File Handling

Storage seen so far

- All variables stored in memory
- Problem: the contents of memory are wiped out when the computer is powered off
- Example: Consider keeping students' records
  - 100 students records are added in array of structures
  - Machine is then powered off after sometime
  - When the machine is powered on, the 100 records entered earlier are all gone!
  - Have to enter again if they are needed

Solution: Files

- A named collection of data, stored in secondary storage like disk, CD-ROM, USB drives etc.
- Persistent storage, not lost when machine is powered off
- Save data in memory to files if needed (file write)
- Read data from file later whenever needed (file read)

Organization of a file

- Stored as sequence of bytes, logically contiguous
  - May not be physically contiguous on disk, but you do not need to worry about that
- The last byte of a file contains the end-of-file character (**EOF**), with ASCII code 1A (hex).
  - While reading a text file, the EOF character can be checked to know the end
- Two kinds of files:
  - Text : contains ASCII codes only
  - Binary : can contain non-ASCII characters
    - Example: Image, audio, video, executable, etc.
    - EOF cannot be used to check end of file

Basic operations on a file

- Open
- Read
- Write
- Close
- Mainly we want to do read or write, but a file has to be opened before read/write, and should be closed after all read/write is over

Opening a File: fopen()

- FILE * is a datatype used to represent a pointer to a file
- fopen takes two parameters, the name of the file to open and the mode in which it is to be opened
- It returns the pointer to the file if the file is opened successfully, or NULL to indicate that it is unable to open the file

Example: opening file.dat for write

```
FILE *fptr;
char filename[ ]= "file2.dat";
fptr = fopen (filename,"w");
if (fptr == NULL) {
    printf (“ERROR IN FILE CREATION”);
    /* DO SOMETHING */
}
```

Modes for opening files

- The second argument of fopen is the mode in which we open the file.

Modes for opening files

- The second argument of fopen is the mode in which we open the file.
  - "r" : opens a file for reading (can only read)
    - Error if the file does not already exists
    - "r+" : allows write also

Modes for opening files

- The second argument of fopen is the mode in which we open the file.
  - "r" : opens a file for reading (can only read)
    - Error if the file does not already exists
    - "r+" : allows write also
  - "w" : creates a file for writing (can only write)
    - Will create the file if it does not exist
    - Caution: writes over all previous contents if the flle already exists
    - "w+" : allows read also

Modes for opening files

- The second argument of fopen is the mode in which we open the file.
  - "r" : opens a file for reading (can only read)
    - Error if the file does not already exists
    - "r+" : allows write also
  - "w" : creates a file for writing (can only write)
    - Will create the file if it does not exist
    - Caution: writes over all previous contents if the flle already exists
    - "w+" : allows read also
  - "a" : opens a file for appending (write at the end of the file)
    - "a+" : allows read also

The exit() function

- Sometimes error checking means we want an emergency exit from a program
- Can be done by the exit() function
- The exit() function, called from anywhere in your C program, will terminate the program at once

Usage of exit( )

```
FILE *fptr;
char filename[]= "file2.dat";
fptr = fopen (filename,"w");
if (fptr == NULL) {
    printf (“ERROR IN FILE CREATION”);
   /* Do something */
   exit(-1);
}
………rest of the program………
```

Writing to a file: fprintf( )

- fprintf() works exactly like printf(), except that its first argument is a file pointer. The remaining two arguments are the same as printf
- The behaviour is exactly the same, except that the writing is done on the file instead of the display

```
FILE *fptr;
fptr = fopen ("file.dat","w");
fprintf (fptr, "Hello World!\n");
fprintf (fptr, “%d %d”, a, b);
```

Reading from a file: fscanf( )

- fscanf() works like scanf(), except that its first argument is a file pointer. The remaining two arguments are the same as scanf
- The behaviour is exactly the same, except
  - The reading is done from the file instead of from the keyboard (think as if you typed the same thing in the file as you would in the keyboard for a scanf with the same arguments)
  - The end-of-file for a text file is checked differently (check against special character EOF)

