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Input/output file

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Standard input/output streams

- 3 standard streams are opened by a program:
 - `stdin`: for input
 - `stdout`: for output
 - `stderr`: for error
- The direction of these streams to peripherals depends on the program, the default is keyboard for **`stdin`**, screen for **`stdout`** and **`stderr`**
- `scanf()` and `printf()` are functions that read/write in **`stdin`** and **`stdout`**
- `perror()` prints the errors to **`stderr`**

Example

Input.c

```
#include <stdio.h>
void main()
{
    int a;
    if ( scanf("%d", &a) != 1 )
        perror("This is not integer\n");
    else
        printf("Input number%d", a);
}
```

\$input ↵
10 ↵
Input number10
\$input ↵
abc ↵
This is not integer
\$input >out.txt ↵
10 ↵
\$input >out.txt ↵
abc ↵
This is not integer

Redirect stdout to file
out.txt

Input/output file

- Files need to be *opened* before use.
- Associate a "*file handler*" to each file
- Modes: read, write, or append
- File input/output functions use the file handler (*not* the filename).
- Need to *close* the file after use.
- Basic file handling functions: **fopen()**, **fclose()**, **fscanf()**, **fprintf()**.
- FILE * is the file handler type

Example

```
#include <stdio.h>
```

```
int main()
```

```
{
```

```
    FILE * out = fopen("hello.txt", "w");
```

Open file to
write

```
    if (out == NULL)
```

```
    {
```

```
        perror("Unable to write to the file.\n");
```

```
        return 1;
```

```
    }
```

Write data to
file

```
    fprintf(out, "Hello world");
```

```
    fclose(out);
```

```
    return 0;
```

Close file when
terminate

```
}
```

Modes in open file

- r: read
- w: write
- a: append
- r+: read/write on a new file if not exist
- w+: write on a new file if not exist
- a+: append on a new file if not exist

fprintf() và printf()

- fprintf works exactly as printf except the output on stdout.
- printf(...) = fprintf(stdout, ...)
- Similarly we have other output streams:
 - fputs(char*, FILE*) and puts(char*)
 - fputc(char, FILE*) and putchar(char)

fscanf() and scanf()

- fscanf work exactly as scanf except the input on stdin.
- The return type of fscanf() and scanf() is the number of elements read.
- Similarly we have other input streams:
 - char* fgets(char*, int *maxlen*, FILE*) and
 - char* gets(char*);
 - int fgetc(FILE*) and int getchar(void)

Input data

- Both **scanf()** and **fscanf()** return:
 - the number of input items converted and assigned successfully
 - or the constant value **EOF** when an error or end-of-file occurs
- Therefore we can also check EOF using function fscanf
- The input process is the process of scanning data on the buffer according to a specific data type.
- After each successful scan, the buffer's pointer shifts to the next space in order to scan data for the next reading time.
- When there is no more data in the buffer, the buffer's pointer points to EOF.
 - To check whether the pointer is at the EOF position or not, using function `int feof(FILE*)`

Input formats

- Input number following formats `%d`, `%l`, `%x`,..., will skip spaces and ↵
- `%s` scans a string not including spaces and ↵.
- `%c` scans any character at the pointer's position (including spaces and ↵)
- Example, if we enter `"12 ab↵"`
 - `"%d%s"` gives us a number 12 and a string "ab"
 - `"%d%c%s"` gives us a number 12, a space and a string "ab"
 - `"%d %c%s"` gives us a number 12, a character a and a string "b"
 - `"%s%s"` gives us two strings "12" and "ab"
 - `"%d%s%c"` give us a number 12, a string "ab" and a character ↵

fflush()

- Function fflush(<stream>) is used to clean an input/output buffer
- When a file is closed, its buffer will be automatically cleaned
- fflush() should be used before scanning a character or a string with gets() or fgets()
- Like enter a character, gets() does not skip any character when scanning. This function scans all spaces and stops at the first ↵. However, ↵ does not include in the target string.

Example

Input.c

```
#include <stdio.h>

void main()
{
    int a;
    char s[20];
    printf("Input a number: ");
    scanf("%d", &a);

    fflush(stdin);
    printf("Input a string: ");
    gets(s);

    printf("number %d, string %s",
        a, s);
}
```

C:\>input ↵
Input a number: 12↵
Input a string: ab↵
number 12, string ab

%d only gets two characters '12' to convert to number, the redundant character ↵ is cleaned by fflush() before enter a string by gets()

Calculate total words of a file

```
#include <stdio.h>

int main()
{
    int count = 0;
    char s[80];
    FILE * f = fopen("text.txt", "r");
    if (f == NULL)
    {
        perror("Failure when opening text file.txt\n");
        return 1;
    }
    while (!feof(f))
        dem += fscanf(f, "%s", s);
    fclose(f);
    printf("Total number of words: %d", dem);
    return 0;
}
```

Open file to read

Read a word each time

fgetc() and fputc()

```
FILE *input, *output;  
input = fopen( "tmp.c", "r" );  
output = fopen( "tmpCopy.c", "w+" );  
  
ch = fgetc( input );  
while( ch != EOF ) {  
    fputc( ch, output );  
    ch = fgetc( input );  
}  
  
fclose(input);  
fclose(output);
```

fgets()

```
#include <stdio.h>
#define LINE_LENGTH 80

main()
{
    FILE* fp;
    char line[LINE_LENGTH];
    int count=0;
    fp=fopen("input.txt","r");
    while ( fgets(line, LINE_LENGTH, fp) != NULL)
        count++;
    printf("File contains %d lines.\n", count);
    fclose(fp);
}
```

Text file vs. binary file

- There is no difference among byte data in binary file
- In text file, byte data are categorized as displayed character and control character.
- A text file is marked as end by a control character (e.g., 26 in DOS)
- To open a file in text mode, we add 't' in the open mode ("r+t", "wt", ...).
- To open a file in binary mode, we add 'b' in the open mode ("r+b", ...).

Input/output in binary mode

```
size_t fread(void* buf, size_t size,  
             size_t num, FILE* f);  
size_t fwrite(void* buf, size_t size,  
             size_t num, FILE* f);
```

- Read and write data in the memory with the pointer *buf*, with the total elements *num*, size of each element *size*

Example:

```
int a[10];  
f=fopen("integer.dat", "r+b");  
fread(a, 10, sizeof(int), f);
```

Exercises

1. Write a program to create a text file F3 by concatenate two text files F1 and F2

F1 = “ha noi”; F2 = “ viet nam” F3 = “ha noi viet nam”

2. Write a program to remove all comments from a C program which is stored in a file. The name of the file is entered from the keyboard. Assume that the program does not have syntax errors.

3. Assume that a data file consisting information about weather in a year has the format for each line as follow: \

<day>/<month> <lowest temperature>-<highest temperature> <humidity>

1/1 11-17 70

2/1 12-17 75

...

4. Write a program read data from this file and print the average temperature of all months in a year, the most humid month and the driest month.



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