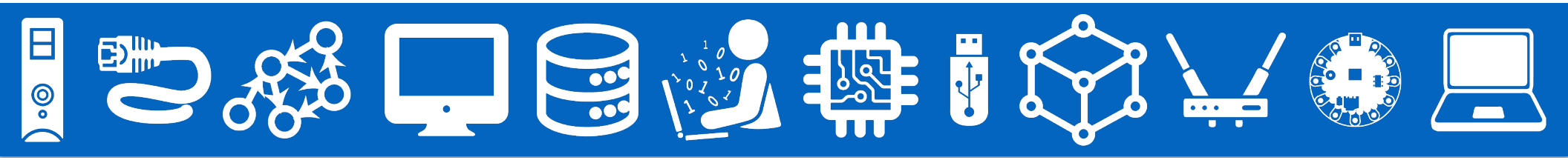
CS134:
Java 2: Data Types & Conditionals

Slide content based on http://www.cs.cmu.edu/~mjs/courses/121-F14-W/Java4Python.pdf



Announcements & Logistics

- **HW 9** due Mon 12/5 @ 10pm
  - Covers "advanced" topics from recent lectures (Python special methods, iterators, efficiency, Java basics)
- **Lab 10 Selection Sort in Java** (next Mon/Tue)
  - No pre-lab work
  - Hope most of you will start and finish during your lab session
- **Final exam reminder: Friday, Dec 16 @ 9:30 AM**
  - Final is cumulative, emphasis on new material since midterm
  - You won't have to write Java code
  - Study guide on Glow
- Course evals next Friday 12/9 (bring a laptop to class if possible)

Do You Have Any Questions?

Last Time

- Discussed high level overview of Java vs Python
- Focused on main differences:
  - Java is a **compiled** language: code is compiled before it is executed!
  - Java is **statically typed**: variables must be explicitly declared
- Looked at "Hello World" in Java
- Started discussing a simple example which takes input and converts Fahrenheit to Celsius

```java
public class Hello {
    public static void main(String args[]) {
            System.out.println("Hello, World!");
    }
}
```

```
terminal% javac Hello.java
terminal% java Hello
Hello, World!
```

Why Java?!

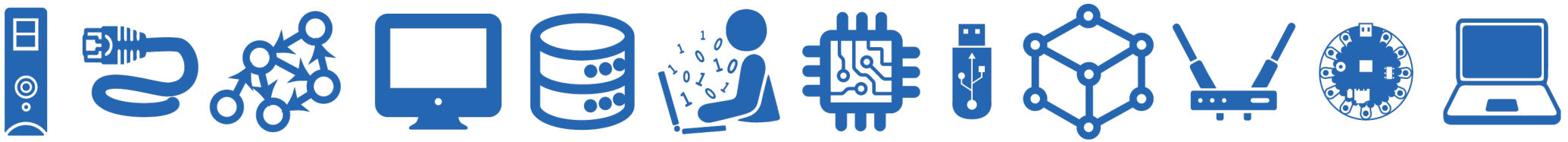
- **Review** Python concepts from the entire semester!
- Explore topics we've mentioned throughout the semester even deeper!
  - Data Types
  - Public/Private/Protected
  - Dynamic vs. Static Arrays
- See what concepts are general to **computer science**, which are limited to specific programming languages
- Good preparation for **CSCI 136**

Today's Plan

- Break down the simple temperature example further
- Move on to more interesting **data types** in Java
  - **Strings**
  - **ArrayLists**
  - **Arrays**
  - **HashMaps**
- Talk about **conditional statements**: very similar to Python!

Recap:

Python vs. Java



Recap: Simple Example in Python

```
def main ():
  fahr = input ("Enter the temperature in F: " )
  cel = (float(fahr) - 32) * 5.0/9.0
  print ("The temperature in C is:" , cel)

if __name__ == "__main__":
    main()
```

- Asks user to enter a temperature in Fahrenheit and converts the string input to float
- Does the computation to convert temperature to Celsius
- Prints result

Simple Example in Java

```
1  import java.util.Scanner;
2
3  public class TempConv {
4     public static void main (String args[]) {
5          Double fahr;
6          Double cel;
7          Scanner in;
8
9          in = new Scanner (System.in);
10         System.out.print("Enter the temperature in F: ");
11         fahr = in.nextDouble ();
12
13         cel = ( fahr - 32) * 5.0/9.0;
14         System.out.println("The temperature in C is: " + cel);
15    }
16 }
```

- Same program in Java: `TempConv.java`

Review: Python vs. Java

Java:

```java
in = new Scanner (System.in);
System.out.print("Enter the temperature in F: ");
fahr = in.nextDouble ();

cel = ( fahr - 32) * 5.0/9.0;
System.out.println("The temperature in C is: " + cel);
```

Python:

```python
fahr = input ("Enter the temperature in F: " )
cel = (float(fahr) - 32) * 5.0/9.0
print ("The temperature in C is:" , cel)
```

- Step 1: Prepare to read input from user.

