**CS2106 Introduction to Operating Systems**

**Lab 1 - Leveling Up on C**

**Answer Book**

Please read the instructions in the main lab sheet before completing this document. Submission deadline is **Sunday 11 February 2024, 1 pm (1300 hrs)**.

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Section 1.

**Question 1.1 (1 mark)**

stdio.h is a standard library in gcc, which means the that statement makes the preprocessor look for the stdio.h file in the system directories which are already defined for the compiler based on where the compiler is installed.

**Question 1.2 (1 mark)**

The static declaration in the context of a variable declaration means that its scope is limited to the file that it is declared in. This allows it to maintain its value across function calls in the file it is declared in. Functions in the same file can access this variable, but another program’s files cannot access them.

**Question 1.3 (1 mark)**

The error is caused by the enq() and deq() methods lacking a function prototype, so the compiler does not know that the functions are declared. Furthermore, the compiler does not support implicit function declarations, as seen in the error log. The compiler also does not have any knowledge of the memory required to allocate for the parameters for each function call as the type and the number of parameters are unclear, preventing the compiler from making a working executable.

**Question 1.4 (1 mark)**

void enq(double);

double deq();

Section 2

**Question 2.1 (1 mark)**

|  |  |  |
| --- | --- | --- |
| **Variable** | **Global / Local** | **Address** |
| p1 | G | 0x55f290f62018 |
| p2 | G | 0x55f290f62020 |
| p3 | G | 0x55f290f62028 |
| p4 | G | 0x55f290f62030 |
| w | L | 0x55f290f62038 |
| x | L | 0x7ffc6709996c |
| y | L | 0x7ffc67099968 |
| z | L | 0x7ffc67099974 |

**Question 2.2 (1 mark)**

|  |  |
| --- | --- |
| **Variable** | **Location (S, D, T or H)** |
| p1 | D |
| p2 | D |
| p3 | D |
| p4 | D |
| w | D |
| x | S |
| y | S |
| z | S |

How I inferred these answers from Q2.1:

Pointers, which are declared globally outside any function, will be stored in the data segment. Since the address of w, 0x55f290f62038, is near the rest of the addresses in the data segment, from range 0x55f290f62018 to 0x55f290f62030, I can infer that they are in the same segment.

x, y, and z, being local variables, are stored on the stack by default.

**Question 2.3 (1 mark)**

As observed from question 2.2, w was created in the data segment, and this allows them to preserve values between calls to a function as the data segment is reserved for global variables which is separate from the stack and the heap, both of which are reserved for local and variables with memory which is dynamically allocated respectively.

This allows them to preserve values between calls to a function if the program is running, as they only get deallocated at the end of the program.

**Question 2.4 (1 mark)**

Declaring a local variable static will allow it to retain its value between calls, but its scope is still limited to the function. Global static variables are visible and accessible throughout the entire file where they are declared.

**Question 2.5 (1 mark)**

I changed line 7 from:

int acc = 0;

to:

**static** int acc = 0;

and this works because the variable acc retains its value with every call of accumulate(x) due to it being static, allowing it to truly accumulate all the values from 1 to 10.

Section 3

**Question 3.1 (1 mark)**

The address of the memory allocated by malloc is from a completely different range of addresses used by x, y, z, and p because malloc dynamically allocates memory on the heap, while x, y, z, and p are allocated on the stack. The stack and heap are also two separate regions of memory, and they are not guaranteed to be close to each other.

**Question 3.2 (1 mark)**

Earlier, the line we were instructed to add into the program was to dynamically allocate memory for the name attribute of the TPerson.

I added a line in freeNode(TPerson \*node) to free up node->name:

`free(node->name)`

This was used to to free up the dynamically allocated memory for p->name earlier, removing the memory leak.

**Question 3.3 (1 mark)**

srun gcc testlist.c llist.c -o testlist

Section 4

**Question 4.1 (1 mark)**

This is because the hash function is dependent on the filename, and changing the old filename to the new filename would not change its position in the hash table and changing it in place using strcpy(node->filename, new\_filename) would prevent the find\_file function from finding the file, as its location would be dependent on its old filename, not its updated filename.

**Question 4.2 (1 mark)**

1. Locate the file in the current hash table using find\_file().
2. If the file cannot be found, throw an error, and return early.
3. Else, save the filesize and the startblock attributes from the file.
4. Call delete\_file() on the old file.
5. Call add\_file() using the new filename, and the old filesize and startblock attributes which we created variables for beforehand.

**TOTAL: \_\_\_\_\_\_\_\_\_\_\_ / 14**