Chapter 4: Loops and Iteration

CS1: Java Programming
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Motivations

Suppose that you need to print a string (e.g., "Welcome to Java!") a hundred times. It would be tedious to have to write the following statement a hundred times:

```
System.out.println("Welcome to Java!");
```

So, how do you solve this problem?

Opening Problem

Problem:

100 times

```
System.out.println("Welcome to Java!");
System.out.println("Welcome to Java!");
System.out.println("Welcome to Java!");
System.out.println("Welcome to Java!");
System.out.println("Welcome to Java!");
System.out.println("Welcome to Java!");


…

…

…
System.out.println("Welcome to Java!");
System.out.println("Welcome to Java!");
System.out.println("Welcome to Java!");
```

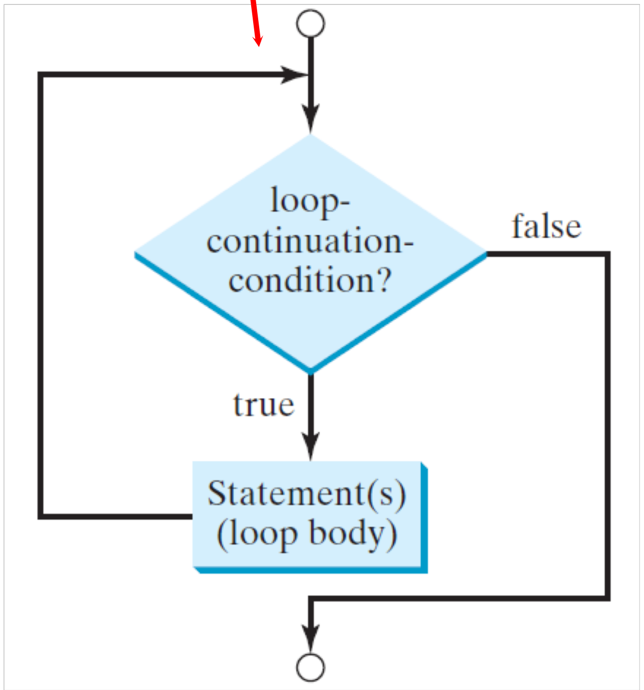
Introducing while Loops

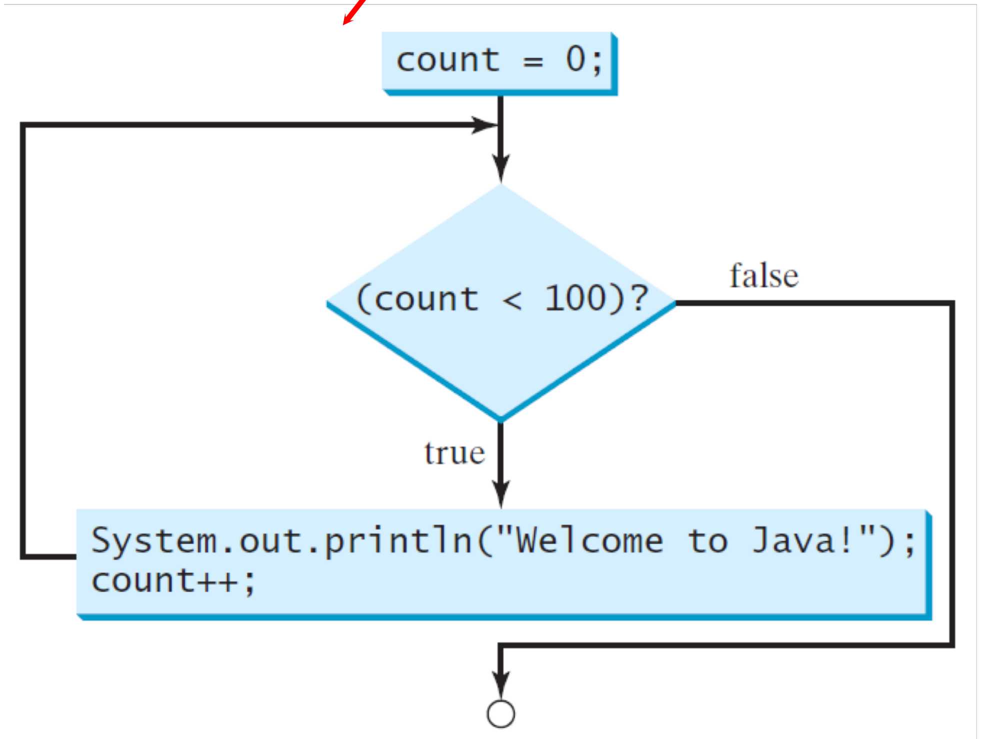
```
int count = 0;
while (count < 100) {
  System.out.println("Welcome to Java");
  count++;
}
```

`while` Loop Flow Chart

```
while (loop-continuation-condition) {
  // loop-body;
  Statement(s);
}
```

```
int count = 0;
while (count < 100) {
  System.out.println("Welcome to Java!");
  count++;
}
```





```
count = 0;
(count < 100)?
System.out.println("Welcome to Java!");
count++;
```

animation

Trace while Loop

Initialize count

```
int count = 0;
while (count < 2) {
  System.out.println("Welcome to Java!");
  count++;
}
```

animation

Trace while Loop, cont.