Review: Python vs. Java

Java:

```java
in = new Scanner (System.in);
System.out.print("Enter the temperature in F: ");
fahr = in.nextDouble ();

cel = ( fahr - 32) * 5.0/9.0;
System.out.println("The temperature in C is: " + cel);
```

Python:

```python
fahr = input ("Enter the temperature in F: " )
cel = (float(fahr) - 32) * 5.0/9.0
print ("The temperature in C is:" , cel)
```

- Step 2: Prompt user for input.

Review: Python vs. Java

Java:

```
in = new Scanner (System.in);
System.out.print("Enter the temperature in F: ");
fahr = in.nextDouble ();

cel = ( fahr - 32) * 5.0/9.0;
System.out.println("The temperature in C is: " + cel);
```

Python:

```
fahr = input ("Enter the temperature in F: " )
cel = (float(fahr) - 32) * 5.0/9.0
print ("The temperature in C is:" , cel)
```

- Step 3: Read user input and convert to float/double (that is, a number with a decimal point).

Review: Python vs. Java

Java:

```
in = new Scanner (System.in);
System.out.print("Enter the temperature in F: ");
fahr = in.nextDouble ();

cel = ( fahr - 32) * 5.0/9.0;
System.out.println("The temperature in C is: " + cel);
```

Python:

```
fahr = input ("Enter the temperature in F: " )
cel = (float(fahr) - 32) * 5.0/9.0
print ("The temperature in C is:" , cel)
```

- Step 4: Perform conversion to Celsius.

Review: Python vs. Java

Java:

```
in = new Scanner (System.in);
System.out.print("Enter the temperature in F: ");
fahr = in.nextDouble ();

cel = ( fahr - 32) * 5.0/9.0;
System.out.println("The temperature in C is: " + cel);
```

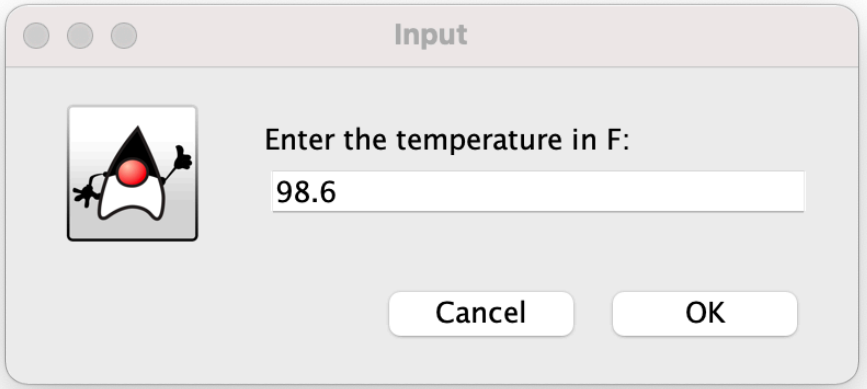
Python:

```
fahr = input ("Enter the temperature in F: " )
cel = (float(fahr) - 32) * 5.0/9.0
print ("The temperature in C is:" , cel)
```

- Step 5: Print result.

An Aside: Java GUIs

- Java has more built-in support for making GUIs and supporting graphical objects
- Here is a graphical version of our program



