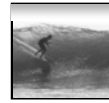




Once Is Not Enough

*Repeating instructions is
the source of great
power in computing*

© 2006, Lawrence Snyder

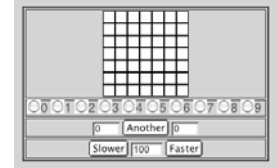
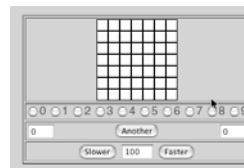


Announcements

Project 2, Part A, Step 3. Aligning the
<input ...> items in the center is OK.

Safari

IE



2

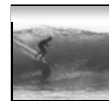


Iteration

"Iteration" is another term for "repeat"

- Iteration doesn't suffer from the question of whether the first item is counted ... in iteration it always is. (Use "repeat" and "iterate" interchangeably unless it matters.)
- Iterating is usually called "looping" in programming
- Programming languages have many kinds of statements to help program loops
- In JS we will use the **for**-statement

3



Sample for-statement

for-statements repeat

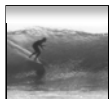
```
for ( i=0; i<7; i++ ) {
    <stuff to be repeated>
}
```

Add 1

Where to stop counting. Number of "reps"

Where to start counting

4



Sample for-statement

for-statements repeat

```
for ( i=0; i<7; i++ ) {
    <stuff to be repeated>
}
```

For example ...

```
for ( i=0; i<7; i++ ) {
    document.write("<img src=RedBox.gif>");
}
```



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Anatomy of for

The **for**-statement syntax

```
for ( <initialize>; <continue test>; <next iteration> ) {
    <statement list>
}
```

for's 3 control specifications -- the "control trio" -- are connected by an iteration variable

- <initialize> -- gives iteration variable its first value
- <continue test> -- this test is performed before starting each cycle of loop; if false, quit
- <next iteration> -- the change to the iteration variable after each cycle

6



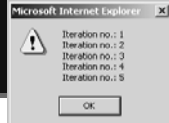
An Iteration

Iterations can count ...

```

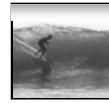
<html><head><title>Test Page</title></head> <body>
<script language="JavaScript">
var i, text = ""; // Initialize text to empty string
for (i=1; i<=5; i=i+1) {
text = text + "Iteration no.: " + i + "\n";
}
alert(text);
</script></body>
</html>

```



Newline in JS

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Iterations Control Actions

Iterations can replicate other things...

```

<html><head><title>Test Page</title></head> <body>
<script language="JavaScript">
var i, text="It's funny!";
for (i=1; i<=3; i=i+1) {
text = text + " Ha!";
}
alert(text);
</script></body>
</html>

```



It is possible to make it a lot funnier by changing the limit variable to, say, i<=1000



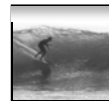
Key Points of Loops

The most important features of loops:

- The starting value of the iteration variable
- The ending value of the iteration variable
- The amount the iteration variable changes

* As explained in the book, it is possible to completely control these features by properly setting the "control trio," but programmers have gotten in the habit of writing a single kind of iteration: WFI

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World Famous Iteration

To loop n times the WFI has this form

```

for ( i=0; i<n; i++) {
  <statement list>
}

```

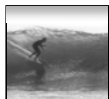
Same as i=i+1

WFI starts at 0, steps by 1, stops (before) n
0, 1, 2, ..., n-1

Advantages:

- Fast to type
- The number of iterations is the number after <
- 0-origin makes it handy for most computations

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"Off By 1" Error

The most common error when working with iterations is to miscount by 1

- Everyone makes this mistake
- A common place where the "off by 1" error matters is in how many times a loop loops
- The importance of the WFI is it tells exactly

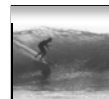
```

for ( i=0; i<n; i++) {
  <statement list>
}

```

Number of iterations

11



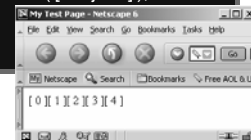
Using Iteration In JS

Print out a row of things

```

<html><head><title>Test Page</title></head> <body>
<script language="JavaScript">
var j;
for (j=0; j<5; j++) {
document.write("[ " + j + " ]");
}
</script></body>
</html>

```



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Doubly Nested Loop

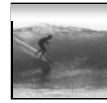
A loop within a loop repeats repetitions

```

<html><head><title>Test Page</title></head> <body>
<script language="JavaScript">
  var i, j;
  for (i=0; i<3; i++) {
    for (j=0; j<5; j++) {
      document.write([' + i + ', ' + j + ' ']);
    }
  }
</script></body>
</html>

```

The new code is shown in white



Arrays and Indexes

We know about names with multiple instances: *Rocky 3*, *QE 2*, *John Paul 2*

- The number is called the name's *index*
- The least index is called the index *origin*
- In programming, variables that can be indexed are called *arrays*
- Declare arrays in JavaScript:
var <identifier> = new Array (<num elements>);
- JavaScript arrays are 0-origin
- Reference array elements w/ brackets: A[0]



Arrays and Loops

Loops and arrays work together

- Declare an array and initialize elements to 8
- ```

var j, A = new Array(5);
for (j=0; j<5; j++) {
 A[j] = 8;
}

```
- five elements:  
A[0], A[1], A[2],  
A[3] & A[4]

WFI and array's indices both start at 0  
Notice what would change to have 1000 elements -- arrays and loops give power

15



## Summary

Iteration is very powerful because a small amount of code specifies a lot of computation

- **for** gives full range of looping limits, steps
- Use any form of **for** that works, but using the WFI is a good habit to adopt
- In a doubly nested loop one iteration has another iteration as its <statement list>
- Arrays are variables with many elements that are referred to by their index

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