CSE 2421 Lab 3 Problem

Pointers, Character Strings, Arrays, Dynamic Memory Allocation,   
and Multiple Levels of Indirection

Due: Friday, 3/8/24 4:59 pm.

Any lab submitted late will be subject to a 10% reduction in points for each hour it is late. Any lab which does not compile using the required Makefile, and run without crashing or freezing WILL RECEIVE AN AUTOMATIC GRADE OF ZERO. It is your responsibility to ensure that your program compiles without errors.

You must read this lab carefully and follow the instructions explicitly to get the correct answers. Do not rush through this lab or you will likely make mistakes and lose points. Pay attention to what is going on in this lab, and how you might need to use these tools in the future.

Goals of this lab:

* Write your own makefile that works with c99.
* Get comfortable pointers.
* Get familiar with multiple levels of indirection.
* Get comfortable dynamic memory allocation/deallocation.
* Get familiar with passing pointers as parameters in functions.
* Get comfortable with character strings
* Get comfortable with using dynamically allocated arrays.

**1 Grading Criteria**

The code and algorithm are well documented, including an explanatory comment for each function, and comments in the code.

A comment should be included in the main function of the program including the programmer’s name as well as explaining the nature of the problem and an overall method of the solution (what you are doing, not how).

A comment should be included before each function documenting what the function does (but not details on how it does it).

A short comment should be included for each logical or syntactic block of statements.

The program should be appropriate to the assignment, well-structured and easy to understand without complicating and confusing flow of control. We will not usually deduct points for the efficiency of your code, but if you do something in a way which is clearly significantly less efficient, we may deduct points.

The results are correct, verifiable, and well-formatted. The program correctly performs as assigned with both the given input and one other (unknown) input file designed to test boundary conditions within your program.

If the grader cannot compile your code using the Makefile you created, with no error or warning messages, you will receive a maximum of 50 points for the lab. If the grader cannot compile your code at all, you will receive a 0 for the lab. No exceptions.

**2 Lab Description**

Write a program that creates a list of inspiring quotes your user has read, and then allow your program’s user to create a subset of this list as a list of quotes that are their favorites. You will not know how many quotes the user wishes to include on the list until the program gets its first input. After the user has finished entering all the quotes, you must prompt the user for a subset of the quotes to put on a second “favorites” list. You must use pointers within this project such that you have one array with char \* as elements that contains all the quotes and an array with char \*\* as elements for the second list. The third item this program does is ask the user whether they want to store a copy of their information to a file on disk. If so, your program will ask for a file name and store the information within that file in the format shown in the example below.

**3 Lab 3 Restrictions**

No variables can be declared outside of a block. That is, no variables can be declared as “global”.

You may only use the C library functions getchar(), scanf(), printf(), and fprintf() for any I/O needs you have while writing this program.

You may create other functions you find useful. If you do, put them in a separate .c file from your main function and create a header file (.h) with their prototypes that gets included in the main .c file.

You must use pointers within this project such that you have an array of char pointers (quotes). The char pointers are to strings that contain a single quote. The variable that holds the address to this array would have to be declared as char \*\*. An array for favorites contains addresses from the quotes array. The variable that holds the address to this array would have to be declared as char \*\*\*.

You cannot use statically declared arrays in this lab to store any of the user data other than the filename in which to store the user’s information. This filename can be a statically declared array that is up to 255 characters long.

You will need to use pointers to access user data.

Your code should work correctly for ANY NUMBER of quotes (including just 1 and up to the limits of available memory, of course), and these numbers are not known in advance.

You may not access any of the allocated storage space using indexes, as is usually done for a statically declared array, but only by using pointers and pointer arithmetic.

You must use the C library functions malloc() or calloc() to allocate all dynamic memory in your program.

The valgrind program must indicate that your program has no memory leaks.

**4 Suggested Steps to Complete the Lab**

Just like in lab 1 and 2, you will do all work on stdlinux. For this lab, you will create a Makefile, which is a textfile you will use to test that your code compiles on stdlinux. As there should only be one Makefile per directory, I recommend creating a new directory for lab3 using

**mkdir lab3**

Then enter into that directory using

**cd lab3**

I recommend creating a simple c file named lab3.c that includes a main method next. You can do this using

**nano lab3.c**

Save this. Before starting to write the code to solve the aforementioned problem, I heavily recommend writing your Makefile.

**nano Makefile**

It is fine to use the Makefile from lab2 as a template, but you must have a rule to make a binary named lab3. You are permitted to use c99 for this lab, but in order to use this, you must include -std=c99 as an option in your gcc compilation for lab3. Similarly, your rule to create a zip file should be updated to create lab3.zip, and should include your c file(s) and your Makefile.

**Do not write code for all of the following in main(). Do decompose the problem into multiple functions based on the bolded subsections below.**

You should initialize your two char \*\* variables in your main function, and use pass by reference.

**Populate the quotes array:**

First, you should prompt the user to enter the number of quotes they plan to enter. The user will enter an integer greater than or equal to 1 to indicate the number of quotes.

You must then dynamically allocate enough memory to hold addresses to all quotes. Then you must dynamically allocate memory to store each individual quote. You can assume that there will be no quotes with more than 300 characters. Remember that all character strings in C are null terminated and that you must allocate space in your string for that null character, in addition to the length of the string you wish to have. Also realize that you won’t know how many of the 300 characters the quote will fill until after you read the quote.

You should then prompt the user to enter each quote on a separate line. You must assume that each quote could contain more than one word and will be separated by a newline character from the next quote. You can assume that the user will enter the input in this format, so you do not need to check to make sure that the format of the input meets this description, and you do not need to reject input which is not properly formatted. You can also assume that the user’s input is correct. If you do not completely understand this description jump to the bottom of this file and check out the example data. You can assume that there will be no duplicate quotes.

