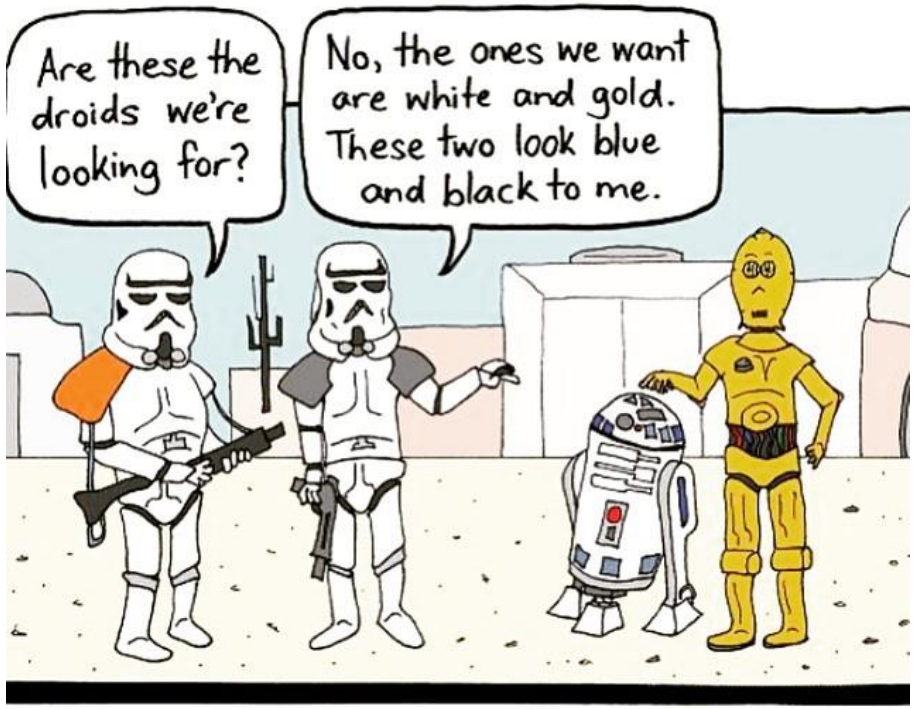
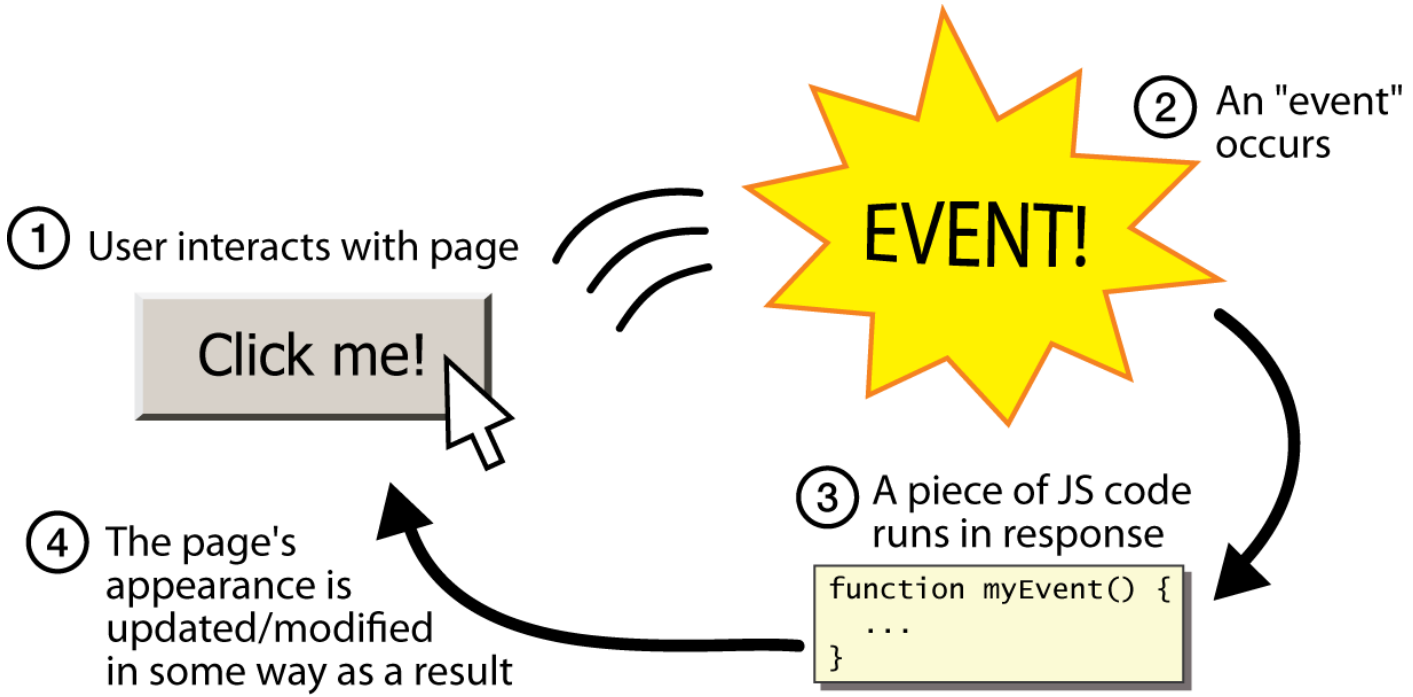
CSE 154



