Functions

INFO/CSE 100, Spring

Fluency in Information Technology

http://www.cs.washington.edu/100

Readings and References

- Reading
  - » *Fluency with Information Technology*
    - Chapter 19, Bean Counter
    - Chapter 20, Abstraction and Functions
- Other References
  - » W3Schools JavaScript tutorial

`http://www.w3schools.com/js/default.asp`
  - » W3Schools JavaScript HTML DOM Objects

`http://www.w3schools.com/js/js_obj_htmldom.asp`
  - » Mozilla Browser

`http://www.mozilla.org/`

Functions

A *function* is a way to bundle a set of instructions and give them a name so that you can reuse them easily

Functions have a specific layout

» <*name*> ← the function name is an identifier

» <*parameter list*> ← list of input variables for the function

» <*statements*> ← the statements do the work

```
function <name> ( <parameter list> ) {
    <statements>
}
```

Example Function

template

```
function <name> ( <parameter list> ) {
   <statements>
}
```

Write a simple function to compute the Body Mass Index when the inputs are in English units (ie, US units)

example

```
// Calculate Body Mass Index in English units
// weight in pounds
// height in inches
// returns body mass index

function bmiE(weightLBS, heightIN)  {
  var heightFt = heightIn / 12; // convert to feet
  return 4.89 * weightLBS / (heightFt * heightFt);
}
```

Develop the function

First, make sure you understand what you want the function to do and how it will accomplish the task.

```
// Calculate Body Mass Index in English units
// weight in pounds
// height in inches
// returns body mass index

function name(parameter list)  {

  statements

}
```

Pick a name for the function

Function names are identifiers

- » start with a letter
- » should have a fairly obvious meaning
- » should not be one of the Javascript reserve words

```
// Calculate Body Mass Index in English units
// weight in pounds
// height in inches
// returns body mass index

function bmiE(parameter list)  {

  statements

}
```

Pick the parameters

Parameter names are also identifiers

- » these are the variable names that your function will use when it is performing its calculations
- » should have a fairly obvious meaning

```
// Calculate Body Mass Index in English units
// weight in pounds
// height in inches
// returns body mass index

function bmiE(weightLBS, heightIN)  {

  statements;

}
```

Functions without Parameters!

- Function do not have to have parameters
  - » But we still need to include the parentheses

```
// Print out Greeting
// Typical Greeting is "Hello World"


function giveGreeting()   {

  document.write("Hello World!");

}
```

Write the function body

The function body includes whichever statements are required to implement the desired capability.

```
// Calculate Body Mass Index in English units
// weight in pounds
// height in inches
// returns body mass index

function bmiE(weightLBS, heightIN)  {
  var heightFt = heightIn / 12; // convert to feet
  return 4.89 * weightLBS / (heightFt * heightFt);
}
```

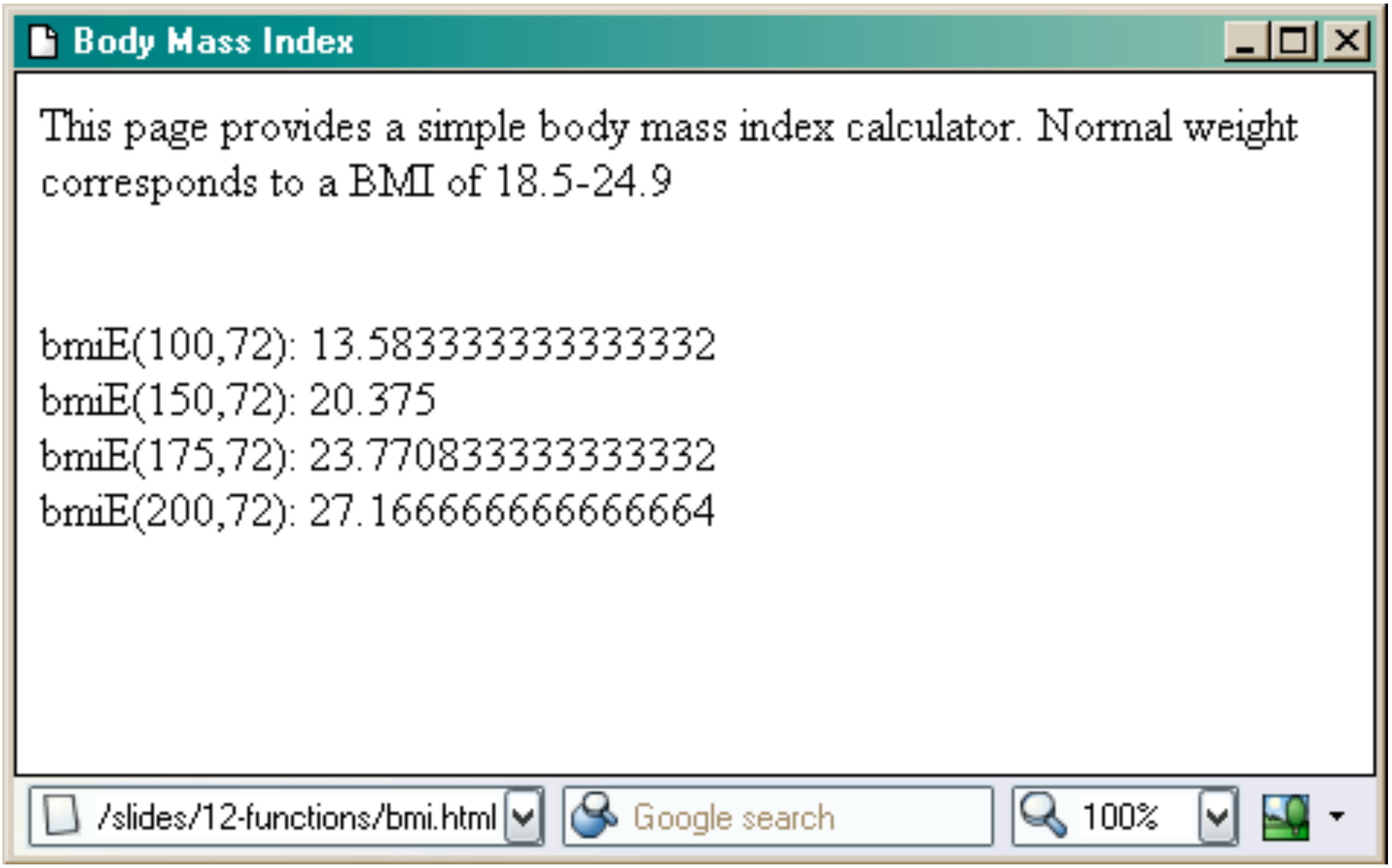
A Simple Testing Template

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
   "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Body Mass Index</title>
<script type="text/javascript">
// Figure Body Mass Index in English units
function bmiE( weightLBS, heightIn ) {
  var heightFt = heightIn / 12; // Change to feet
  return 4.89 * weightLBS / (heightFt * heightFt);
}
</script>
</head>
<body>
<p>This page provides a simple body mass index calculator.
Normal weight corresponds to a BMI of 18.5-24.9</p>
<script type="text/javascript">
document.writeln("<br>bmiE(100,72): "+bmiE(100,72));
document.writeln("<br>bmiE(150,72): "+bmiE(150,72));
document.writeln("<br>bmiE(175,72): "+bmiE(175,72));
document.writeln("<br>bmiE(200,72): "+bmiE(200,72));
</script>
</body>
</html>
```

The new function

Test statements

Try the function and see how it works



This page provides a simple body mass index calculator. Normal weight corresponds to a BMI of 18.5-24.9