After reading in all quotes in using a function you have written, your program’s main function must print all quotes back out with a number next to each one.

**Populate the favorites array:**

You should then ask the user to enter a number representing how many quotes they wish to put on their favorites list. The favorites list will consist of a subset (up through all the quotes on the list) of the quotes on the quotes list. Once you have this number, you must dynamically allocate enough space for an array of 8-byte addresses for favorites.

The user will then specify by quote number which quotes should be included on the favorites list.

Your program must then print the quotes on the favorites list.

**Save the data to a file:**

Next, your program must ask whether the user wishes to store this information to a text file. They indicate yes/no with 1(yes) or 2(no).

If the user wishes to save the data, you must prompt the use for the filename to be used, open a file by that name, and then confirm to the user the data has been saved.

Prior to exiting the program, you must free() all dynamically allocated memory. You can determine whether you have managed to accomplish this with the valgrind tool.

**5 LOGGING OUT & SUBMITTING**

Always be sure your linux prompt reflects the correct directory or folder where all files to be submitted reside. If you are not in the directory with your files, the following will not work correctly.

You must submit this and all following lab assignments electronically to Carmen in .zip file format. The zip command works as follows:

**zip <zip-filename> <files-to-submit>**

Once you execute the command, you should find a file in your lab3 directory called lab3.zip; this is the file that must be uploaded to Carmen.

To exit the terminal window, type the following command at the LINUX prompt then hit the enter key:

**exit**

You will download the completed code from stdlinux to your computer’s terminal or command line:

**scp username@stdlinux:cse2421/lab3/lab3.zip .**

**Remember, there is a . at the end of the above command, after a space. Upload the resulting lab2.zip file from your computer to the Lab 3 assignment on Carmen.**

**Note:** It is YOUR responsibility to make sure your code can compile and run on stdlinux, using required gcc options without generating any errors or warnings or segmentation faults, etc. Any program that generates errors or warnings when compiled, or which does not run without system errors, will receive 0 points. No exceptions!

**6 Sample I/O**

See below for a sample input to the program. Your program must work for all valid input not just this one. Be creative with your test data!!!

Sample Screen Input/Output for this lab: (user provided input is in green.)

How many quotes do you plan to enter? 9

Enter the 9 quotes one to a line: Failure is not fatal, but failure to change might be. – Woody Hayes

Perfection is not attainable, but if we chase perfection, we can catch excellence. – Woody Hayes

We must have perseverance and, above all, confidence in ourselves. We must believe that we are gifted for something, and that this thing, at whatever cost, must be attained. — Marie Curie

The only thing even in this world is the number of hours in a day. The difference in winning or losing is what you do with those hours. – Woody Hayes

No one can make you feel inferior without your consent. — Eleanor Roosevelt

There is something you must always remember. You are braver than you believe, stronger than you seem, and smarter than you think. — A.A. Milne

Nothing that comes easy in this world is worth a damn. – Woody Hayes

You can never really pay back. You can only pay forward. – Woody Hayes

Once you learn to quit, it becomes a habit. – Woody Hayes

You’ve entered:

1. Failure is not fatal, but failure to change might be. – Woody Hayes

2. Perfection is not attainable, but if we chase perfection, we can catch excellence. – Woody Hayes

3. We must have perseverance and, above all, confidence in ourselves. We must believe that we are gifted for something, and that this thing, at whatever cost, must be attained. — Marie Curie

4. The only thing even in this world is the number of hours in a day. The difference in winning or losing is what you do with those hours. – Woody Hayes

5. No one can make you feel inferior without your consent. — Eleanor Roosevelt

6. There is something you must always remember. You are braver than you believe, stronger than you seem, and smarter than you think. — A.A. Milne

7. Nothing that comes easy in this world is worth a damn. – Woody Hayes

8. You can never really pay back. You can only pay forward. – Woody Hayes

9. Once you learn to quit, it becomes a habit. – Woody Hayes

Of those 9 quotes, how many do you plan to put on your favorites list? 5

Enter the number next to each quote you want on your favorites list: 1 3 5 7 9

The quotes on your favorites list are:

1. Failure is not fatal, but failure to change might be. – Woody Hayes

2. We must have perseverance and, above all, confidence in ourselves. We must believe that we are gifted for something, and that this thing, at whatever cost, must be attained. — Marie Curie

3. No one can make you feel inferior without your consent. — Eleanor Roosevelt

4. Nothing that comes easy in this world is worth a damn. – Woody Hayes

5. Once you learn to quit, it becomes a habit. – Woody Hayes

Do you want to save them (1=yes, 2=no): 1

What file name do you want to use? Quotes

Your quotes list and favorites have been saved to the file Quotes

Sample File Output for this lab:

Inspiring Quotes:

Failure is not fatal, but failure to change might be. – Woody Hayes

Perfection is not attainable, but if we chase perfection, we can catch excellence. – Woody Hayes

We must have perseverance and, above all, confidence in ourselves. We must believe that we are gifted for something, and that this thing, at whatever cost, must be attained. — Marie Curie

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You can never really pay back. You can only pay forward. – Woody Hayes

Once you learn to quit, it becomes a habit. – Woody Hayes

My Favorites are:

Failure is not fatal, but failure to change might be. – Woody Hayes

We must have perseverance and, above all, confidence in ourselves. We must believe that we are gifted for something, and that this thing, at whatever cost, must be attained. — Marie Curie

No one can make you feel inferior without your consent. — Eleanor Roosevelt

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