LECTURE 7: THE DOCUMENT OBJECT MODEL (DOM); UNOBTRUSIVE JAVASCRIPT

Event-driven programming



- JS programs have no `main`; they respond to user actions called **events**
- **event-driven programming**: writing programs driven by user events

Event handlers

```HTML
<element attributes onclick="function();">...
```

```HTML
<div onclick="myFunction();">Click me!</div>
```

Click me!

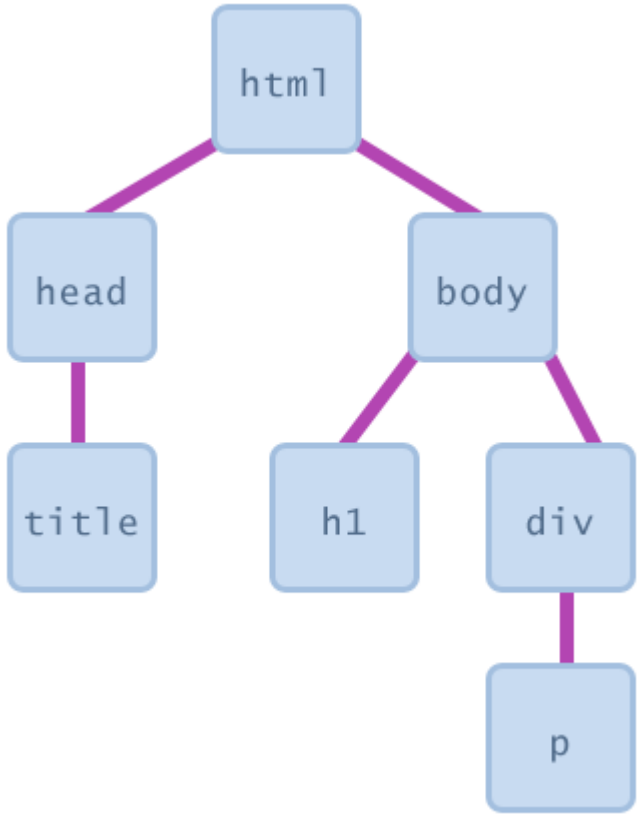
HTML

- JavaScript functions can be set as **event handlers**
  - when you interact with the element, the function will execute
- `onclick` is just one of many event HTML attributes we'll use

