Lab 2

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Objectives:

- Understand memory architecture.
- Translate between binary and decimal number formats.
- Discuss the differences between, and some issues with, integer and floating-point formats.
- Create a Flow chart and use it to implement a C++ program.
- Begin exploration of basic input and output.

Procedures:

Binary Numbers and Memory Architecture

1. From the information in your textbook and classroom lectures describe how memory is structured in the computer, along with what is meant by *addressing*.

Memory is structured into volite and nonvolitile memory. Main memory also know as RAM is volitle. RAM and its temporary storage and is lost when the computer shuts off. Then their is secondary storage which is nonvolitle and the computer can store it for long periods of time. It usually stored in disk drives like ssd and hard drives.

2. Translate the following decimal values into 8-bit binary numbers (DO NOT USE A CALCULATOR!):

a) 11 00001011

b) 27 00100101

c) 56 00111000

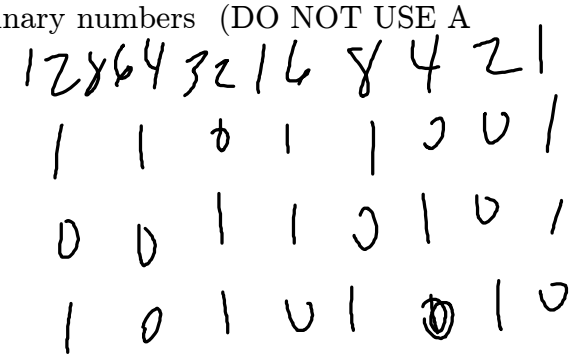
d) 38 00100110

3. What is the decimal representation of the following binary numbers (DO NOT USE A CALCULATOR!):

a) 11011001 217

b) 00110101 83

c) 10101010 170



d) 11111111 255

Numeric Data Types – Integers and Floating Point

4. What types of data can be represented in C++ programs?

int

char

floating

double

5. Explain how integers are represented in C++.

Integers uses whole numbers in C++.

Integers are represented as signed and unsigned. Signed is when you give a variable a number. While unsigned is what the system generates or has already embedded. Integers are represented as whole numbers.

6. Visit the following site and read its contents:
http://www.cprogramming.com/tutorial/floating_point/understanding_floating_point.html
Explain what the author means by *Accuracy* and *Precision*. How do integers and floating-point numbers differ concerning *Accuracy* and *Precision*?

Intergers are accurate because the provide no overflow. Give out whole numbers however because of that they cannot have the greatest precision. This where floating-points are better because they can provide more precision. They dont discard the overflow information. However, with the excess detail floating-point it can be hard to represent that can be used to build something. Intergers can be represented in binary while

7. Visit the following site and read its contents:
http://www.cprogramming.com/tutorial/floating_point/understanding_floating_point_representation.html
Based on your reading there and in the textbook, along with classroom lectures, explain how floating-point numbers are represented in C++.

Floating point uses decimal point defrentiate from integers.

8. Examine the program to the right: Look up the "isnan" definition for c++.

a) What is the function of isnan?

Returns whether x is a NaN

(Not-A-Number) value

```
1 #include<iostream>
2 #include<math.h>
3 using namespace std;
4
5 int main()
6 {
7    float x = 1.0;
8    float y = 0.0;
9    float z = 0.0;
10    y = x + 0.000001;
11    z = x + 0.0000000000000001;
12    cout << "X > X   -> " << (x>x) << endl;
13    cout << "Y > X   -> " << (y>x) << endl;
14    cout << "Z > X   -> " << (z>x) << endl;
15
16    cout << "11.1/0.0 -> " << 11.1/0.0 << endl;
17    cout << "0.0/0.0  -> " << 0.0/0.0 <<endl;
18    cout << "log(0)   -> " << log(0)  << endl;
19    cout << "sqrt(-1) -> " << sqrt(-1) << endl;
20
21    float a = 2.0/10.0;
22    cout << "a == a   -> " << (a==a) << endl;
23    cout << "a -> " << a << "     2.0/10.0 -> " << 2.0/10.0 << endl;
24    cout << "a == 2.0/10.0 -> " << (a == 2.0/10.0) << endl;
25
26    cout << "ISNAN(sqrt(-1)) -> " <<  isnan(sqrt(-1))  << endl;
27    cout << "ISNAN(5) -> " <<  isnan(5)  << endl;
28
29    return 0;
30 }
```

b) What do think that the output of each of the cout statements in the program will be?

