CSCI 210 – Systems Programming
Sample Final Exam

First Name, Last Name:

Print your name clearly above. Put your name on each page in case the pages get separated. There are 7 pages in this exam, check that you have them all.

Answer the questions by circling the letter of the correct answer like so:

What is the name of the Mines Linux server, we mainly use for class activities?

(a) alamode
(b) isengard
(c) mordor
(d) quickfox

If you have a question or need additional scratch paper, raise your hand. Each question is worth 3 points. The exam contains a total of **60 points.**

Duration: 60 minutes

You are allowed to bring one double-sided notes sheet.

1. What is the output of the following code segment? (Assume that all required header files are included and there is no compile error)

```
int arr[10] = {1,2,3,4,5,6,7,8,9,10};
int *p,*q;
p = arr+3;
q = p+2;
printf("%d\n",q[p-arr]);
```

(a) 6
(b) 2
(c) 9
(d) 8

2. What is the output of the following code?

```
#include <stdio.h>
void f(int *arr) {
     arr[-2]=5;
     arr[2]=4;
}
int main() {
     int b[5] = {0,1,0,1,0};
     f(b+2);
     for (int i=0;i<5;i++) printf("%d ",b[i]);
     return 0;
}
```

(a) 0 1 0 1 0
(b) 5 1 0 1 4
(c) runtime error
(d) compile error

3. What is the output of the following code segment? (Assume that all required header files are included and there is no compile error)

```
char str[]="abcdef";
printf("%c\n",*(str+3));
```

(a) a
(b) d
(c) e
(d) undefined behavior

4. What is the output of the following code segment? (Assume that all required header files are included and there is no compile error)

```
char str[10];
str[0]='H';
str[1]='A';
str[2]='L';
printf("%s\n",str+1);
```

(a) HAL
(b) AL
(c) L
(d) undefined behavior

5. Which of the following is a false statement about malloc()?

(a) malloc() will result in a SIGTERM signal if the requested number of bytes cannot be allocated.

(b) malloc() returns a pointer to the first byte of the allocated space.

(c) Memory allocated by malloc() can be used within the same process until freed.

(d) The number of bytes to be allocated is provided as input to malloc().

6. Which one of the following statements would allocate space to store 10 C strings assuming that all the individual strings to be stored are string literals?

```
(a) strings = (char **)malloc(sizeof(char *)*10);
(b) strings = (char *)malloc(sizeof(char *)*10);
(c) strings = (char *)malloc(sizeof(char )*10);
(d) strings = (char **)malloc(sizeof(char)*10);
```

7. How do you declare a function pointer in C that points to a function taking two integers as arguments and returning a float?

```
(e) float *func(int, int);
(f) float (*func)(int, int);
(g) float *(*func)(int, int);
(h) float func(int, int);
```

8. Which one of the functions calls send a function pointer as input to the called function, given that `h` is a function, which takes two integers and returns a float pointer?

```
(a) foo(*h);
(b) foo(*h(3,5));
(c) foo(h);
(d) foo(**h);
```

9. Which of the following function calls causes a process to go into kernel mode?

```
(a) fork()
(b) exec()
(c) wait()
(d) All of the above
```

10. When a child process created with `fork()` terminates, which of the following system calls can a parent process use to retrieve its exit status?

```
(a) exec()
(b) wait() or waitpd()
(c) exit()
(d) kill()
```

11. Which signal cannot be caught, blocked, or ignored by a process?

(a) `SIGKILL`
(b) `SIGINT`
(c) `SIGTERM`
(d) `SIGPIPE`

12. What are the three possible dispositions of a signal?

(a) default action, ignore, custom handler

(b) terminate process, custom handler, default action

(c) block process custom handler, ignore

(d) ignore, terminate process, default action

13. What happens when a process writes to a pipe, but no process is reading from the other end?

(a) The write operation blocks until a reader is available.

(b) The write operation completes successfully with no error.

(c) A `SIGPIPE` signal is sent to the writing process.

(d) The data is discarded

14. What is the primary difference between a pipe and a FIFO?

(a) A pipe can only be used within a single process.

(b) A FIFO allows communication between unrelated processes.

(c) A pipe is slower than a FIFO.

(d) A FIFO requires the `pipe()` system call.

15. What happens if `pthread_join()` is called on a thread that has already terminated?

(a) A segmentation fault occurs.

(b) The return value of the thread is retrieved.

(c) The call to `pthread_join()` is ignored.

(d) Undefined behavior occurs.

16. Which of the following statements about threads is incorrect?

(a) Every process has at least one thread.

(b) Thread creation is faster than process creation.

(c) A thread is created by specifying a starter function.

(d) The main thread is the last process to terminate in a process.

17. Which of the following system calls is **not** used to set up a server socket for listening to client connections?

(a) `socket()`
(b) `bind()`
(c) `listen()`
(d) `connect()`

18. Which of the following statements about UNIX domain sockets is incorrect?

(a) A UNIX domain socket is always bound to the localhost IP.

(b) UNIX domains sockets allow communication between computers that run UNIX/Linux variants

(c) UNIX domain sockets always use the datagram socket type.

(d) All of the above

19. What is the output of the following code segment? (Assume that all required header files are included and there is no compile error)

```
char name1[10] = "Alice";
char name2[10] = "John";
char name3[10] = "Jack";
char *names[3] = {name1, name2, name3};
printf("%s\n",2+*names);
```

(a) ice
(b) Jack
(c) ck
(d) John

20. What is the output of the following code segment? (Assume that all required header files are included and there is no compile error)

```
char *s="coffee", *p;
p = s;
while (*p) {
     printf("%c", *(p++));
     if (*p == 'e') break;
     else p++;
}
```

(a) cof
(b) coff
(c) cfe
(d) coffe