

CS 332/532 – 1G- Systems Programming

Lab 6

Objectives

The objective of this lab is to introduce you to standard I/O libraries and I/O streams.

1. Introduction of standard I/O streams.
2. Write a program to read given comma separated file and use C structures to store and display the data.
3. Write a program to read given comma separated file, then sort given fields, and write sorted data into new file.

Description

Example 1:

Open I/O Stream: The standard I/O stream allows you to open a file in read, write, or append modes. This mode can be combined in a single open function call (see Figure 5.2 in Section 5.5 of the textbook for a complete list of options that can be specified). For example:

```
FILE *fptr;  
fptr = fopen("listings.csv", "rw+");
```

Here file name is “listings.csv”, the file is open for reading and writing.

Input Stream: The standard I/O stream allows us to read from the open file. These functions allow us to read a file character by character – `getchar()`, line by line – `fgets()`, or with specific size – `fread()` (see Section 5.6 in textbook).

Output Stream: The standard I/O stream allow you to write to an open file. These functions allow you to write to a file character by character – `putchar()`, line by line – `fputs()`, or with specific size – `fwrite()` (see Section 5.6 in textbook).

Now let’s use these functions and write a program. We will use APIs available in Linux and C to develop different versions of this program as shown below:

1. uses *getc* function to read one element at a time (we implement a function called *getLine*) - `getline1.c`
2. uses the *getline* function provided by the C library - `getline2.c`
3. uses *getdelim* function (similar to version 2, except that we use space as the delimiter not newline) - `getline3.c`
4. uses *fgets* function - `getline4.c`
5. uses *fscanf* function (note the difference between the first four versions and this version) - `getline5.c`
6. uses *fprintf* function to write output to a file and also uses *fprintf* instead of *printf* to write to standard output and standard error streams - `getline6.c`

You can use the corresponding man page to find out more about each of the functions used above. You can also extend the above examples to use *putc*, *puts*, *putchar*, *fputc*, and *fputs* functions to write the output.

Example 2:

We will now write a program to read a comma separated file ("listing.csv") and use the C structures to store and display the data on the console. The program and the sample input file used are available here: `listing.c` and `listings.csv`

The given file has 13 different attributes and these attributes can be divided into three different datatypes: integer, character array, and float. And collectively we can create a C structure to represent these attributes and then create an array of such structures to store multiple entities.

1. Define a structure called `listing` with all attributes as individual members of the struct `listing`.

```
struct listing {
    int id, host_id, minimum_nights, number_of_reviews, calculated_host_listing
    s_count, availability_365;
    char *host_name, *neighbourhood_group, *neighbourhood, *room_type;
    float latitude, longitude, price;
};
```

2. Define a function which can help to parse each line in the file and return the above defined structure. For this task you need to learn the string tokenizer function (*strtok*) which is available in `<string.h>` header file. You can find out more about the *strtok* function by typing *man strtok*. You will notice that when you invoke the *strtok* function for the first time you provide the pointer to the character array and on subsequent invocations of *strtok* we use *NULL* as the argument.

```

struct listing getfields(char* line){
    struct listing item;

    item.id = atoi(strtok(line, ","));
    item.host_id = atoi(strtok(NULL, ","));
    item.host_name = strdup(strtok(NULL, ","));
    item.neighbourhood_group = strdup(strtok(NULL, ","));
    item.neighbourhood = strdup(strtok(NULL, ","));
    item.latitude = atof(strtok(NULL, ","));
    item.longitude = atof(strtok(NULL, ","));
    item.room_type = strdup(strtok(NULL, ","));
    item.price = atof(strtok(NULL, ","));
    item.minimum_nights = atoi(strtok(NULL, ","));
    item.number_of_reviews = atoi(strtok(NULL, ","));
    item.calculated_host_listings_count = atoi(strtok(NULL, ","));
    item.availability_365 = atoi(strtok(NULL, ","));

    return item;
}

```

Note: Read the man pages for the functions `strtok`, `atoi`, `atof`, `strdup` that are used in the above example.

3. Now use *fpopen* function to open file in read only mode. Notice that the *fpopen* function returns a pointer of *FILE* type (file pointer) unlike the *open* function that returns an *integer* value as the file descriptor.

```
FILE *fptr = fopen("listings.csv", "r");
```

4. Then loop through till the end of file (use `fgets` function) and store all data in the array of structures.

```

count = 0;
while (fgets(line, LINESIZE, fptr) != NULL){
    list_items[count++] = getfields(line);
}

```

5. Now invoke the function to display the structure in a loop.

```

for (i=0; i<count; i++)
    displayStruct(list_items[i]);

```

6. Finally, use `fclose` function to close the file.

```
fclose(fptr);
```

Homework

Write a program to read the input file `listings.csv` and write two new functions that will sort the data based on the `host_name` and `price`. You can perform the following steps in the C program:

1. Implement Step 1 to 5 as described in the Exercise above.
2. Now use any sorting algorithm to sort by the keys `host_name` and `price` separately. Make sure when you sort on any given attribute that you rearrange the entire structure. For example, if you are sorting the whole list by `host_name` then you need to change the order of structures based on the `host_name`. Use the `qsort` function provided by the C library for sorting. Here is an example from the man page on how to use `qsort` function: `funcptr2.c`
3. Then open new files in write mode.
4. Then loop through all new structure and use `fputs` or similar write function to write the sorted structure to new files.
5. Close the files.
6. Test your program.
7. Create a file called `README.md` and include instructions for compiling and executing your program.

Submission

You are required to submit the lab solution to Canvas

1. To upload solution to Canvas: Upload the C source code, PDF version of C source code, and `README.txt` file to Canvas. Do not include any executable or object files.

Use the following command to create PDFs of your source code.(replace the `<Source_code_File_name>` and `<Output_Source_code_File_name>` with your C source code file name):

```
$enscript <Source_code_File_Name>.c -o - | ps2pdf - <Output_Source_code_File_Name>.pdf
```