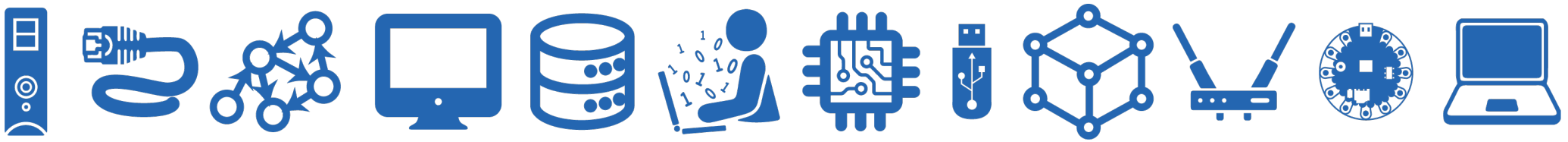

```
import javax.swing.*;

public class TempConvGUI {
    public static void main (String args[]) {
        Double fahr, cel;
        String fahrString;

        fahrString = JOptionPane.showInputDialog("Enter the temperature in F: " );
        fahr = Double.valueOf(fahrString);

        cel = (fahr - 32) * 5.0 / 9.0;
        JOptionPane.showMessageDialog(null, "The temperature in C is " + cel );
    }
}
```

Data Type:
Strings



Data Type: Strings

- Strings in Java and Python are similar, slightly different **syntax**
- Like Python, Java Strings are also **immutable**
- Java Strings **do not support an indexing or slicing operator**
- Instead of indexing, we create **substrings** in Java
- Java strictly uses **method calls** (no operators); Java does not support operator overloading in general

Python	Java	Description
`str[3]`	`str.charAt(3)`	Return character in 3rd position
`str[2:5]`	`str.substring(2,5)`	Return substring from 2nd to 4th
`len(str)`	`str.length()`	Return the length of the string
`str.find('x')`	`str.indexOf('x')`	Find the first occurrence of x
`str.split()`	`str.split(" ")`	Split the string on whitespace into a list/array of strings
`str.split(',')`	`str.split(',')`	Split the string at `','` into a list/array of strings
`str + str`	`str.concat(str)`	Concatenate two strings together
`str.strip()`	`str.trim()`	Remove any whitespace at the beginning or end

Strings

Java:

```
String s = "Almost winter break";
```

```
s.substring(0,3);
```

```
Alm
```

```
s.substring(4,7);
```

```
st
```

Python:

```
s = "Almost winter break"
```

```
s[:3]
```

```
'Alm'
```

```
s[4:7]
```

```
'st '
```

Strings

Java:

```
String s = "Almost winter break";
```

```
s.substring(0,3);
```

```
Alm
```

```
s.substring(4,7);
```

```
st
```

```
s.toUpperCase();
```

```
ALMOST WINTER BREAK
```

```
s.toLowerCase();
```

```
almost winter break
```

```
String [] array = s.split(" ");
```

Returns an array

```
System.out.println(Arrays.toString(array));
```

```
[Almost, winter, break]
```

Syntax to print an array

Python:

```
s = "Almost winter break"
```

```
s[:3]
```

```
'Alm'
```

```
s[4:7]
```

```
'st '
```

```
s.upper()
```

```
'ALMOST WINTER BREAK'
```

```
s.lower()
```

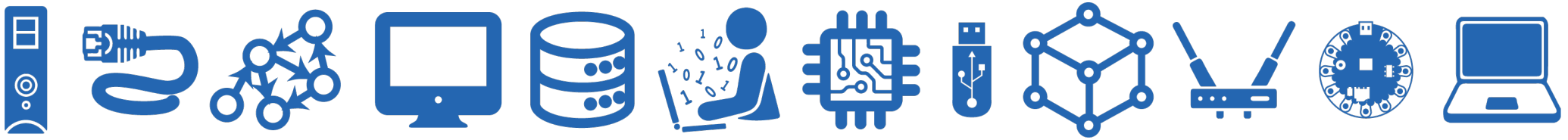
```
'almost winter break'
```

```
array = s.split()
```

```
print(array)
```

```
['Almost', 'winter', 'break']
```

Data Type:
ArrayLists



Data Type: ArrayLists

- Java `ArrayLists` are roughly equivalent to Python `lists`
- Both are **dynamic arrays** (that grow and shrink in size automatically)
- Unlike Python where a list can contain anything, in Java we declare what **type** of objects our `ArrayList` is going to contain
- We ***cannot use*** `[]` operator in `ArrayLists`
  - Rely on **methods** (like `get(), set(), add()`) to manipulate the list
- Let's compare `ArrayLists` to `lists` in Python
- We will also discuss Java `Arrays` which are also similar to Python `lists` but are statically-sized, more commonly used, and support `[]` operator

ArrayLists vs. Lists

Java:

```
ArrayList<String> alist=new ArrayList<String>();
alist.add("Jeannie");
alist.add("Rohit");
alist.add("Lida");
alist.add("Steve");
alist.add("Dan");
alist.add("Sam");
```

