

The `for` loop

Repetition with `for` loops

- So far, repeating a statement is redundant:

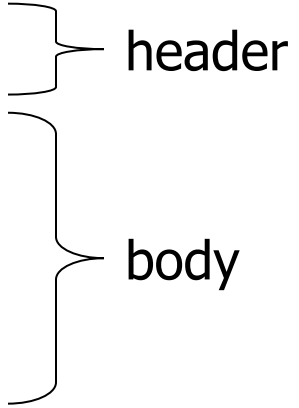
```
System.out.println("Homer says:");  
System.out.println("I am so smart");  
System.out.println("I am so smart");  
System.out.println("I am so smart");  
System.out.println("I am so smart");  
System.out.println("S-M-R-T... I mean S-M-A-R-T");
```

- Java's **`for loop`** statement performs a task many times.

```
System.out.println("Homer says:");  
for (int i = 1; i <= 4; i++) {    // repeat 4 times  
    System.out.println("I am so smart");  
}  
System.out.println("S-M-R-T... I mean S-M-A-R-T");
```

for loop syntax

```
for (initialization; test; update) {  
    statement;  
    statement;  
    ...  
    statement;  
}
```



header

body

- Perform **initialization** once.
- Repeat the following:
 - Check if the **test** is true. If not, stop.
 - Execute the **statements**.
 - Perform the **update**.

Initialization

```
for (int i = 1; i <= 6; i++) {  
    System.out.println("I am so smart");  
}
```

- Tells Java what variable to use in the loop
 - Performed once as the loop begins
 - The variable is called a *loop counter*
 - can use any name, not just `i`
 - can start at any value, not just `1`

Test

```
for (int i = 1; i <= 6; i++) {  
    System.out.println("I am so smart");  
}
```

- Tests the loop counter variable against a limit
 - Uses comparison operators:
 - < less than
 - <= less than or equal to
 - > greater than
 - >= greater than or equal to

Increment and decrement

shortcuts to increase or decrease a variable's value by 1

Shorthand

variable++;

variable--;

```
int x = 2;
```

```
x++;
```

```
double gpa = 2.5;
```

```
gpa--;
```

Equivalent longer version

variable = **variable** + 1;

variable = **variable** - 1;

```
// x = x + 1;
```

```
// x now stores 3
```

```
// gpa = gpa - 1;
```

```
// gpa now stores 1.5
```

Modify-and-assign

shortcuts to modify a variable's value

Shorthand

variable += **value**;

variable -= **value**;

variable *= **value**;

variable /= **value**;

variable %= **value**;

Equivalent longer version

variable = **variable** + **value**;

variable = **variable** - **value**;

variable = **variable** * **value**;

variable = **variable** / **value**;

variable = **variable** % **value**;

x += 3;

gpa -= 0.5;

number *= 2;

// x = x + 3;

// gpa = gpa - 0.5;

// number = number * 2;

Repetition over a range

```
System.out.println("1 squared = " + 1 * 1);  
System.out.println("2 squared = " + 2 * 2);  
System.out.println("3 squared = " + 3 * 3);  
System.out.println("4 squared = " + 4 * 4);  
System.out.println("5 squared = " + 5 * 5);  
System.out.println("6 squared = " + 6 * 6);
```

– Intuition: "I want to print a line for each number from 1 to 6"

- The `for` loop does exactly that!

```
for (int i = 1; i <= 6; i++) {  
    System.out.println(i + " squared = " + (i * i));  
}
```

