CSSE 332 -- Operating Systems

Introduction to Multi-threading

Name: _____

Question 1. (5 points) What are the main differences between a *thread* and a *process*? In your answer, list out the pieces of memory and the processor that are shared between threads and those that are not.

Question 2. (5 points) Consider the following function that we'd like to run in its own separate thread:

```
1 void *thread_function(void *arg) {
2   // argument contains an id given to the thread
3   int my_id = *(int*)arg;
4
5   printf("Hello from thread %d\n", my_id);
6   return NULL;
7 }
```

In the box below, write a piece of code that would create and run this function in a new thread. Make sure to include the code that waits for the created thread to return.

Question 3. (5 points) Consider the following piece of code, how many threads would we end up with when it executes?

```
pthread_t threads[5];
for(int i = 0; i < 5; i++) {
  pthread_create(&threads[i], 0, some_function, 0);
}
```

Question 4. (5 points) Consider the following snippet of code:

```
void thread_fn(void *arg) {
  int *id = *(int*)arg;
  printf("Thread %d executing\n", id);
  return 0;
}

// somewhere else
pthread_t threads[5];
for(int i = 0; i < 5; i++) {
  pthread_create(&threads[i], 0, thread_fn, &i);
}
```

In the box below, write down for each thread, the output that will be printed on the screen. For example, write something like `Thread 1:   Thread 0 executing` and so on.

Question 5. (5 points) Consider the following snippet of code:

```c
void thread_fn(void *arg) {
  int id = *(int*)arg;
  printf("Thread %d is executing \n", id);
  return 0;
}

// somewhere else
pthread_t threads[5];
int ids[5];
for(int i = 0; i < 5; i++) {
  ids[i] = i+1;
  pthread_create(&threads[i], NULL, thread_fn, &ids[i]);
}

for(int i = 0; i < 5; i++) {
  pthread_join(threads[i], 0);
}
printf("All the threads have returned\n");
```

In the box below, write the order in which the print outs will show up on the console when this code executes.

Question 6. (10 points) Please write down two **sentences** describing two new things that you learned in this session.

Question 7. (10 points) Please write down two things that you are still not very clear about, or any questions that you might have that the session did not go over or did not cover well.