Advanced C Programming & Lab

13. File IO

Sejong University

Outline

1) **File IO**

2) File IO Procedures

3) Text File vs. Binary File

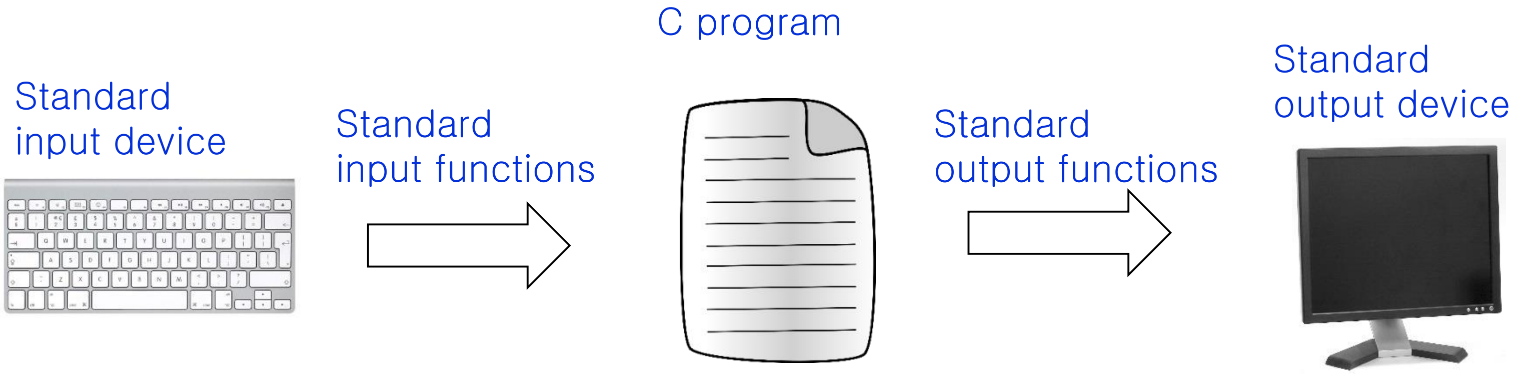
4) File IO Function: Text File

5) File IO Function: Binary File

6) File IO Functions

1) File IO

- **Standard IO**
  - Input: a standard input device (keyboard)
    output: a standard output device (monitor)
  - Standard input functions: scanf(), getchar(), gets()
  - Standard output functions: printf(), putchar(), puts()
  - Terminating a program, input and output results will disappear



