Iteration in Programming

while loops and loop control variable

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Topics list

1. Repetition in Programming – Intro to looping
2. Use of loops (while loops).

What Is Iteration?

Iteration means repeating a set of instructions.

Computers are very good at repetition.

Example:

- Calculate pay for 1,000 employees
- Same algorithm, repeated many times
- We use **loops** instead of rewriting code.

Recap: Boolean conditions

- A boolean condition is an expression that evaluates to either true or false

```
x < 50
i <= 10
name.equals("John")
```

- Boolean conditions can be used to control:
  - Selection i.e. if statements and
  - Iteration i.e. loops (we will look at these now).

Why We Need Loops?

Write the all the numbers between 1 and 5 inclusive

- Without loop:

```
System.out.println(1);
System.out.println(2);
System.out.println(3);
System.out.println(4);
System.out.println(5);
```

This is inefficient and not scalable.

Thinking in Loops

Instead, we want to say:

"Do this 5 times, changing a value each time."

We will use:

- A variable that changes
- A condition that controls repetition

```
System.out.println(i);
```

With the value of i going from 1 to 5

This leads us to **loops**.

Topics list

1. Repetition in Programming – Intro to looping

2. Use of loops (while loops).

Loops in Programming

- There are three types of loop in (Java) programming:
  - **while** loops
  - **for** loops
  - **do while** loops

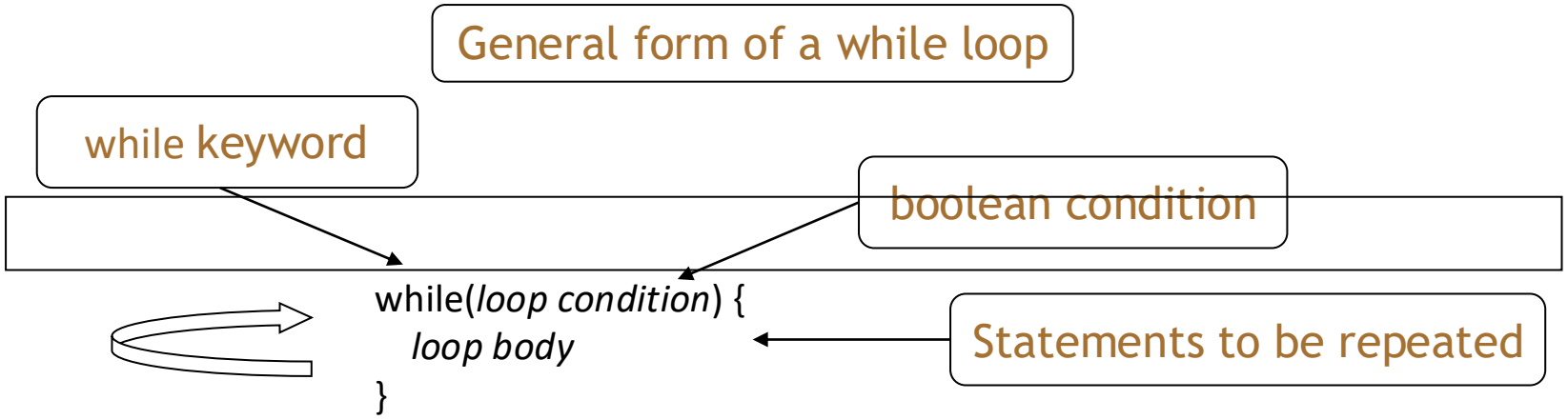
The while Loop

A while loop means:

> “While this condition is true, keep repeating these statements.”

If the condition becomes false, the loop stops.

while loop pseudo code



Pseudo-code expression of the actions of a while loop

while we wish to continue, do the things in the loop body

Loop Control Variable (LCV)

A **loop control variable (LCV)**:

- Controls how many times the loop runs
- Is checked in the loop condition
- Is updated inside the loop

Without an LCV, loops often run forever.

