JavaScript

Lecture 17

CS 638 Web Programming

Overview of lecture

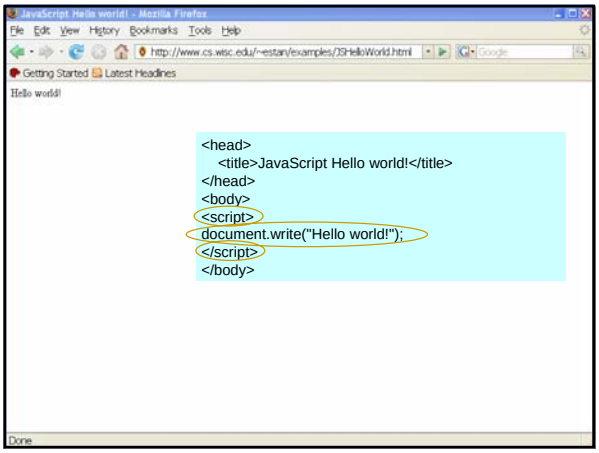
- On client side programming with JavaScript
- The core language
- Arrays
- Objects
- Variables, typing, and scoping

Why is JavaScript important?

- Web pages can contain JavaScript programs executed inside the browser
  - Supported by all major browsers
    - Microsoft's version called Jscript (the language is the same)
  - User may disable JavaScript due to security fears
    - This is default for some newer versions of Internet Explorer
- Client-side programming important for web because
  - Can promptly validate user input
  - Can update the web page without postback to server
  - Allows page to react to user actions other than pushing a "submit" button – more interactivity

What is JavaScript?

- Interpreted, object-oriented programming language with dynamic typing
  - Introduced by Netscape with Netscape 2.0 in 1995
  - Standardized as ECMAScript by ECMA (European Computer Manufacturers Association)
  - Not related to Java other than the name
- Tightly integrated with browser
  - Can handle many types of events generated by the normal interaction between user and browser
  - Can modify the internal objects based on which the browser renders the web page



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Syntax similar to C++

- Statement block delimited by "{" and "}"
- Statements separated by ;
  - If single command per line, the ; can be left out
- Spaces, indentation have no semantic value
- Comments after // or between /* and */
- Identifiers contain $, _, letters and digits
  - Cannot start with a digit
  - Variable names and keywords case sensitive

The if and switch statements

```
if(expression)
  statement

if (expression1)
  statement1
else if (expression2)
  statement2
…
else if (expressionk)
  statementk
else
  catch_all_statement
```

```
switch(n){
case 1: // if n==1
  statements1
  break;
case 2: // if n==2
  statements2
  break;
default: // otherwise
  statements3
}
```

- The case labels can be strings or even expressions

Loops

```
while (expression)
  statement


do
  statement
while (expression);


for (init;test;incr)
  statement
```

- `break` ends the innermost loop or `switch`
- `continue` jumps to the end of loop
- Labels can be used with nested loops

```
outer: for(i=0;i<5;i++){
  for(j=0;j<5;j++){
      a[i][j]++;
      if(a[i][j]<0)
          break outer;
  }
}
```

Functions and exceptions

- Defined as

```
function fname (args){
  statements;
}
```

- Invoked as

```
fname(args)
```

- Execution of function can be terminated with

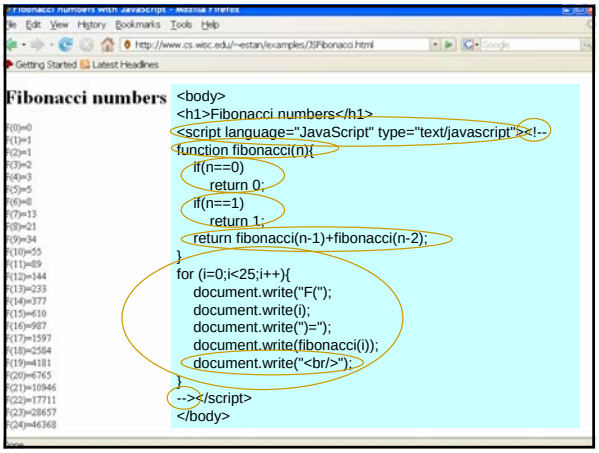
```
return expression;
```

- To throw an exception

```
throw expression;
```

- To catch an exception

```
try{
  statements1
}catch (e){
  statements2
}finally{
  statements3
}
```

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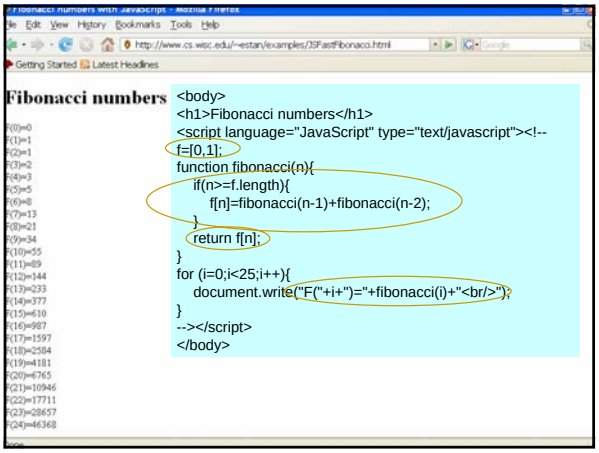
JavaScript Arrays