Document Object Model (DOM)

a set of JavaScript objects that represent each element on the page

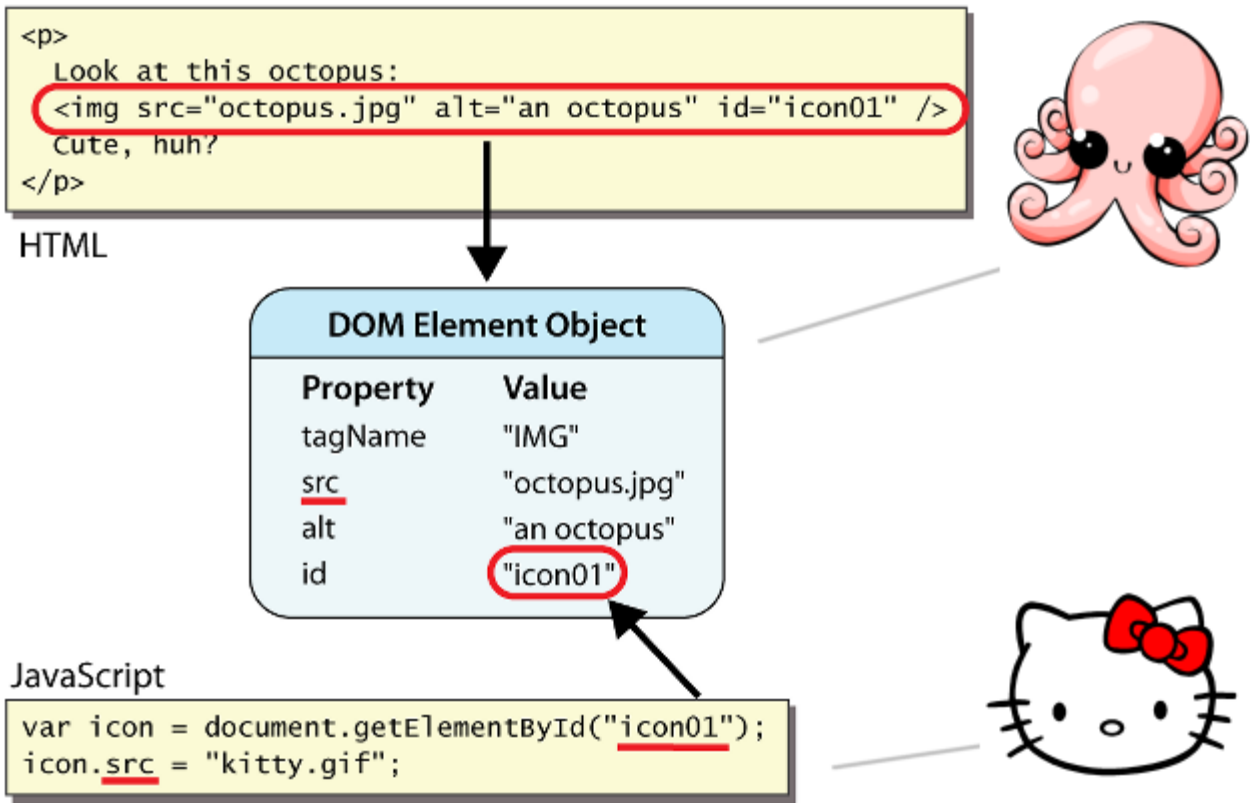
- each tag in a page corresponds to a JavaScript DOM object
- JS code can talk to these objects to examine elements' state
  - e.g. see whether a box is checked
- we can change state
  - e.g. insert some new text into a `div`
- we can change styles
  - e.g. make a paragraph red



DOM element objects

- access/modify the attributes of a DOM object with *objectName*.*attributeName*

- most DOM object attributes have the same names as the corresponding HTML attribute
  - `img` tag's `src` property
  - `a` tag's `href` property



DOM object properties

```html
<div id="main" class="foo bar">
  <p>See our <a href="sale.html" id="saleslink">Sales</a> today!</p>
  <img id="icon" src="images/borat.jpg" alt="Borat" />
</div>
```
HTML