Construction of while loop

Declare and initialise loop control variable (LCV)

while(boolean condition based on LCV is true)

{

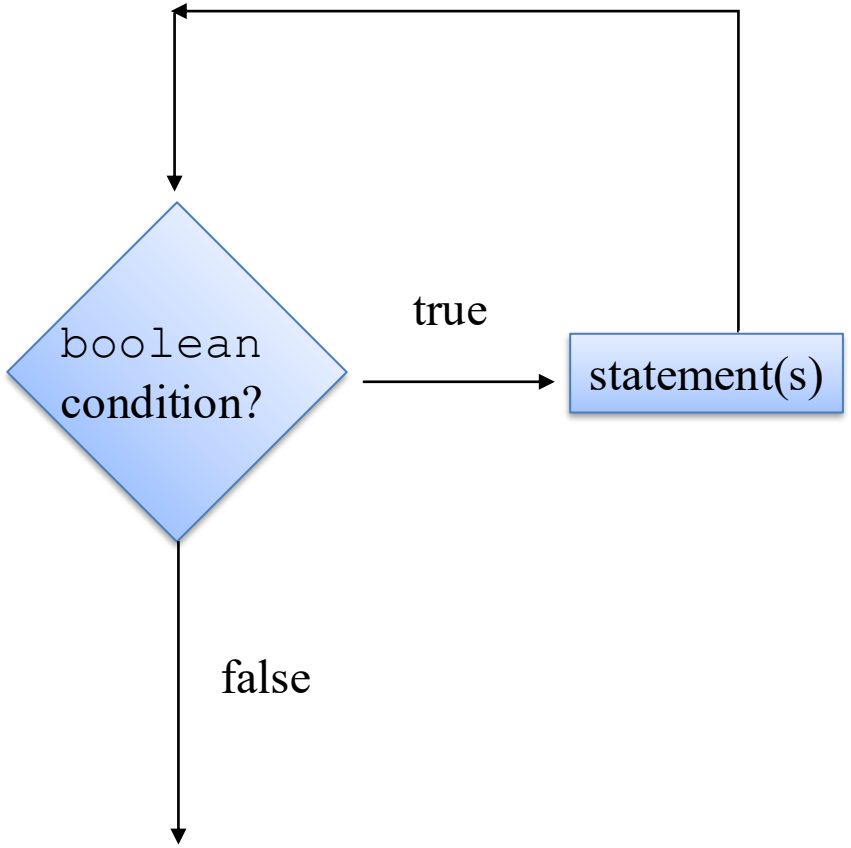
“do the job to be repeated”

“update the LCV”

