



# Reference Types

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# Opening Discussion

- Let's look at solutions to the interclass problem.
- What people want to learn in Java.
  - ◆ How to use it.
  - ◆ Making a football or stats program.
  - ◆ Pretty pictures (graphics).
  - ◆ A scheduling/organizing program.
  - ◆ Formal logic.
  - ◆ Tracking spending.
  - ◆ Flash movies.
- Difference between these
  - ◆ `Scanner sc=new Scanner(System.in);`
  - ◆ `Scanner kdb=new Scanner(System.in);`
- Difference between Java, C, and C++. What is windows written in?



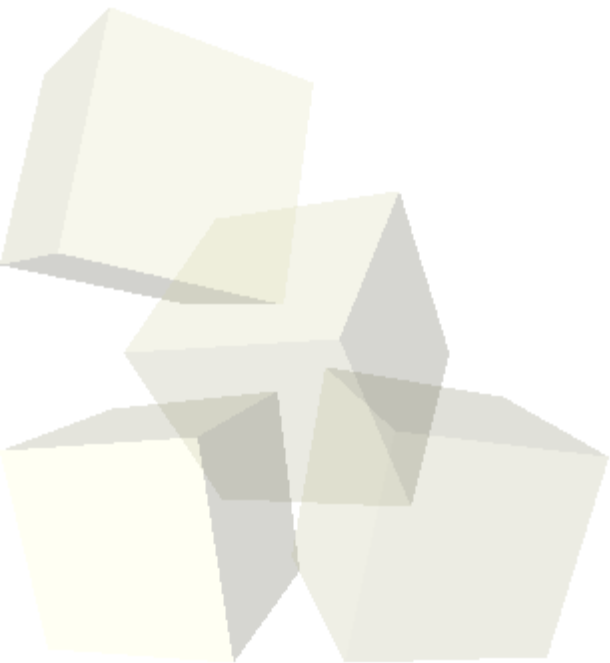
# Reference Types

- The “built in” primitive types are not the only types in Java. Classes define types as well. These are called reference types.
- We declare variables for reference types just like we would for primitive types.
- Reference types can either refer to an object of the proper type, or they can be null.
- Trying to use a null reference causes an exception.
- You have already used a reference type variable when you use Scanner. Scanner is a class in the Java libraries.



# What is a Reference?

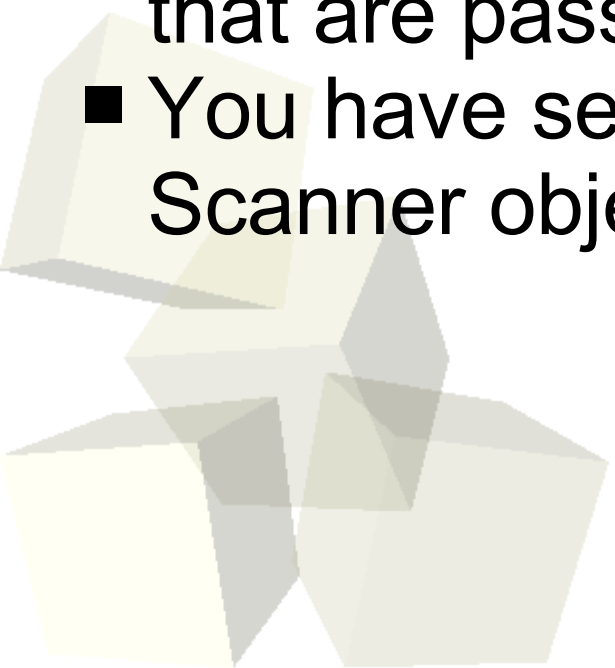
- Reference variables are called that for a reason. Instead of being an object, they refer to an object.
- This is in contrast to a primitive variable which actually is the thing you declare it to be.
- Because of this, a single reference variable could refer to several different objects over it's life.





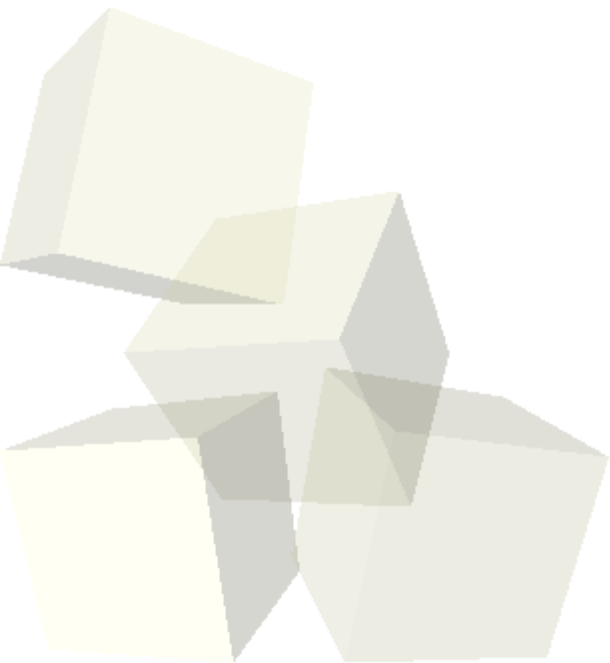
# Instantiating Objects

- To make a new object we use the new keyword. The syntax for making an object is as follows:
  - `new Type(argumentList)`
- You will often see this on the right side of an assignment.
- This tells Java to go out and get memory and set up an object of the specified type using that values that are passed in.
- You have seen this already when working with a Scanner object to read values.



# Calling Methods/Sending Messages

- Once you have a reference variable that refers to a real object you can use the dot notation to call methods on that object.
- This is what you have been doing with the Scanner object when you call methods like `nextDouble()`.





# The String Type

- One of the most fundamental classes in Java is the String class. It represents any set of characters that you need to work with.
- Let's look at String in the API.
- The + operator is overloaded for String. Operators only work on primitives and, in this one instance, Strings.
- Difference between null and empty Strings.
- String literals are put in double quotes.
- String objects are immutable. They don't change. Instead you build new String objects.
- Checking equality.
  - ◆ Use the equals method, not ==.



# Wrapper Classes

- There are some other classes that are very fundamental to Java that your book doesn't mention.
- These are the wrapper classes in Java that have names like primitives, but start with capital letters.
- For our purposes, the main use of these classes are the helpful methods they in them. These include things like converting strings to numbers.







- Write a little segment of code that has the user input a word and prints out how many letters are in the word.
- Interclass Problem – Do problem 8.8. Warning: this isn't hard to program, but will take some thought.