```
bmiE(100,72): 13.583333333333332
bmiE(150,72): 20.375
bmiE(175,72): 23.770833333333332
bmiE(200,72): 27.166666666666664
```

Fancy Function Features

```
<head>
<title>Body Mass Index</title>
<script type="text/javascript">
// Calculate Body Mass Index in English units
// weight in pounds
// height in inches
// returns body mass index
function bmiE(weightLBS, heightIN)  {
  var heightFt = heightIn / 12; // convert to feet
  return 4.89 * weightLBS / (heightFt * heightFt);
}
</script>
</head>
```

<script> in <head> location, comments, keywords, formal parameters, curly brackets, parentheses, operators, expressions, assignment statement, return statement, semi-colon

Using Fancy Functions

```
<body>
<p>This page provides a simple body mass index
calculator.
Normal weight corresponds to a BMI of 18.5-24.9</p>
<script type="text/javascript">
document.writeln("<br>bmiE(100,72): "+bmiE(100,72)+");
document.writeln("<br>bmiE(150,72): "+bmiE(150,72)+");
document.writeln("<br>bmiE(175,72): "+bmiE(175,72)+");
document.writeln("<br>bmiE(200,72): "+bmiE(200,72)+");
</script>
</body>
```

<script> in <body> location, document, writeln function call, strings, string concatenation, bmiE function call, arguments (aka actual parameters)

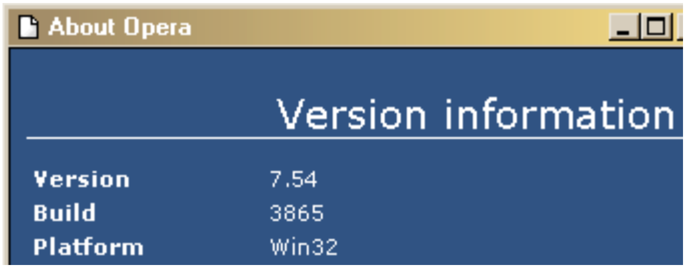
Global or Local?!?

- Scope of a variable describes where and when it can be referenced
  - » Local variables are only known inside of a function (curly braces)
  - » Global variables are know by all the Javascript inside of <script> </script> pairs