C program

Standard input device

Standard input functions

Standard output functions

Standard output device

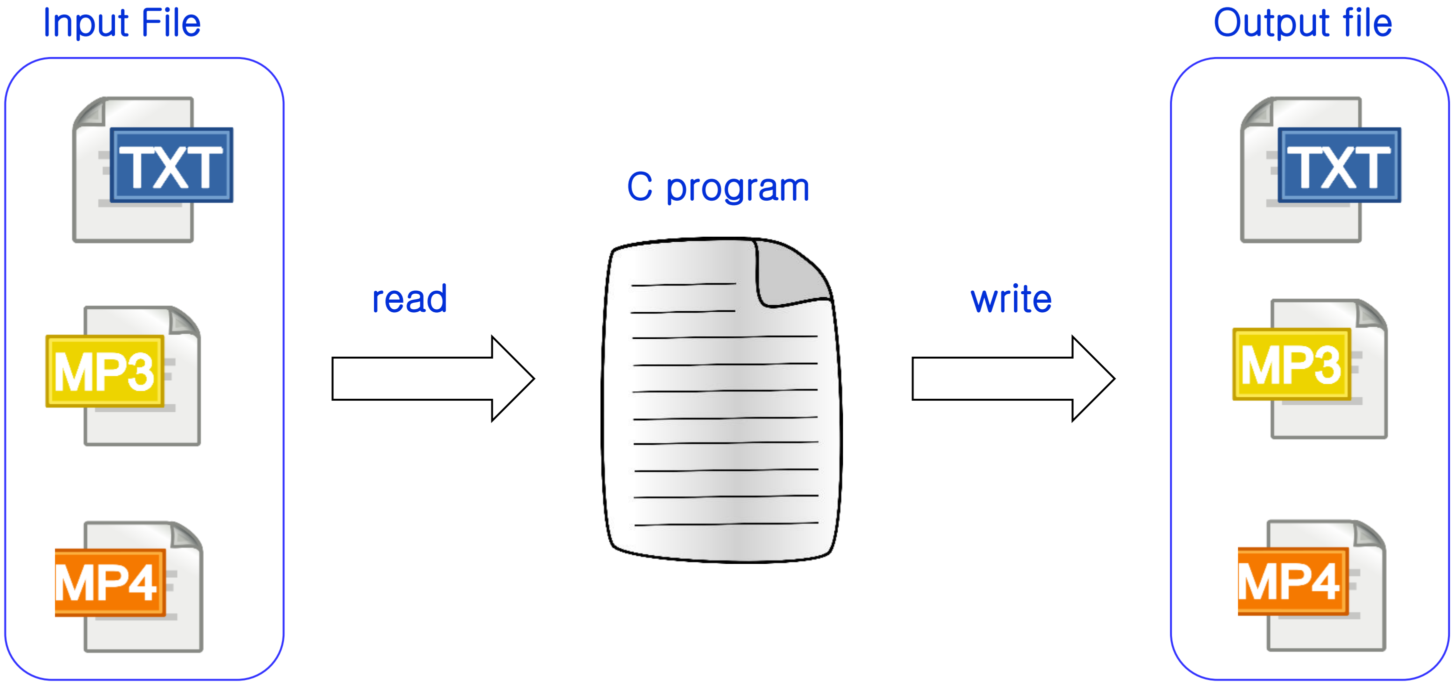
1) File IO

- **Need to store data??**

➔ File Input/Output

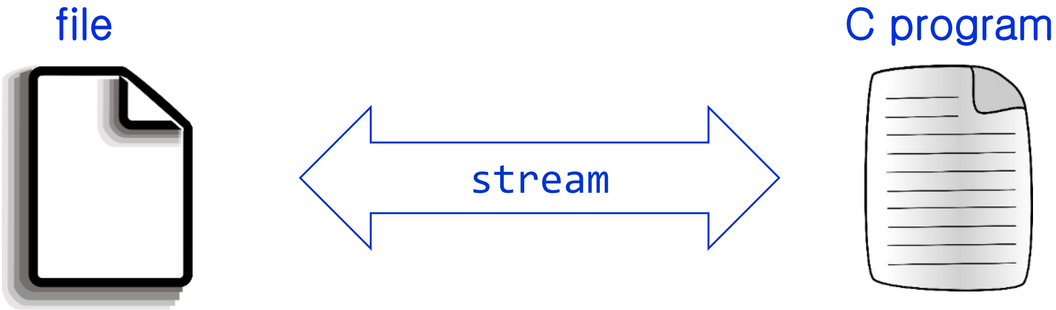
✓ Read data from a file output to a file

✓ C provides library functions



1) File IO

- **Data transfer: program - file**



- **Stream**
  - Logical interface between a program and a file (logical data interface)
  - Specifically, use FILE structure and file buffer
  - Consistent I/O → improve efficiency of I/O
    - ✓ Programming, independent of devices

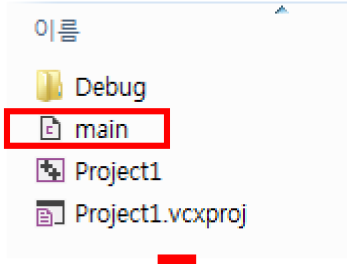
1) File IO

- **Execute the following program**

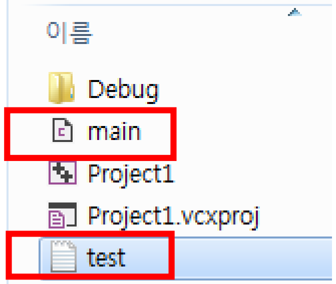
main.c

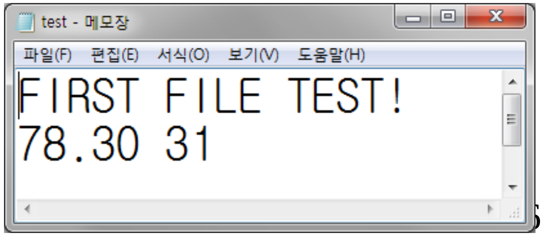
```
#include <stdio.h>

int main()
{
    double weight = 78.3;
    int age = 31;

    FILE *fp;
    fp = fopen(“test.txt”, “w”);

    fprintf(fp, “FIRST FILE TEST!\n”);
    fprintf(fp, “%.2f %d\n”, weight, age);

    fclose(fp);

    return 0;
}
```

Directory including main.c



Results: create text.txt!





```
FIRST FILE TEST!
78.30 31
```

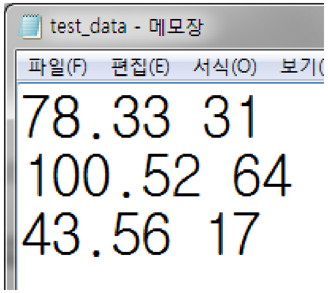
1) File IO

- **Create “test_data.txt” in the current working directory, execute the following program.**

main.c

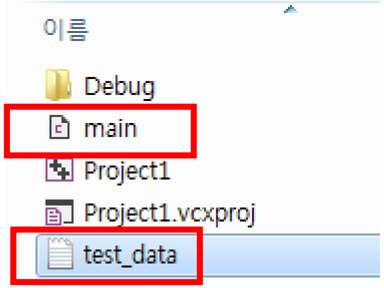
```
#include <stdio.h>
#define SIZE 3
int main()
{
	double weight;
	int age, i;

	FILE *fp;
	fp = fopen("test_data.txt", "r");

	for (i = 0; i < SIZE; i++)
	{
		fscanf(fp, "%lf %d", &weight, &age);
		printf("%.2f %d₩n", weight, age);
	}

	fclose(fp);
	return 0;
}
```

test_data.txt :
(use notepad)

