ICS 2103 – INTRODUCTION TO SYSTEMS PROGRAMMING

ASSIGNMENT

INSTRUCTIONS: *in case you don't have Linux installed, go to*
http://www.tutorialspoint.com/execute_bash_online.php

And use it for the following assignment.

- Go to project and click '+' . in the new window, paste the code and click save icon.
- Right click the file in the project pane and rename the file with a .c extension.
- Use the gcc compiler (and gdb debugger when necessary) to run you programs.

Take screen prints of your terminal at each relevant point and use it to explain your answers.

---

1. Debug the following code by compiling it for debugging (use gcc –g name of program) and executing it within a debugger (run a.out). from the information that follows at which line of code does the program crash? Why does it crash there?

```
/* This code has a compile-time error, and at
** least one run-time error. */
#include <stdio.h>
#include <math.h>
main(int argc,char *argv[])
{
int n,i;
int d2,count,
double d1;
while (1)
{
printf("Enter a number (0 to quit): ");
scanf("%d",&n);
if (n == 0)
break;
count=0;
for (i=0; i<n; i++)
{
d1=(double)n/(double)i;
d2=n/i;
if (fabs(d1-(double)d2) < 0.00001)
count++;
}
```

```
if (count == 2)
printf("%d is prime\n",n);
else
printf("%d is not prime\n",n);
}
}
```

Explain the difference between compile time error and run time error.

2. The following program compiles and executes but does not do what its designer intended. The program is supposed to allow a user to enter five integers, sorting the list from smallest to largest each time a new number is entered. However, when tested on a simple sequence, the program fails to sort correctly.
   Use a debugger to track down what is going wrong. Set a breakpoint at line 14 (w=n[i];). Use the display command to view the value for the variable n, which shows the current list of numbers, and the variables s and i, which show the indices of the two numbers about to be swapped. Use the continue command to pause the program at the same point (line 14) after one number has been entered, after two numbers have been entered, and after three numbers have been entered.
   By that point you should see the problem. Is it a bug or a program design flaw?

```
#include <stdio.h>
main()
{
int n[5],s,i,j,w;
for (i=0; i<5; i++)
{
printf("Enter any integer: ");
scanf("%d",&(n[i]));

s=0; /* find index of smallest */
for (j=1; j<=i; j++)
if (n[j] < n[s])
s=j;
w=n[i]; /* swap smallest with current */
n[i]=n[s];
n[s]=w;
}
for (i=0; i<5; i++)
printf("%d\n",n[i]);
}
```

3. During the writing and compiling of a program, what two steps must be taken to make use of a library?

4. Write a memory map for the following code. Show all values at the end of execution of the program.

```
#include <stdio.h>
main()
{
int x[2][3][2];
int i,j,k;
for (i=0; i<3; i++)
for (j=0; j<2; j++)
x[0][i][j]=i*3+j;
for (k=0; k<2; k++)
     for (j=0; j<2; j++)
     x[1][k][j]=x[0][j][k]-1;
     }
```

5. What is a system call? For what are system calls used?
6. Write out the memory map for the following code, providing all values at the end of execution. It can be written using multiple maps, or areas of memory, one for each process. What is the exact output produced by this program?

```
#include <stdio.h>
#include <unistd.h>
main()
{
int i,j,k;
k=0;
for (j=0; j<4; j++)
k=k+j;
i=fork();

if (i == 0)
for (i=3; i<k; i++)
j=j-i;
else
i=k%3;
printf("%d %d %d\n",i,j,k);
                }
```

CAT 2

1. What is a process?
2. State the UNIX command for viewing the current processes
3. Define the following process properties;
    a. TTY
    b. PID
    c. PPID
    d. UID
    e. ARGS
4. How are processes born in UNIX?
5. Define the following types of processes;
    a. Daemon
    b. Zombie
    c. Orphaned
6. Write a program to demonstrate that fork is called once but returns twice. Use comments and a short description to explain your code.
7. Write a program to demonstrate dynamic memory allocation using malloc? With explanations.