CPT106

C++ Programming and Software Engineering II

Lecture 10 File Operation

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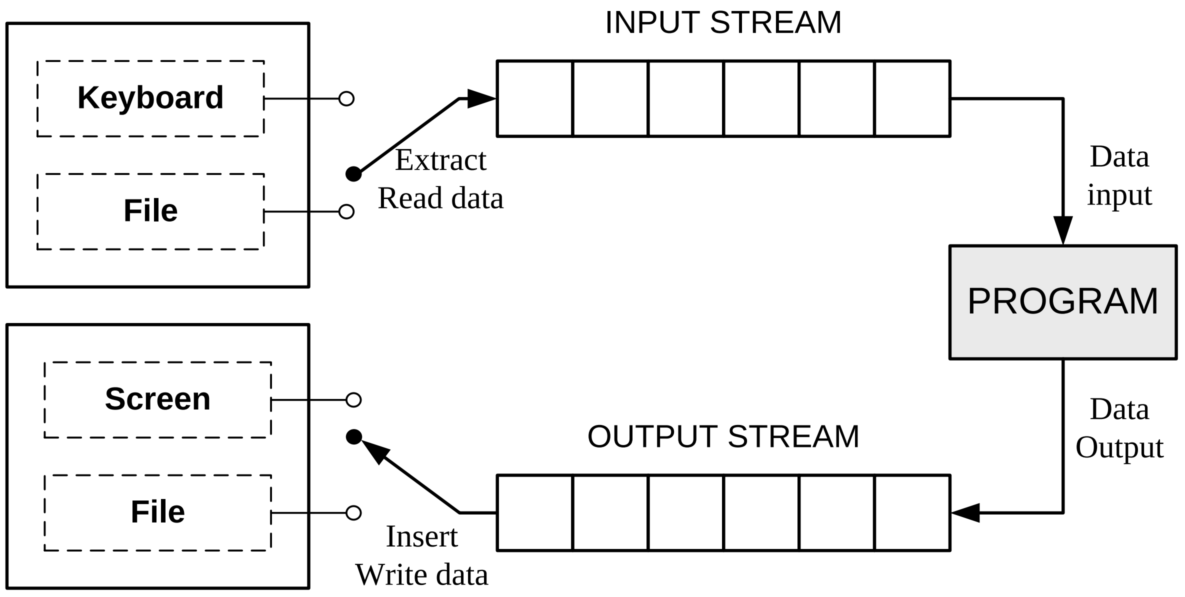
Office hour: 14:00-16:00 Monday

Outline

- File Stream
  - Classes for stream operations
  - Opening and Closing a file
  - Detecting the end-of-file
  - File modes
- Sequential input and output operations
- File Pointers
  - Pointer manipulation functions

1.1 Stream

- The I/O system handles file operations using file streams as the interface between the programs and the files.
  - Input stream: supply data to the program;
  - Output stream: receive data from the program.



Input stream extracts (read) data from the file and the output stream insert (write) data to the file.