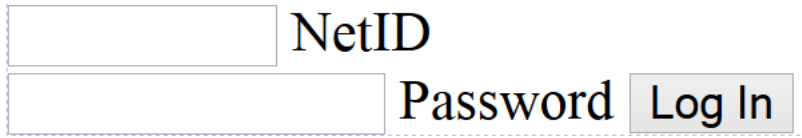
```js
var mainDiv = document.getElementById("main");
var icon    = document.getElementById("icon");
var theLink = document.getElementById("saleslink");
```
JS

Property	Description	Example
tagName	element's HTML tag	mainDiv.tagName is "DIV"
className	CSS classes of element	mainDiv.className is "foo bar"
innerHTML	content in element	mainDiv.innerHTML is "\n <p>See our <a hr...
src	URL target of an image	icon.src is "images/borat.jpg"
href	URL target of a link	theLink.href is "sale.html"

Text fields: <input>

```
<input type="text" size="10" maxlength="8" /> NetID <br />
<input type="password" size="16" /> Password
```

HTML



output

- input attributes: disabled, maxlength, readonly, size, value
- size attribute controls onscreen width of text field
- maxlength limits how many characters user is able to type into field

Text boxes: <textarea>

a multi-line text input area (inline)

```
<textarea rows="4" cols="20">
Type your comments here.
</textarea>
```

HTML

Type your comments here.

output

- initial text is placed inside textarea tag (optional)
- required rows and cols attributes specify height/width in characters
- optional readonly attribute means text cannot be modified

DOM properties for form controls

```
<input id="sid" type="text" size="7" maxlength="7" />
<input id="frosh" type="checkbox" checked="checked" /> Freshman?
```
HTML

```
var sid   = document.getElementById("sid");
var frosh = document.getElementById("frosh");
```
JS

output

Property	Description	Example
value	the text/value chosen by the user	sid.value could be "1234567"
checked	whether a box is checked	frosh.checked is true
disabled	whether a control is disabled (boolean)	frosh.disabled is false
readOnly	whether a text box is read-only	sid.readOnly is false

Adjusting styles with the DOM

```
objectName.style.propertyName = "value";
```
JS

```
<button onclick="colorIt();">Click me!</button>
<span id="fancytext">Don't forget your homework!</span>
```
HTML

```
function colorIt() {
  var text = document.getElementById("fancytext");
  text.style.color = "#ff5500";
  text.style.fontSize = "40pt";
}
```
JS

output

Property	Description
style	lets you set any CSS style property for an element

- same properties as in CSS, but with camelCasedNames, not names-with-underscores
  - examples: `backgroundColor`, `borderLeftWidth`, `fontFamily`

Unobtrusive JavaScript

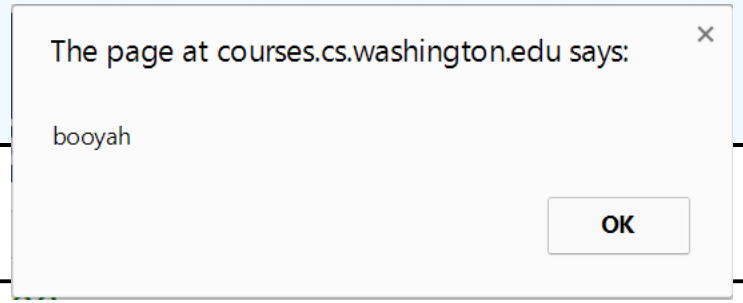
- JavaScript event code seen previously was *obtrusive*, in the HTML; this is bad style
- now we'll see how to write *unobtrusive* JavaScript code
  - HTML with no JavaScript code inside the tags
  - uses the JS DOM to attach and execute all JavaScript event handlers
- allows separation of web site into 3 major categories:
  - **content** (HTML) - what is it?
  - **presentation** (CSS) - how does it look?
  - **behavior** (JavaScript) - how does it respond to user interaction?