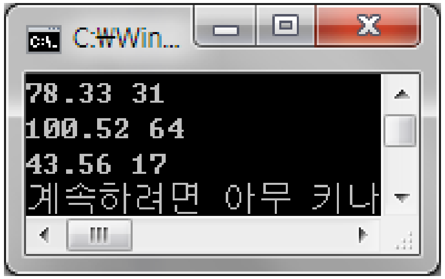


```
78.33 31
100.52 64
43.56 17
```

Copy test_data.txt to the directory where main.c is

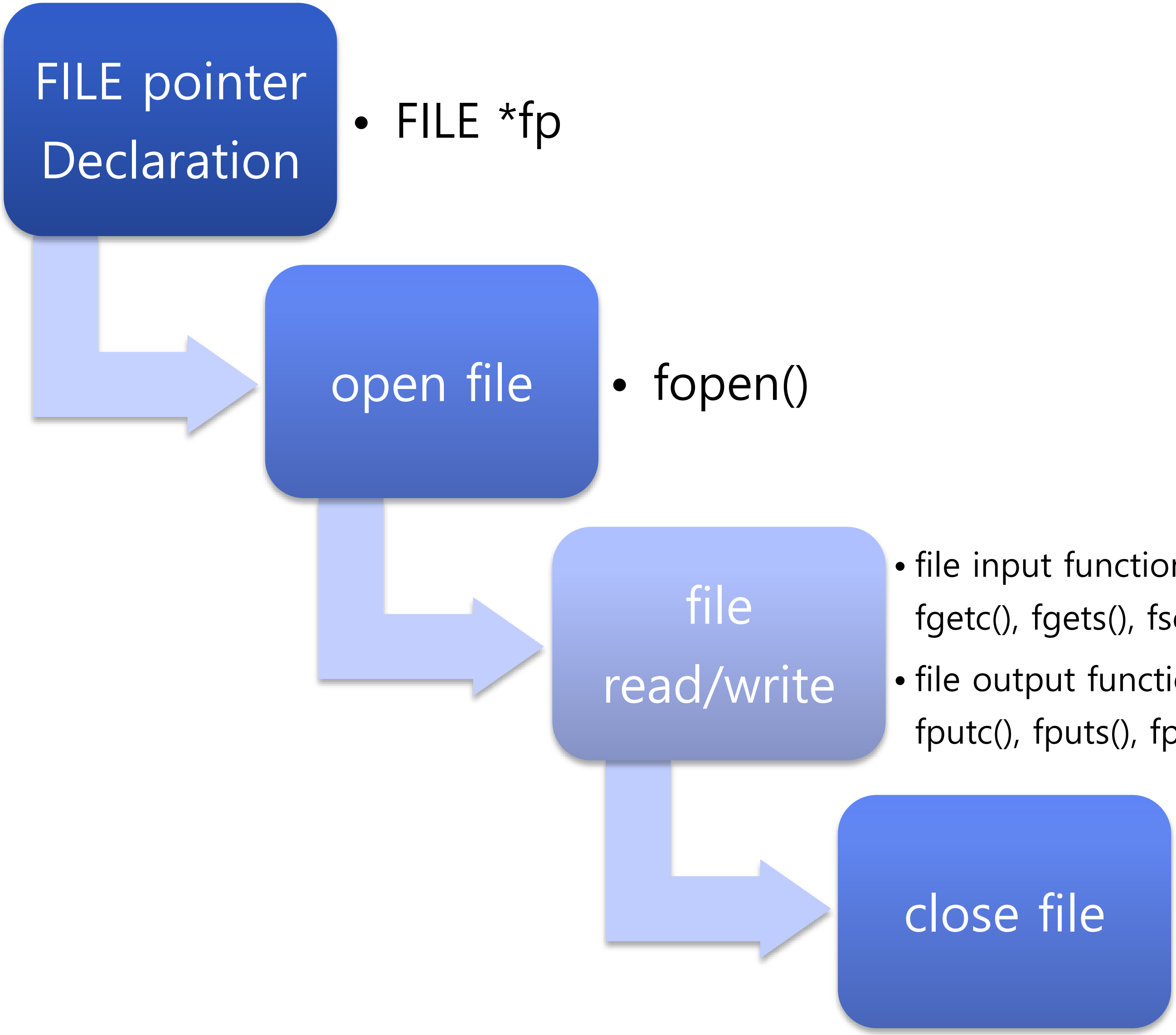


Result



```
78.33 31
100.52 64
43.56 17
계속하려면 아무 키나
```

1) File IO



FILE pointer Declaration

- FILE *fp

open file

- fopen()

file read/write

- file input functions:
  fgetc(), fgets(), fscanf(), fread()
- file output functions:
  fputc(), fputs(), fprintf(), fwrite()

close file

- fclose()

Outline

1) File IO

2) **File IO Procedures**

3) Text File vs. Binary File

4) File IO Function: Text File

5) File IO Function: Binary File

6) File IO Functions

2) File IO Procedures

- **Must include <stdio.h>**

- **Declare file pointer**
  - File pointer: pointer to a FILE structure
  - Declare a pointer to a FILE structure
  - Usage

```
FILE  * file_pointer_name;
```

Upper-case!!

2) File IO Procedures

- **file open: fopen() function**
  - Create a IO stream for the given file
  - Return a file pointer to the given file

Function Prototype	**FILE *fopen(char *filename, char *filemode);**	
Function Argument	filename	Name of a file to associate the file steam to
	filemode	Type of stream
Return Type	✓ successful → FILE pointer ✓ failed → NULL	

2) File IO Procedures

- **Function argument: filename (1/3)**
  - The position to find the file to be opened
    - ✓ May depend on environment, settings, and etc
    - ✓ Not specified → **current working directory**
      - ✓ Current working directory = where the current source code is
      - ✓ ex) fopen(“test.dat”, “filemode”);

filename!

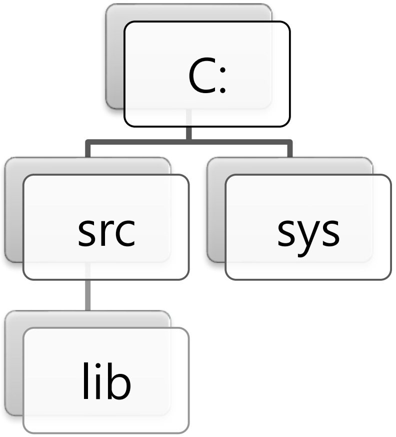
2) File IO Procedures

- **Function argument: filename (2/3)**
  - File is not in the current working directory → give **Path** to the file!
    - ✓ Absolute file path
      - ✓ Including root directory, subdirectories
      - ✓ Regardless of computer environment, file path never change
      - ✓ Ex) fopen("C:₩₩C_pro₩₩Project₩₩test.dat", "filemode");
        - » C drive > subdirectory C_pro > subdirectory Project > a file test.dat
        - » ₩₩: ₩ - backslash(₩) twice

2) File IO Procedures

- **Function argument: filename (3/3)**
  - Relative file path
    - ✓ Depend on the computer environment
    - ✓ Based on the current working directory
    - ✓ Ex) current working directory: src

```
fopen("lib₩₩data.txt", "filemode");
fopen("..₩₩sys₩₩data2.txt", "filemode");
```



< Figure 1 >

2) File IO Procedures

- **Function argument: filemode**
  - Specify the purpose of file opening
  - Mode can prevent mis-usage of a file

< Filemode>

type	mode	meaning	explanation
Input	r	Read	✓ For opening ✓ Cannot open the file → NULL
Output	w	Write	✓ For writing ✓ File does not exist → create a new file ✓ File exists → Delete its content, write the new content
	a	Append	✓ Append to a file ✓ File does not exist → create a new file ✓ File exist → Writhe to the end of the existing file