Reading from a file: fscanf( )

```
FILE *fptr;
fptr = fopen (“input.dat”, “r”);
/* Check it's open */
if (fptr == NULL)
  {
     printf(“Error in opening file \n”);
     exit(-1);
  }
fscanf (fptr, “%d %d”,&x, &y);
```

EOF checking in a loop

```
char ch;
while (fscanf(fptr, “%c”,
&ch) != EOF)
{
   /* not end of file; read */
}
```

Reading lines from a file: fgets()

- Takes three parameters
  - a character array str, maximum number of characters to read size, and a file pointer fp
- Reads from the file fp into the array str until any one of these happens
  - No. of characters read = size - 1
  - \n is read (the char \n is added to str)
  - EOF is reached or an error occurs
- ‘\0’ added at end of str if no error
- Returns NULL on error or EOF, otherwise returns pointer to str

Reading lines from a file: fgets()

```
FILE *fptr;
char line[1000];
/* Open file and check it is open */
while (fgets(line,1000,fptr) != NULL)
{
   printf ("Read line %s\n",line);
}
```

Writing lines to a file: fputs()

- Takes two parameters
  - A string str (null terminated) and a file pointer fp
- Writes the string pointed to by str into the file
- Returns non-negative integer on success, EOF on error

Reading/Writing a character: fgetc(), fputc()

- Equivalent of getchar(), putchar() for reading/writing char from/to keyboard
- Exactly same, except that the first parameter is a file pointer
- Equivalent to reading/writing a byte (the char)

```
int fgetc(FILE *fp);
int fputc(int c, FILE *fp);
```

- Example:

```
char c;
c = fgetc(fp1); fputc(c, fp2);
```

Formatted and Un-formatted I/O

- Formatted I/O
  - Using fprintf/fscanf
  - Can specify format strings to directly read as integers, float etc.
- Unformatted I/O
  - Using fgets/fputs/fgetc/fputc
  - No format string to read different data types
  - Need to read as characters and convert explicitly

Closing a file

- Should close a file when no more read/write to a file is needed in the rest of the program
- File is closed using fclose() and the file pointer

```
FILE *fptr;
char filename[]= "myfile.dat";
fptr = fopen (filename,"w");
fprintf (fptr,"Hello World of filing!\n");
…. Any more read/write to myfile.dat….
fclose (fptr);
```

Command Line Arguments

What are they?

- A program can be executed by directly typing a command with parameters at the prompt

```
$ cc –o test test.c
$ ./a.out in.dat out.dat
$ prog_name param_1 param_2 param_3
  ..
```

  - The individual items specified are separated from one another by spaces
    - First item is the program name

What do they mean?

- Recall that main() is also a function
- It can also take parameters, just like other C function
- The items in the command line are passed as parameters to main
- Parameters argc and argv in main keeps track of the items specified in the command line