ArrayList of Stings

```
true
```

```
System.out.println(alist);  // print the list
```

```
[Jeannie, Rohit, Lida, Steve, Dan, Sam]
```

Python:

```
alist = []
alist.append("Jeannie")
alist.append("Rohit")
alist.append("Lida")
alist.append("Steve")
alist.append("Dan")
alist.append("Sam")
```

```
print(alist)
```

```
['Jeannie', 'Rohit', 'Lida', 'Steve', 'Dan', 'Sam']
```

ArrayLists vs. Lists

Java:

```
ArrayList<String> alist=new ArrayList<String>();
alist.add("Jeannie");
alist.add("Rohit");
alist.add("Lida");
alist.add("Steve");
alist.add("Dan");
alist.add("Sam");
```

```
true
```

```
System.out.println(alist);  // print the list
```

```
[Jeannie, Rohit, Lida, Steve, Dan, Sam]
```

```
alist.add(3, "Iris");// add Iris to index 3
```

```
System.out.println(alist);
```

```
[Jeannie, Rohit, Lida, Iris, Steve, Dan, Sam]
```

```
alist.get(2);// get the element at index 2
```

```
Lida
```

```
// set index 5 to Steve (returns old value)
alist.set(5, "Steve");
```

```
Dan
```

```
System.out.println(alist);
```

```
[Jeannie, Rohit, Lida, Iris, Steve, Steve, Sam]
```

Python:

```
alist = []
alist.append("Jeannie")
alist.append("Rohit")
alist.append("Lida")
alist.append("Steve")
alist.append("Dan")
alist.append("Sam")
```

```
print(alist)
```

```
['Jeannie', 'Rohit', 'Lida', 'Steve', 'Dan', 'Sam']
```

```
alist.insert(3, "Iris")
```

```
print(alist)
```

```
['Jeannie', 'Rohit', 'Lida', 'Iris', 'Steve', 'Dan', 'Sam']
```

```
alist[2]
```

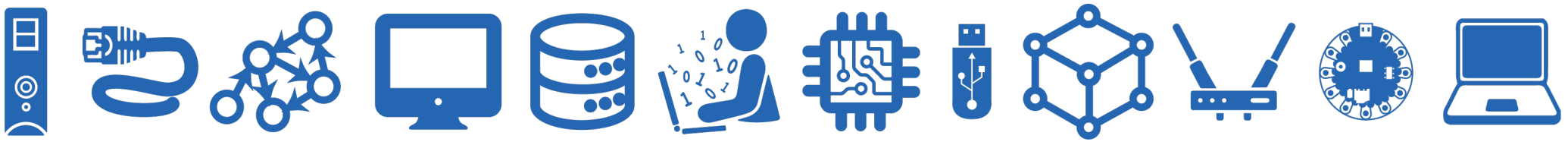
```
'Lida'
```

```
alist[5] = "Steve"
```

```
print(alist)
```

```
['Jeannie', 'Rohit', 'Lida', 'Iris', 'Steve', 'Steve', 'Sam']
```

Data Type:
Arrays



Data Type: Arrays

- An `array` is a primitive data structure in Java (with corresponding `Arrays` objectified class), and are also similar to `Lists`
- They do ***support [ ] list notation***
- They **cannot dynamically shrink and grow**
- To declare a new array object in Java, we need to specify the **type** of its values and the **size** it will have
    - Size must be **specified directly**, or
    - Can just **assign values** at declaration
- Unlike lists in Python we cannot store heterogeneous types in an array!

Data Type: Arrays

- An `array` is a primitive data structure in Java
- Can use list notation and assign values directly (but cannot grow or shrink)

```java
import java.util.Arrays;

public class Test {

  public static void main(String args[]) {
    int size = 10;

    // option 1: create an array directly
    int [] array1 = new int[] {2, 3, 5};

    // option 2: declare an with size then assign values
    int [] array2 = new int [3];
    array2[0] = 2;
    array2[1] = 3;
    array2[2] = 5;

    System.out.println(Arrays.toString(array1));
    System.out.println(Arrays.toString(array2));
  }
}
```

Declaring a statically-sized array by initializing it with values

Declare empty array with size and then assign values later

Java Arrays: More Examples

```
import java.util.Arrays;
```

```
String [] myList = new String[6];
```