2) File IO Procedures

- **fopen() function**

```
FILE *fp;                              //FILE structure pointer

fp = fopen(“abc.txt”, “w”);            //abc.txt, open for writing
```

```
FILE *fp2;

fp2 = fopen(“data/text.dat”, “a”);

 //subdirectory data, text.dat, open to append to the file
```

2) File IO Procedures

- **Caution: fopen()**
  - Should check the return type

```
FILE *fp;
fp = fopen(“data.txt”, “r”);
if (fp == NULL)
{
        printf(“Couldn’t open file!”);
        return -1;
}
```

2) File IO Procedures

- **File close: fclose()**
  - Close the file stream to the given file
    - ✓ Writhe the remaining buffered output

Function Prototype	**FILE *fclose(FILE *fp);**	
Function Argument	fp	File pointer to a file to be closed
Return Type	✓ successful → return 0 ✓ failed → return EOF	

※ **EOF (End Of File)**?

✓ Constant (-1) to represent the end of a file

✓ To check whether errors occured or file reading completed

2) File IO Procedures

- **fclose()**

```
FILE *fp;
fp = fopen(“test.dat”, “r”);
if (fp == NULL)
{
            printf(“file reading successful!₩n”);
            return -1;
}
fclose(fp);
printf(“file close successful!₩n”);
```

2) File IO Procedures

- **Practice: file I/O**
  - Open and close a file text1.txt in read mode
  - Open and close a file data1.dat in write mode which is located in the parent directory of the current working directory
  - Open and close a file text2.dat in append mode which is located in the subdirectory Project of the current working directory

2) File IO Procedures

Standard input/output stream: automatic

FILE pointer	Stream	Meaning
stdin	Standard input stream	Input from a keyboard
stdout	Standard output stream	Output to a monitor
stderr	Standard error stream	Error message to a monitor

Outline

1) File IO

2) File IO Procedures

3) **Text File vs. Binary File**

4) File IO Function: Text File

5) File IO Function: Binary File

6) File IO Functions

3) Text File vs. Binary File

- **Type of file storage**

	Text file	**Binary file**
properties	✓human-readable characters ✓Easy to read the file ✓Can read the file using notepad ✓All data are converted to character strings ✓Process sequentially	✓Computer-readable data ✓Need a specific application to access the file ✓Cannot read the file using notepad ✓Numerical data are not converted to character strings ✓Take less amount of storage than text files ✓Fast to read and write ✓Store each block of data (Byes) ➔ Random access

3) Text File vs. Binary File

- **fopen() function argument: filemode (1/3)**
  ① Type of file access (refer to p. 16)
  ② Type of file storage

	Text mode	**Binary mode**
properties	✓ Text file I/O ✓ Automatic newline conversion (OS may differently process it) ✓ Programmer does not need to handle newline conversion	✓ Binary file I/O ✓ Stored as binary ✓ Do not need to mark the end of a line ✓ NULL and newline are treated as data ✓ Better to store numerical data

3) Text File vs. Binary File

- **fopen() function argument: filemode (2/3)**

Text	Binary	Explanation
r (rt)	rb	✓ Open for reading ✓ Cannot open a file → NULL
w (wt)	wb	✓ Open for writing ✓ File does not exist → Create a new file ✓ File exists → Delete its content, write the new content
a (at)	ab	✓ Open to append to the file ✓ File does not exist → Create a new file ✓ File exists → Writhe to the end of the existing file

3) Text File vs. Binary File

- **fopen() function argument: filemode (3/3)**

Text	**Binary**	**explanation**
r+	rb+	✓ Open for reading and writing ✓ File should exist
w+	wb+	✓ Open for reading and writing ✓ File does not exist → Create a new file ✓ File exists → Delete its content, write the new content
a+	ab+	✓ Open to read and append to the file ✓ File does not exist → Create a new file ✓ File exists → Can read from a random position, but write to the end of the file

3) Text File vs. Binary File

- **Text mode: fopen()**

```
FILE *fp;                          //FILE structure pointer
fp = fopen(“test.txt”, “r”);       //test.txt, read mode
```

- **Binary mode: fopen()**

```
FILE *fp;                          //FILE structure pointer
fp = fopen(“test.dat”, “rb”);      //test.dat, binary read mode
```

3) Text File vs. Binary File

- **File I/O functions**

Type	**Unit**	**Input**	**Output**
Text File	Character	fgetc()	fputc()
	Strings	fgets()	fputs()
	Specified Format	fscanf()	fprintf()
Binary File	Block	fread()	fwrite()

※ C provides file I/O functions in stdio.h

3) Text File vs. Binary File

- **File I/O functions**
  - fopen() function argument for file input
    - ✓ filename: file to read
    - ✓ filemode (read mode)
      - ✓ Text file: “r”
      - ✓ Binary file: “rb”
  - fopen() function argument for file output
    - ✓ filename: file to write
    - ✓ filemode (write or append mode)
      - ✓ Text file: “w” or “a”
      - ✓ Binary file: “wb” or “ab”

Outline

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4) **File IO Function: Text File**

5) File IO Function: Binary File

6) File IO Functions

4) File IO Function: Text File

- **Formatted input: fscanf()**
  - Read formatted input from a stream
  - Can read several types of data (integer, character, strings, etc)
  - First argument is a FILE pointer, the rest is the same with scanf()

Function Prototype	**int *fscanf(FILE *fp, char *format, arg1, arg2, …);**	
Function Argument	fp	FILE pointer
	Format	Format specifiers
	arg1, arg2, …	List of variables
Return Type	✓ Successful → Number of inputs ✓ End-of-File/error → EOF	

4) File IO Function: Text File

- **fscanf() function**

```
char str[10];
int num;
FILE *fp = fopen("data.txt", “r");
if (fp == NULL)
{
    printf(“Couldn’t open file!”);
    return -1;
 }
 fscanf(fp, “%s %d”, str, &num);
```