Stream and buffers

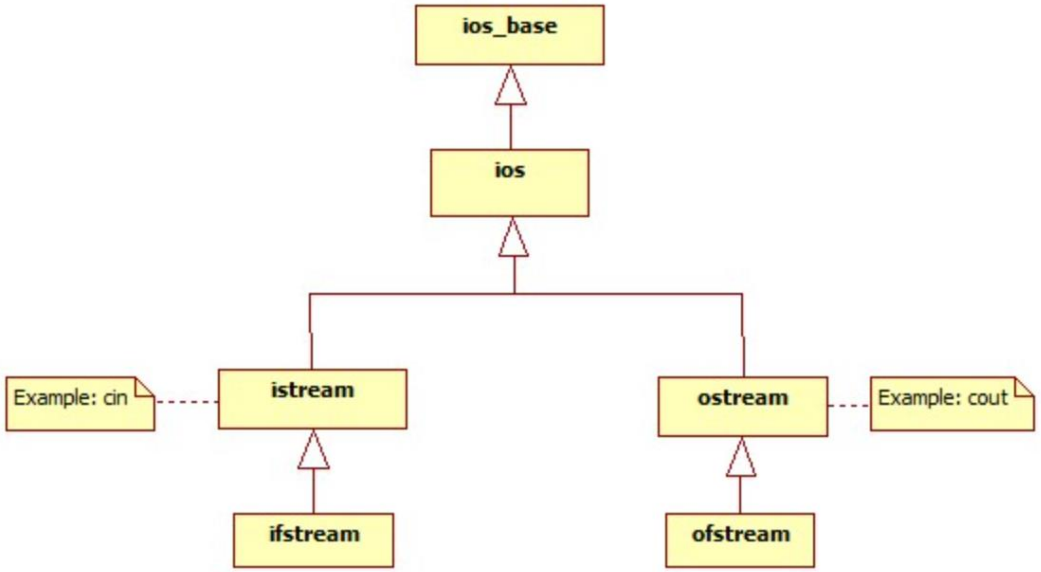
- A C++ program views input or output as a stream of bytes.
  - On input: a program extracts bytes from an input stream.
  - On output: a program inserts bytes to the output stream.
- A stream acts as an intermediary between the program and the stream’s source or destination. In this way the C++ program merely examines the stream of bytes without needing to know where the bytes come from.
- Usually, input and output can be handled more efficiently by using a ***buffer***.

Buffers

- A *buffer* is a block of memory used as an intermediate , temporary storage facility for the transfer of information from a device (i.e. hard disk) to a program or from a program to a device.
- Typically, devices such as disk drivers transfer information in blocks of 512 bytes or more, whereas programmes often process information 1 byte at a time. The buffer help match these two disparate rates of information transfer.
  - Information can be transferred between a buffer and a file, using large chunks of data of the size most efficiently handled by device;
  - Information can be transferred between a buffer and a program in a byte-to-byte flow that is more conveniently for processing.

1.2 Classes for stream operations

- The I/O system contains a set of classes that define the file handling methods are declared in "**`fstream`**".
  - Therefore, it is always needed to include this file in any program that uses file operation.
  - Syntax: **`#include <fstream>`**



1.3 Opening and Closing a file

- To open a file
  - First create a file stream => declaration
  - Then link it to the file name => assignment

    Initialisation
  - A file stream can be defined using the classes **`ifstream`**, **`ofstream`** and **`fstream`**.
  - A file can be opened in two ways:
    - 1. Using the constructor function:

```
ifstream infile("data.txt");
ofstream outfile("newdata.txt");
```

    - 2. Using the method **`open()`** :

```
ofstream outfile;
outfile.open("newdata1.txt");
outfile.open("newdata2.txt");
```

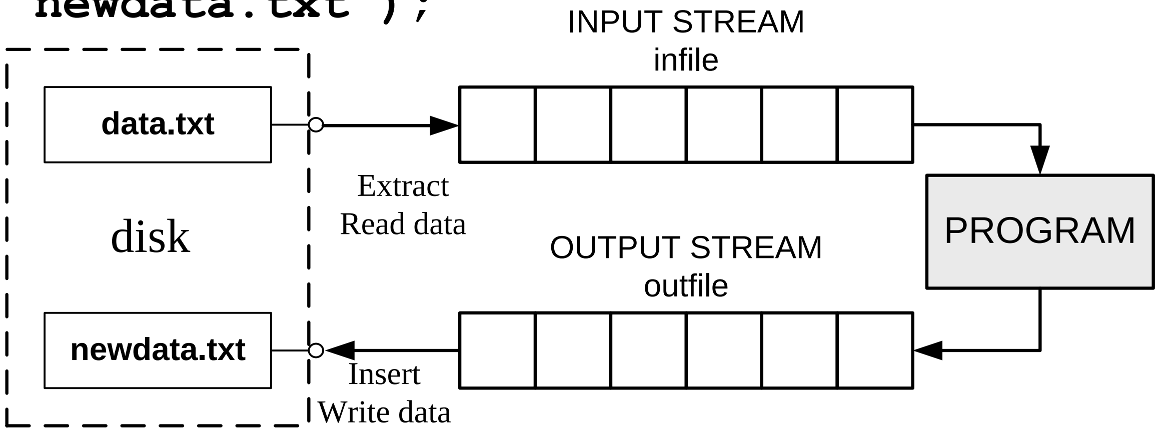
1.3 Opening and Closing a file

- 1. Using the constructor function:

```
ifstream infile(“data.txt”);
ofstream outfile(“newdata.txt”);
```