- Initialized by assigning an array literal `a=[]` or by using constructor `a=new Array(1,2,3)`
- Elements' indices start with 0
- Can grow by assignment to inexistent element
- The `length` property gives length – `a.length`
- Arrays are sparse: `a=['first'];` `a[99]='hundredth'` gives `a` two elements and a `length` of 100
- Special value `undefined` returned when inexistent element read – no exception thrown!



Useful array methods

- `join()` combines elements into a single string
  - Default separator ',' but can specify different one
  - `String.split()` method gives array of substrings
- `reverse()` reverses the order of elements
- `sort()` sorts elements in alphabetic order
- `slice(`*`from`*`,`*`to`*`)` returns elements between indices *`from`* and *`to`*
  - Negative "indices" give distance from end of array
- `pop()` deletes and returns last element
- `push(`*`e`*`)` adds *`e`* to end of array, returns new length
- `shift()` deletes and returns first element (shifts others)
- `unshift(`*`e`*`)` adds *`e`* to beginning of array (shifts others)

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JavaScript objects

- Objects are little more than associative arrays
  - `obj.property` is same as `obj["property"]`
  - To create a new property, just assign to it
  - Object methods are properties whose values are functions
    - They can use the keyword `this` to refer to object
- Prototype-based inheritance (no classes)
  - Object `x` also inherits all properties of `x.prototype`
  - The constructor is just a function that uses the keyword `this` to access the new object
  - "Class properties" simulated with properties of constructor

C# vs. JavaScript objects

```
class Circle{
  private int x,y,radius;
  private const double pi=3.14;
  public Circle(int xc, int yc, int r){
    x=xc;y=yc;radius=r;
  }
  public double getArea(){
    return radius*radius*pi;
  }
  public double getDist(){
    return Math.Sqrt((double)(x*x+y*y));
  }
}
...
  static void Main(string[] args){
    Circle c = new Circle(2,4,3);
    Console.WriteLine("Area is {0}",c.getArea());
    Console.WriteLine("Distance is {0}", c.getDist());
  }
```

```
function Circle(xc,yc,r){
  this.x=xc;
  this.y=yc;
  this.radius=r;
}
Circle.prototype.getArea=function(){
  return this.radius*this.radius*Circle.pi;
}
Circle.prototype.getDist=function(){
  return Math.sqrt(this.x*this.x+this.y*this.y);
}
Circle.pi=3.14;
c=new Circle(2,4,3);
document.write("Area is "+c.getArea()+"<br/>");
document.write("Distance is "+c.getDist()+"<br/>");
```

Traversing an object

The `for/in` loop

```
point={x:2,y:4};
for (p in point)
  document.write(p);
```

- Does not go through inherited properties
- For arrays, the `for/in` loop goes through the indices of elements

The `in` operator

```
point={x:2,y:4};
has_x="x" in point;
has_z="z" in point;
```

- Checks inherited properties
- For arrays, the `in` operator tests whether the element with the given index exists

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Most important types

- Numbers – `15` or `0xff` or `5.19` or `5.7e15`
- Strings – `'abc'` or `"abc"` or `'a\'\nb'`
  - Concatenation using `+`
- Booleans – `true` or `false`
- Functions – `sq=function(x){return x*x;}`
- Arrays – `[1,2,3]` or `['abc',[2,5],8]`
- Objects – `{x:2,y:3}` or `{color:"blue",age:5}`
  - No classes – all objects are of the same type
  - Functions and arrays are also objects

JavaScript variables

- All variables untyped – `x=4;x='xyz';x=[]`
- Variables are either global or local to function
  - No block scope!!!
- Variables are declared using the `var` keyword
  - Assigning to unused name implicitly declares it as a global
  - Reading an undeclared variable causes an error

Types	Passed/copied by	Comparison
boolean, number	value	value
string	immutable	value
object (arrays, functions)	reference	reference

Some JavaScript operators

Operator(s)	Operand type(s)	Operation performed
. [] ()	object, identifier array, integer function, argument	Property access Array index Function call
++,-- !	lvalue bolean	Increment, decrement Logical complement
*,/,%	number, number	Multiplication, division, remainder
+,-	number, number	Addition, subtraction
<<,>>,>>>	integer, integer	Shift operations
<,<=,>,>=	num./string, num./string	Comparisons (numeric or lexicographic)
==,===,!==,!===	any, any	(in)equality, (non)identity
Bitwise operators, boolean operators, conditional operator		
=	lvalue, any	Assignment
+=,-=,*=,…	lvalue, any	Assignment with operation