➔ Read strings and integers using fp associated with data.txt,

Store them in an array str and integer num

4) File IO Function: Text File

- **Formatted output: fprintf()**
  - Formatted output to a stream
  - First argument is a FILE pointer, the rest is the same with printf()

Function Prototype	**int *fprintf(FILE *fp, char *format, arg1, arg2, …);**	
Function Argument	fp	FILE pointer
	Format	Format specifiers
	arg1, arg2, …	List of variables
Return Type	✓ successful → number of inputs (Byes) ✓ failed/error → negative number	

4) File IO Function: Text File

- **fprintf() function**

```
int age = 25;
FILE *fp = fopen("data.txt", “w");
if (fp == NULL)
{
    printf(“Couldn’t open file!”);
    return -1;
 }
 fprintf(fp, “Age: %d”, age);
 fprintf(stdout, “Age: %d”, age);      // printf(“Age: %d”, age);
```

➔ Write “Age: 25” in a file data.txt using fp, same as on a monitor

4) File IO Function: Text File

- **Get a character: fgetc()**
  - Get a character from a stream

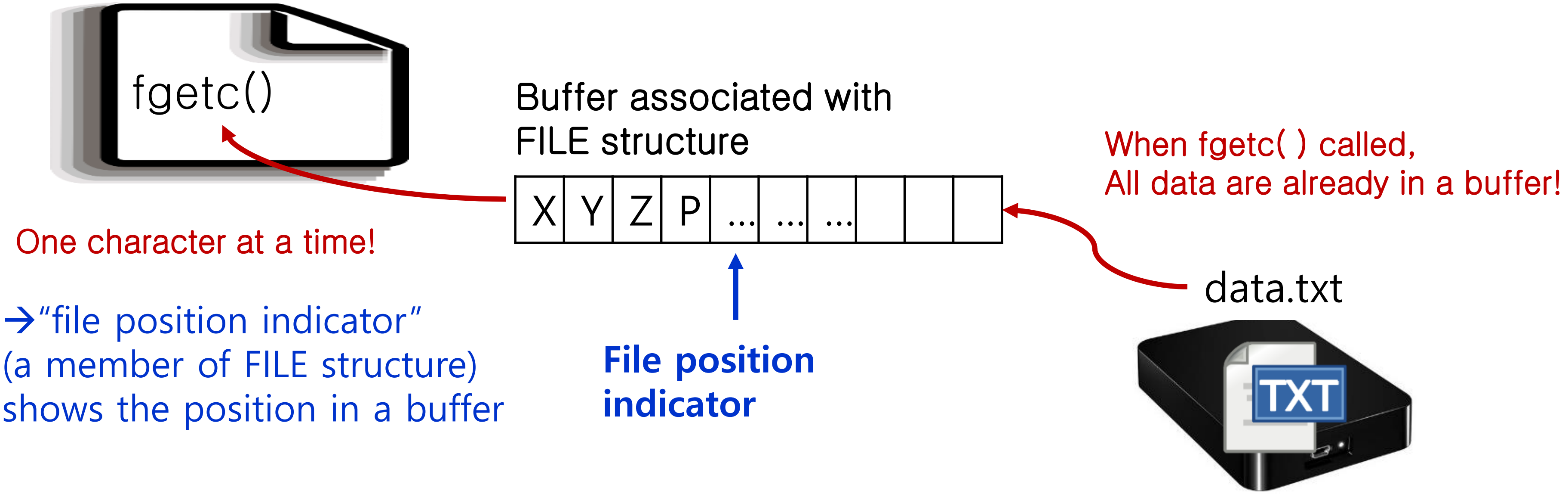
Function Prototype	**int fgetc(FILE *fp);**	
Function Argument	fp	FILE pointer
Return Type	✓ successful → received character ✓ Failed/error → EOF	

- **Write a character: fputc()**
  - Write a character to a stream

Function Prototype	**int fputc(int char, FILE *fp);**	
Function Argument	char	Character to write
	fp	FILE pointer
Return Type	✓ Successful → written character ✓ Failed/error → EOF	

4) File IO Function: Text File

- **fgetc() procedures**



Buffer associated with
FILE structure

X	Y	Z	P	…	…	…			

When fgetc( ) called,
All data are already in a buffer!

One character at a time!

→"file position indicator"
(a member of FILE structure)
shows the position in a buffer

File position indicator

- **fputs() procedures**
  - Use a buffer just like fgetc()
  - Write to a buffer when receiving a character
    Write to a disk when receiving a new line

4) File IO Function: Text File

- **File I/O**

```
#include <stdio.h>

int main()
{
    FILE *fp1, *fp2;
    char ch;

    fp1 = fopen(“input.txt”, “r”);
    if (fp1 == NULL)
    {
         printf(“Couldn’t open file!”);
         return -1;
    }
    fp2 = fopen(“output.txt”, “w”);
    if (fp2 == NULL)
    {
         printf(“Couldn’t open file!”);
         return -1;
     }
```

```
    while((ch = fgetc(fp1)) != EOF)
    {
            printf(“%c”, ch);
            fputc(ch, fp2);
    }

     fclose(fp1);
     fclose(fp2);

     return 0;
}
```

4) File IO Function: Text File

- **Get characters from a stream: fgets()**
  - Read characters/strings from a file
  - **New lines** in a file are treated as **characters/strings**
  - Maximum number of characters to be read is determined
    - ✓ (Maximum number of characters – 1) + NULL
  - Happened to have a new line?