Case 1:

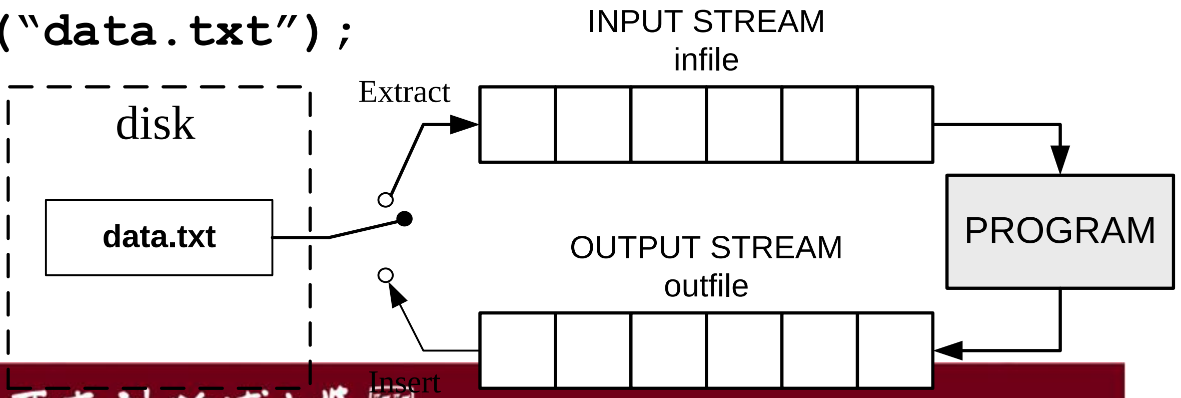
Link to different file



```
ifstream infile(“data.txt”);
ofstream outfile(“data.txt”);
```

Case 2:

Link to the same file



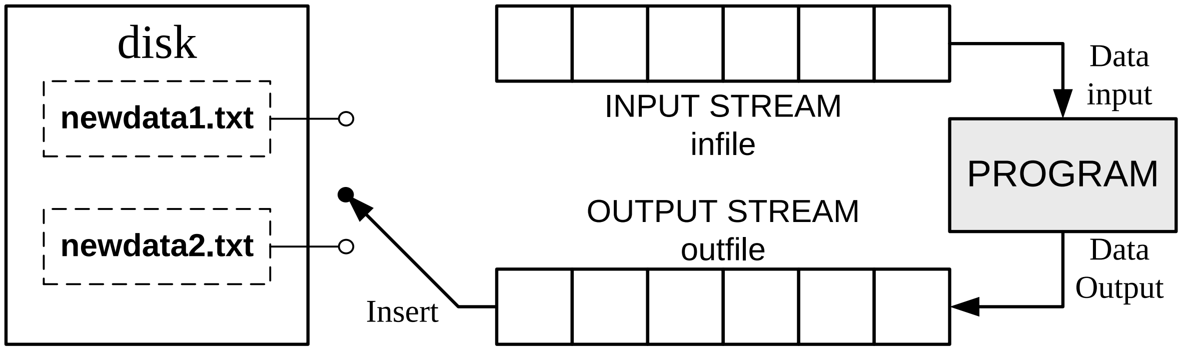
1.3 Opening and Closing a file

- 2. Using the method **`open()`** :

```
ofstream fout;
fout.open("newdata1.txt");
fout.open("newdata2.txt");
```

Case 3:

Link to same stream



- When a file is opened for writing, a new file is created if there is no file of that name;
- If a file by that name exists already, then its contents are deleted and the file is presented as a clean file.

