

MIT-IIT Robotics Program

Logic Flow – Booleans, Logical & Relational Operators, Conditionals, While Loops

Amartya Shankha Biswas

May 29, 2017

Outline

- 1 Expressions Recap
- 2 Logical Expressions
 - Booleans
 - New Operators
- 3 Conditionals
 - If Else Statements
 - Nested Conditionals
 - Exercises
- 4 Loops
 - While Loop
 - Counters
 - Exercises

4

Area of Circle

```
float R, area;  
float pi = 3.14159;
```

Area of Circle

```
float R, area;  
float pi = 3.14159;  
  
area = pi * R * R;  
cout << "Area of Circle:  
cout << area << endl;
```

```
int N, sum_of_numbers;  
cin >> N;
```

```
int N, sum_of_numbers;  
cin >> N;  
sum_of_numbers = N*(N+1)/2;
```

Find Last Digit of Number

```
int N, last_digit;  
cin >> N;
```

Find Last Digit of Number

```
int N, last_digit;  
cin >> N;  
last_digit = N % 10;
```


Remove Last Digit of Number

Go from 12345 \longrightarrow 1234 \longrightarrow 123.

```
int N;  
cin >> N;
```

Remove Last Digit of Number

Go from 12345 \longrightarrow 1234 \longrightarrow 123.

```
int N;  
cin >> N;  
N = N / 10;
```

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Booleans

A New Data Type

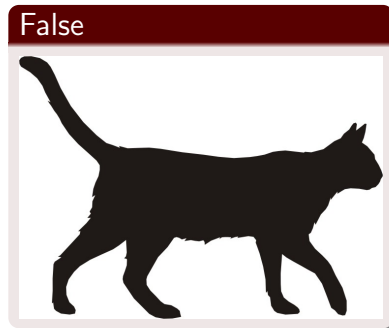
Booleans only have two possible values – True or False

Booleans

A New Data Type

Booleans only have two possible values – True or False

Statement: Schrodinger's cat is dead !



Booleans

A New Data Type

- In C++ we have a **bool** data-type

```
bool var = true;
```

Booleans

A New Data Type

- In C++ we have a **bool** data-type
 - `bool var = true;`
- Actually stored as integer
 - **true** is 1 and **false** is 0

Booleans

A New Data Type

- In C++ we have a **bool** data-type
 - `bool` var = `true`;
- Actually stored as integer
 - **true** is 1 and **false** is 0
- In the other direction
 - Zero value is **true**
 - Non-Zero value is **false**

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Relational Operators

| Operation | Common Symbol | C++ Symbol | Expression |
|------------|---------------|------------|------------|
| Equals | = | == | $(a == b)$ |
| Not Equals | \neq | != | $(a != b)$ |

Relational Operators

| Operation | Common Symbol | C++ Symbol | Expression |
|---------------------|---------------|--------------------|--------------|
| Equals | $=$ | <code>==</code> | $(a == b)$ |
| Not Equals | \neq | <code>!=</code> | $(a != b)$ |
| Less Than | $<$ | <code><</code> | $(a < b)$ |
| Greater Than | $>$ | <code>></code> | $(a > b)$ |
| Less Than Equals | \leq | <code><=</code> | $(a \leq b)$ |
| Greater Than Equals | \geq | <code>>=</code> | $(a \geq b)$ |

Logical Operators

| Operation | Symbol | Expression |
|-----------|--------|-------------------------------------|
| And | && | $(a \neq b) \ \&\& \ (a \% 2 == 0)$ |
| Or | | $(a > b) \ \ (a/2 > 4)$ |
| Not | ! | $!(a == b)$ |

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If and Else

The **else** statement is optional.

```
if (temperature >= 38)
    cout << "Buy an ice ceam cone" << endl;
```

If and Else

The **else** statement is optional.

```
if (temperature >= 38)
    cout << "Buy an ice cream cone" << endl;
else
    cout << "Buy a lollipop" << endl;
```

