Why do we need looping?

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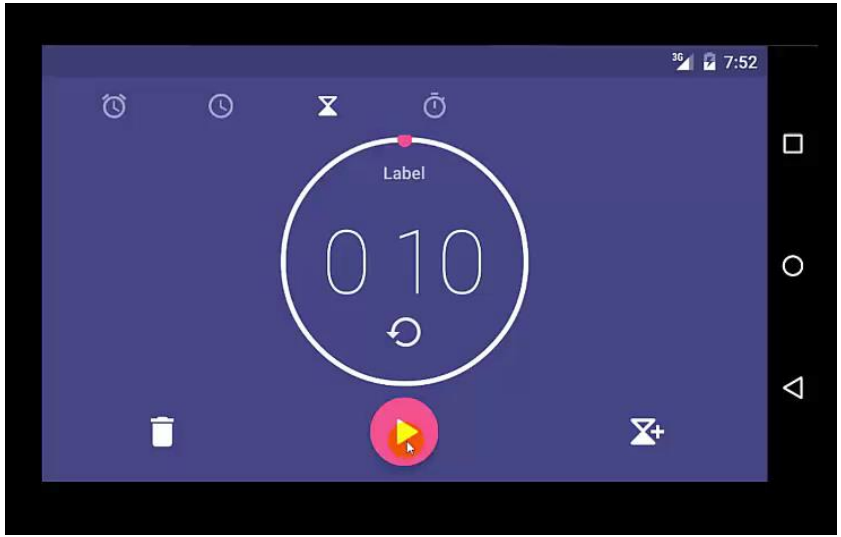
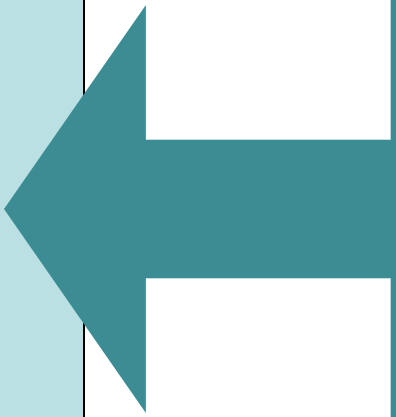


Unleash power of computer

```
...
out.println(10);
out.println(9);
out.println(8);
out.println(7);
out.println(6);
out.println(5);
out.println(4);
out.println(3);
out.println(2);
out.println(1);
...
```



Time for human to write one line of code:
~2 seconds

Time for computer to execute one line of code:
~0.001 seconds

Unleash power of computer

```
...
out.println(10);
out.println(9);
out.println(8);
out.println(7);
out.println(6);
out.println(5);
out.println(4);
out.println(3);
out.println(2);
out.println(1);
...
```

Without loops…

Humanity would spend more time writing code than the computer would executing it!

Introduction to Java For Loops

Loops make repetition easier

```
out.println(1 + " doubled = " + 2 * 1);
out.println(2 + " doubled = " + 2 * 2);
out.println(3 + " doubled = " + 2 * 3);
out.println(4 + " doubled = " + 2 * 4);
out.println(5 + " doubled = " + 2 * 5);
```

Loops make repetition easier

```
out.println(1 + " doubled = " + 2 * 1);
out.println(2 + " doubled = " + 2 * 2);
out.println(3 + " doubled = " + 2 * 3);
out.println(4 + " doubled = " + 2 * 4);
out.println(5 + " doubled = " + 2 * 5);
```

Intuition:
"I want to print a line for each number from 1 to 5"

Loops make repetition easier

Java's for loop: causes lines of code to be repeated

```
out.println(1 + " doubled = " + 2 * 1);
out.println(2 + " doubled = " + 2 * 2);
out.println(3 + " doubled = " + 2 * 3);
out.println(4 + " doubled = " + 2 * 4);
out.println(5 + " doubled = " + 2 * 5);
```


```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Loops make repetition easier

Java's for loop: causes lines of code to be repeated

```
out.println(1 + " doubled = " + 2 * 1);
out.println(2 + " doubled = " + 2 * 2);
out.println(3 + " doubled = " + 2 * 3);
out.println(4 + " doubled = " + 2 * 4);
out.println(5 + " doubled = " + 2 * 5);
```

Does same as

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Read as: "for each integer i from 1 to 5, do…"

Execution of the Java For Loop

Structure of the `for` loop

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Let’s consider this code that prints 5 lines more closely

Structure of the `for` loop

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

body

Body:
Code to execute repeatedly

Structure of the `for` loop

Header:
Tells how many time to repeat

```
for (int i = 1; i <= 5; i = i+1) {
   out.println(i + " doubled = " + 2 * i);
}
```

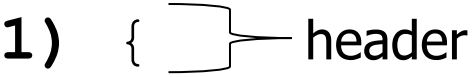
header

body

Body:
Code to execute repeatedly

Execution of the `for` loop

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```



The header controls the execution

- Contains 3 parts

Execution of the `for` loop

Initialization – performed ***once***

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Execution of the `for` loop

Initialization – performed ***once***

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Tells Java what variable to use in the loop and gives it a starting value

Execution of the `for` loop

Test – will loop if test is true

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Execution of the `for` loop

Test – will loop if test is true

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Performed ***before*** each execution of body

Execution of the `for` loop

Test – will loop if test is true

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Typically uses comparison operators:

<	less than
<=	less than or equal to
>	greater than
>=	greater than or equal to

Execution of the `for` loop

Update – change the loop variable

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Execution of the `for` loop

Update – change the loop variable

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Performed ***after*** each execution of body

Execution of the `for` loop

Update – change the loop variable

```
for (int i = 1; i <= 5; i = i+1) {
   out.println(i + " doubled = " + 2 * i);
}
```

Executed as if it appeared here

Execution of the `for` loop

Update – change the loop variable

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Can be any expression that changes the loop variable

Usually simply use: **`i++`**

Execution of the `for` loop

```
for (int i = 1; i <= 5; i = i+1) {
  out.println(i + " doubled = " + 2 * i);
}
```

Flow chart depicting a for loop