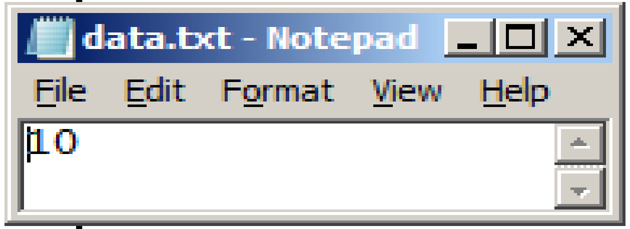
1.3 Opening and Closing a file

- The connection with a file is closed automatically when the stream object expires (when the program terminates)
- It is invalid to link one file to different stream, or link two files to one stream simultaneously -> disconnect / close the file before reconnection.
  - Example: Case 2 and 3 in previous slides
- To close a file
  - Syntax:

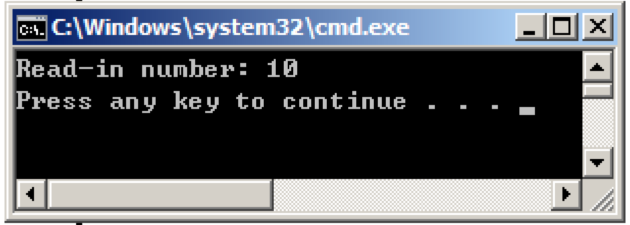
```
Case2:      ifstream infile(“data.txt”);
            ofstream outfile(“data.txt”);
Case3:      ofstream fout;
            fout.open(“newdata1.txt”);
            fout.open(“newdata2.txt”);
```

Example of Using Files I/O

```
#include <iostream>
#include <fstream>
using namespace std;

int main()
{
        int num=10,result;
        ofstream outfile("data.txt");
        outfile<<num<<endl;
        outfile.close();

        ifstream infile("data.txt");
        infile>>result;
        cout<<"Read-in number: "<<result<<endl;
        infile.close();

        return 0;
}
```



```
10
```



```
Read-in number: 10
Press any key to continue . . .
```

?

```
D:\\CppCode\\data.txt
```

Use escape sequence for the complete path of the file name

1.4 Detecting the end-of-file

- Detection of the end-of-file condition is necessary for preventing any further attempt to read data from the file.
- **`eof()`** is a member function of **`ios`** class, which returns a non-zero value if the end-of-file (EOF) condition is encountered.

```
ifstream fin(“data.txt”);
fin.eof ()          % ==0, not EOF
fin.eof ()          % !=0, EOF
```

  – Use the following statement to terminate the program on reaching the end of the file

```
if(fin.eof()!=0)
{ exit(1);}
```

1.5 More about **`open()`** : file modes

- When opening the file (connecting the file to an stream object), use second argument to specify the file mode:
  - Syntax:

```
ifstream fin("data.txt",mode);
```

  - The prototype functions contain default values as:

```
ios::in      for ifstream (open for read-only)
ios::out     for ofstream (open for write-only)
```

  - More file mode parameters:

```
ios::app     Append to end-of-file
ios::ate     Go to end-of-file on opening
ios::trunc   Delete the contents of the file if exist
ios::binary Binary file
```

  - The mode can combine, such as:

```
fout("data.txt",ios::app|ios::binary);
```

2. Sequential input and output operations

- The stream classes support a number of member functions for performing the input and output operations on files.
  - Extraction and insertion symbol:
    - **<<** and **>>**
    - Example:

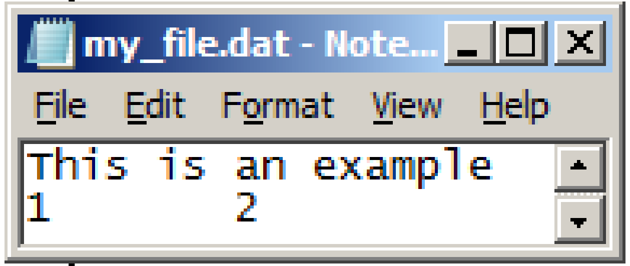
```
outfile <<num <<endl;
infile >>result;
```

  - Single character operation:
    - **put()** and **get()**
    - Example:

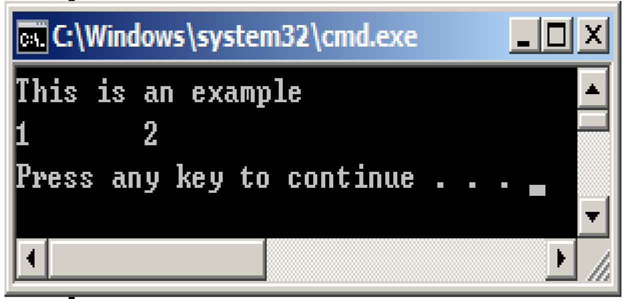
```
outfile.put(‘A’);
infile.get(ch);
infile.getline(cstr,20);
```