When declaring, either define size or give specific values. (Not necessary to do both!)

```
String [] myList = {"Jeannie", "Rohit", "Lida", "Steve", "Dan", "Sam"};
```

```
System.out.println(Arrays.toString(myList));
```

```
[Jeannie, Rohit, Lida, Steve, Dan, Sam]
```

Java provides an array wrapper class called `Arrays` that provides convenient static methods for working with primitive arrays

```
System.out.println(myList[2]);
```

```
Lida
```

Can use list notation

```
myList[4] = "Aaron";
```

```
Aaron
```

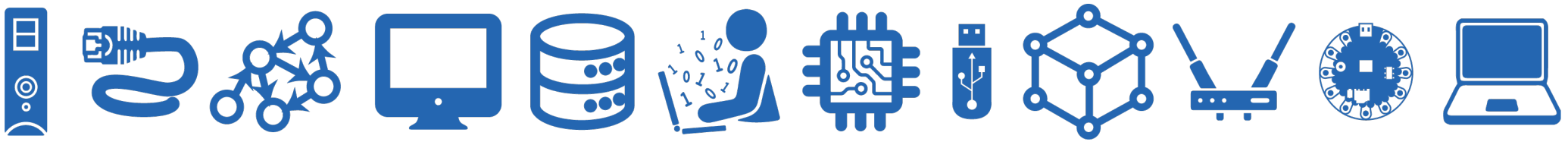
Can replace values, but can't easily insert

```
System.out.println(Arrays.toString(myList));
```

```
[Jeannie, Rohit, Lida, Steve, Aaron, Sam]
```

Print values of array

Data Type:
HashMaps



Other Data Types: Dictionaries

- `HashMaps` in Java are roughly equivalent to **`Dictionaries`** in Python
- Provide easy (O(1)) access to key, value pairs
- Provide convenient methods for interacting with the keys, values efficiently
- Require keys to be unique
- Java **`HashMaps`** do not support `[]` operator
  - Must use methods (like **`put(), get(), containsKey()`**) to manipulate **`HashMap`**
- Python **`Dictionaries`** support `[]` operator **and** methods

HashMaps vs. Dictionaries

Keys are Integers, Values are Strings

Java:

```
HashMap<Integer, String> csCourses;
csCourses = new HashMap<Integer, String>();
csCourses.put(237, "Computer Organization");
csCourses.put(134, "Intro to Computer Science");
csCourses.put(136, "Data Structures");
csCourses.put(256, "Algorithms");
```

```
csCourses.get(237);
```

```
Computer Organization
```

```
csCourses.get(134);
```

```
Intro to Computer Science
```

```
csCourses.containsKey(134);
```

```
true
```

```
csCourses.containsKey(361);
```

```
false
```

```
csCourses.containsValue("Data Structures");
```

```
true
```

Python:

```
csCourses = dict()
csCourses[237] = "Computer Organization"
csCourses[134] = "Intro to Computer Science"
csCourses[136] = "Data Structures"
csCourses[256] = "Algorithms"
```

```
csCourses[237]
```

```
'Computer Organization'
```

```
csCourses.get(134)
```

```
'Intro to Computer Science'
```

```
134 in csCourses
```

```
True
```

```
361 in csCourses.keys()
```

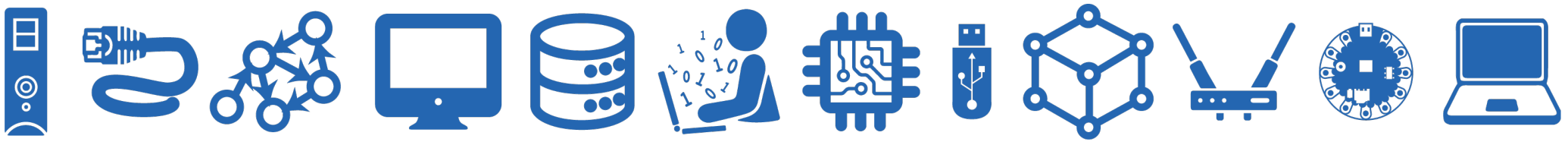
```
False
```

```
"Data Structures" in csCourses.values()
```

```
True
```

Programming Language Features:

Conditionals



Programming Language Features

- **Basic features:**
  - Data Types
  - Reading user input
  - Loops
  - Conditionals
- **Advanced topics:**
  - Classes
  - Interfaces
  - Collections
  - Graphical User Interface Programming

