

# While Loops

## Overview

We have already covered the `if` statement. A `while` loop is exactly the same with the addition of at least one branch and a label. It really is that simple.

To illustrate this, here is a flow chart of an `if` statement (on the left) compared to a `while` loop (on the right).

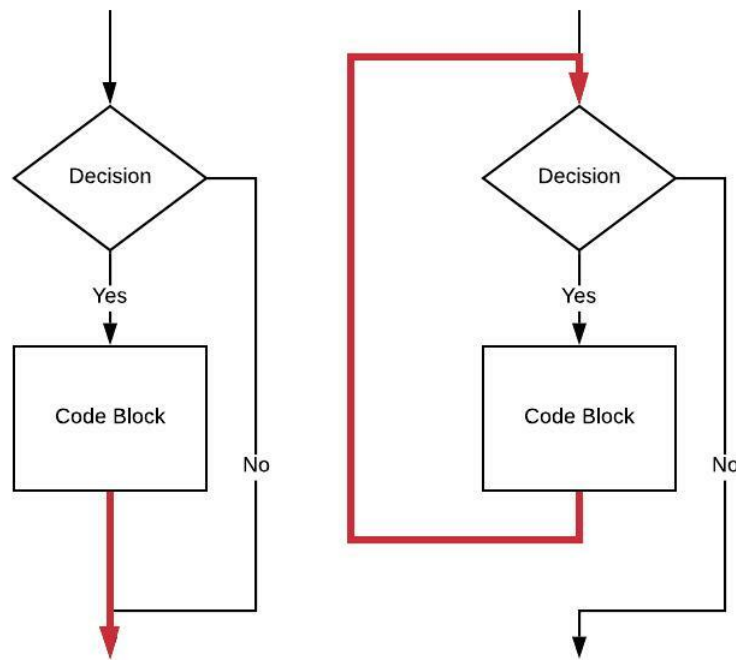


Figure 1: while loop

The closing brace in an `if` statement is indicated by the red arrow head. This isn't a branch, the code flow simply falls through to the statement beyond the closing brace. In the `while` loop, the behavior of the closing brace changes to be that of a branch back to just before the evaluation of the boolean condition (the "Decision").

A new label is placed before evaluating the "Decision".

A new unconditional branch is placed after the end of the "Code Block."

For review, consider this C or C++ code:

```

if (a >= b) {
    // CODE BLOCK
}

```

here is the assembly language for this if statement:

```

    // Assume value of a is in x0                // 1
    // Assume value of b is in x1                // 2
    cmp     x0, x1                               // 3
    ble     1f                                   // 4
    // CODE BLOCK                               // 5
1:                                           // 6

```

Now, consider this while loop:

```

while (a >= b) {
    // CODE BLOCK
}

```

Here is the code for the while showing the addition of one new label and one new unconditional branch:

```

    // Assume value of a is in x0                // 1
    // Assume value of b is in x1                // 2
                                           // 3
1: cmp     x0, x1                               // 4
    ble     2f                                   // 5
    // CODE BLOCK                               // 6
    b       1b                                   // 7
                                           // 8
2:                                           // 9

```

Temporary label 2 on line 9 takes the place of the line after the closing brace in a while loop.

Temporary label 1 on line 4 is the end point of the red arrow in the right hand flow chart above.

## Summary

A while loop is an extension of the if statement. A simple if contains one conditional branch and one label.

A while loop contains at least two labels, one conditional branch and one unconditional branch. We acknowledge the possibility that the unconditional branch could be made a conditional one, but this is rarely done in assembly language and impossible in higher level languages like C and C++ since the branch is simply the closing }.

## Questions

1

(T | F) This code has a problem:

```
// Assume value of a is in x0 // 1
// Assume value of b is in x1 // 2
// 3
1: cmp    x0, x1 // 4
   b      2f     // 5
// CODE BLOCK   // 6
   b      1b     // 7
// 8
2:             // 9
```

Answer: True - the unconditional branch on line 5 doesn't reference the results of the `cmp` that comes before it. The CODE BLOCK will never be executed.

2

(T | F) This attempt at a `while` loop has a problem:

```
// Assume value of a is in x0 // 1
// Assume value of b is in x1 // 2
// 3
1: cmp    x0, x1 // 4
   ble    2f     // 5
// CODE BLOCK   // 6
// 7
2:             // 8
```

Answer: True - missing a branch back to label 1, there is no loop.