```
// Calculate Percentage of Study Hours/Week
// time in hours
// returns hours
var days = 7;
function calculateStudyHrs(time)  {
  var totalHrs = 24 * days;
  return time/totalHrs;
}
```

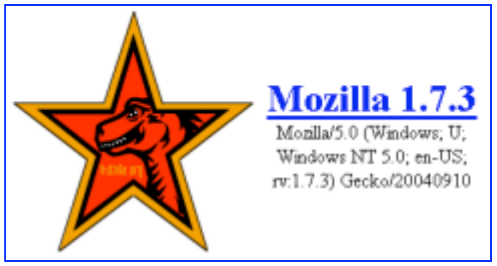
Comments on Debugging

- Debugging JavaScript can be hard
  - » The browsers all implement things a little differently, particularly old browsers
    - *upgrade* if you are using something old!

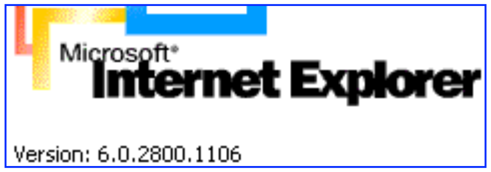

About Opera

Version information

Version	7.54
Build	3865
Platform	Win32

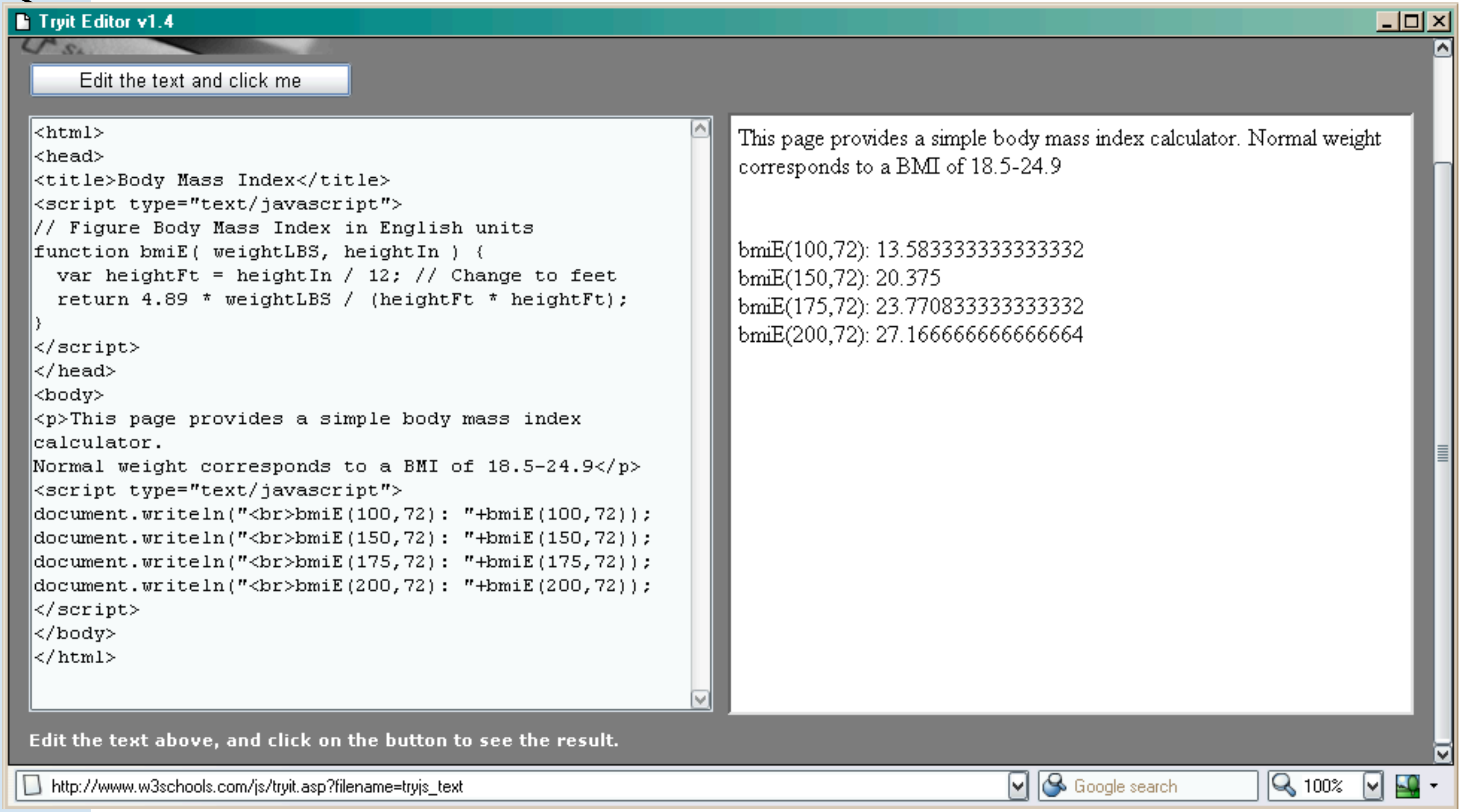

Mozilla 1.7.3

Mozilla/5.0 (Windows; U; Windows NT 5.0; en-US; rv:1.7.3) Gecko/20040910


Microsoft® Internet Explorer

Version: 6.0.2800.1106

Use the W3Schools TryIt Editor


Tryit Editor v1.4
Edit the text and click me
http://www.w3schools.com/js/tryit.asp?filename=tryjs_text
Google search
100%

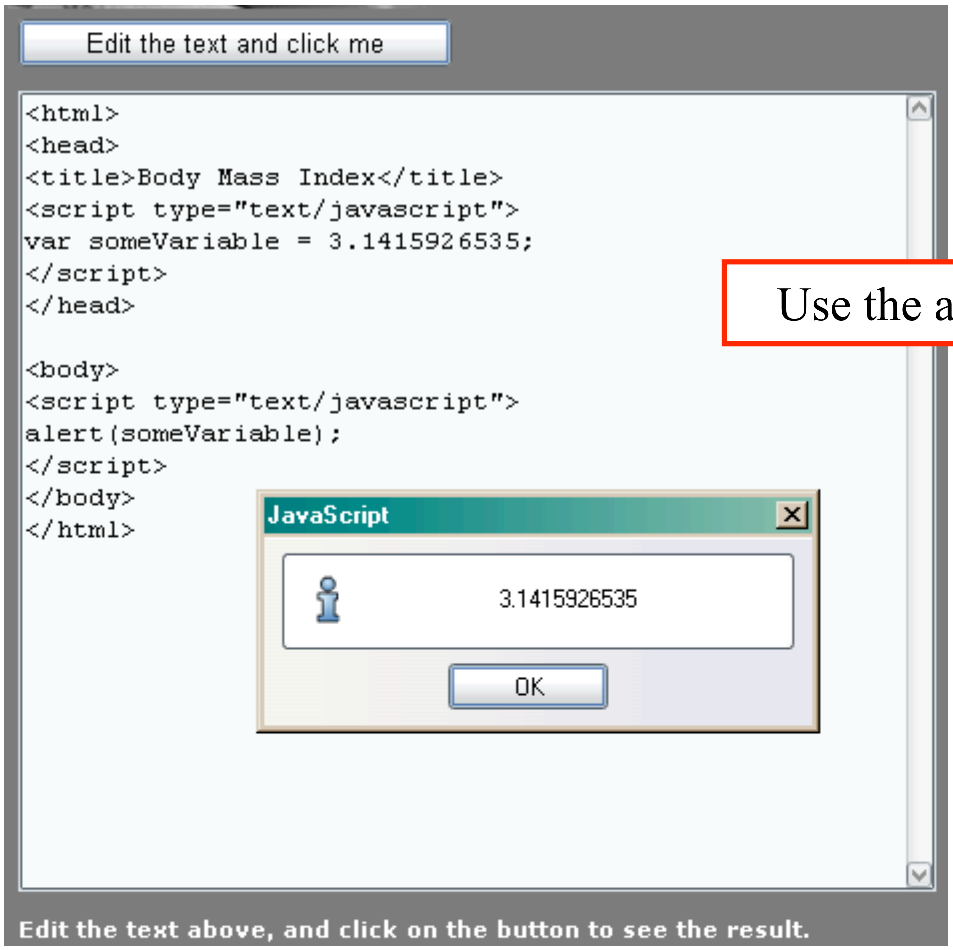
```
<html>
<head>
<title>Body Mass Index</title>
<script type="text/javascript">
// Figure Body Mass Index in English units
function bmiE( weightLBS, heightIn ) {
  var heightFt = heightIn / 12; // Change to feet
  return 4.89 * weightLBS / (heightFt * heightFt);
}
</script>
</head>
<body>
<p>This page provides a simple body mass index
calculator.
Normal weight corresponds to a BMI of 18.5-24.9</p>
<script type="text/javascript">
document.writeln("<br>bmiE(100,72): "+bmiE(100,72));
document.writeln("<br>bmiE(150,72): "+bmiE(150,72));
document.writeln("<br>bmiE(175,72): "+bmiE(175,72));
document.writeln("<br>bmiE(200,72): "+bmiE(200,72));
</script>
</body>
</html>
```

This page provides a simple body mass index calculator. Normal weight corresponds to a BMI of 18.5-24.9