}

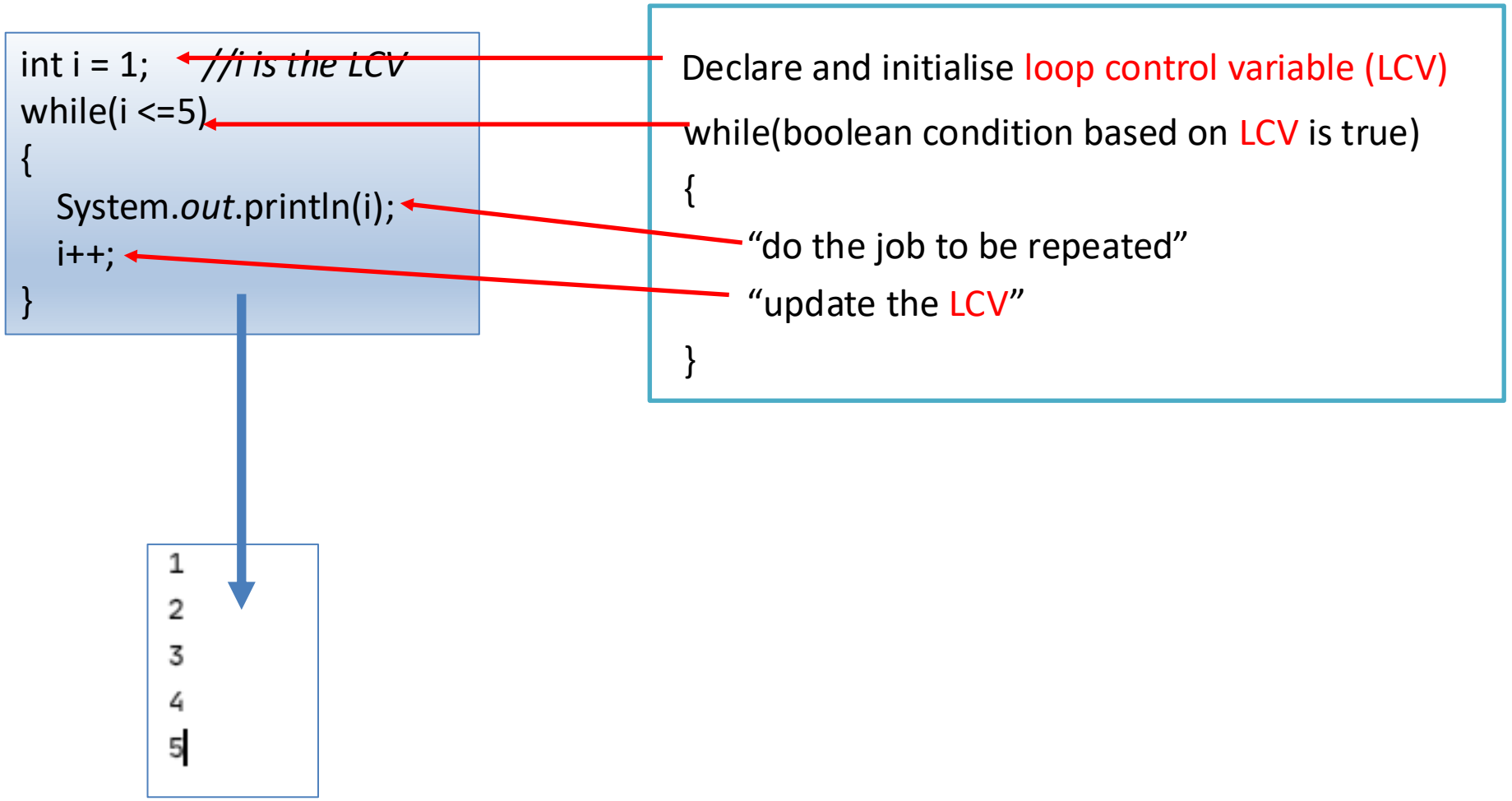
This structure should always be used

`while` loop Flowchart

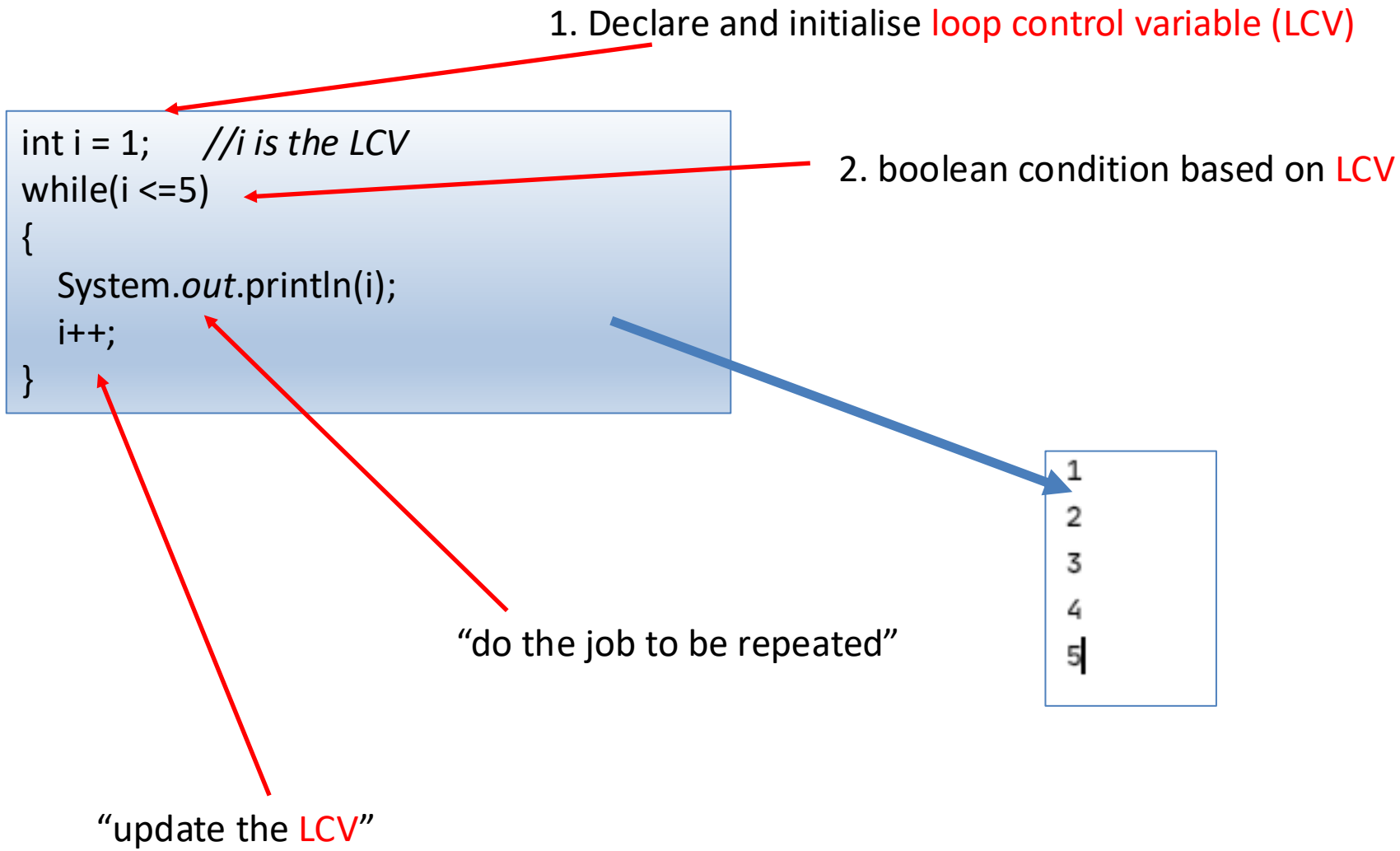



```
int i = 1;          //i is the LCV
while(i <=5)
{
   System.out.println(i);
    i++;
}
```