Line 12: X > X -> 0

Line 13: Y > X -> 1

Line 14: Z > X -> 0

Line 16: 11.1/0.0 -> undefined

Line 17: 0.0/0.0 -> underfined

Line 18: log (0) -> underfined

Line 19: sqrt(-1) -> underfined

Line 22: a == a -> 1

Line 23: a -> 0.2 2.0/10.0 -> 0.2

Line 24: a == 2.0/10.0 -> 0

Line 26: ISNAN(sqrt(-1)) -> 1

Line 27: ISNAN(5) -> 0

c) Type in the program and save it as prog2a.cpp. Compile prog2a.cpp using your compiler. What is the command that you issued to compile the program? If you used an IDE how did you do it?

I typed out the program into the main.cpp and ran it.

d) Run the program you compiled above. Examine its output and compare it to the estimations you made in section

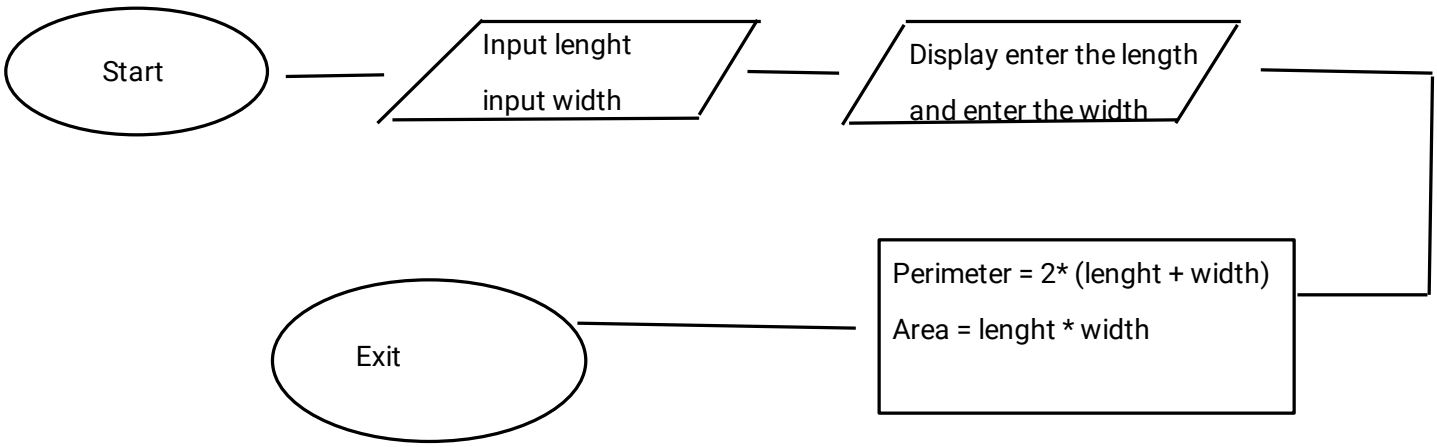
(b) of this question (above). Explain any discrepancies between your estimation and the actual results. Also, explain the output for Line 14.

They were very similar but used different language to define values of infinite outputs.

Flow charts, program design, and implementation

10. Create a complete C++ program that lets a user calculate the perimeter and area of a rectangle given the length and width. Print the length and width, as well as the perimeter and area, to the screen.

a) Create a Flow chart to conceptualize the problem, listing the inputs, outputs, and processing steps that must occur in the program. Make sure to check your algorithm by hand tracing the output for a given set of inputs. Make sure to assign appropriate variable names to your variables. Draw the flow chart below:



b) Write a complete C++ program to implement the algorithm from your flow chart, declaring the variables you

identified in the previous step. Assign some reasonable values for the length and width. Attach a copy of this

program to your lab sheet.

c) Compile your program.

d) Run and check your program. Make sure the output is correct.

11. Examine the following program:

a) Type in the program. Compile the prog2b.cpp source file and run it.

```
1 #include<iostream>
2 using namespace std;
3
4 int main()
5 {
6    int x;
7    cout << "Type in an integer: ";
8    cin >> x;
9    cout << "You typed the number " << x << endl;
10
11    return 0;
12 }
```

b) Explain the operation of Line 8. What does *cin* do?

You can use Google to look up the answer if this was not covered in class yet.

The line is used to accept an input.

c) Line 7 is often referred to as a prompt. Explain why we need a prompt for this program. (what would happen if we did not have one?)

If we did not have a prompt the user would not know what information must be inputted into the program.

d) Run the program again, and when prompted for an integer, enter a floating-point number. What is the output of the program? How/why does it differ from your input?

The program reverts to a whole number. It goes back to the previous whole number.

e) Alter the area/perimeter program you wrote in section 10 of this lab. Use *cin* to read the length and width from the keyboard. Attach a copy of your modified program to this lab sheet.