```
bmiE(100,72): 13.583333333333332
bmiE(150,72): 20.375
bmiE(175,72): 23.770833333333332
bmiE(200,72): 27.166666666666664
```

Edit the text above, and click on the button to see the result.

Display results using alert(...)



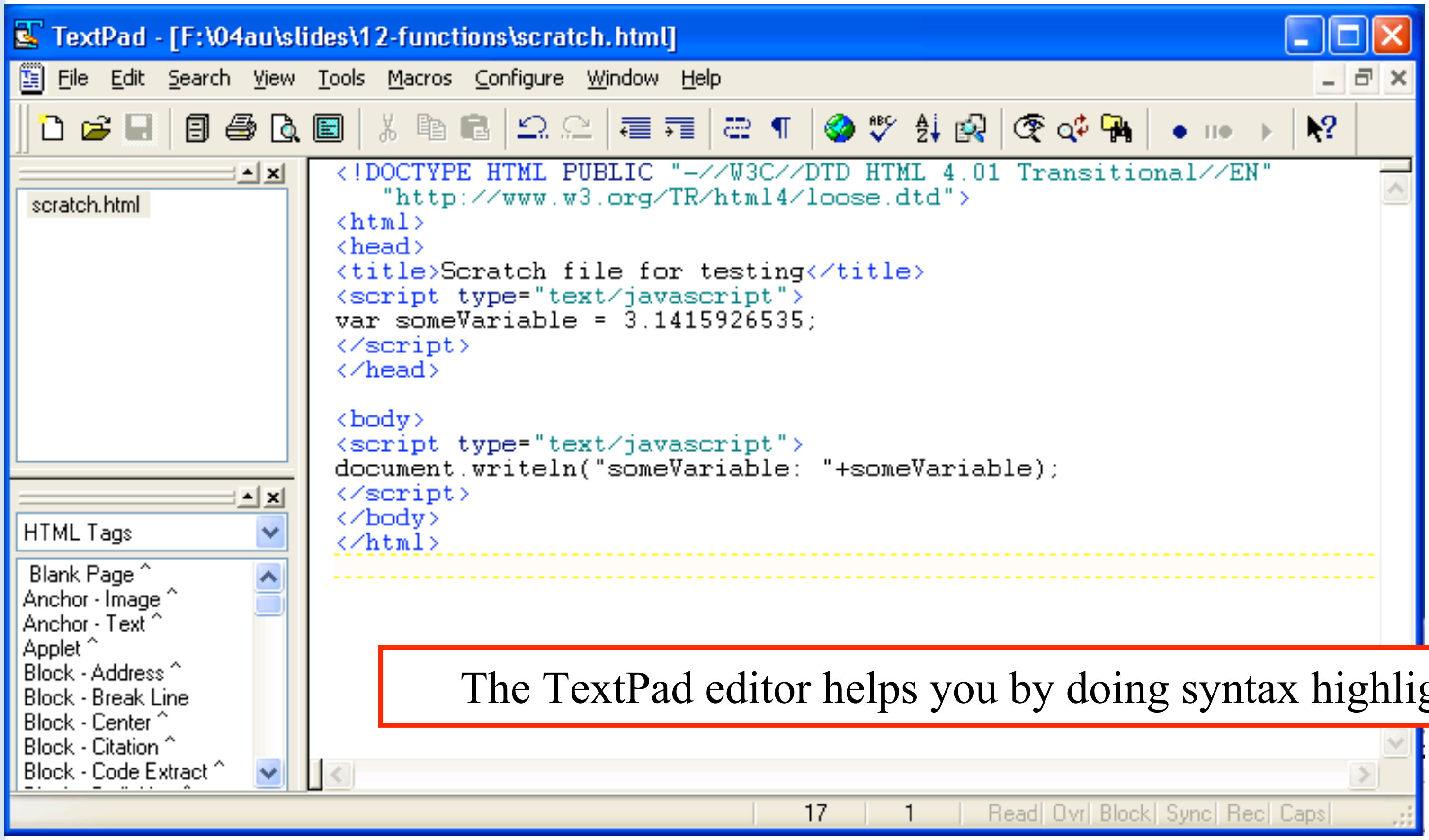
```
<html>
<head>
<title>Body Mass Index</title>
<script type="text/javascript">
var someVariable = 3.14159265 35;
</script>
</head>

<body>
<script type="text/javascript">
alert(someVariable);
</script>
</body>
</html>
```

```
3.1415926535
```

Edit the text above, and click on the button to see the result.

Use the alert("This is a message") function

Use an editor that helps you

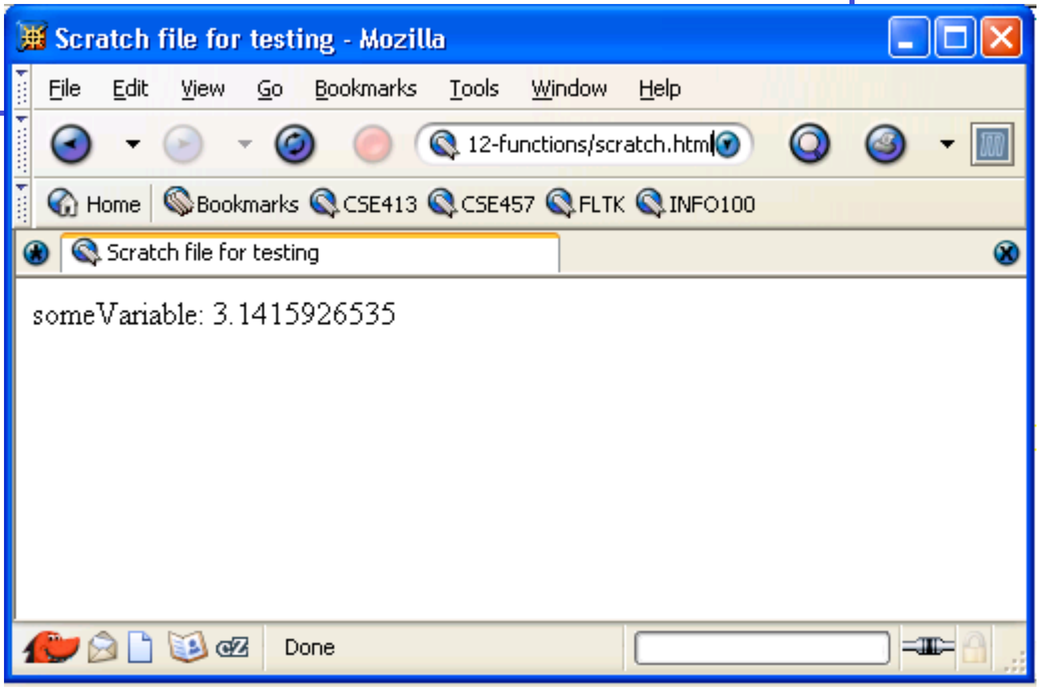


```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
   "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Scratch file for testing</title>
<script type="text/javascript">
var someVariable = 3.1415926535;
</script>
</head>

<body>
<script type="text/javascript">
document.writeln("someVariable: "+someVariable);
</script>
</body>
</html>
```

The TextPad editor helps you by doing syntax highlighting.

Display results using writeln(...)