(count < 2) is true

```
int count = 0;
while (count < 2) {
  System.out.println("Welcome to Java!");
  count++;
}
```

animation

Trace while Loop, cont.

```
int count = 0;
while (count < 2) {
  System.out.println("Welcome to Java!");
  count++;
}
```

Print Welcome to Java

animation

Trace while Loop, cont.

```
int count = 0;
while (count < 2) {
 System.out.println("Welcome to Java!");
 count++;
}
```

Increase count by 1
count is 1 now

animation

Trace while Loop, cont.

```
int count = 0;
while (count < 2) {
  System.out.println("Welcome to Java!");
  count++;
}
```

(count < 2) is still true since count is 1

animation

Trace while Loop, cont.

```
int count = 0;
while (count < 2) {
  System.out.println("Welcome to Java!");
  count++;
}
```

Print Welcome to Java

animation

Trace while Loop, cont.

```
int count = 0;
while (count < 2) {
  System.out.println("Welcome to Java!");
  count++;
}
```

Increase count by 1
count is 2 now

animation

Trace while Loop, cont.

(count < 2) is false since count is 2 now

```
int count = 0;
while (count < 2) {
  System.out.println("Welcome to Java!");
  count++;
}
```

animation

Trace while Loop

```
int count = 0;
while (count < 2) {
  System.out.println("Welcome to Java!");
  count++;
}
```

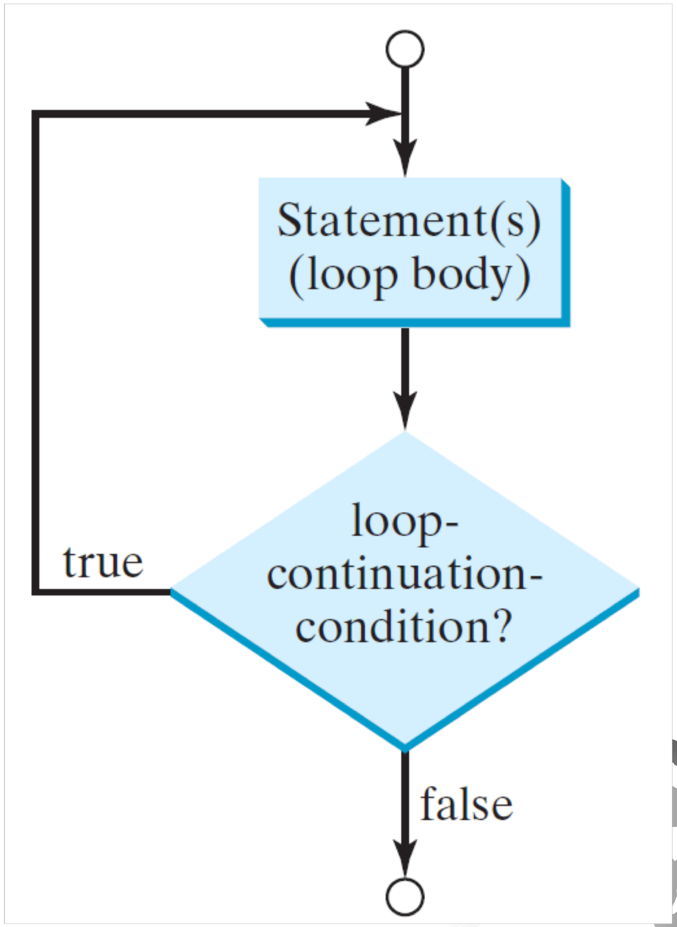
The loop exits. Execute the next statement after the loop.

Caution

Don’t use floating-point values for equality checking in a loop control. Since floating-point values are approximations for some values, using them could result in imprecise counter values and inaccurate results. Consider the following code for computing 1 + 0.9 + 0.8 + ... + 0.1:

```
double item = 1; double sum = 0;
while (item != 0) { // No guarantee item will be 0
  sum += item;
  item -= 0.1;
}
System.out.println(sum);
```

do-while Loop



```
do {
  // Loop body;
  Statement(s);
} while (loop-continuation-condition);
```

Your Turn!