  ➔ Characters before the new line are returned

4) File IO Function: Text File

- **Get characters from a stream: fgets()**

Function Prototype	**char *fgets(char *s, int n, FILE *fp);**	
Function Argument	s	Pointer to a string
	n	Maximum number of characters
	fp	FILE pointer
Return Type	✓ Successful → string s ✓ Failed/error → NULL	

4) File IO Function: Text File

- **Example: fgets()**

```
char str1[20], str2[20], str3[20];
FILE *fp = fopen(“info.txt", "r");
```

info.txt

```
Neungdong-ro,↲
Gwangjin-gu, Seoul, Korea.↲
```

1) fgets(str1, 20, fp);

N	e	u	n	g	d	o	n	g	-	r	o	,	₩n	₩0				

→ Characters before the new line are written to an array str1 (including NULL)

2) fgets(str2, 20, fp);

G	w	a	n	g	j	i	n	-	g	u	,		S	e	o	u	l	₩0

→ 19 characters are written to an array str2 (including NULL)

3) fgets(str3, 20, fp);

,		K	o	r	e	a	.	₩n	₩0									

→ Characters before the new line are written to an array str3 (including NULL)

4) File IO Function: Text File

- **Write strings to a stream: fputs()**
  - Write characters/strings to a stream
  - Omit NULL and the new line

Function Prototype	**int fputs(char *str, FILE *fp);**	
Function Argument	str	Characters to be written
	fp	FILE pointer
Return Type	✓ Successful → Number of bytes to be written ✓ Failed/error → EOF	

4) File IO Function: Text File

- **File I/O**

```
#include <stdio.h>

int main()
{
    char str[100];
    FILE *fp1, *fp2;

    fp1 = fopen(“input.txt”, “r”);
    if (fp1 == NULL)
    {
       printf(“Couldn’t open file!”);
       return -1;
    }
    fp2 = fopen(“output.txt”, “w”);
    if (fp2 == NULL)
    {
        printf(“Couldn’t open file!”);
        return -1;
     }
```

```
    while(fgets(str, sizeof(str), fp1) != NULL)
    {
           printf(“%s”, str);
           fputs(str, fp2);
     }

     fclose(fp1);
     fclose(fp2);

     return 0;
  }
```

4) File IO Function: Text File

- **Check “End-Of-File "**

① Return Type

function	
fgetc()	At the end of a file, return EOF(-1)
fgets()	At the end of a file, return NULL(0)
fscanf()	At the end of a file, return EOF(-1)

② Use feof()

4) File IO Function: Text File

- **feof()**
  - Check whether the end-of-file indicator associated with the stream is set
  - Must include <stdio.h>

Function Prototype	**int feof(FILE *fp);**	
Function Argument	fp	FILE pointer
Return Type	✓ End-of-file → return a non-zero value ✓ no → return 0	

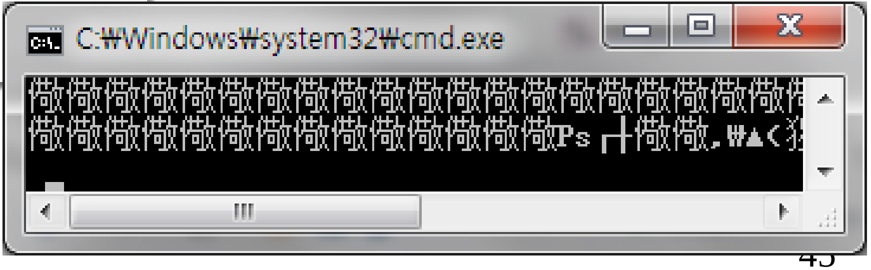
- **EOF vs. feof()**
  - At the end of any file, EOF exists → EOF is a part of a file
  - feof() returns 0 when it reaches EOF!

4) File IO Function: Text File

- **Caution: feof()**
  - Ex1) Empty the file data.txt, and execute the following?

```c
#include <stdio.h>

int main()
{
    FILE *fp;
    char str[100];

    fp = fopen("data.txt", "r");
    if (fp == NULL)
    {
        printf("Couldn’t open file!");
        return -1;
    }
```

```c
    while(!feof(fp))
    {
        fgets(str, sizeof(str), fp);
        printf("%s", str);
    }
    fclose(fp);
    return 0;
}
```



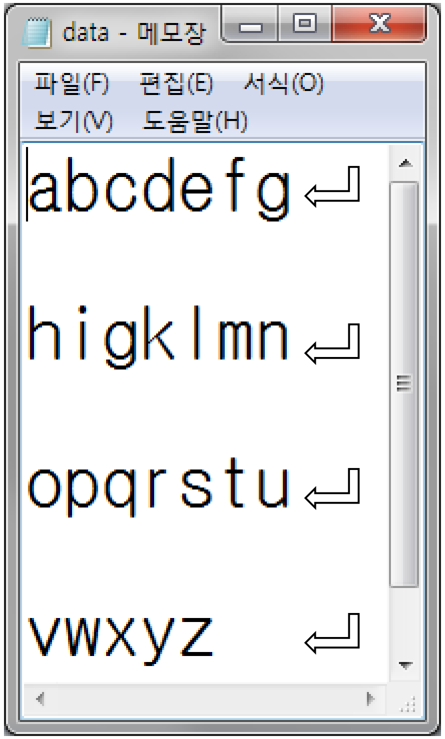
C:₩Windows₩system32₩cmd.exe

```
儆儆儆儆儆儆儆儆儆儆儆儆儆儆儆儆儆儆儆儆儆
儆儆儆儆儆儆儆儆儆儆儆儆儆儆Ps ┤儆儆,₩▲<
```

4) File IO Function: Text File

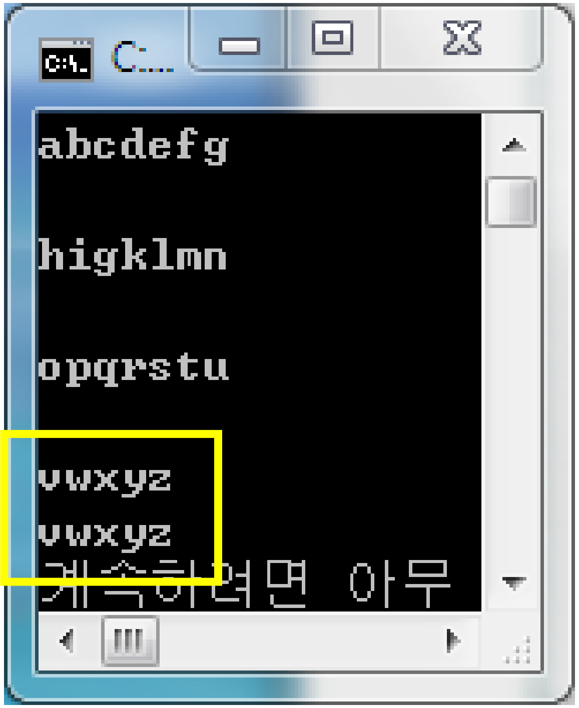
- **Caution: feof()**
  - Ex2) Create a file data.txt as below, Execute the previous program?