Obtrusive event handlers (bad)

```
<button onclick="okayClick();">OK</button>
```
HTML

```
// called when OK button is clicked
function okayClick() {
  alert("booyah");
}
```
JS

OK



output

- this is bad style (HTML is cluttered with JS code)
- goal: remove all JavaScript code from the HTML body

Attaching an event handler in JavaScript code

```
objectName.onevent = function;
```
JS

```
<button id="ok">OK</button>
```
HTML

```
var okButton = document.getElementById("ok");
okButton.onclick = okayClick;
```
JS

- it is legal to attach event handlers to elements' DOM objects in your JavaScript code
  - notice that you do **not** put parentheses after the function's name
- this is better style than attaching them in the HTML

When does my code run?

```html
<html>
  <head>
    <script src="myfile.js" type="text/javascript"></script>
  </head>
  <body> ... </body> </html>
```
HTML

```
var x = 3;
function f(n) { return n + 1; }
function g(n) { return n - 1; }
x = f(x);
```
JS

- your file's JS code runs the moment the browser loads the `script` tag
  - any variables are declared immediately
  - any functions are declared but not called, unless your global code explicitly calls them
- at this point in time, the browser has not yet read your page's `body`
  - none of the DOM objects for tags on the page have been created yet

A failed attempt at being unobtrusive

```html
<html>
  <head>
    <script src="myfile.js" type="text/javascript"></script>
  </head>
  <body>
    <div><button id="ok">OK</button></div>
```

HTML

```
var ok = document.getElementById("ok");
ok.onclick = okayClick;   // error: null
```

JS

- problem: global JS code runs the moment the script is loaded
- script in head is processed before page's body has loaded
  - no elements are available yet or can be accessed yet via the DOM
- we need a way to attach the handler after the page has loaded...

The window.onload event

```
function functionName() {
  // code to initialize the page
  ...
}

// run this function once the page has finished loading
window.onload = functionName;
```

- there is a global event called `window.onload` event that occurs at the moment the page body is done being loaded
- if you attach a function as a handler for `window.onload`, it will run at that time

An unobtrusive event handler

```
<button id="ok">OK</button>                    <!-- (1) -->
```

HTML

```
// called when page loads; sets up event handlers
function pageLoad() {
  var ok = document.getElementById("ok");   // (3)
  ok.onclick = okayClick;
}

function okayClick() {
  alert("booyah");                          // (4)
}

window.onload = pageLoad;                   // (2)
```

JS

output

Anonymous functions

```
function(parameters) {
  statements;
}
```
JS

- JavaScript allows you to declare **anonymous functions**
- quickly creates a function without giving it a name
- can be stored as a variable, attached as an event handler, etc.

Anonymous function example

```
window.onload = function() {
  var ok = document.getElementById("ok");
  ok.onclick = okayClick;
};

function okayClick() {
  alert("booyah");
}
```

JS

output

- or the following is also legal (though harder to read and bad style):

```
window.onload = function() {
  document.getElementById("ok").onclick = function() {
    alert("booyah");
  };
};
```

Unobtrusive styling

```
function okayClick() {
  this.style.color = "red";
  this.className = "highlighted";
}
```
JS

```
.highlighted { color: red; }
```
CSS

- well-written JavaScript code should contain as little CSS as possible
- use JS to set CSS classes/IDs on elements
- define the styles of those classes/IDs in your CSS file

The danger of global variables

```
var count = 0;
function incr(n) {
  count += n;
}
function reset() {
  count = 0;
}

incr(4);
incr(2);
console.log(count);
```
JS

- globals can be bad; other code and other JS files can see and modify them
- How many global symbols are introduced by the above code?
- 3 global symbols: `count`, `incr`, and `reset`

Enclosing code in a function

```
function everything() {
  var count = 0;
  function incr(n) {
    count += n;
  }
  function reset() {
    count = 0;
  }

  incr(4);
  incr(2);
  console.log(count);
}

everything();
// call the function to run the code
```

- the above example moves all the code into a function; variables and functions declared inside another function are local to it, not global

- How many global symbols are introduced by the above code?
- 1 global symbol: `everything` (can we get it down to 0?)