How to access them?

```
int main (int argc, char *argv[]);
```

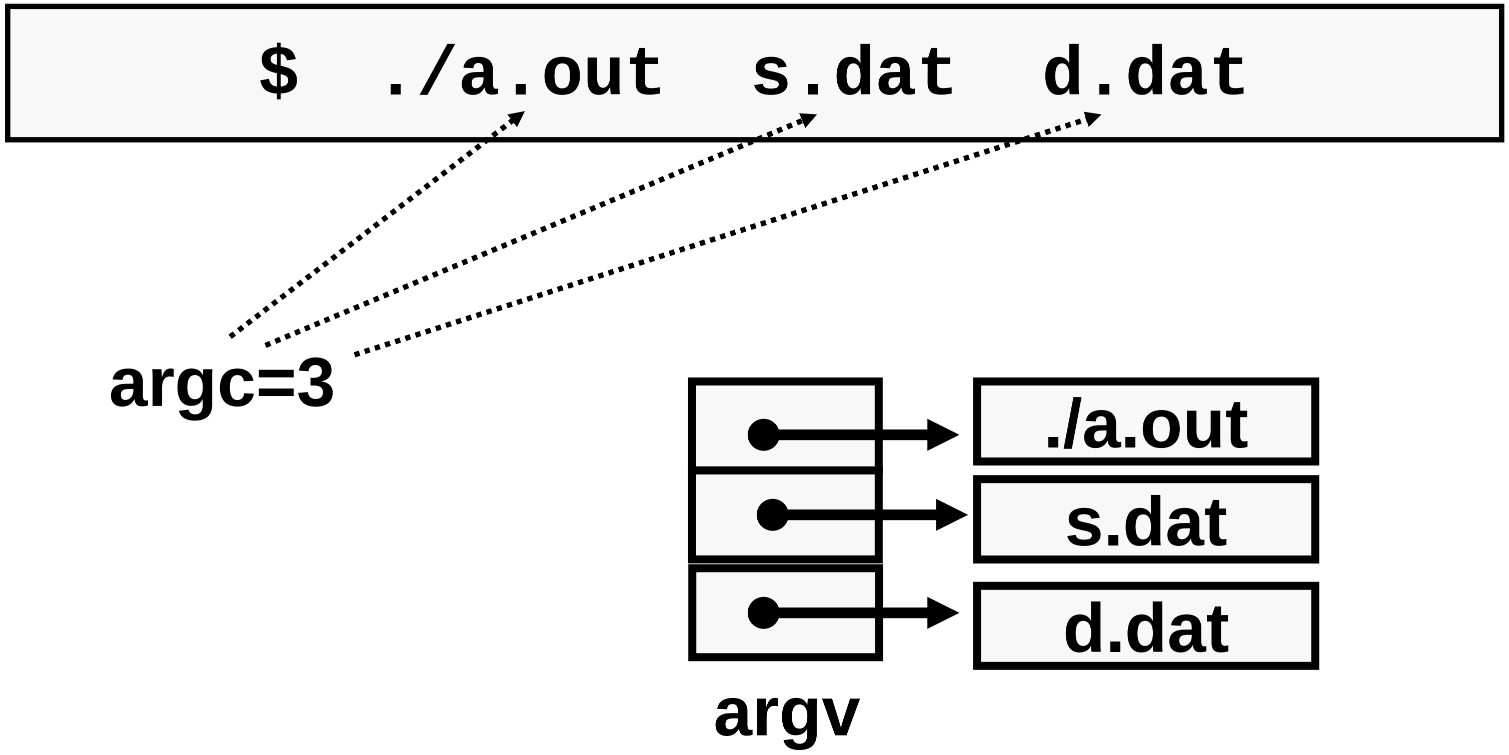
Argument Count

Array of strings as command line arguments including the command itself.

The parameters are filled up with the command line arguments typed when the program is run

They can now be accessed inside main just like any other variable

Example: Contd.



argv[0] = “./a.out” argv[1] = “s.dat” argv[2] = “d.dat”

Contd.

- Still there is a problem
  - All the arguments are passed as strings in argv[ ]
  - But the intention may have been to pass an int/float etc.
- Solution: Use sscanf()
  - Exactly same as scanf, just reads from a string (char *) instead of from the keyboard
  - The first parameter is the string pointer, the next two parameters are exactly the same as scanf

Example

- Write a program that takes as command line arguments 2 integers, and prints their sum

```
int main(int argc, char *argv[ ])
{
    int i, n1, n2;
    printf("No. of arg is %d\n", argc);
    for (i=0; i<argc; ++i)
        printf("%s\n", argv[i]);
    sscanf(argv[1], "%d", &n1);
    sscanf(argv[2], "%d", &n2);
    printf("Sum is %d\n", n1 + n2);
    return 0;
}
```

```
$ ./a.out 32  54
No. of arg is 3
./a.out
32
54
Sum is 86
```