If and Else

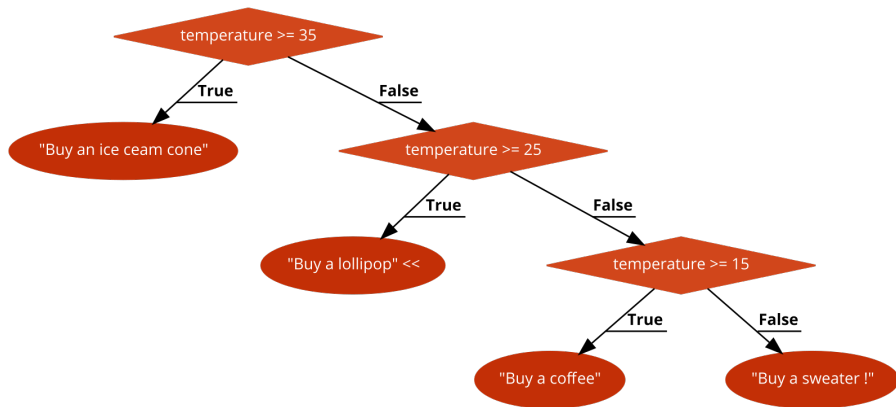
The **else** statement is optional.

```
if (temperature >= 38)
    cout << "Buy an ice cream cone" << endl;
else
    cout << "Buy a lollipop" << endl;
```

Must use a block (surrounded by curly braces) for more than one line.

```
if (number_of_lines > 1) {
    cout << "More than one line.";
    cout << "Have to use a block.";
}
else {
    cout << "Curly braces are optional.";
}
```


Cascading



The if...else if...else Statement

To test multiple conditions, we can cascade if statements

```
if (temperature >= 35) {  
    cout << "Buy an ice cream cone" << endl;  
}  
else if (temperature >= 25) {  
    cout << "Buy a lollipop" << endl;  
}  
else if (temperature >= 15) {  
    cout << "Buy a coffee" << endl;  
}  
else {  
    cout << "Buy a sweater !" << endl;  
}
```

The **if...else if...else** Statement

- The first statement must be an **if**.

The **if...else if...else** Statement

- The first statement must be an **if**.
- After this, there can be any number of **else if** statements.

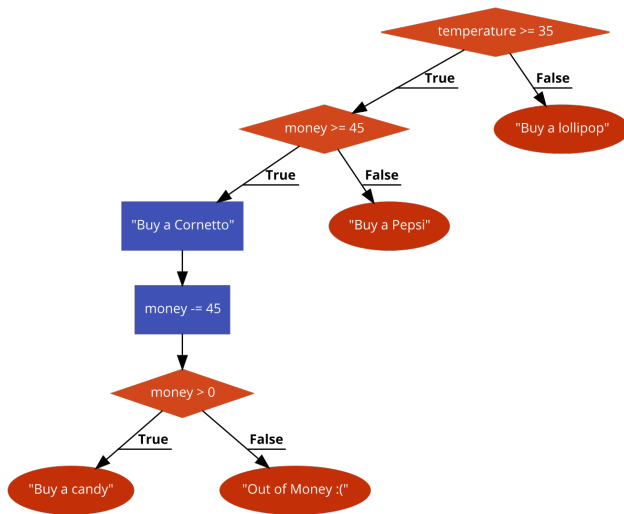
The **if...else if...else** Statement

- The first statement must be an **if**.
- After this, there can be any number of **else if** statements.
- At the end, there can be one (or zero) **else** statement.

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Nesting



Nested Conditionals

```
if (temperature >= 35) {  
    if (money >= 45) {  
        cout << "Buy a Cornetto" << endl;  
        money -= 45;  
        if (money > 0) {  
            cout << "Buy a candy" << endl;  
        }  
        else  
            cout << "Out of Money :(" << endl;  
    }  
    else  
        cout << "Buy a Pepsi" << endl;  
}  
else {  
    cout << "Buy a lollipop" << endl;  
}
```


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Lab Time !

Write programs for each of the following specifications

| Input | Output |
|-----------------------------------------------------------------------|------------------------------------------------------------|
| Four integers | Maximum and second max value |
| Cutoff for A, B, C grades, and also marks of one student (out of 100) | 1. Are the cutoffs valid ? 2. Student's grade (A,B,C) |
| Three points (vertices of triangle) in terms of (x, y) coordinates | Whether the triangle is equilateral, isosceles, or scalene |

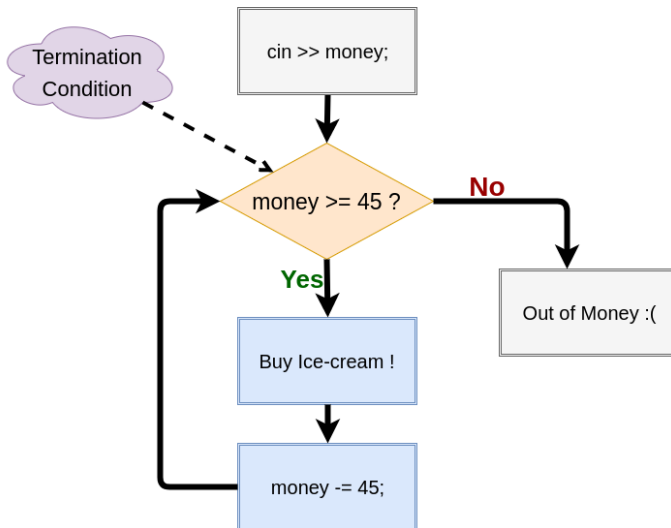
Write a program that takes as input, the coefficients of a quadratic equation ($Ax^2 + Bx + C$), and outputs the roots (both real and imaginary).