<data.txt>



```
abcdefg ↵

higklmn ↵

opqrstu ↵

vwxyz   ↵
```

<Result>



```
abcdefg

higklmn

opqrstu

vwxyz
vwxyz
계속하려면 아무
```

4) File IO Function: Text File

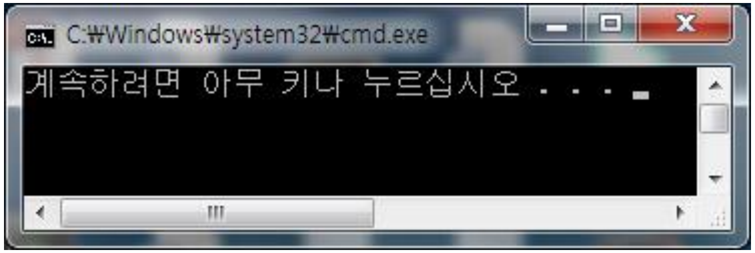
- **Caution: feof()**
  - Why?
    - ✓ Automatically add the special character (^Z), indicating the end of a file
      - ✓ Empty file contains ^Z (Ex1)
      - ✓ Issues with the position of ^Z (Ex2)
    - ✓ feof(fp) return value = 0 (False)
      - ✓ Passing ^Z, feof(fp) return a non-zero value (True)
  - Solution
    - ✓ Read data first, then check if it reaches the end-of-file

4) File IO Function: Text File

- **Caution: feof()**
  - Modified code

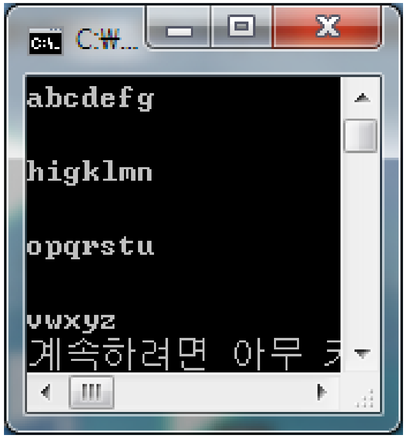
```
#include <stdio.h>

int main()
{
    FILE *fp;
    char str[100];

    fp = fopen("data.txt", "r");
    if (fp == NULL)
    {
        printf("Couldn’t open file!");
        return -1;
    }
fgets(str, sizeof(str), fp);
while(!feof(fp))
    {
            printf("%s", str);
            fgets(str, sizeof(str), fp);
    }
    fclose(fp);
    return 0;
}
```

<Ex1>



```
계속하려면 아무 키나 누르십시오 . . . _
```

<Ex2>



```
abcdefg

higklmn

opqrstu

vwxyz
계속하려면 아무 ㅋ
```

Outline

1) File IO

2) File IO Procedures

3) Text File vs. Binary File

4) File IO Function: Text File

5) **File IO Function: Binary File**

6) File IO Functions

5) File IO Function: Binary File

- **File I/O per block**
  - Binary files
  - Read/Write data per block
    - ✓ Block: a set of consecutive data (in Bytes)
  - Generally, I/O for a fixed size of data
  - fread() and fwrite()

5) File IO Function: Binary File

- **Binary file: fread()**
  - Read data blocks from a binary file

Function Prototype	**unsigned int fread(void *ptr, unsigned int size, unsigned int n, FILE *fp);**	
Function Argument	ptr	Starting address of a buffer to read data from a file
	size	Number of bytes to read (size of a block)
	n	number of blocks
	fp	FILE pointer
Return Type	✓ successful → number of blocks (n) to be read ✓ Failed/EOF → return a value < n	
Meaning	Read (size * n) bytes of data from a binary file, write to a buffer, and return the number of blocks	

5) File IO Function: Binary File

- **fread()**

```
int height, age[10];
FILE *fp = fopen("data.bin", "rb");
```

fread(&height, sizeof(int), 1, fp);

➔ Read one block (int type) of data using fp associated with a binary file and write to the memory space pointed by the address of height

➔ i.e., read one integer and writhe to the variable height

fread(age, sizeof(int), 10, fp);

➔ read 10 blocks of data using fp associated with a binary file and write to the memory space pointed by the starting address of the array age

➔ i.e., read 10 integers and write to the array age

5) File IO Function: Binary File

- **Binary file: fwrite()**
  - Write data blocks to a binary file

Function Prototype	**unsigned int fwrite(const void *ptr, unsigned int size, unsigned int n, FILE *fp);**	
Function Argument	ptr	Starting address of a buffer containing data to write to a file
	size	Number of bytes to write (size of a block)
	n	Number of blocks
	fp	FILE pointer
Return Type	✓ successful → Number of blocks (n) to be written ✓ failed → return a non-zero value < n	
Meaning	Write (size * n) bytes of data to a binary file and return the number of blocks	

5) File IO Function: Binary File

- **fwrite()**

  Int height, age[10];

  FILE *fp = fopen(“data.bin”, “wb");

  fwrite(&height, sizeof(int), 1, fp);

  ➔ Read one block (int type) from the memory space pointed by the address of the variable height and write to a binary filed associated with fp

  ➔ i.e., read one integer from the variable height and write to the file data.bin

  fwrite(age, sizeof(int), 10, stdout);