```
<body>
<script type="text/javascript">
document.writeln("someVariable:
"+someVariable);
</script>
</body>
```


Scratch file for testing - Mozilla
File Edit View Go Bookmarks Tools Window Help
12-functions/scratch.html
Home Bookmarks CSE413 CSE457 FLTK INFO100
Scratch file for testing
Done

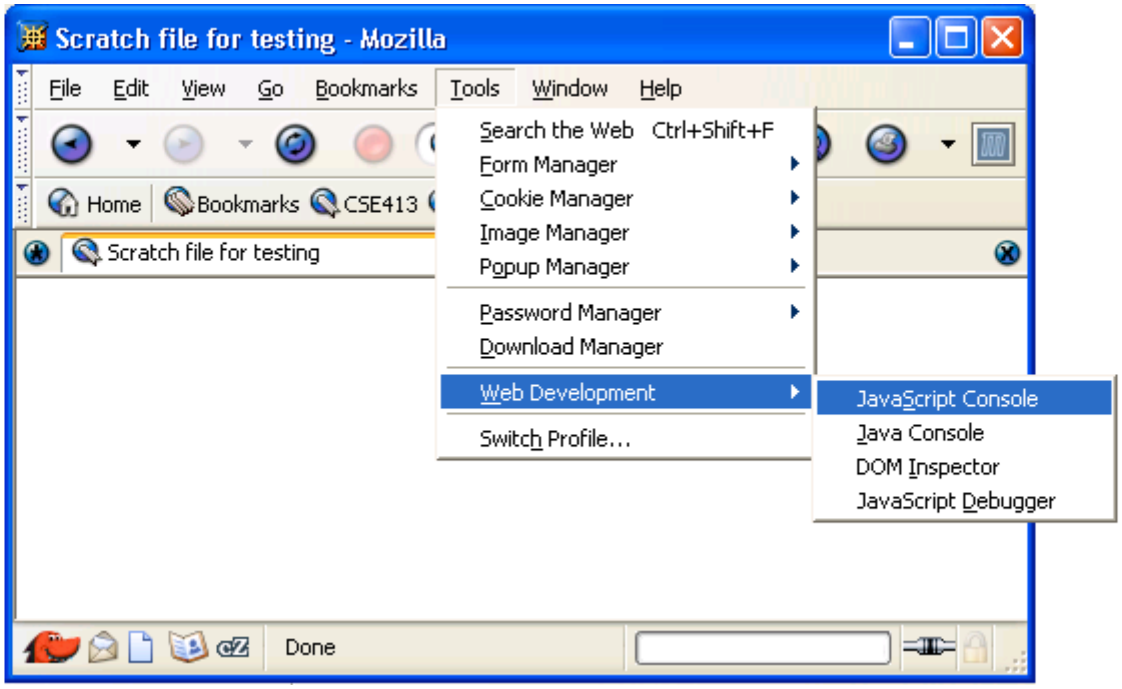
```
someVariable: 3.1415926535
```

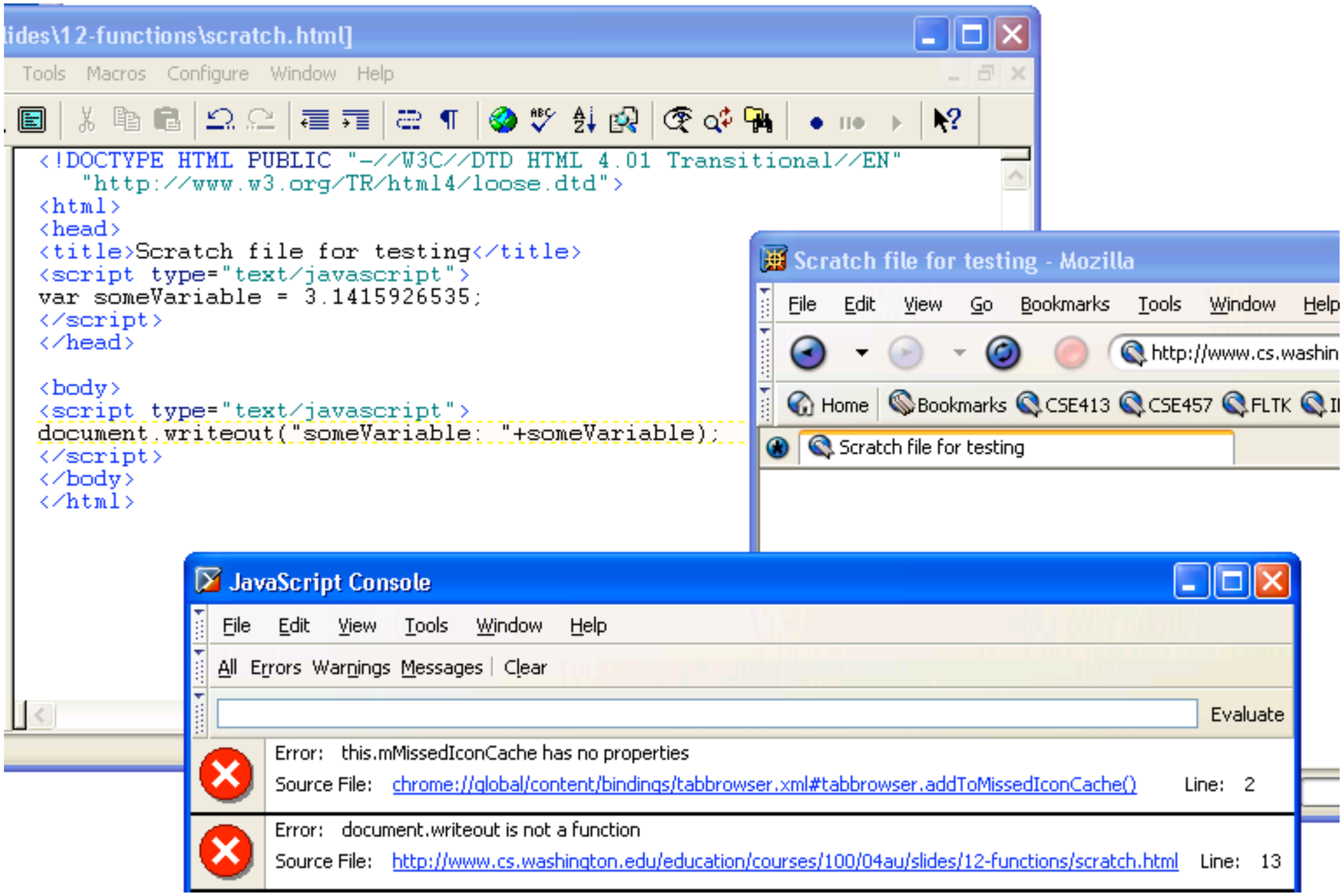
Use a browser that helps you

- All browsers try to be forgiving of errors, which means that they generally don't produce a lot of error messages
  - » use a browser that *helps you debug* like Mozilla

Mozilla 1.7.3
Mozilla/5.0 (Windows; U; Windows NT 5.0; en-US; rv:1.7.3) Gecko/20040910

enable Mozilla JavaScript Console





lides\12-functions\scratch.html]
Tools Macros Configure Window Help
Scratch file for testing - Mozilla
File Edit View Go Bookmarks Tools Window Help
http://www.cs.washin
Home Bookmarks CSE413 CSE457 FLTK
Scratch file for testing
JavaScript Console
File Edit View Tools Window Help
All Errors Warnings Messages Clear
Evaluate

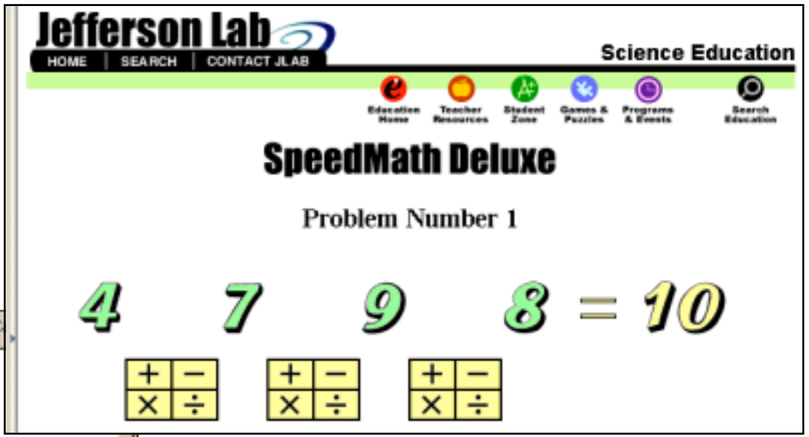
```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
   "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Scratch file for testing</title>
<script type="text/javascript">
var someVariable = 3.1415926535;
</script>
</head>

