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C Pointers, Dynamic Memory, File Processing, Basic C++

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CSCI291, Lab #4 Report

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1. Lab Objectives, Methodology

The goal of this lab is to utilize Pointers/Dynamic Data Structures combined with File Processing to write programs for real life scenarios. We are also introduced to basic C++ programming, learning how to scan input / print output and implementing default function parameters / passing parameters as reference.

- Pointers allow programs to simulate pass-by-reference, which enables passing functions between functions, to create and manipulate data structures that can change size at execution time, hence they are dynamic.

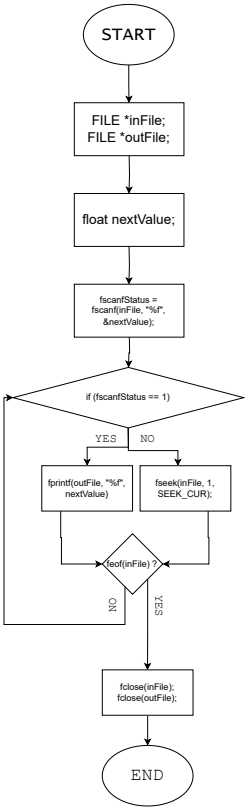
- File Processing is the process of opening up files in a physical drive for reading or writing. ASCII/Text and Binary files can be processed.

- C++ was developed as an evolved implementation of C which enables Object Oriented Programming. It became ISO/standard in 1998.

2. Basic Data Processing

Our first task is to write a program that processes a text file with data by using **`fopen(data.txt)`** consisting of floats and unintentional chars. The program must only scan the floats with **`fscanf()`** and ignore the chars with the use of **`fseek()`**

```
ikea :: Lab/lab4/q1 <main*> » cat data.txt
A 10.0 12.0 14.0 B 20.0 22.0 24.0 C 30.0 32.0 34.0 D 40.0 42.0 44.7 E
ikea :: Lab/lab4/q1 <main*> » ./data_processing
Invalid float
Invalid float
Invalid float
Invalid float
Invalid float
ikea :: Lab/lab4/q1 <main*> » cat dataOut.txt
10.0 12.0 14.0 20.0 22.0 24.0 30.0 32.0 34.0 40.0 42.0 44.7 %
ikea :: Lab/lab4/q1 <main*> »
```



3. LSB Steganography

Steganography is the practice (or "art") of embedding "secret" information within a cover. [1] In the case of this lab assignment, we are hiding a secret image within a cover image and extracting it again using an LSB (Least-Significant-Bits) algorithm which creates a "stego" image pixel whose most significant "nibble" [2] is the cover image pixel and least significant "nibble" is the secret image [3]. To extract this secret image, the reverse is done. C Bitwise operators, especially XOR, are used to achieve this.

```
Cover Image Pixel: 10100000
Secret Image Pixel: 00111111
Stego Image Pixel: 10100011
```

Figure 1: Steganography encoding with LSB algorithm (N=4)

```
Stego Image Pixel: 10100011
Cover Image Pixel: 10100000
Secret Image Pixel: 00110000
```

Figure 2: Steganography decoding, LSB algorithm (N=4)

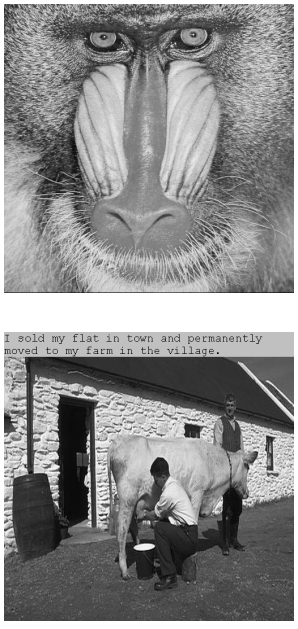


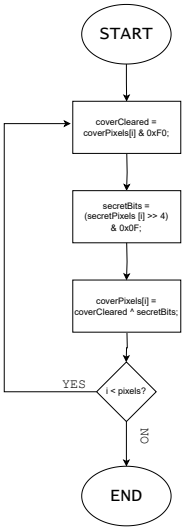
Figure 3: Cover and Secret Images (top to bottom)

[1] https://www.comptia.org/blog/what-is-steganography

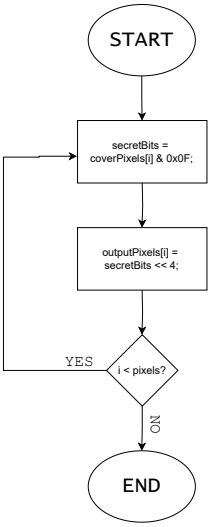
[2] https://en.wikipedia.org/wiki/Nibble

3.1. LSB Steganography [flowchart(s)]

embedLSB(*coverPixels, *secretPixels, width, height)



extractLSB(*coverPixels, *secretPixels, width, height)



