TRIBHUVAN UNIVERSITY

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HIMALAYA COLLEGE OF ENGINEERING

CHYASAL, LALITPUR

Lab Report No: -09

Title: - Steam Computation

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OBJECTIVE

- To understand the concept of streams in C++.
- To implement input and output operations using stream classes.
- To learn about the use of file streams for reading from and writing to files.
- To differentiate between cin/cout**,** ifstream/ofstream, and fstream**.**

THEORY

In C++, stream computation refers to the process of performing input and output (I/O) operations using streams. A stream is an abstraction representing a continuous flow of data between a program and external sources or destinations, such as the keyboard, console, or files. Streams provide a uniform, device-independent, and object-oriented interface to handle data transfer. This abstraction hides the complexities of device-specific operations, allowing programmers to read from or write to different devices seamlessly.

Conceptually, a stream is a sequence of bytes flowing into or out of a program. Input streams transfer data into the program (for example, cin reads input from the keyboard).Output streams transfer data out of the program (for example, cout writes output to the console).Besides console I/O, streams can also be used to read from or write to files or memory buffers.

Why to Use Streams?

1. Simplifies I/O operations: Streams allow programmers to use simple syntax (>> and <<) for input and output.

2. Device independence: The same stream operations work with different data sources/destinations (console, files, memory).

3. Supports formatted and unformatted data: Enables flexible data handling (numbers, text, binary).

4. Error handling: Streams provide built-in mechanisms to detect and manage errors during I/O.

5. Extensibility: Stream classes can be extended for custom devices or data formats**.**

Types of Streams in C++

- **Standard I/O Streams**:

    a. cin → standard input (keyboard)
    b. cout → standard output (console)
    c. cerr → standard error (unbuffered)
    d. clog → standard error (buffered)

- **File I/O Streams**:

    1. ifstream → input file stream (for reading from files)
    2. ofstream → output file stream (for writing to files)
    3. fstream → input/output file stream (for both reading and writing)

2. Input/Output Using cin and cout.

Example:

```
int age;
cout << "Enter your age: ";
cin >> age;
cout << "You are " << age << " years old.";
```

3. File Handling in C++

File streams are part of the <fstream> header in C++. They allow programs to store and retrieve data from disk files, which is essential for data persistence.

- **Opening a File**:

    Files can be opened using constructors or the open() function.

```
ofstream fileOut("data.txt");
ifstream fileIn("data.txt");
```

- **Writing to a File**:

```
ofstream file("example.txt");
file << "Hello, file!";
file.close();
```

- **Reading from a File**:

  ```
  ifstream file("example.txt");
  string line;
  while(getline(file, line)) {
     cout << line << endl;
  }
  file.close();
  ```

- **Checking File Status**:
  Always verify that the file has been opened successfully using .is_open() method or by checking the stream object.

4. **File Modes**

Different modes are used to open a file:

- ios::in – open for reading
- ios::out – open for writing
- ios::app – append mode
- ios::trunc – truncate file if exists
- ios::binary – binary mode

Example:

```
fstream file("file.txt", ios::in | ios::out | ios::app);
```

Advantages of Using File Streams

- Enables persistent data storage.
- Allows large amounts of data to be processed without overloading memory.
- Provides a mechanism for reading and writing data in a structured way.