<body>
<script type="text/javascript">
document.writeout("someVariable: "+someVariable);
</script>
</body>
</html>
```

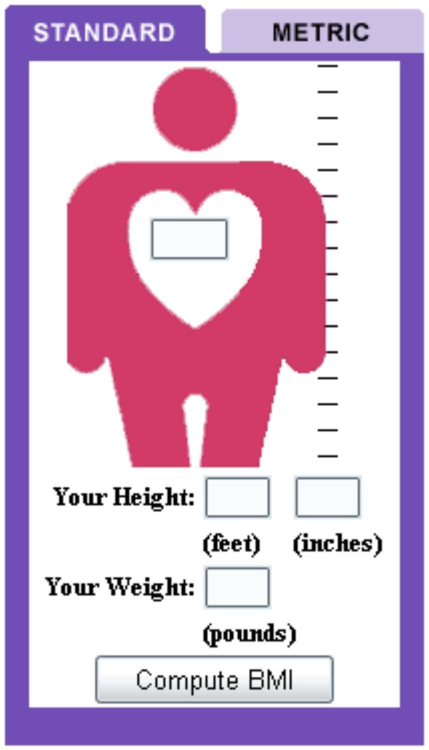
```
Error: this.mMissedIconCache has no properties
Source File: chrome://global/content/bindings/tabbrowser.xml#tabbrowser.addToMissedIconCache()    Line: 2

Error: document.writeout is not a function
Source File: http://www.cs.washington.edu/education/courses/100/04au/slides/12-functions/scratch.html    Line: 13
```

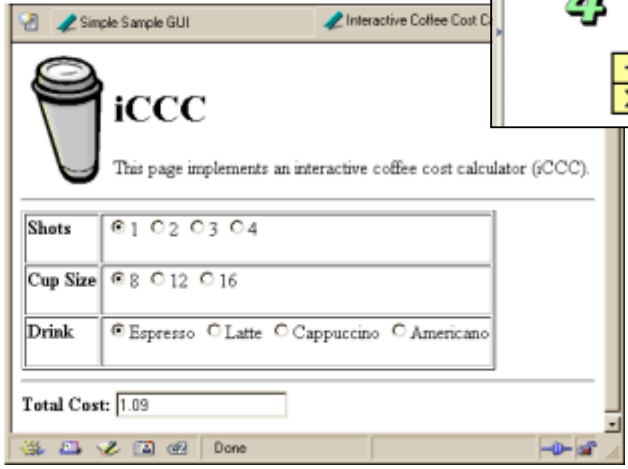
The Mozilla JavaScript console helps you by showing good error messages.

Graphical User Interfaces (GUIs)

We can also use JavaScript to create Graphical User Interfaces.





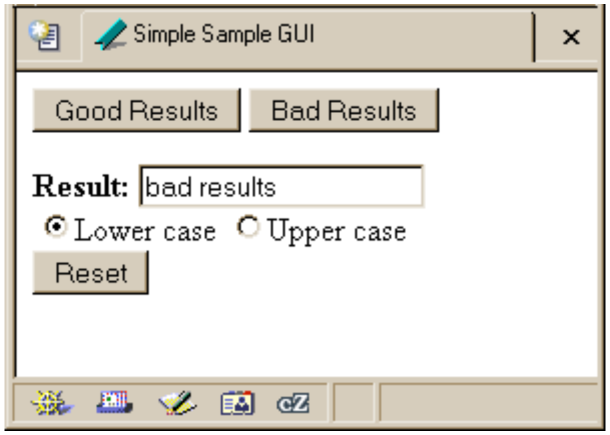


iCCC

This page implements an interactive coffee cost calculator (iCCC).

Shots	[✓ 1] 2 3 4
Cup Size	[✓ 8] 12 16
Drink	[✓ Espresso] Latte Cappuccino Americano

Total Cost: 1.09

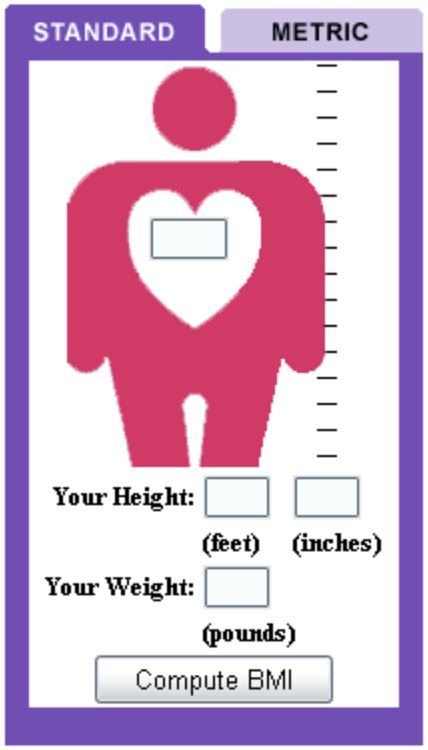


Result: bad results

[✓ Lower case] Upper case

GUIs

A Graphical User Interface provides an intuitive way to control a program instead of having to memorize commands



- text fields with labels to *request user entry*
- text fields with labels to *display results*
- buttons to *command action*
- radio buttons and checkboxes to *set conditions*

A simple example

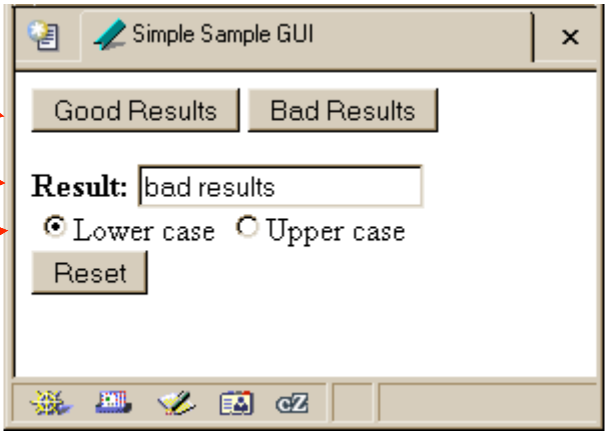
This GUI has several simple controls.

Two buttons to control the results

One text field to display the results

One pair of radio buttons to control the display

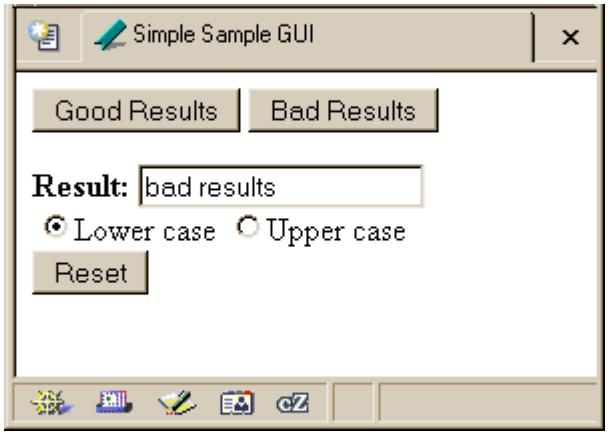
One button to reinitialize



http://www.cs.washington.edu/education/courses/100/04au/slides/13-gui/gui.html

A simple example

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
   "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Simple Sample GUI</title>
<script type="text/javascript">
 javascript function code
</script>
</head>

<body>
 HTML form layout and specification
</body>
</html>
```



