Looping

CSE 142, Summer 2003

Computer Programming 1

http://www.cs.washington.edu/education/courses/142/03su/

Readings and References

- Reading
  - » Chapter 12, *Intro to Programming and Object-Oriented Design Using Java*, Niño and Hosch
- Other References
  - » The Java Language Specification

    http://java.sun.com/docs/books/jls/
  - » The Oracle

Bacon:	http://www.cs.virginia.edu/oracle/
Stars:	http://www.cs.virginia.edu/oracle/star_links.html
Baseball:	http://www.baseball-reference.com/oracle/

What is a loop?

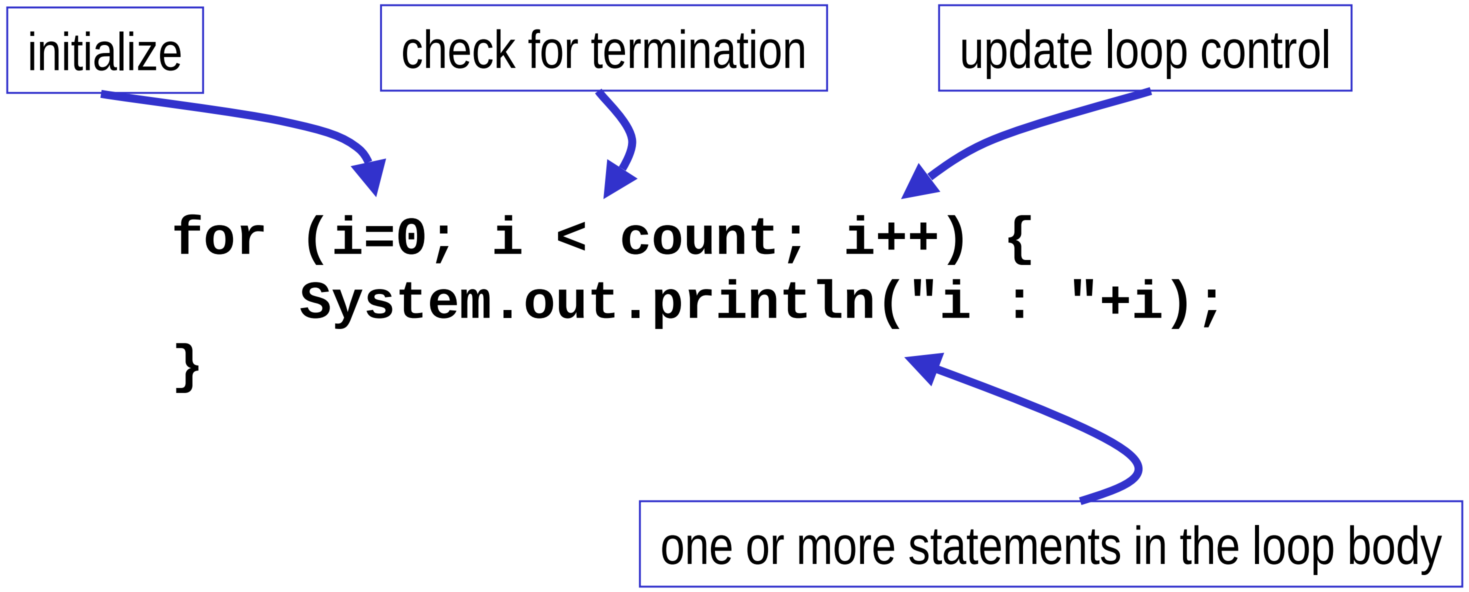
- Loop - some definitions from dictionary.com
  - » Something having a shape, order, or path of motion that is circular or curved over on itself.
  - » A segment of film or magnetic tape whose ends are joined, making a strip that can be continuously replayed.
  - » Computer Science. A sequence of instructions that repeats either a specified number of times or until a particular condition is met.

Why do we want loops in our code?

