

## TutorTube: If Statements

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### Introduction

Computer programs can only follow the instructions we specifically give it. This means that instructions are carried out in sequential order. The first instruction executes, then the second, then the third and so on.

Sometimes our programs need to perform something more complicated though. What if we want the user to decide whether to add two numbers or multiply them? The program would then have to make a choice, so how do we have the program choose between two different options?

We can achieve this with branches. Branches are a way of making decisions within our program. A branch executes when a certain condition is met. **If statements** are an example of a branch.

### The Example

Let's take a look at an example. We're going to add two numbers together, **a** and **b**. Let's set **a** equal to five and **b** equal to six. We're going to store the sum of these two numbers in the variable **sum** which is equal to **a** plus **b**. In our example, we're going to add these two numbers together. If the **sum** is larger than 10, we want to output "larger than 10." So, if the sum is larger than 10, output "larger than 10."

First, we need to identify the condition. The condition is a Boolean expression that we test for. Some Boolean expressions to test for can be: **if a == b, a != b, a <= b, a >= b, a < b, or a > b.**

So, what **if statements** do is that if the condition is **true** then do x. The condition can be found by asking the question "what needs to be true in order to execute my branch?" So, if we want output larger than 10 when **sum** is larger than 10, then we need to test for what? What needs to be true in order to output larger than 10? Well the condition is that **sum** has to be greater than 10.

### Creating Our If Statement

Let's set up our **if statement**. We write: **if** followed by two parentheses, followed by two curly brackets. Inside the parentheses is where we put our condition, **sum > 10**. Inside the brackets is where we put what we want to do if the condition is **true**. So if the condition is **true**, if **sum > 10** evaluates to **true**, then I want to **cout << "larger than 10."**

What our code now does is add the two numbers together, **a** and **b**, and stores it in **sum**. This **if statement** checks if the **sum** is greater than 10. If **sum** is greater than 10, this branch is executed: **cout << "larger than 10."** What happens between the two brackets only happens if this condition is **true**.

## Creating If-Else Statement

What if we want to choose between two different options? We can use what's called an **if-else statement**. It works the same as an **if statement**, but we add a second set of instructions when the condition is **false**.

So, to add to our example, let's output "Not larger than 10" if the sum of **a** and **b** are not greater than 10. We take our **if statement** and at the end of it add the word "**else**" followed by two more curly brackets. Between the two curly brackets is where we put what happens when the condition is **false**. So, to output "Not larger than 10" when **sum** is not greater than 10 then we put **cout << "Not larger than 10"** here.

What our program now does is test if **sum** is greater than 10. If this evaluates to **true**, then this branch will execute where "Larger than 10" is outputted. If **sum > 10** evaluates to **false**, or if **sum** is less than or equal to 10, then "Not larger than 10" will be outputted.

Let's test that. So, right now **a** and **b** are 5 and 6. If we add 5 and 6 together we get 11. 11 is larger than 10, so when I run the program, I expect "Larger than 10" to be outputted. Let's see if that's the case.

I'm going to compile and run. "Larger than 10." Perfect! This is what we were expecting.

Going back into the program, we can test and see if the other condition executes. So, let's pick two numbers whose sum is less than ten, so let's do five and two. Five plus two is seven. Seven is not greater than ten, so when we reach the **if statement**, "seven greater than ten?" This is incorrect, so this evaluates to **false**, and we run the second branch.

Let's test that. Let's compile and run. "Not larger than 10." This is what we expected.

To summarize so far, in our **if-else statement** if whatever between the parentheses is **true**, the first branch executes. If whatever is between the parentheses is **false**, the second branch executes. What we now have is the ability to carry out two different instructions based on conditions in our code our code. We can now make decisions.

## Using Else-If

This looks great for problems with two options, but what if we want multiple things to happen? What if we want three different options or four different options? The good thing is that we can carry this out as many times as we need to.

So, let's output "Larger than five" if the sum is not larger than 10 but is larger than 5. So what we can do here, is after this **if statement**, we can add another **else**. We can say **else if (sum > 5)** output "Larger than 5."

Let's break down what's happening here. Right now **a** and **b** are five and two. Five plus two is equal to seven. **Sum** is equal to seven. We test if **sum** is greater than ten. Seven is not greater than ten, so this first branch is skipped. We go to this **else statement**. This **else** says that if **sum** is greater than 5 we **cout** this. So **sum** is equal to 7. 7 is greater than 5, so this branch is executed. Because this branch is executed, this **else statement** never happens, and we exit the brackets at the end and continue on with the program.

Let's test that and see if it happens. "Larger than five." Perfect! The main thing to keep in mind is that using **if**, **else-if**, **else-if** is that only one thing can execute. Only one branch can happen. So, if the first branch happens the other two cannot happen. If the first branch doesn't happen, then either the second branch or third branch have to happen.

You do not need an **else**. We could get rid of this **else** and just have an **else-if**. We can test for any number of combinations.

## Outro

So, that's going to do it for this video. Thank you very much for watching and have a great day.

## Code

```
#include <iostream>
using namespace std;
int main(){
    int a , b;
    a = 5;
    b = 2;
```

```
int sum = a + b;
//If the sum is larger than 10, output "larger than 10"
//What needs to be true in order to execute my branch?
//Condition: sum > 10
if(sum > 10 ) {
    cout << "Larger than 10" << endl;
}
else if(sum > 5){
    cout << "Larger than 5" << endl;
}
else {
    cout << "Not larger than 10" << endl;
}
return 0;
}
```