The "module pattern"

```
(function() {
    statements;
})();
```
JS

- wraps all of your file's code in an anonymous function that is declared and immediately called
- 0 global symbols will be introduced!
- the variables and functions defined by your code cannot be messed with externally

Module pattern example

```
(function() {
  var count = 0;
  function incr(n) {
    count += n;
  }
  function reset() {
    count = 0;
  }

  incr(4);
  incr(2);
  console.log(count);
})();
```

JS

- How many global symbols are introduced by the above code?
- 0 global symbols

JavaScript "strict" mode

```
"use strict";

your code...
```

```
6  "use strict";
7
8  function calculate() {
9      abc = 42;
10
11 Uncaught ReferenceError: abc is not defined
12
13     // go get the subtotal and tip amounts from the page
14     var subtotalBox = document.getElementById("subtotal");
```

- writing `"use strict";` at the very top of your JS file turns on strict syntax checking:
  - shows an error if you try to assign to an undeclared variable
  - stops you from overwriting key JS system libraries
  - forbids some unsafe or error-prone language features
- You should *always* turn on strict mode for your code in this class!

Checkboxes: <input>

yes/no choices that can be checked and unchecked (inline)

```
<input type="checkbox" name="lettuce" /> Lettuce
<input type="checkbox" name="tomato" checked="checked" /> Tomato
<input type="checkbox" name="pickles" checked="checked" /> Pickles
```

HTML

output

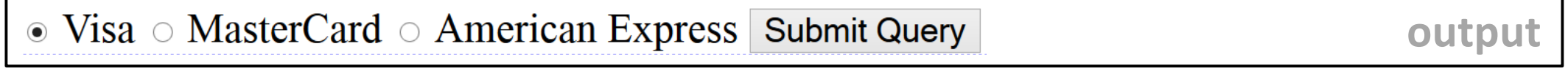
- none, 1, or many checkboxes can be checked at same time
- when sent to server, any checked boxes will be sent with value on:
  - http://webster.cs.washington.edu/params.php?tomato=on&pickles=on
- use checked="checked" attribute in HTML to initially check the box

Radio buttons: <input>

sets of mutually exclusive choices (inline)

```
<input type="radio" name="cc" value="visa" checked="checked" /> Visa
<input type="radio" name="cc" value="mastercard" /> MasterCard
<input type="radio" name="cc" value="amex" /> American Express
```

HTML



output

- grouped by name attribute (only one can be checked at a time)
- must specify a value for each one or else it will be sent as value on

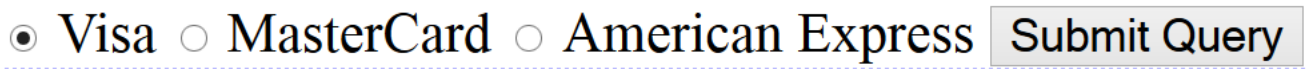
Text labels: <label>

```
<label><input type="radio" name="cc" value="visa"
checked="checked" /> Visa</label>

<label><input type="radio" name="cc" value="mastercard" />
MasterCard</label>

<label><input type="radio" name="cc" value="amex" /> American
Express</label>
```

HTML



output

- associates nearby text with control, so you can click text to activate control
- can be used with checkboxes or radio buttons
- label element can be targeted by CSS style rules

Drop-down list: <select>, <option>

menus of choices that collapse and expand (inline)

```
<select name="favoritecharacter">
  <option>Jerry</option>
  <option>George</option>
  <option selected="selected">Kramer</option>
  <option>Elaine</option>
</select>
```

HTML

- option element represents each choice
- select optional attributes: disabled, multiple, size
- optional selected attribute sets which one is initially chosen