  ➔ Read 10 blocks (int type) and write to a monitor (standard output device)

  ➔ i.e., read 10 integers from the array age and write to a monitor

5) File IO Function: Binary File

- **Binary File**

```
#include <stdio.h>
struct person{
   char name[8];
   int age;
} data[10]={{“Tom”,46}, {“James",33}, {“Jane",21}};

void main()
{
   FILE *fp;
   struct person buf[10];
   int i;

   fp=fopen("data.txt", "w");
   fwrite(data, sizeof(struct person), 3, fp);
   fclose(fp);

   fp=fopen("data.txt", "r");
   fread(buf, sizeof(struct person), 3, fp);
   for(i=0; i<=2; i++){
      printf(“i=%d %s %d\n", i, buf[i].name, buf[i].age);
   }
   fclose(fp);
}
```

Outline

1) File IO

2) File IO Procedures

3) Text File vs. Binary File

4) File IO Function: Text File

5) File IO Function: Binary File

6) **File IO Functions**

6) File IO Functions

- **Random access to a file**
  - Binary file
  - Read/Write at a random position
  - Use file position indicator to set the starting position of file read/write
    - ✓ File position indicator: the starting position to be read and written
  - Functions: fseek(), rewind(), ftell()
    - ✓ Read/write at any position in a binary file
    - ✓ Must include <stdio.h>

6) File IO Functions

- **fseek() (1/2)**
  - Set the file position indicator to a new position
  - The file position indicator associated with fp is defined by adding offset to the origin
  - New position becomes (origin + offset) Bytes
  - origin: one of constants SEEK_SET(0), SEEK_CUR(1), SEEK_END(2)

6) File IO Functions

- **fseek() (2/2)**

Function Prototype	**int fseek(FILE *fp, long int offset, int origin);**	
Function Argument	fp	FILE pointer
	offset	✓ Number of bytes to offset from origin - (+): forward direction (succeeding the reference) - (-): reverse direction (preceding the reference)
	origin	✓ Reference for the offset - SEEK_SET(0): beginning of a file - SEEK_CUR(1): current position - SEEK_END(2): end of a file
Return Type	✓ Successful → return 0 ✓ Failed → return a non-zero value	

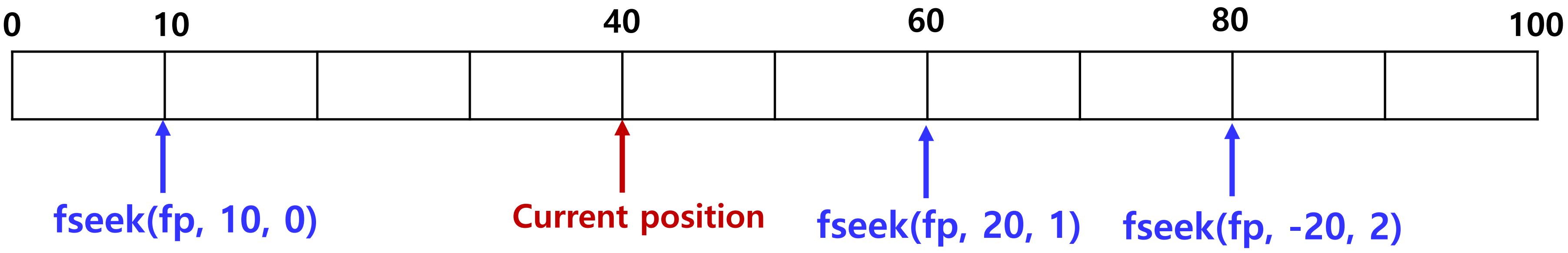
6) File IO Functions

- **fseek()**
  - fseek(fp, 10, SEEK_SET);

    → 10 bytes from the beginning of the file
  - fseek(fp, 20, SEEK_CUR);

    → 20 bytes from the current position of the file position indicator
  - fseek(fp, -20, SEEK_END);

    → 20 bytes from the end of the file



6) File IO Functions

- **rewind()**
  - Set the file position indicator to the beginning of the file
  - Same as fseek(fp, 0, SEEK_SET)

Function Prototype	**void rewind(FILE *fp)**	
Function Argument	fp	FILE pointer

6) File IO Functions

- **ftell()**
  - Return the current position of the file position indicator
  - Number of bytes from the beginning of the file
    - ✓ Assumption) starting position is 0!

Function Prototype	**long ftell (FILE *fp);**	
Function Argument	fp	FILE pointer
Return Type	✓ successful → the current file position ✓ failed/error → return -1	

6) File IO Functions

- **Example: fseek() and ftell()**

```
#include <stdio.h>
int main()
{
    FILE *fp;
    int size;
    fp = fopen(“data.txt”, “rb”);
    if (fp == NULL)
    {
        printf(“Couldn’t open file!”);
        return -1;
    }
    fseek(fp, 0, SEEK_END);
    size = ftell(fp);
    fclose(fp);
    printf(“Size of the file: %d bytes.\n”, size);
    return 0;
}
```

6) File IO Functions

- **When to write data from a buffer to a file?**
  - ① buffer is full
  - ② closing a file
  - ③ terminating a program
- **buffer flush?**
  - Explicitly transfer data in a buffer to a file
    Clear up the buffer
  - fflush()
    - ✓ Must include <stdio.h>

Function Prototype	**int fflush(FILE *fp);**	
Function Argument	fp	FILE pointer
Example	fflush(stdout) → Data output to a monitor	

6) File IO Functions

- **fflush()**

```
#include <stdio.h>
char mybuf[30];
int main()
{
    FILE *fp;
    fp = fopen(“data.txt”, “r+”);
    if (fp == NULL)
    {
        printf(“Couldn’t open file!”);
        return -1;
    }
    fputs(“Remove data (fflush) ”, fp);
    fflush(fp);
    fgets(mybuf, 30, fp);
    puts(mybuf);
    fclose(fp);
    return 0;
}
```