LAB PROGRAMS

1) Write a program to store and retrieve 'n' records of items (item_ID, name, price, mfd_date, company) in Inventory system.

```cpp
#include <iostream>
#include <vector>
#include <string>
#include <fstream>
using namespace std;
struct Item {
    int item_ID;
    string name;
    double price;
    string mfd_date;
    string company;
};
int main() {
    int n;
    cout << "Enter number of items: ";
    cin >> n;
    cin.ignore();
    vector<Item> inventory;
    for (int i = 0; i < n; ++i) {
        Item temp;
        cout << "\nEnter details for item " << i + 1 << ":\n";
        cout << "Item ID: ";
        cin >> temp.item_ID;
        cin.ignore();
    cout << "Name: ";
        getline(cin, temp.name);
    cout << "Price: ";
        cin >> temp.price;
        cin.ignore();
    cout << "Manufacturing Date (YYYY-MM-DD): ";
        getline(cin, temp.mfd_date);
    cout << "Company: ";
        getline(cin, temp.company);
    inventory.push_back(temp);
    }
    ofstream fout("inventory.txt");
    if (!fout) {
      cout << "Error opening file for writing.\n";
        return 1;
    }
    for (const auto& item : inventory) {
        fout << item.item_ID << "," << item.name << "," << item.price << "," << item.mfd_date << "," << item.company << endl;
    }
    fout.close();

    cout << "\n--- Inventory Records ---\n";
    for (const auto& item : inventory) {
        cout << "Item ID: " << item.item_ID << endl;
        cout << "Name: " << item.name << endl;
        cout << "Price: $" << item.price << endl;
        cout << "Manufacturing Date: " << item.mfd_date << endl;
        cout << "Company: " << item.company << endl;
        cout << "--------------------------\n";
    }
    cout << "Inventory has been saved to inventory.txt\n";
        return 0;
}
```

```
Enter number of items: 1

Enter details for item 1:
Item ID: 14
Name: Earbuds
Price: 24999
Manufacturing Date (YYYY-MM-DD): 2024-08-15
Company: Samsung

--- Inventory Records ---
Item ID: 14
Name: Earbuds
Price: $24999
Manufacturing Date: 2024-08-15
Company: Samsung
--------------------------
Inventory has been saved to inventory.txt
```

2) Write a program to write the information of students in a file. And also display their details in console.

```cpp
#include <iostream>
#include <fstream>
#include <vector>
#include <string>
using namespace std;
struct Student {
    int roll;
    string name;
    int age;
    string course;
};
int main() {
    int n;
    cout << "Enter number of students: ";
    cin >> n;
    cin.ignore();

    vector<Student> students;

    for (int i = 0; i < n; ++i) {
        Student s;
        cout << "\nEnter details for student " << i + 1 << ":\n";
        cout << "Roll number: ";
        cin >> s.roll;
        cin.ignore();
        cout << "Name: ";
        getline(cin, s.name);
        cout << "Age: ";
        cin >> s.age;
        cin.ignore();
        cout << "Course: ";
        getline(cin, s.course);
        students.push_back(s);
    }
ofstream fout("students.txt");
    if (!fout) {
        cout << "Error opening file for writing.\n";
        return 1;
    }
    for (const auto& s : students) {
        fout << s.roll << "," << s.name << "," << s.age << "," << s.course << endl;
    }
    fout.close();
 cout << "\n--- Student Details ---\n";
    for (const auto& s : students) {
        cout << "Roll: " << s.roll << endl;
        cout << "Name: " << s.name << endl;
        cout << "Age: " << s.age << endl;
        cout << "Course: " << s.course << endl;
        cout << "----------------------\n";
    }
 return 0;
}
```

```
Enter number of students: 1

Enter details for student 1:
Roll number: 14
Name: Diwas Pokhrel
Age: 20
Course: BEI

--- Student Details ---
Roll: 14
Name: Diwas Pokhrel
Age: 20
Course: BEI
----------------------
```

Discussion:

The concept of stream computation in C++ is integral to managing input and output operations in both console and file-based programs. During this lab, we experimented with both standard and file streams to understand how data flows in and out of a C++ program.Using cin and cout helped us build interactive programs, while ifstream, ofstream, and fstream allowed us to work with files. A key takeaway was the importance of proper file handling, such as checking if a file exists before accessing it and ensuring it's closed after operations are complete. We also learned about file modes that affect how data is read or written.

Conclusion:

The lab on stream computation in C++ provided a solid understanding of how input and output operations are handled in a C++ program. We learned about the importance of cin, cout, and how file streams are used for reading from and writing to files. The use of stream classes from the <iostream> and <fstream> libraries makes input/output operations in C++ both efficient and flexible.We also realized the importance of checking file status, handling errors, and using appropriate file modes. Mastering stream operations is crucial for developing real-world applications where data storage and retrieval are necessary.