[3] https://www.geeksforgeeks.org/swap-two-nibbles-byte/

3.2. LSB Steganography [testing]

The program successfully embeds and extracts **`farm.pgm`** into and from **`baboon.pgm`**

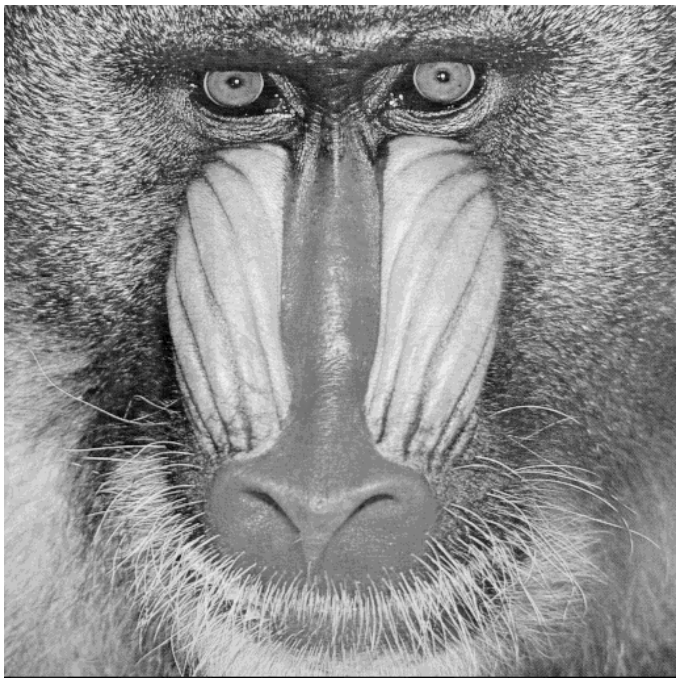


Figure 4: Stego Image in Binary

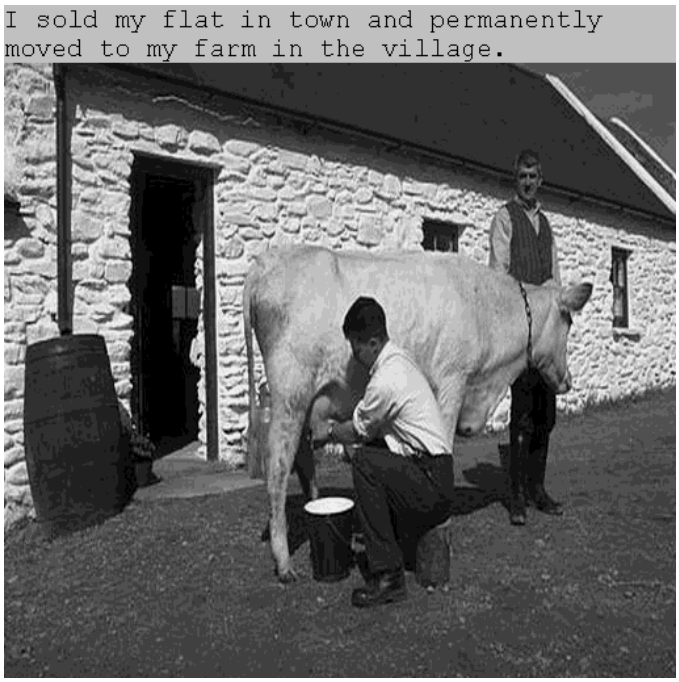
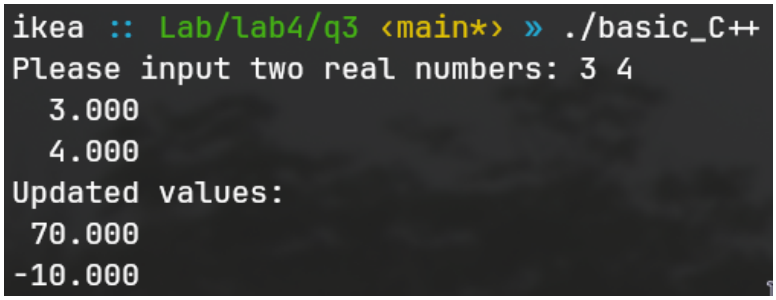


Figure 5: Extracted Secret Image from Stego

4. Basic C++ Programming [`cin, cout,` testing]

C++ is a programming language that evolved from C (hence ++), which became the industry standard in 1998. Some of its syntax is simpler compared to C. Other features exclusive to C++ include default function parameters, which are parameters that don't need to be provided with values.

Table 1: C++ substitutes for C		
Function	C	C++
Scanning Input	scanf()	cin >>
Printing Output	printf()	cout <<



The input values which are passed to "a" and "b" do change after update_scale is called since they are passed to the function by reference, meaning the parameters also change.