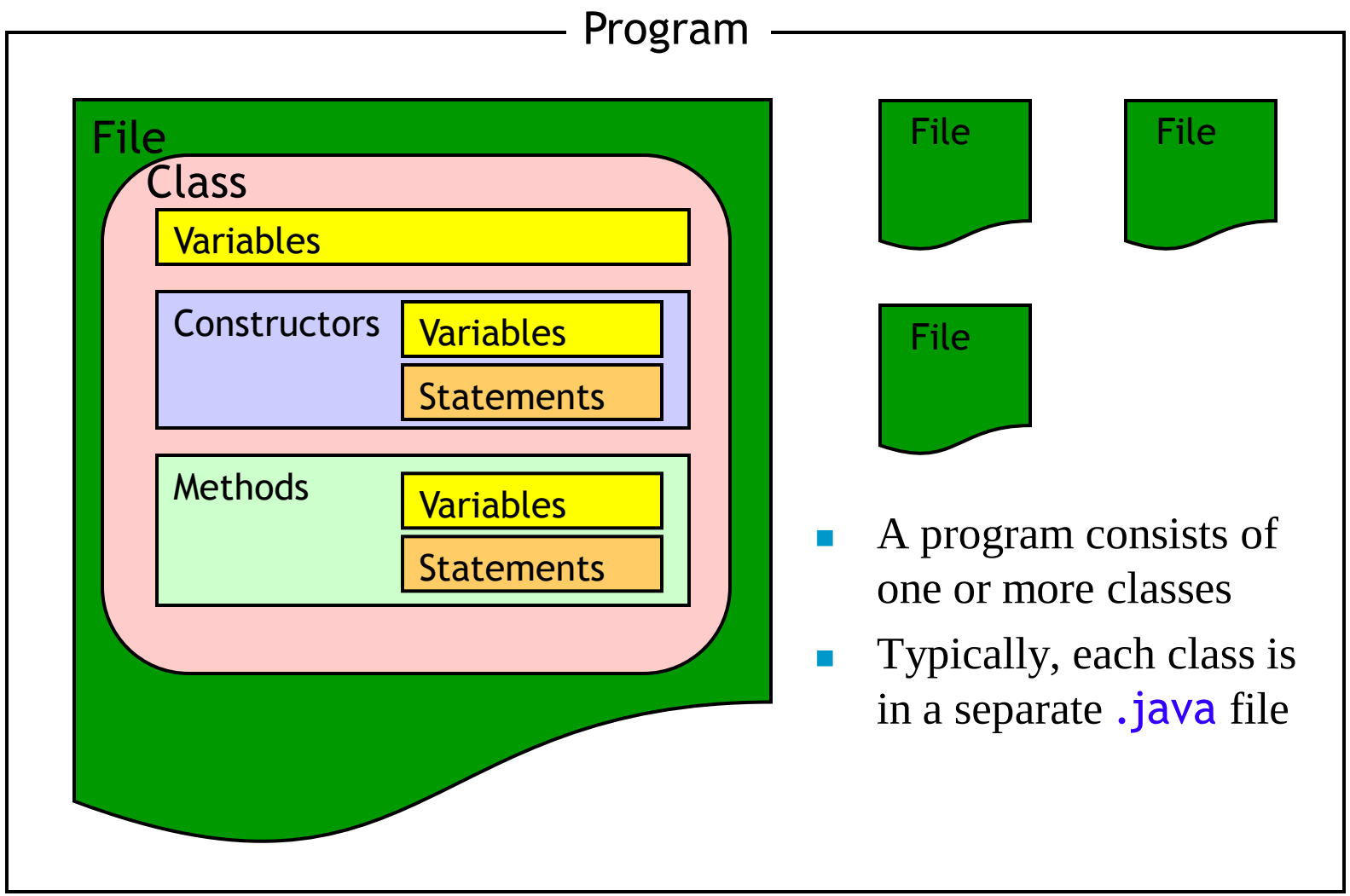
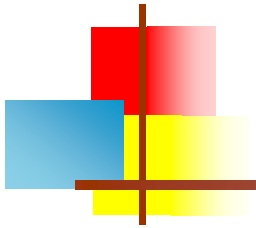
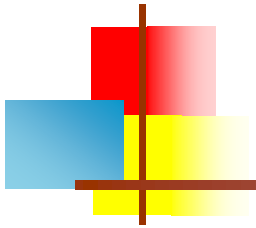
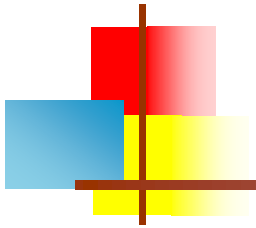
- The keyword void is used to indicate that a method doesn't return a value
- The return statement must not specify a value
- Example:
  - ```
    void printAge(String name, int age) {
        System.out.println(name + " is " + age + " years old.");
        return;
    }
    ```
- There are two ways to return from a void method:
  - Execute a return statement
  - Reach the closing brace of the method
    ```



Sending messages to objects

- We don't perform operations on objects, we "talk" to them
  - This is called sending a message to the object
- A message looks like this:

  ***object*.*method*(*extra information*)**

  - The ***object*** is the thing we are talking to
  - The ***method*** is a name of the action we want the object to take
  - The ***extra information*** is anything required by the method in order to do its job
- Examples:

```
g.setColor(Color.pink);
amountOfRed = Color.pink.getRed( );
```



Putting it all together

```
class Person {

  // fields
  String name;
  int age;

  // constructor
  Person(String name) {
    this.name = name;
    age = 0;
  }

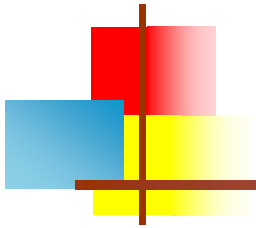
  // methods
  String getName() {
    return name;
  }

  void birthday() {
    age = age + 1;
    System.out.println(
      "Happy birthday!");
  }
}
```



Using our new class

```
Person john;
john = new Person("John Smith");

System.out.print (john.getName());
System.out.println(" is having a birthday!");
john.birthday();
```

- Of course, this code must *also* be inside a class!

Diagram of program structure



- A program consists of one or more classes
- Typically, each class is in a separate `.java` file



null

- If you declare a variable to have a given object type, for example,
  - Person john;
  - String name;
- ...and if you have not yet assigned a value to it, for example, with
  - john = new Person();
    String name = “John Smith";
- ...then the value of the variable is null
- null is a legal value, but there isn’t much you can do with it
  - It’s an error to refer to its fields, because it has none
  - It’s an error to send a message to it, because it has no methods
  - The error you will see is NullPointerException



Methods and static methods

- Java has two kinds of methods: static methods and non-static methods (called instance methods)
  - However, before we can talk about what it means to be static, we have to learn a lot more about classes and objects
  - Most methods you write *should not*, and *will not* be static
- Every Java program has a
  public static void main(String[ ] args)
  method
  - This starts us in a "static context"
  - To "escape from static", I recommend starting every program in a certain way, as shown on the next slide



Escaping from static

- ```
  class MyClass {

      public static void main(String[] args) {
          new MyClass().run();
      }

      void run() {
          // Your real code begins here
      }
  }
  ```
- You can replace the names MyClass and run with names of your choice, but notice that each name occurs in two places, and they have to match up
  ```



The End

The problem with object-oriented languages is they've got all this implicit environment that they carry around with them. You wanted a banana but what you got was a gorilla holding the banana and the entire jungle.

— Joe Armstrong

Though this be madness, yet there is method in it.

— Shakespeare, *Hamlet*