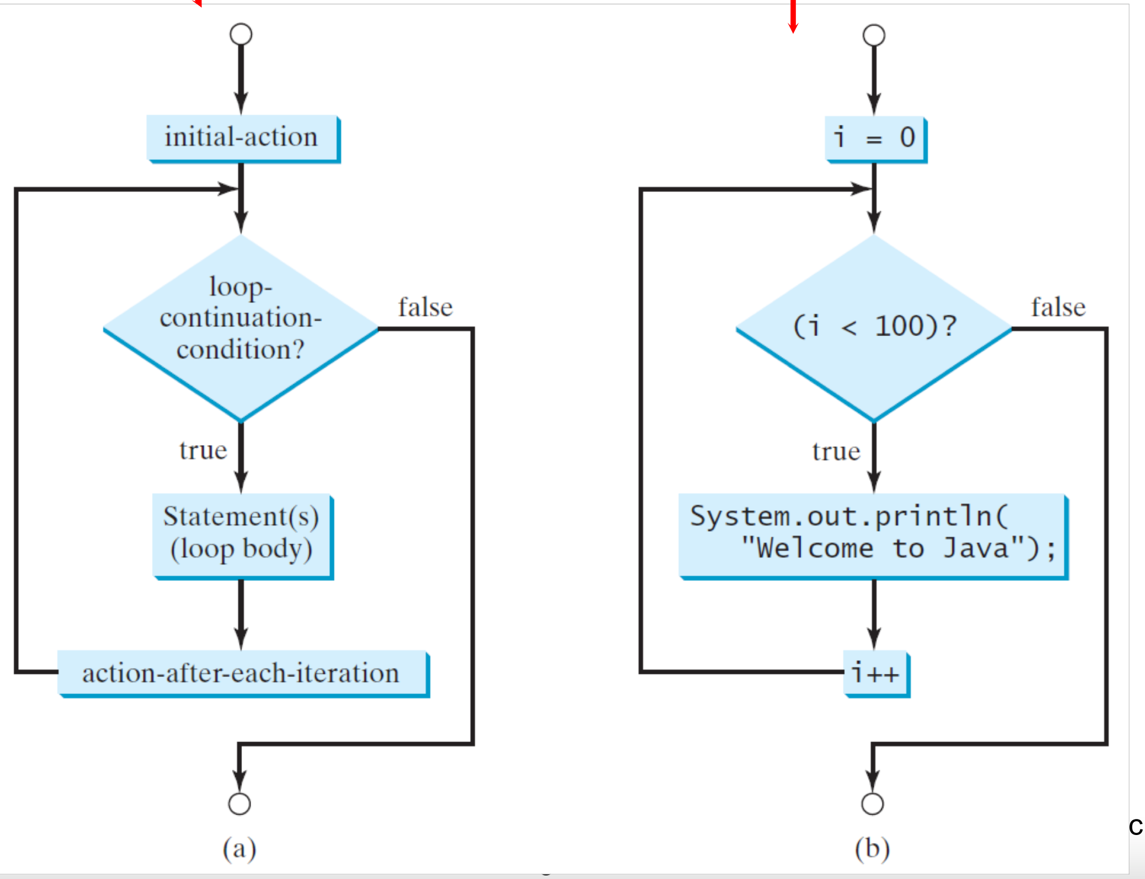
Write a program that reads and calculates the sum of an unspecified number of integers from the keyboard and sum them up. Print your intermediate results.

The input 0 signifies the end of the input.

for Loops

```
for (initial-action; loop-
    continuation-condition; action-
    after-each-iteration) {
  // loop body;
  Statement(s);
}
```

```
for (int i = 0; i < 100; i++) {
  System.out.println(
    "Welcome to Java!");
}
```



initial-action
loop-continuation-condition?
false
true
Statement(s) (loop body)
action-after-each-iteration
(a)
i = 0
(i < 100)?
false
true
System.out.println("Welcome to Java");
i++
(b)

animation

Trace for Loop

```
int i;
for (i = 0; i < 2; i++) {
  System.out.println(
    "Welcome to Java!");
}
```

Declare i

animation

Trace for Loop, cont.

```
int i;
for (i = 0; i < 2; i++) {
 System.out.println(
   "Welcome to Java!");
}
```

Execute initializer
i is now 0

animation

Trace for Loop, cont.

```
int i;
for (i = 0; i < 2; i++) {
  System.out.println( "Welcome to Java!");
}
```

(i < 2) is true
since i is 0

animation

Trace for Loop, cont.

Print Welcome to Java

```
int i;
for (i = 0; i < 2; i++) {
 System.out.println("Welcome to Java!");
}
```

animation

Trace for Loop, cont.

Execute adjustment statement
i now is 1

```
int i;
for (i = 0; i < 2; i++) {
  System.out.println("Welcome to Java!");
}
```

animation

Trace for Loop, cont.

```
int i;
for (i = 0; i < 2; i++) {
  System.out.println("Welcome to Java!");
}
```

(i < 2) is still true
since i is 1

animation

Trace for Loop, cont.

Print Welcome to Java

```
int i;
for (i = 0; i < 2; i++) {
  System.out.println("Welcome to Java!");
}
```

animation

Trace for Loop, cont.

Execute adjustment statement
i now is 2

```
int i;
for (i = 0; i < 2; i++) {
  System.out.println("Welcome to Java!");
}
```

animation

Trace for Loop, cont.

```
int i;
for (i = 0; i < 2; i++) {
  System.out.println("Welcome to Java!");
}
```

(i < 2) is false
since i is 2

animation

Trace for Loop, cont.

```
int i;
for (i = 0; i < 2; i++) {
  System.out.println("Welcome to Java!");
}
```

Exit the loop. Execute the next statement after the loop