Using <select> for lists

```
<select name="favoritecharacter[]" size="3" multiple="multiple">
  <option>Jerry</option>
  <option>George</option>
  <option>Kramer</option>
  <option>Elaine</option>
  <option selected="selected">Newman</option>
</select>
```

HTML

output

- optional multiple attribute allows selecting multiple items with shift- or ctrl-click
  - must declare parameter's name with [] if you allow multiple selections
- option tags can be set to be initially selected

Option groups: <optgroup>

```
<select name="favoritecharacter">
  <optgroup label="Major Characters">
    <option>Jerry</option>
    <option>George</option>
    <option>Kramer</option>
    <option>Elaine</option>
  </optgroup>
  <optgroup label="Minor Characters">
    <option>Newman</option>
    <option>Susan</option>
  </optgroup>
</select>
```

HTML

Submit Query

output

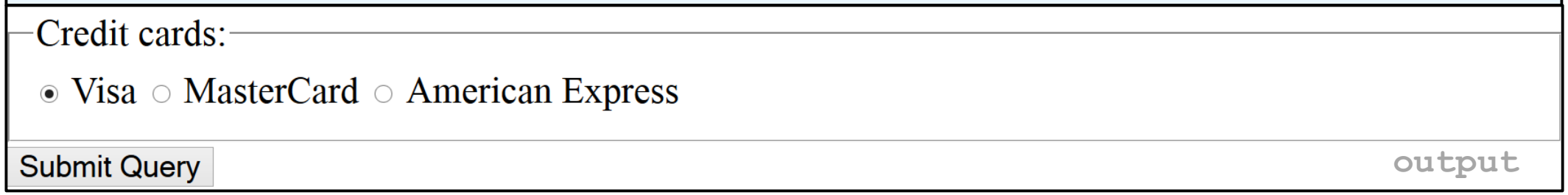
- What should we do if we don't like the bold appearance of the optgroups?

Grouping input: <fieldset>, <legend>

groups of input fields with optional caption (block)

```
<fieldset>
  <legend>Credit cards:</legend>
  <input type="radio" name="cc" value="visa" checked="checked" /> Visa
  <input type="radio" name="cc" value="mastercard" /> MasterCard
  <input type="radio" name="cc" value="amex" /> American Express
</fieldset>
```

HTML



output

- fieldset groups related input fields, adds a border; legend supplies a caption

Styling form controls

```
element[attribute="value"] {
  property : value;
  property : value;
  ...
  property : value;
}
```
CSS

```
input[type="text"] {
  background-color: yellow;
  font-weight: bold;
}
```
CSS

Borat

output

- attribute selector: matches only elements that have a particular attribute value
- useful for controls because many share the same element (input)

More about form controls

```
<select id="captain">
  <option value="kirk">James T. Kirk</option>
  <option value="picard">Jean-Luc Picard</option>
  <option value="cisco">Benjamin Cisco</option>
</select>
<label> <input id="trekkie" type="checkbox" /> I'm a Trekkie
</label>
```

HTML

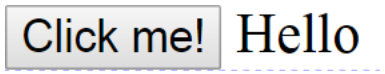
output

- when talking to a text box or `select`, you usually want its `value`
- when talking to a checkbox or radio button, you probably want to know if it's `checked` (true/false)

The innerHTML property

```
<button onclick="addText();">Click me!</button>
<span id="output">Hello </span>
```
HTML

```
function addText() {
  var span = document.getElementById("output");
  span.innerHTML += " bro";
}
```
JS



output

- can change the text inside most elements by setting the `innerHTML` property

Abuse of innerHTML

```
// bad style!
var paragraph = document.getElementById("welcome");
paragraph.innerHTML =
                "<p>text and <a href=\"page.html\">link</a>";
```

JS

- `innerHTML` can inject arbitrary HTML content into the page
- however, this is prone to bugs and errors and is considered poor style
- we forbid using `innerHTML` to inject HTML tags; inject plain text only
  - (later, we'll see a better way to inject content with HTML tags in it)