CS100J   October 07, 2003
Loops

Repetitive statements, or **iterative statements**, or **loops**

Start reading chapter 7 on loops.
The lectures on the ProgramLive CD can be a big help.

"O! Thou hast damnable iteration and art, indeed, able to corrupt a saint." Shakespeare, *Henry IV*, Pt I, 1 ii

"Use not vain repetition, as the heathen do." *Matthew* V, 48

Your "if" is the only peacemaker; much virtue if "if". Shakespeare, *As You Like It*.

1

The while loop

System.out.println(5*5);
System.out.println(6*6);
System.out.println(7*7);
System.out.println(8*8);

int k= 5;
while (k != 9) {
    System.out.println(k*k);
    k= k+1;
}

To execute the while loop:

(1) Evaluate condition k != 9;
    if false, stop execution.

(2) Execute the repetend.

(3) Repeat again from step (1).

Repetend: the thing to be repeated. The block:
    {
    …
    }

2

The while loop

int k= 5;
while (k != 9) {
    System.out.println(k*k);
    k= k+1;
}

To execute the while loop:

(1) evaluate condition k != 9;
if it is false, stop execution.

(2) Execute the repetend.

(3) Repeat again from step (1).

Trace execution of the loop: Section 7.1.2 shows you how to "trace" execution of a loop, showing the values of variables as you go. STUDY THIS SECTION!

3

The while loop: syntax

while (<condition>)
    <repetend>

<condition>: a boolean expression.

<repetend>: a statement.

while (<condition> {
    sequence of declarations
    and statements
}

BUT: We always make the <repetend> a block.

4

What value of x or n makes this assertion true?

x is the sum of 1..n

x		n	1
x		n	3
x		n	4
x		n	0
x	0	n	

h..k is the set of values

    h, h+1, h+1, …, k.

Example: 3..6 is 3, 4, 5, 6.

In this notation, we require h ≤ k−1.

h..h−1 is the empty set.

What's simplest solution to this? Make the range 1..n as small as possible.

| x | | n | |

5

Understanding assertions

What value of d makes this assertion true?

m [1] d [   ]

d is the number of days before month m

Below, write in English what has to be done to d so that the final assertion is true. Make it a COMMAND to do something

// { d is the number of days before month m and m is in 1..11 }

m= m + 1;

// { d is the number of days before month m and m is in 2..12 }

m [?]

d [?]

h..k is the set of values   h, h+1, h+1, …, k.
In this notation, we require h ≤ k−1.   h..h−1 is the empty set.

6

Understanding assertions

What value of m makes this assertion true?

d is the number of days before month m   m [   ]   d [31]

Below, write in English what has to be done to d so that the final assertion is true. Make it a COMMAND to do something

// { d is the number of days before month m and m is in 1..11 }

m= m + 1;

m [?]

d [?]

// { d is the number of days before month m and m is in 2..12 }

h..k is the set of values   h, h+1, h+1, …, k.
In this notation, we require h ≤ k–1.   h..h–1 is the empty set.

7

Understanding assertions

What value of x makes this assertion true?

b		x	
b	**false**	x	1
b	[ ]	x	16
b	[ ]	x	10

b = "some value in 5..9 divides x"

Below, fill in the assignments so that the assertion is true afterward.

k=   ;

b=   ;   b [ ]   x [?]

// { b = "some value in 2..k divides x" }   k [ ]

h..k is the set of values   h, h+1, h+1, …, k.
In this notation, we require h ≤ k–1.   h..h–1 is the empty set.

8

Understanding assertions

Fill in the space after the assignment to k with an if-statement so that the assertion remains true after execution.

// { b = "some value in 2..k divides x" }

k= k + 1 ;

Make up an example, if it helps, but learn to work in this more abstract setting

b [?]   x [?]

// { b = "some value in 2..k divides x" }   k [?]

h..k is the set of values   h, h+1, h+1, …, k.
In this notation, we require h ≤ k–1.   h..h–1 is the empty set.

9

Understanding assertions

// { nothing has been printed }

k=   ;

// {squares of 5..k-1 printed}

Fill in the assignments on this page so that the assertions following them are true.

k=   ;

// {All chars in String s[0..k–1] are '$'}

// { k ≥ 1 }

k=   ;

c=   ;

// // {c is the smallest character in s[0..k–1]}

Hint: make the range 0..k–1 as small as possible

10

Understanding assertions

Suppose this assertion is true:

    x = sum of 1..k

Under what extra condition is this one true?

    x = sum of 1..n

Put your answer here

Suppose this assertion is true:

    x = sum of h..10

Under what extra condition is this one true?

    x = sum of 1..10

Put your answer here

Suppose this assertion is true:

    no value in h..k divides x

Under what extra condition is this one true?

    no value in 2..n–1 divides x

Put your answer here

11

Understanding assertions

```
   0 1 2 3 4 5 6 7 8
v  X Y Z X A C Z Z Z
```
This is a Vector of Characters

```
   0    3    k       8
v  | ≥ C | ? | all Z's |   k  6
```

*This is an assertion about v and k. It is **true** because chars of v[0..3] are greater than 'C' and chars of v[6..8] are 'Z's.*

```
   0    3    k       8
v  | ≥ C | ? | all Z's |   k  5
```

```
   0       k        8
v  | ≥ C     | all Z's |   k  6
```

```
   0       k        8
v  | ≥ W | A|C | all Z's |   k  4
```

Indicate whether each of these 3 assertions is true or false.

12