Sorting

Write a program that accepts N numbers as input, and prints them out in ascending order.

Iteration

Repeat the Same Instructions many times



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While Loop

```
cin >> money;
while (money >= 45){
    cout << "Buy an ice ceam cone" << endl;
    money -= 45;
    cout << "Money remaining: " << money << endl;
}
cout << "Out of Money" << endl;
```

While Loop

```
cin >> money;
while (money >= 45){
    cout << "Buy an ice ceam cone" << endl;
    money -= 45;
    cout << "Money remaining: " << money << endl;
}
cout << "Out of Money" << endl;
```

If the input *money* is 200, this results in the following output.

```
Buy an ice ceam cone
Money remaining: 155
Buy an ice ceam cone
Money remaining: 110
Buy an ice ceam cone
Money remaining: 65
Buy an ice ceam cone
Money remaining: 20
```

Compare this to the If Statement

```
cin >> money;  
if (money >= 45){  
    cout << "Buy an ice ceam cone" << endl;  
    money -= 45;  
    cout << "Money remaining: " << money << endl;  
}  
cout << "Out of Money" << endl;
```

If the input *money* is 200, this results in the following output.

```
Buy an ice ceam cone  
Money remaining: 155
```

While Loop

```
cin >> money;
while (money >= 45){
    cout << "Buy an ice ceam cone" << endl;
    money -= 45;
    cout << "Money remaining: " << money << endl;
}
cout << "Out of Money" << endl;
```

If the input *money* is 200, this results in the following output.

```
Buy an ice ceam cone
Money remaining: 155
Buy an ice ceam cone
Money remaining: 110
. . .
```


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Unknown Number of Inputs

- User specifies the number of inputs
 - Take N inputs and arrange them in ascending order.
 - Find the average of N numbers

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Unknown Number of Inputs

- User specifies the number of inputs
 - Take N inputs and arrange them in ascending order.
 - Find the average of N numbers
- Thoughts ?
- Use a counter variable
 - Initialize counter to zero

```
int counter = 0;
```

Unknown Number of Inputs

- User specifies the number of inputs
 - Take N inputs and arrange them in ascending order.
 - Find the average of N numbers

- Thoughts ?

- Use a counter variable

- Initialize counter to zero

```
int counter = 0;
```

- Increment counter at every loop iteration

```
counter += 1; OR counter++;
```

Unknown Number of Inputs

- User specifies the number of inputs
 - Take N inputs and arrange them in ascending order.
 - Find the average of N numbers

- Thoughts ?

- Use a counter variable
 - Initialize counter to zero

```
int counter = 0;
```

- Increment counter at every loop iteration

```
counter += 1; OR counter++;
```

- Terminate when counter hits N

```
while (counter < N) { . . . }
```

Using a Counter

```
int counter = 0, N;  
cin >> N;                                //Number of inputs  
while (counter < N) {  
    // Body of Loop. Take input, process data etc . .  
    counter++;                            //Increment Counter  
    cout << "Counter Value:" << counter << endl;  
}  
cout << "Exited Loop\n";
```

Using a Counter

```
int counter = 0, N;  
cin >> N;                                //Number of inputs  
while (counter < N) {  
    // Body of Loop. Take input, process data etc . .  
    counter++;                            //Increment Counter  
    cout << "Counter Value:" << counter << endl;  
}  
cout << "Exited Loop\n";
```

If the input N is 6, this results in the following output.

```
Counter Value:1  
Counter Value:2  
Counter Value:3  
Counter Value:4  
Counter Value:5  
Counter Value:6  
Exited Loop
```


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Lab Time !

Write programs for each of the following specifications

Write a program to find the average of N numbers. Take N as input from the user, and then take in N numbers as input.

Write a program that takes as input N , and outputs the sum of its digits.

Write a program to find the maximum and minimum of N numbers. Take N as input from the user, and then take in N numbers as input.

Write a program to find the second maximum of N numbers.

Age Guessing Game

Write a program that asks the user questions of the form "Is your age less than 50". The user can only respond with 1 (yes) or 0 (no).

Challenge – Guess age in seven questions or less.