Example 2 of Using Files I/O

```
#include <iostream>
#include <fstream>
using namespace std;

int main()
{
        char line[20];
        int m1, m2;
        ofstream fout("my_file.dat");
        fout<<"This is an example"<<endl;
        fout<<1<< "\t" <<2<<endl;
        fout.close();

        ifstream fin("my_file.dat");
        fin.getline(line,20);
        fin>>m1>>m2;
        cout<<line<<endl;
        cout<<m1<<"\t" <<m2<<endl;
        fin.close();

        return 0;
}
```



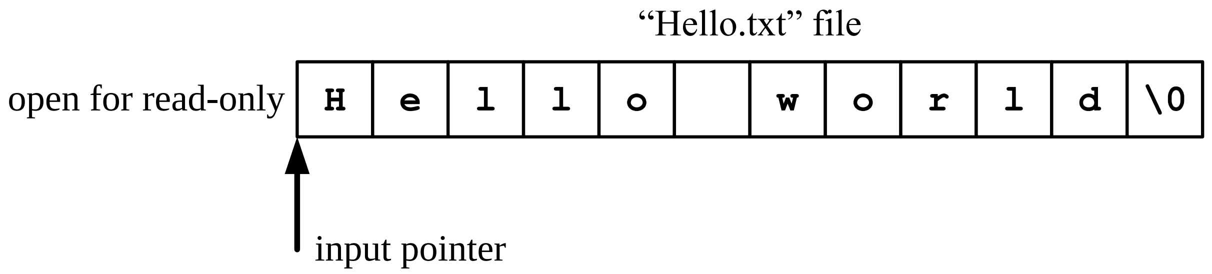
```
This is an example
1	2
```

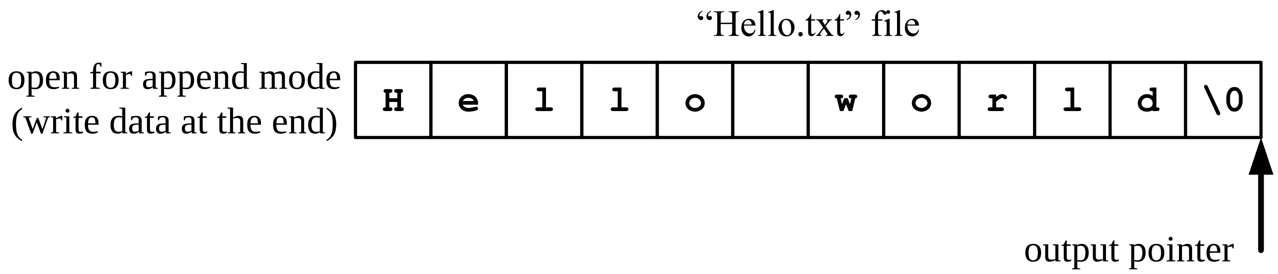


```
This is an example
1       2
Press any key to continue . . .
```

3.1 File Pointers

- Each file has two associated pointers: input pointer (or get pointer), and the output pointer (or put pointer).
  - get pointer: for reading the content of a given file location
  - put pointer: for writing to a given file location





3.2 Pointer manipulation functions

- The file stream classes support the following functions to manage the pointer:
  - **`seekg()`**: moves get pointer (input) to a specified location
  - **`seekp()`**: moves put pointer (output) to a specified location
  - **`tellg()`**: gives the current position of the get pointer (input)
  - **`tellp()`**: gives the current position of the put pointer (output)
- These functions take two arguments:
  - **`offset:`** number of bytes
  - **`refpostion:`** reference position
    - **`ios::beg, ios::cur, ios::end`**
  - Example:

```
fout.seekg(0,ios::beg);// Go to beginning of the file
fout.seekg(N,ios::cur);// Go forward by N byte from the current position
fout.seekg(-1,ios::end);// Go backward by 1 byte from the end
```