LBSC 690: Week 10

Programming, JavaScript

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Software

- Software "does something"
  - Tells the machine how to operate on some data
- Software models aspects of reality
  - Input and output represent the state of the world
  - Software describes how the two are related
- Examples:
  - Ballistic computations
  - Visa's credit card verification system
  - Google
  - Microsoft Word

Types of Software

- Application programs (e.g., PowerPoint)
  - What you normally think of as a "software''
- Compilers and interpreters
  - Programs used to write other programs
- Operating system (e.g., Windows XP)
  - Manages computing resources
- Embedded software (e.g., TiVO)
  - Programs permanently embedded inside some physical device

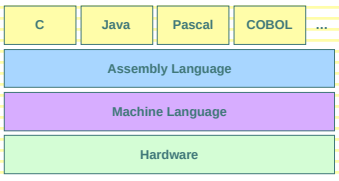
Programming Languages

- Software "does something"
  - Programming languages tell the machine "what to do"
- Special purpose: geared towards specific tasks
  - Complex math (e.g., Matlab)
  - Databases (e.g., SQL)
- General purpose: able to accomplish anything
  - Examples: Java, JavaScript, Perl, C, C++, ...

Types of Programming

- Machine language
  - Language that the machine can directly understand
- Assembly language
  - Directly specifies actions of the machine
  - Assembler changes instructions to machine code
- High-level languages
  - Specifies machine instructions at a more abstract level
  - Compiler/interpreter translates to machine language
  - Examples: C/C++, Java, JavaScript
- Visual programming languages
  - Visually arrange interface components
  - Example: Visual Basic

Types of Languages



Machine Language

- Everything is a binary number
  - Operations
  - Data
  - Memory locations
- For instance

```
00001000  00010101  01010110  0010
```

  - 00001000 ADD
  - 00010101 first number (21)
  - 01010110 second number (86)
  - 0010 register 2

Assembly Language

- One level up from machine language
  - Symbolic instructions
  - Symbols representing memory locations
- For instance

```
ADD   21, 86,  R2
```

- Assembly code is directly translatable into machine language

High-Level Languages

- Instructions represent higher-level constructs
  - Closer to how humans approach problems
  - Must be converted into machine code by a compiler or interpreter

Programming: Overview

- A program consists of a sequence of instructions
- Basic concepts:
  - Data types
  - Variables
  - Basic operations
  - Instructions
- Structures for controlling how instructions are executed:
  - Sequential
  - Conditional
  - Repetition

Programming: Foundations

- Data types = things that you can operate on
  - Boolean: true, false
  - Number: 5, 9, 3.1415926
  - String: “Hello World”
- Variables hold values of a particular data type
  - Represented as symbols (e.g., *x*)
- Operations = things that you can do
  - *-x* reverse the sign of *x* (negation)
  - 6+5 Add 6 and 5 (numeric)
  - “Hello” + “World” Concatenate two strings
  - 2.1 * 3 Multiply two values
  - *x*++ increase value of *x* by 1

Basic Instructions

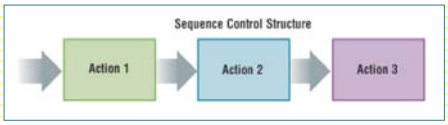
- Assignment = store the result of an operation
  - *x* = 5 set the value of *x* to be 5
  - *x* += y *x* = *x* + *y*
  - *x* *= 5 *x* = *x* * 5
- In JavaScript, *var* declares a variable
  - var b = true; create a boolean *b* and set it to true
  - var n = 1; create a number *n* and set it to 1
  - var s = “hello”; create a string *s* and set it to “hello”
- In JavaScript, all instructions end with a semicolon (;)

Basic Control Structures

- Sequential
  - Perform instructions one after another
- Conditional
  - Perform instructions contingent on something else being true
- Repetition
  - Repeat instructions until a condition is met

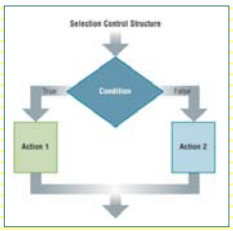
Not much different from cooking recipes!

