CS 399 NETWORKS & SYSTEMS SPRING 2022 MIDTERM I
Instructor Calvin Deutschbein

Roster Name	
Sign here to affirm the Honor Code	

This exam will be timed to take 60 Minutes.

It will be scored out of 200 Points.

It will make up 20% of Final Grade.

SECTION I: C LANGUAGE   **60 Points**

Part 1: Terminology: *4 Questions @ 5 Points each =*   *20 Points*

Which of the following is not a type in C?

    A. Short
    B. Long
    C. Double
    D. Half

What is the value of x?

```
x  =  15  &   31;
```

    A. 0
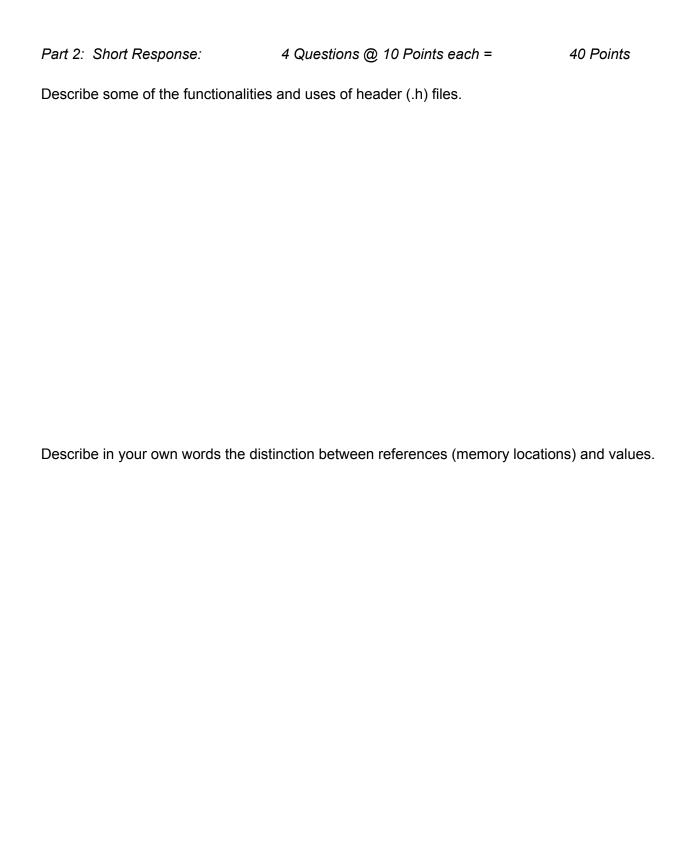   B. 1
    C. 15
    D. 16

What is the value of x?

```
x  =  15  |   31;
```

    A. 0
    B. 1
    C. 15
    D. 16

What is the value of x?

```
x  =  15  ||  31;
```

    A. 0
    B. 1
    C. 15
    D. 16

Describe some of the functionalities and uses of header (.h) files.

Describe in your own words the distinction between references (memory locations) and values.

What is printed by this program and why?

```
int main()
{
        char *strs[2];
        strs[0] = "hello";
        strs[1] = "world";
        printf("%d\n", strs[1][1]);
        return 0;
}
```

What is printed by this program and why?

```
int main()
{
        char *strs[2];
        strs[0] = "hello";
        strs[1] = "world";
        printf("%d\n", strs[1]);
        return 0;
}
```

SECTION II: SYSTEMS   **90 Points**

Part 3: Multiple Choice: *4 Questions @ 5 Points each =*   *20 Points*

Which of the following commands runs an executable file, such as a.out?

    A. ./a.out
    B. a.out
    C. gcc a.out
    D. man a.out

Which of the following commands looks up (some) C language functions?

    A. cat
    B. gcc
    C. git
    D. man

Which of the following best describes `'\0'` ?

    A. The integer value zero
    B. A point value that has not been initialized
    C. The "null terminator" in a null terminated string
    D. The exit status of a program when main does not return 0

Which of the following best describes a gcc error.

    A. Code is compiled into a program that will seg fault.
    B. Code is compiled into a program with a memory leak.
    C. Code is not compiled and no program is generated.
    D. Code is not compiled and the output program cannot be run.

Part 4: Debugging: *30 Points*

Suppose you are working on a bst.c and bst.h in the spirit of plist.c and plist.h - a C and header file that implement a data structure using structs.

Describe what, if any, errors exist in the function "max" and how to fix them.

```
struct bst_struct
{
    void *data;
    bst less;
    bst more;
};
typedef struct bst_struct *bst;

void *max(bst t)
{
    while (bst)
    {
        bst = bst.less;
    }
    return bst.data;
}
```

Part 5: Writing C   *40 Points*

Write a C function that accepts as input some integer n and returns as output some integer that represents the logarithm of n in base two. You should not use any library functions (such as log) from math.h or any other libraries.

```
log2(16); // returns 4
log2(15); // returns 3
```

Part 6: Scientific Computing *50 Points*

Implement a matrix multiplication function given the following function declaration:

```
uint64_t **mult(int m, int n, int p, uint64_t **a, uint64_t **b)
```

Where *a* and *b* are 2D uint64_t arrays of size *m* by *n* and *n* by *p* respectively, and the return matrix is malloced 2D array of size *m* by *p* which we denote *c*. Each location in *c* is calculated as follows:

$$c_{ij} = a_{i1}b_{1j} + a_{i2}b_{2j} + \cdots + a_{in}b_{nj} = \sum_{k=1}^{n} a_{ik}b_{kj},$$