

**CS100J October 21, 2003**

**For Loops**

**Reading: Secs 7.5-7.6**

Q1, Q2, and A2 are in the Carpenter basement, to be picked up when a consultant is there.

**Quote for the Day:**

Perhaps the most valuable result of all education is the ability to make yourself do the thing you have to do, when it ought to be done, whether you like it or not; it is the first lesson that ought to be learned; and however early a man's training begins, it is probably the last lesson that he learns thoroughly.

Thomas Henry Huxley

1825 - 1895

Technical Education, 1877

## The for-loop

```
// {n >= 0}
int k= 1;
x= 0;
// inv: x = sum of 1..(k-1)
while (k != 20) {
    x= x + k;
    k= k+1;
}
// x = sum of 1..19
```

**k** is a **loop counter**. Initialized before the loop and changed only in the last statement of the repetend of the while-loop

## The for loop

```
// {n >= 0}
```

```
int k= 1;
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x= 0;
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```
// inv: x = sum of 1..(k-1)
```

```
while (k != 20) {
```

```
    x= x + k;
```

```
    k= k+1;
```

```
}
```

```
// x = sum of 1..19
```

```
// {n >= 0}
```

```
x= 0;
```

```
// inv: x = sum of 1..(k-1)
```

```
for (int k = 1; k != 20; k= k+1) {
```

```
    x= x + k;
```

```
}
```

```
// x = sum of 1..19
```

**k is a loop counter.** Initialized before the loop and changed only in the last statement of the repetend of the while-loop

## Syntax and semantics of the for loop

```
for ( initialization ; condition ; progress ) {  
    repetend  
}
```

**meaning of for-loop:**

initialization

```
while ( condition ) {
```

*repetend*

*progress*

```
}
```

```
x= 0;  
// inv: x = sum of 1..(k-1)  
for (int k = 1; k != 20; k= k+1) {  
    x= x + k;  
}  
// x = sum of 1..19
```

**k is a loop counter.** Initialized before the loop and not changed in the repetend of the for-loop.

## Scope of the counter of a for-loop

```
x= 0;
int k= 1;
// inv: x = sum of 1..(k-1)
while (k != 20) {
    x= x + k;
    k= k + 1;
}
// x = sum of 1..19
System.out.println(k);
```

```
x= 0;
// inv: x = sum of 1..(k-1)
for ( int k = 1; k != 20; k= k+1) {
    x= x + k;
}
// x = sum of 1..19
System.out.println(k);
```

Illegal: Scope of k  
is only the loop.

## A for-loop schema to process a range of integers

```
// Process m..n  
// inv: m..k-1 has been processed  
      and  $m \leq k \leq n+1$   
for (int k= m; k <= n; k= k+1) {  
    Process k;  
}  
// Post: m..n has been processed
```

## Use the schema to count number of 'e's in a string

```
// Process m..n
// inv: m..k-1 processed, m <= k <= n+1
for (int k= m; k <= n; k= k+1) {
    Process k;
} // Post: m..n processed
```

```
// Store in x the no. of 'e's in s[0..s.length()-1]
// inv: m..k-1 processed, m <= k <= n+1
for (int k= m; k <= n; k= k+1) {
    Process k;
} // Post: m..n processed
```

Example:

s = "sequioa", x = 1

s = "defense", x = 2

m:

n:

## Which loop condition do you like better?

```
// Process 0..n
k= 1;
// inv: 0..k-1 processed, 0 <= k <= n+1
while (k <= n) {
    Process k;
    k= k+1;
}
// post: 0..n processed
```

```
// Process 0..n
k= 1;
// inv: 0..k-1 processed, 0 <= k <= n+1
while (k != n+1) {
    Process k;
    k= k+1;
}
// post: 0..n processed
```