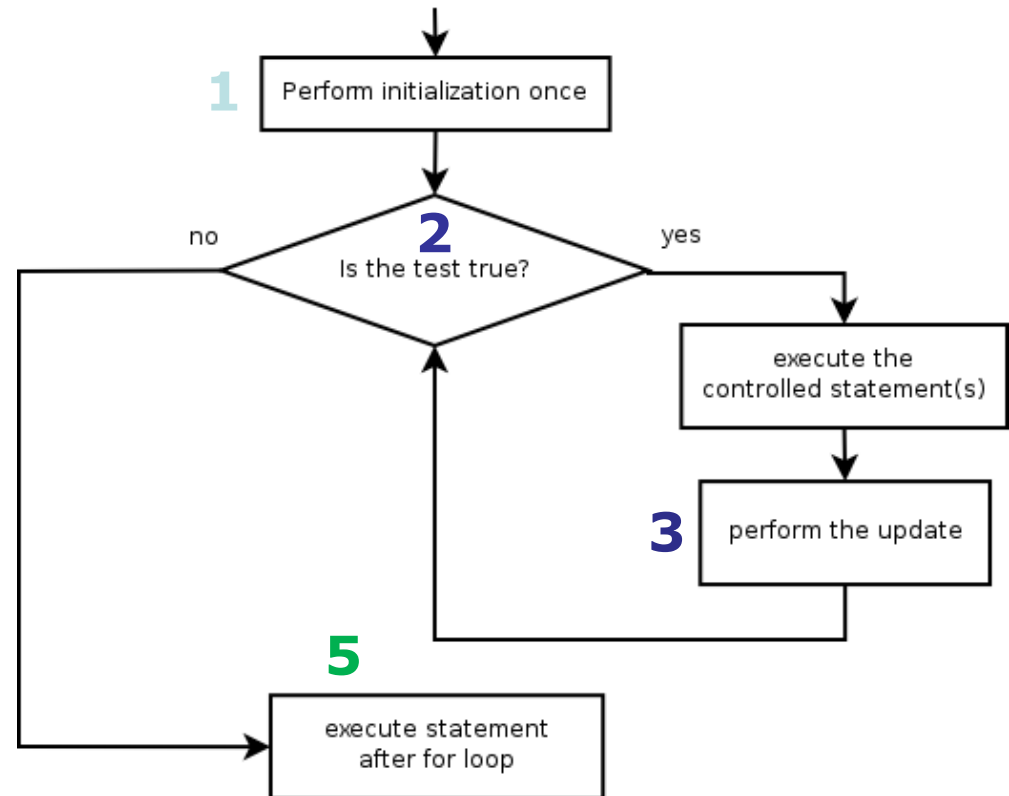
– "For each integer `i` from 1 through 6, print ..."

Loop walkthrough

```
for (int i = 1; i <= 4; i++) {  
    System.out.println(i + " squared = " + (i * i));  
}  
5 System.out.println("Whoo!");
```

Output:

```
1 squared = 1  
2 squared = 4  
3 squared = 9  
4 squared = 16  
Whoo!
```



Multi-line loop body

```
System.out.println("+-----+");  
for (int i = 1; i <= 3; i++) {  
    System.out.println("\\      /");  
    System.out.println("/      \\");  
}  
System.out.println("+-----+");
```

– Output:

```
+-----+  
\\      /  
/      \  
\\      /  
/      \  
\\      /  
/      \  
+-----+
```

Expressions for counter

```
int highTemp = 5;  
for (int i = -3; i <= highTemp / 2; i++) {  
    System.out.println(i * 1.8 + 32);  
}
```

– Output:

26.6
28.4
30.2
32.0
33.8
35.6

System.out.print

- Prints without moving to a new line
 - allows you to print partial messages on the same line

```
int highestTemp = 5;
for (int i = -3; i <= highestTemp / 2; i++) {
    System.out.print((i * 1.8 + 32) + "  ");
}
```

- Output:

26.6 28.4 30.2 32.0 33.8 35.6

- Concatenate " " to separate the numbers

Counting down

- The **update** can use `--` to make the loop count down.
 - The **test** must say `>` instead of `<`

```
System.out.print("T-minus ");
for (int i = 10; i >= 1; i--) {
    System.out.print(i + ", ");
}
System.out.println("blastoff!");
System.out.println("The end.");
```

– Output:

```
T-minus 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, blastoff!
The end.
```