For Loops

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The `for` Loop

- Another loop statement, **`for`**, is best for when you can determine in advance how many times you need to execute the loop (counting loop).
- The **`for`** statement includes the three parts needed for loops: initialize, test, and update.
  - All this information is conveniently placed at the beginning of the loop.
- All three loop statements (`while`, `do`, and `for`) are functionally equivalent.

The `for` statement

- The form of the **`for`** statement is

  `for` (*<initialize>*; *<boolean_expression>; <update>*)
  <statement>

- First, the *initialize* statement is executed.
- If *boolean_expression* evaluates to `true`, then *statement* (body of loop) is executed, followed by the *update* statement.
- The loop repeats until the *boolean_expression* evaluates to `false`.

The `for` statement

- The form of the **`for`** statement is

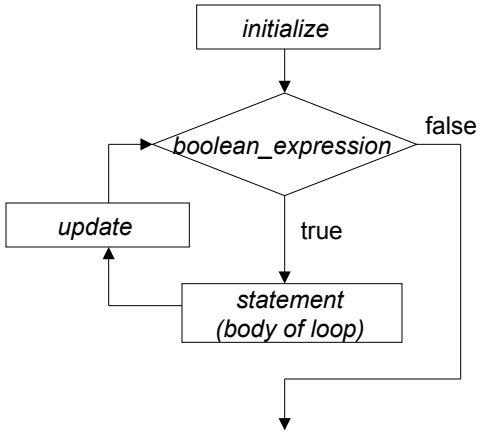
  `for` (*<initialize>*; *<boolean_expression>; <update>*)
  <statement>

- It is equivalent to

```
<initialize>;
while (<boolean_expression>) {
    <statement>
    <update>;
}
```

executed after *statement (body of loop)*

The `for` Flowchart



A `for` Loop Example

```
int sum = 0;
for (int i = 1; i <= n; i++) {
    sum += i*i;
}
System.out.println(sum);
```

Which variable is the loop control variable?

n = 4

sum	i	
0		
	1	< i <= n ?
1		
	2	< i <= n ?
5		
	3	< i <= n ?
14		
	4	< i <= n ?
30		
	5	< i <= n ?

Another `for` Loop Example

```
int sum = 0;
for (int i = 1; i <= n; i+=3) {
    sum += i;
}
System.out.println(sum);
```

n = 11

sum	i	
0		
	1	< i <= n ?
1		
	4	< i <= n ?
5		
	7	< i <= n ?
12		
	10	< i <= n ?
22		
	13	< i <= n ?

Scope

- The ***scope*** of a variable is the area within a program that can reference the variable.
- The scope depends on where the variable is declared.

```
int sum = 0;
for (int i = 1; i <= n; i++) {
    sum += i*i;
}
System.out.println(sum);
```

Scope of variable **`i`**

Scope

```
int sum = 0;
int i;
for (i = 1; i <= n; i++) {
    sum += i*i;
}
System.out.println("Sum of first " + (i-1)
       + " integers squared is " + sum);
```

Scope of variable **i**

Nested Loops

- A loop can have another loop inside of it.
- For each iteration of the outside loop, the inside loop runs completely.
- Often it is easiest to read from the inside out.
- Example:

How many lines are printed?

```
for (int i = 1; i <= 5; i++) {
   for (int j = 1; j <= 3; j++) {
      System.out.println(i + " " + j);
   }
}
```

What happens if we write println(i + j)?

Palindromes

- A *palindrome* is word, phrase, or sequence that reads the same backwards as forwards.
- Example: Bob by Weird Al Yankovic

  (A parody of Bob Dylan's Subterranean Homesick Blues)

  http://www.youtube.com/watch?v=Nej4xJe4Tdg

How would you test whether a string is a palindrome?

Which Loops?

- `for` loops are more natural when we know how many iterations we need (*definite* or *counting* loops).

  Examples:
  - Print "*" 10 times
  - Print the even numbers between 10 and the value of n
- `while` and `do` loops are more natural when we want to keep looping until some outcome (*indefinite* or *result controlled* loops).

  Examples:
  - Prompt the user **until** the user inputs the data in the correct form.
  - Continue looping **until** we reached a million dollars.