Booleans

- **Boolean** (or **boolean**) values in Java:
  - **true** and **false** (no capitalization)
  - Example: **Boolean b = true**
- **Boolean** operators in Java**:**
  - **&&** - and
  - **||** - or
  - **!** - not
  - Most other operators (<, >, ==, etc) are the same as Python

Conditional Statements

- **Conditional** (if-else) statements in Python and Java are very similar
- Let's consider three basic patterns

1. Simple if in Python:

```
if condition:
    statement1
    statement2
    ...
```

Simple if in Java:

```
if (condition) {
    statement1;
    statement2;
    ...
}
```

Conditional Statements

- **Conditional** (if-else) statements in Python and Java are very similar
- Let's consider three basic patterns

2. if else in Python:

```
if condition:
    statement1
    statement2
    ...
else:
    statement1
    statement2
    ...
```

if else in Java:

```
if (condition) {
    statement1;
    statement2;
    ...
} else {
    statement1;
    statement2;
    ...
}
```

Note the use of ( ) and { }

Conditional Statements

- **Conditional** (if-else) statements in Python and Java are very similar
- Let's consider three basic patterns

3. if elif else in Python:

```
if condition:
    statement1
    statement2
    ...
elif condition:
    statement1
    statement2
    ...
else:
    statement1
    statement2
    ...
```

Nested if else if in Java:

```
if (condition) {
    statement1;
    statement2;
    ...
} else if (condition) {
    statement1;
    statement2;
    ...
} else {
    statement1;
    statement2;
    ...
}
```

Java does not have an elif equivalent

Conditional Statements

Java:

```java
int a = 1;
int b = 2;
if (a < b) {
    System.out.println("a < b");
}
```

```
a < b
```

```java
if (a > b) {
    System.out.println("a > b");
} else {
    System.out.println("a < b");
}
```

```
a < b
```

Notice the && (logical AND) operator

```java
int c = 3;
if (a > b && a > c) {
    System.out.println("a is largest");
} else if (b > a && b > c) {
    System.out.println("b is largest");
} else {
    System.out.println("c is largest");
}
```

```
c is largest
```

Python:

```python
a = 1
b = 2
if a < b:
    print("a < b")
```

```
a < b
```

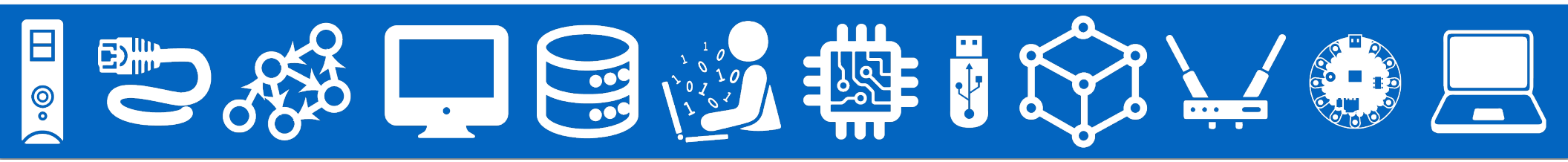
```python
if a > b:
    print("a > b")
else:
    print("a < b")
```

```
a < b
```

```python
c = 3
if a > b and a > c:
    print("a is largest")
elif b > a and b > c:
    print("b is largest")
else:
    print("c is largest")
```

```
c is largest
```

The end!



Lecture 5 Revisited

- Recall one of the first examples we looked at involving conditionals in Python (slightly modified to accept user input)

```
def main():
    temp = float(input("Enter temp: "))
    if temp > 80:
        print("It is a hot one out there.")
    elif temp >= 60:
        print("Nice day out, enjoy!")
    elif temp >= 40:
        print("Chilly day, wear a sweater.")
    else:
        print("Its freezing out, bring a winter jacket!")

if __name__ == "__main__":
    main()
```

Lecture 5 Revisited

- Let's write it in Java!

Lecture 5 Revisited

```java
import java.util.Scanner;

public class WeatherFinal {
  public static void main (String args[]) {
    double temp;
    Scanner in;

    in = new Scanner(System.in);
    System.out.print("Enter temp: ");
    temp = in.nextDouble();

    if (temp > 80) {
      System.out.println("It is a hot one out there.");
    } else if (temp >= 60) {
      System.out.println("Nice day out, enjoy!");
    } else if (temp >= 40) {
      System.out.println("Chilly day, wear a sweater.");
    } else {
      System.out.println("Its freezing out, bring a winter jacket!");
    }
  }
}
```

Could use Double here as well.