Example - while



Example – while

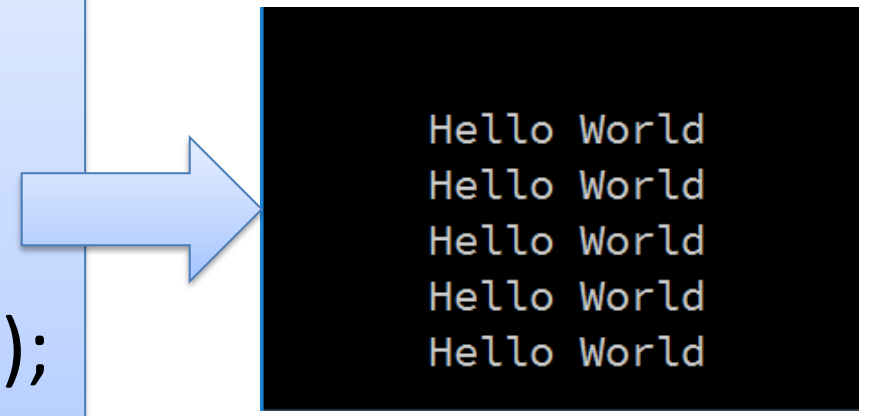


Some Study Exercises

This basic while loop,
produces this output.

```
int i = 1;

while (i <=5)
 {
  System.out.println("Hello World");
  i++;
 }
```



Form of loop - revisited

- Write the all the numbers between 1 and 5 inclusive

  – With a loop:

    - do this 5 times

```
System.out.println(i);
```

With the value of i going from 1 to 5

Solution – What's the difference?

```java
public class Driver {

    public static void main(String args[]){

        for(int i = 1; i<=5; i++){
            System.out.println(i);
        }

        int i = 0;
        while(i < 5){
            System.out.println(i+1);
            i++;
        }

        i=1;
        do{
            System.out.println(i);
            i++;
        }while(i<6);

    }
}
```

Common Mistakes

Common errors with while loops:

- Forgetting to update the LCV
- Incorrect loop condition
- Off-by-one errors

These can cause **infinite loops** or incorrect output.

Some Study Exercises

1. Change the code so that “Hello World” is printed out 10 times.
2. Change the code so that the numbers from 1 to 10 (inclusive) are printed out, one line at a time.
3. Change the code so that the numbers from 10 to 1 are printed out.

Questions?