

CSE 142 Computer Programming I

File Input/Output

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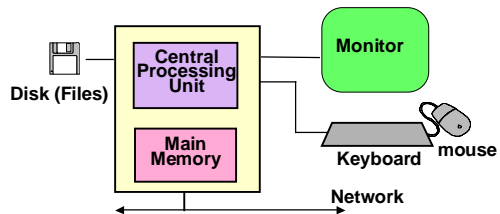
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Overview

Concepts
External disk files
Opening files for reading/writing
File variables
File I/O
Closing Files
Reading
Textbook sec. 12.1

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Review: What is I/O?



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Files Defined

A "file" is a collection of data on disk

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Why Have Files?

- Large volume of input data
- Large volume of output data
- More permanent storage of data
- Transfer to other programs
- Multiple simultaneous input and/or output streams

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Data Files

Business Data: customer files, payroll files, ...

Scientific Data: weather data, environmental data, topographic maps, ...

Image Data: web images, satellite images, medical images, ...

Web Data: HTML, GIF, JPEG, PNG, XML, ...

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Files vs. File Names

A **"file"** is a collection of data on disk
Managed by the user and the operating system
Permanent

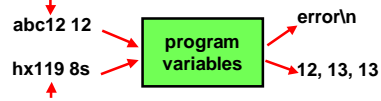
A **"file name"** is how the user and OS know the file follows OS naming rules

We'll look at using text files in a C program

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Files as Streams of Characters

keyboard/screen are special cases
input / output streams of characters



Multiple streams can be used simultaneously
In reality, stream flows through a buffer rather than directly into or out of variables.

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Files vs. File Variables

Key idea

A **file** is a collection of data on disk
For our purposes, a sequence of characters

But a C program can only operate directly on variables (data in main memory), so...

Need to make a connection between the data on the disk and variables in main memory

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Files vs. File Variables

A **file variable** is a data structure in the C program which represents the file
Temporary: exists only when program runs

There is a struct called FILE in <stdio.h>

Details of the struct are private to the standard C I/O library routines

File variables in C programs are **pointers** to a **FILE struct**.

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FILE *myfile;

What's in *stdio.h*?

Prototypes for I/O functions.

Definitions of useful **#define** constants

Example: EOF for End of File

Definition of **FILE struct** to represent information about open files.

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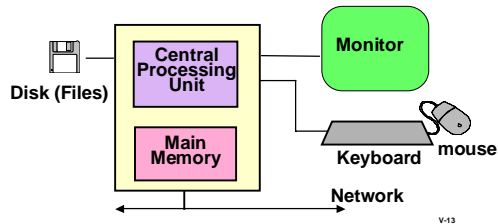
Opening A File

"Opening" a file: making a connection between the operating system (file name) and the C program (file variable)

Files must be opened before they can be used

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Computer System



Opening A File

To open a disk file in C:
library function *fopen*
specify "r" (read, input) or "w" (write, output)
NB String "r", not char 'r' !

Files *stdin/stdout* (used by *scanf/printf*) are automatically opened and connected to the keyboard and display

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File Open Example

*/*usually done only once in a program*/
/*usually done near beginning of program*/*

*FILE *infile, *outfile; /*file variables*/
char ch;*

/ Open input and output files */
infile = fopen ("Student_Data", "r");
outfile = fopen ("New_Student_Data", "w");*

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File I/O: *fscanf* and *fprintf*

Once a file has been opened...

use *fscanf* and *fprintf* to read or write data from/to the file

Use the file variable returned by *fopen* to identify the file to be read/written

File must already be open before *fscanf* or *fprintf* is used!

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File I/O: *fscanf* and *fprintf*

fscanf: works just like *scanf*, but 1st parameter is a file variable

fscanf (filepi, "%...", &var, ...);

fprintf: works just like *printf*, but 1st parameter is a file variable

fprintf (filepo, "%...", var, ...);

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Copying a File

/ Copy a file one character at a time */
/* files must already be open before this*/*

```
fscanf (infile, "%c", &ch);  
while ( /*...we just read a character .. */ ) {  
    fprintf (outfile, "%c", ch);  
    fscanf (infile, "%c", &ch);  
}
```

Question: How do we tell when we've read the last character from the input file? V-18

Review: (f)scanf return value

Both `scanf` and `fscanf` are really int-valued functions

Besides storing input values in variables, they return a **status code**:

- Tells the number of values successfully read
- Can be used to see if the number of values read is the number expected. If not, there must have been an error.
- Can also be used to detect when end of file is reached

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End of File (EOF) Status

EOF: a special status value
Returned by `scanf` and `fscanf` when end of data is reached

defined in `stdio.h`
`#define EOF` (some negative value)

I/O library routines use **EOF** in various ways to signal end of file.

Your programs can check for **EOF**

EOF is a status, not an input value!!

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File Copy Example, Concluded

```
/* Copy a file one char at a time until EOF*/
/* files must already be open before this*/
status = fscanf (infile, "%c", &ch);
while ( status != EOF ) {
    fprintf (outfile, "%c", ch);
    status = fscanf (infile, "%c", &ch);
}
```

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Closing A File

Breaks the link between file variable and file
Usually done only once in a program, near end of program

Closing an output file is essential, or data may be lost!

```
infile = fopen ("Student_Data", "r" );
.../*process the file */
...
/*when completely done with the file:*/
fclose (infile);
```

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File Copy (Compact Edition)

```
/* Many C programmers use this style*/
...
while ( fscanf (infile, "%c", &ch) != EOF )
    fprintf (outfile, "%c", ch);

printf ("File copied.\n");
fclose (infile);
fclose (outfile);
```

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Review: Essential Functions for Text File I/O

`fopen` and `fclose`

`fscanf`:

```
status = fscanf (filepi, "%...", &var, ... );
/* fscanf returns EOF on end of file */
```

`fprintf`:

```
fprintf (filepo, "%...", var, ... );
```

File must already be open before `fscanf` or `fprintf` is used

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Building Applications with Files

With *fopen*, *fclose*, *fprintf*, and *fscanf* you can write lots of useful programs involving files

Many errors and exceptions can arise when using files

- A robust program must handle errors

- Use *scanf*'s return value to check for errors

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Summary

Files are collections of data on disk

A file must be opened before use

A file should be closed after use

fprintf is used to write text files

fscanf is used to read text files

scanf/fscanf operation returns a status

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