Result: bad results

[✓ Lower case] Upper case

Layout of the GUI

- The layout of the page is controlled with HTML in the body of the page

```
<body>
 HTML form layout and specification
</body>
</html>
```

- The layout and controls are provided using new tags
  - » <form id="buttonForm">
  - » <button type="button" ...
  - » <input type="text" …
  - » <input type="radio" …
  - » <button type="reset" …

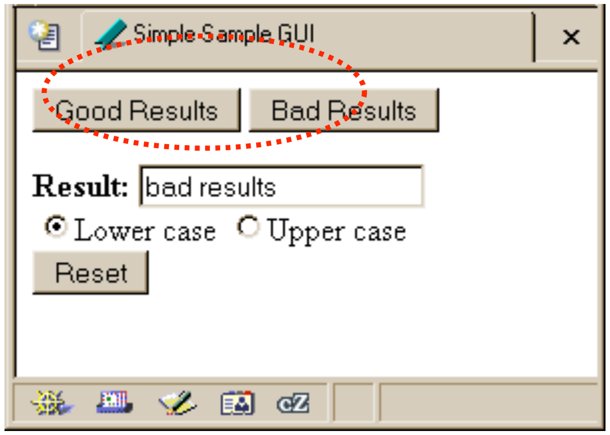
<form>

- HTML forms provide a way for the user to enter data into a web page
  - » A form can contain several different types of entry, control, and display elements
  - » The data in a form can be passed back to the web server, or it can be processed locally on the client
    - All of our forms will processed locally
- A form is defined with the <form id="dmvForm"> ... </form> tag
  - » The form has various attributes like *id*, so we can refer to it and its elements later
  - » the form *contains* various elements like <input> and <button>

<button type="button" ...>

```
<form>
<button type="button"
  onclick="setResults('good results')">Good Results</button>
<button type="button"
  onclick="setResults('bad results')">Bad Results</button>
</form>
```

- a <button> can have one of three types
  - » type "button" is used locally
  - » type " submit" sends data back to the server
  - » type "reset" re-initializes the form
- the value of the "onclick" attribute is some JavaScript code, in this case a call to the function `setResults(`*`string`*`)`



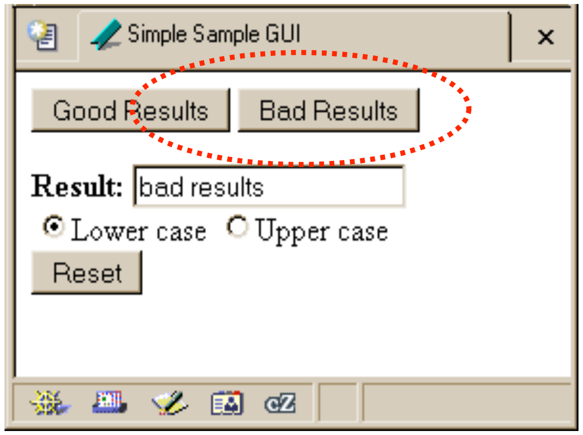
Result: bad results

[✓ Lower case] Upper case

<input type="text" ...>

```
<form>
<b>Result:</b>
<input type="text" value="nada" readonly id="resultField">
<br>
<input type="radio" name="case" id="radioLC" checked
  onclick="setResults(document.getElementById('resultField').value)">Lowercase
<input type="radio" name="case" id="radioUC"
  onclick="setResults(document.getElementById('resultField').value)">Uppercase
<br><button type="reset">Reset</button>
</form>
```

- an `<input>` with `type="text"` is used for user input and program output
- `value="nada"` sets the initial (and reset) value
- `readonly` means that the user cannot set the value, only the script can set the value
- `id="resultField"` gives us a way to identify this particular control in our JavaScript

