Programming

Why is programming fun?

First is the sheer joy of making things. As the child delights in his mud pie, so the adult enjoys building things, especially things of his own design. I think this delight must be an image of God’s delight in making things, a delight shown in the distinctness and newness of each leaf and each snowflake.

Source: Frederick P. Brooks, Jr. The Mythical Man-Month: Essays on Software Engineering

Homework

By today you should have read

* Chapters 20 and 21 in Fluency

Once is Not Enough

Iteration Principles

Iteration: Play It Again, Sam

The process of repetition:

* looping through a series of statements to repeat them

FOR LOOPS

Again and again, and again
Repetition is good

The for Loop Basic Syntax

for (<initialization>; <continuation>; <next iteration>) {
    <statement list>
}

* Text that is not in brackets <> must be given literally
* The whole sequence of statements in the statement list is performed for each iteration
* Computer completes the whole statement sequence of the <statement list> before beginning the next iteration
The Iteration Variable

- Control specification: the three operations in the parentheses of the for loop
  - Control the number of times the loop iterates
  - by using an iteration variable (must be declared)

JavaScript Rules for for Loops (cont'd)

- The World-Famous Iteration
  - JavaScript uses the same for loop statement as other programming languages, so thousands of loops with this structure are written every day:
    ```javascript
    for (j = 0; j < n; j++) {...}
    ```
  - Most frequently written for loop of all time
  - Easy to see iteration count:
    - Always n times

The Iteration Variable (cont'd)

- Example:
  ```javascript
  for (j = 1; j <= 3; j = j + 1) {
  ...
  } 
  ```
  - Here's what happens:
    - The first operation is the <initialization>
      - Sets the iteration variable's value for the first iteration of the loop. Done only once.
    - The next operation is <continuation>
      - Test. If the test has a false outcome, the <statement list> is skipped.
      - If the test has a true outcome, the <statement list> is performed. When the statements are complete, the <next iteration> operation is performed.
    - Repeats with the continuation test, performs same sequence of steps.

How a for Loop Works

- Consider a computation on declared variables j and text
  ```javascript
  text = "She said ";
  for (j = 1; j <= 3; j = j + 1) {
    text = text + "Never! ";
  }
  alert(text); 
  ```

How a for Loop Works

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JavaScript Rules for for Loops

• The Iteration Variable: j = 1;
  * Must be declared, and follow rules for variable identifiers
  * i, j, and k are the most common choices

• The Starting Point
  * Iteration can begin anywhere, including negative numbers

• Continuation/Termination Test  j <= 3
  * Test is any expression resulting in a Boolean value (true/false)
  * Continuation must involve iteration variable to avoid infinite loop

• Step Size  j = j + 1
  * Amount of change from one iteration to the next
  * Often called the increment or decrement

Experiments with Flipping Coins

• To practice for loops, we experiment with flipping electronic coins
  * We can use the function randNum(2), which returns either 0 (tails) or 1 (heads)
  * Set up an iteration in which our randNum() function is performed 100 times, and statistics gathered
Experiments with Flipping Coins

• **A Nested Loop**
  - To run several trials, consider the entire loop we just looked at as one Trial
  - Create another `for` loop containing this Trial unit, adding a couple of needed statements
  - We have a loop within a loop (nested loop) which causes the Trial loop (0-99) to run five times

Experiments with Flipping Coins

• **A Diagram of Results**
  - To show how far off a perfect 50-50 score a trial is, display with diagram
  - Compute the distance from 50-50 and show that number using asterisks
    ```javascript
    var heads = 0, tails = 0;
    //Iteration vars
    for (i = 0; i < 100; i++) {
        //Trial line 1
        for (j = 0; j < 5; j++){
            //Trial line 2
            if (randNum(2) == 1)
                //Trial line 3
                heads++;
            else
                //Trial line 4
                tails++;
        }
        alert("Heads: " + heads + " and Tails: " + tails);
        //Trial line 5
        function randNum(range) {
            return Math.floor(range*Math.random());
        }
        //Trial line 6
    }
    //Additional
    alert("Heads: " + heads + " and Tails: " + tails);
    //Outer loop end
    ```
  - Demo....

Experiments with Flipping Coins

• **Demo...**
Indexing

- Process of creating a sequence of names by associating a base name with a number (like Apollo 13 or Henry VIII)
  - Each indexed item is called an element of the base-named sequence
- Index Syntax
  - Index number is enclosed in square brackets \([\ ]\)
- Iterations can be used to refer to all elements of a name
  - \(A[j]\) for successive iterations over \(j\) referring to different elements of \(A\)

Indexing (cont'd)

- Index Origin
  - The point at which indexing begins (the least index)
  - In life, the first element may begin with 1, or have no number (Queen Elizabeth)
  - JavaScript always uses index origin 0

Rules for Arrays

- Arrays are normal variables initialized by:
  ```javascript
  new Array (<number of elements>);
  ```
- \(<\text{number of elements}>\) is number of items in array
- Array indexing begins at 0
- Greatest index is \(<\text{number of elements}> - 1\)
- Number of elements is array length
- Index values range from 0 to (length - 1)

Array Reference Syntax

- Array reference is array name together with index enclosed in brackets (non-negative integer or expression or variable that resolves to non-negative integer)
  ```javascript
  array[i]
  ```
- World-Famous Iteration, or 0-origin loop iteration, is perfect for arrays

JavaScript Rules for for Loops (cont'd)

- The World-Famous Iteration for looping through an array:
  ```javascript
  for ( i = 0; i < fruits.length; i++ )
  {
    alert(fruits[i]);
  }
  ```
  - \(\text{.length}\) is a built-in JavaScript property that always gives you the length of an array.

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Reflections

- Write for 10 minutes on this topic:
  - First describe and then compare and contrast:
    - Dante and
    - The Students server
  - Be sure to answer these questions:
    - How are they connected?
    - How do you access each one?
Homework

• Read Fluency chapter 22 for Friday!
• Quiz 4 Thursday and Friday
  * See email for details on what to review