

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*.

The while loop

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

To execute the while loop:

- (1) Evaluate condition $k \neq 9$; if false, stop execution.
- (2) Execute the repetend.
- (3) Repeat again from step (1).

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

Repetend: the thing to be repeated. The block:

```
{
...
}
```

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 $k \neq 9$; 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!

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.

Understanding assertions

What value of x or n makes this assertion true?

x is the sum of 1..n x 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 $h \leq k-1$.
h..h-1 is the empty set.

x n

x n

x n

x n

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

x n

Understanding assertions

What value of d makes this assertion true?

d is the number of days before month m m d

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

d m

h..k is the set of values h, h+1, h+1, ..., k.
In this notation, we require $h \leq k-1$. h..h-1 is the empty set.

Understanding assertions

What value of m makes this assertion true?

d is the number of days before month m m d

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

```

h..k is the set of values h, h+1, h+1, ..., k.
In this notation, we require $h \leq k-1$. **h..h-1** is the empty set.

Understanding assertions

What value of x makes this assertion true?

b x

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

b x

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

```
k =  ;
b =  ;
// { 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 $h \leq k-1$. **h..h-1** is the empty set.

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 $h \leq k-1$. **h..h-1** is the empty set.

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

Understanding assertions

Suppose this assertion is true:
x = sum of 1..k
Under what extra condition is this one true?
Put your answer here

Suppose this assertion is true:
x = sum of h..10
Under what extra condition is this one true?
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

Understanding assertions

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

```
0 3 k 8
v [ ≥ C ? all Z's ] k 
```

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 
```

```
0 k 8
v [ ≥ C all Z's ] k 
```

```
0 k 8
v [ ≥ W A C all Z's ] k 
```

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