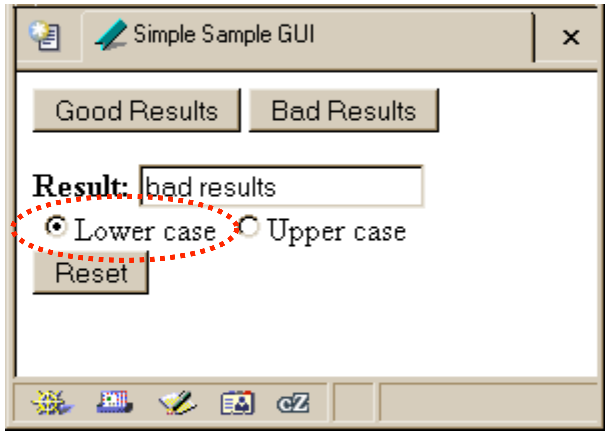


Result: bad results
[✓ Lower case] Upper case

<input type="radio" ...>

```
<form>
<b>Result:</b>
<input type="text" value="nada" readonly id="resultField">
<br>
<input type="radio" name="case" id="radioLC" checked
  onclick="setResults(document.getElementById('resultField').value)">Lowercase
<input type="radio" name="case" id="radioUC"
  onclick="setResults(document.getElementById('resultField').value)">Uppercase
<br><button type="reset">Reset</button>
</form>
```

- an `<input>` with `type="radio"` allows the user to select one of several choices
- `name="case"` identifies all the buttons in the same group (only one will be selected at a time)
- `onclick` attribute gives the JavaScript to execute when the user clicks this button
- `id="radioLC"` gives us a way to identify this particular control in our JavaScript

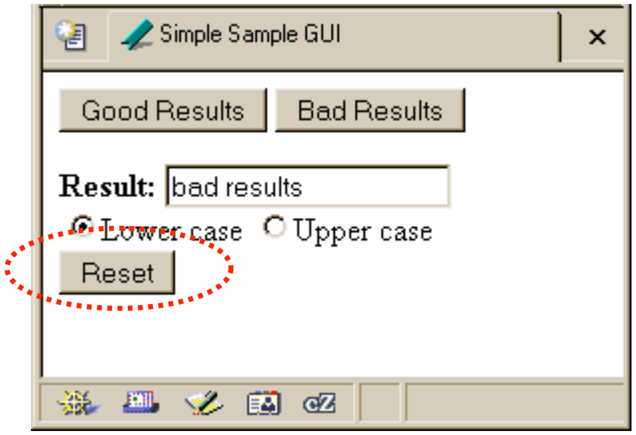


Result: bad results
[✓ Lower case] Upper case

<button type="reset" ...>

```
<form>
<b>Result:</b>
<input type="text" value="nada" readonly id="resultField">
<br>
<input type="radio" name="case" id="radioLC" checked
  onclick="setResults(document.getElementById('resultField').value)">Lowercase
<input type="radio" name="case" id="radioUC"
  onclick="setResults(document.getElementById('resultField').value)">Uppercase
<br><button type="reset">Reset</button>
</form>
```

- a `<button>` with `type="reset"` resets all the other controls in the same form to their original values



Result: bad results

[✓ Lower case] Upper case

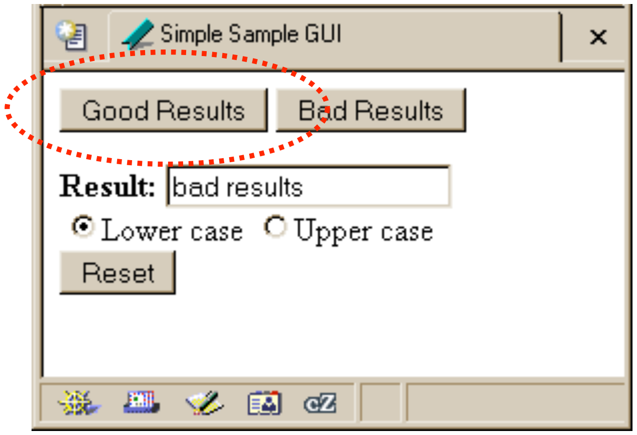
Events Cause Processing

- After drawing a page, the browser sits idle waiting for something to happen … when we give input, we cause *events*
- Processing events is the task of a block of code called an event handler
  - » The code to execute is identified in the tag using the appropriate attribute
  - » There are many event types
    - onClick, onChange, onMouseOver ...

request processing of an event

```
<form>
<button type="button"
  onclick="setResults('good results')">Good Results</button>
<button type="button"
  onclick="setResults('bad results')">Bad Results</button>
</form>
```

- the `onclick` attribute defines some JavaScript to call when the button is clicked
- in this case, the code is a call to the `setResults(`*`string`*`)` function defined in the page `<head>`
- the appropriate string value is supplied to the `setResults(`*`string`*`)` function and then the function executes



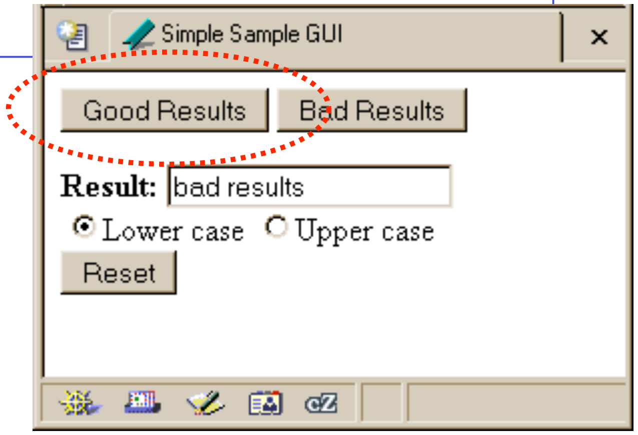
Result: bad results

[✓ Lower case] Upper case

process a button’s onclick event

```
<script type="text/javascript">
function setResults(resultString) {
  var tempString = resultString;
  if (document.getElementById("radioLC").checked) {
    tempString = tempString.toLowerCase();
  } else if (document.getElementById("radioUC").checked) {
    tempString = tempString.toUpperCase();
  }
  document.getElementById("resultField").value = tempString;
}
</script>
```

- the `setResults(string)` function is called by several event processors
- in every case, it takes the string that it is given, decides if upper or lower case is desired, and sets the `resultField` accordingly



Result: bad results
[✓ Lower case] Upper case

setResults(resultString)

```
<script type="text/javascript">
function setResults(resultString) {
  var tempString = resultString;
  if (document.getElementById("radioLC").checked) {
    tempString = tempString.toLowerCase();
  } else if (document.getElementById("radioUC").checked) {
    tempString = tempString.toUpperCase();
  }
  document.getElementById("resultField").value = tempString;
}
</script>
```

parameter variable, local variable, if/else statement, field reference, call to toLowerCase() function