Sequential Control Structure




```
var a = 2;
var b = 3;
var c = a * b;
```


Conditional Control Structure

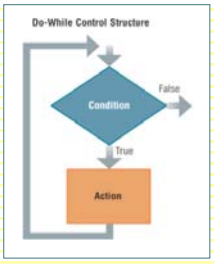



```
if (gender == "male") {
    greeting = "Hello, Sir";
} else {
    greeting = "Hello, Madam";
}
```


Test Conditions

- x == y — true if *x* and *y* are equal
- x != y — true if *x* and *y* are not equal
- x > y — true if *x* is greater than *y*
- x <= y — true if *x* is smaller than or equal to *y*
- x && y — true if both *x* and *y* are true
- x || y — true if either *x* or *y* is true
- !x — true if *x* is false

Repetition Control Structure



Program Example 1:

```
n = 1;
while ( n <= 10) {
  document.writeln(n);
  n++;
}
```

Program Example 2:

```
For (n = 1; n <= 10; n++) {
  document.writeln(n);
}
```


Arrays

- A set of elements grouped together
  - For example, the number of days in each month
- Each element is assigned an index
  - A number used to refer to that element
    - For example, *x*[4] is the fifth element (count from zero!)
  - Arrays and repetitions work naturally together

Functions

- Reusable code for doing a single task
- A function takes in one or more parameters and returns one value

```
function convertToCelsius(f) {
    var celsius = 5/9 * (f-32);
    return celsius;
}

function weirdAddition(a, b) {
    var result = a + b - 0.5;
    return result;
}
```


Calling Functions

- When you "call" a function, you invoke the set of instructions it represents

```
c = convertToCelsius(60);

function convertToCelsius(f) {
    var celsius = 5/9 * (f-32);
    return celsius;
}
```


More Examples

```
var f = 60;
c = convertToCelsius(f);

r = weirdAddition(2, 4);

var a = 2;
var b = 3;
r = weirdAddition(a, b);
```


Programming Paradigms

- Procedural Programming
  - Group instructions into meaningful functions
  - Examples: C, Pascal, Perl
- Object oriented programming
  - Group "data" and "methods" into "objects"
  - Naturally represents the world around us
  - Examples: C++, Java

Algorithms

- Derived from the name of the Persian mathematician Al-Khwarizmi
- A sequence of well-defined instructions designed to accomplish a certain task

Programming for the Web

- Common Gateway Interface (CGI) [Server-side]
  - User inputs information into a form
  - Form values passed to the sever via CGI
  - Program on the server generates a Web page as a response
- JavaScript [Client-side, interpreted]
  - Human-readable "source code" sent to the browser
  - Web browser runs the program
- Java applets [Client-side, compiled]
  - Machine-readable "bytecode" sent to browser
  - Web browser runs the program
  - Not related to JavaScript (other than similarities in syntax)

Where is the JavaScript?

- JavaScript is usually kept in the <head> section of an HTML document

```
…
<head>
<script language="JavaScript" type="text/javascript">
<!--
function calculate() {
 var num = eval(document.input.number.value);
…
 document.output.number.value = total;
}
//-->
</script>
</head>
…
```

Handling Events

- When does code actually get executed?
- Events:
  - User actions trigger “events”
  - Embedded in all modern GUIs
- Event handlers are used to respond to events
  - Examples of event handlers in JavaScript
    - onMouseover: the mouse moved over an object
    - onMouseout: the mouse moved off an object
    - onClick: the user clicked on an object

Input and Output

- How do you get information to/from the user?
  - Forms provide a method for accepting input and displaying output

In HTML

```
<form name="input" action="">
Please enter a number:
<input size="10" value=" " name="number"/>
</form>
<form name="output" action="">
The sum of all numbers up to the number above is
<input size="10" value=" " name="number" readonly="true"/>
</form>
```

Reads in a value
eval function turns it into a number

JavaScript code

```
var num = eval(document.input.number.value);
document.output.number.value = 10;
```

Changes the value in the textbox

JavaScript Resources

- Google “javascript”
  - Tutorials: to learn to write programs
  - Code: to do things you want to do (“borrow”)
- Books

Programming Tips

- Details are everything!
  - Careful where you place that comma, semi-colon, etc.
- Write a little bit of code at a time
  - Add a small new functionality, make sure it works, then move on
  - Don’t try to write a large program all at once
- Debug by outputting the state of the program
  - Print out the value of variables using document.write
  - Is the value what you expected?