- Do something for a given number of times or for every object in a collection of objects
  - » for every Acrobat in the list, ask them to clap
  - » for every shape in the blob, move the shape
  - » find the classroom with the most seats
  - » calculate the average action count for all Acrobats
  - » make a list of all movies that Kevin Bacon has appeared in with Harrison Ford
- *Termination* of some loops is *based on a count*

The **`for`** loop

- A counting loop is usually implemented with **`for`**
  - » The **`for`** statement is defined in section 14.13 of the Java Language Specification



```
for (i=0; i < count; i++) {
    System.out.println("i : "+i);
}
```

`for` example

- a counting loop implemented with **`for`**

can declare variable here
or use existing variable

check for termination
i runs from 0 to 19

update loop control
shorthand for **`i=i+1;`**

```
for (int i=0; i<20; i++) {
    testB.grow();
}
```

limited life of a loop control variable

- The scope of a local variable declared in the ForInit part of a for statement includes all of the following:
  - » Its own initializer
  - » Any further declarators to the right in the ForInit part of the for statement
  - » The Expression and ForUpdate parts of the for statement
  - » The contained Statement

from Java Language Specification, section 6.3

some shortcuts

- **`i++`**
  - » `theAnimal = pets.get(i++);`
  - » get the value of i for use in the call to get(int), then increment i and store the incremented value
  - » This is known as post-increment
- **`++i`**
  - » `theAnimal = pets.get(++i);`
  - » get the value of i, increment it, set a copy aside for the call to get(int) and store incremented value in i
  - » This is known as pre-increment

compound assignment operators

- can shorten statements like this
  - » from this: **`a = a + b;`**
  - » to this: **`a += b;`**

- Any time the left hand side is repeated on the right hand side as a simple operand you can use a compound assignment operator

```
step = step / 2;      ⇔     step /= 2;
area = area * factor  ⇔     area *= factor;
```

Multiplication Table Specification

- Specification
  - » provide a method that prints a multiplication table
  - » method takes two integer parameters
    - row count
    - column count
  - » use System.out.println to display the table

A Simple Implementation

```
/**
 * Print a table of multiplied values.
 * @param m number of rows in the table
 * @param n number of columns in the table
 */
public void multA(int m, int n) {
  // for each row
  for (int i=0; i<=m; i++) {
    // for each column
    for (int j =0; j<=n; j++) {
      System.out.print((i*j)+" ");
    }
    System.out.println();
  }
}
```

Why do we want loops in our code?

- Keep doing something until we arrive at a termination condition
  - » read until the end of an input command file
  - » search the disk until we find a requested file
  - » read packets from the network until all information for a web page has been read in
  - » remove items from a request queue and process them until the queue is empty
- *Termination* of some loops is *based on a condition*

The **`while`** loop

- condition loop is usually implemented with **`while`**
  - » The **`while`** statement is defined in section 14.11 of the Java Language Specification

initialize

check for termination

```
periods = 0;
toDate = base;
while (toDate < goal) {
    toDate = toDate+(toDate*rate);
    periods = periods+1;
}
```

one or more statements in the loop body

Note: reaching a limit by counting is satisfying a condition.
`for` loops can be rewritten as **`while`** loops, and vice versa

`while` example

- a condition loop implemented with **`while`**

check for termination
indeterminate

any variable can be part
of the controlling condition

update loop control
operation of the loop
causes changes that
will eventually cause
loop to terminate

```
boolean atEndOfFile = false;
while (!atEndOfFile) {
        read another line and set atEndOfFile if appropriate
        process the new line if needed
}
```

body of loop may not execute at all

- Notice that depending on the values of the control variables, it is quite possible that the body of the loop will not execute at all in both **`for`** and **`while`**

check for termination
`toDate` is already greater than **`goal`**, and so the entire loop is skipped

```
goal = 75;
...
periods = 0;
toDate = 100;
while (toDate < goal) {
    toDate += toDate*rate;
    periods++;
}
```