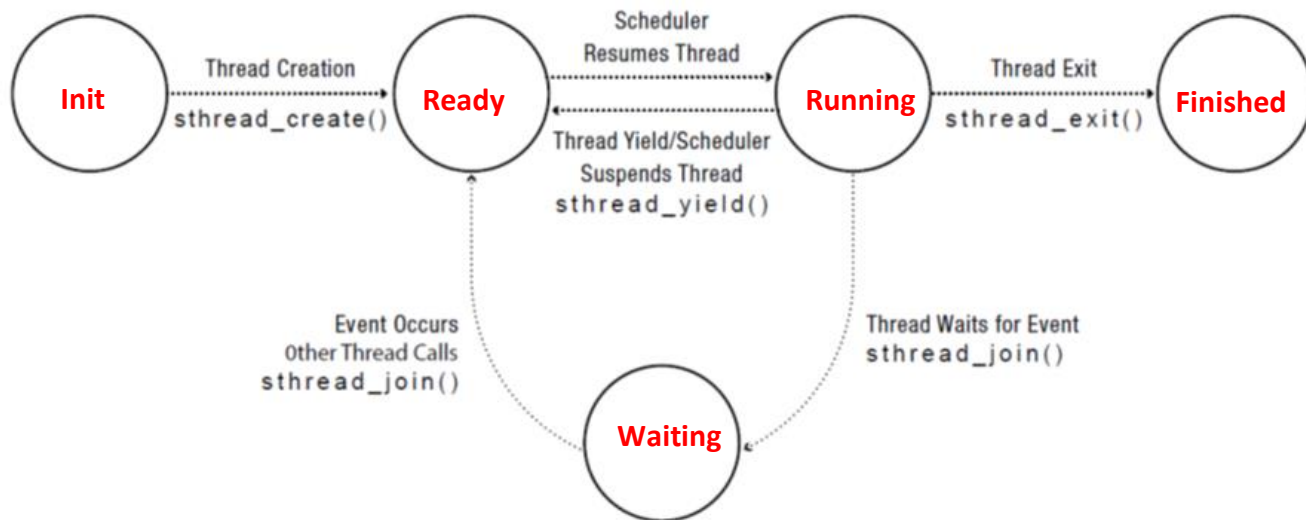1.(4 points) In the following thread state diagram, label the states (i.e., write the labels inside the circles) with the state names: Finished, Init, Ready, Running, and Waiting.

2. (2 points) A shared counter starts with value 0. Ignoring any compiler or hardware instruction reordering, what is the set of possible final values for the counter when the following three threads are run without mutual exclusion?

   shared_counter = 0;

int local;	int local;	int local;
T1S1: local = shared_counter;	T2S1: local = shared_counter;	T3S1: local = shared_counter;
T1S2: local = local + 1;	T2S2: local = local + 1;	T3S2: local = local + 1;
T1S3: shared_counter = local;	T2S3: shared_counter = local;	T3S3: shared_counter = local;

   {1, 2, 3}

3. (2 points) Suppose that you mistakenly create a local variable *v* in one thread *t1* and pass a pointer to v to another thread *t2*. Is it possible that a write by *t2* to *v* will cause *t1* to execute the wrong code?

   Yes, Threads provide no protection from read/write by other threads. If a pointer/reference is passed from one thread, t1, to another thread, t2, within the same process, then the receiving thread, t2, can write bad code into the sending thread, t1.

threadHello.c program

```
1 #define NTHREADS 10
2 thread_t threads[NTHREADS];
3 main() {
4    for (i = 0; i < NTHREADS; i++) { thread_create(&threads[i], &go, i); }
5    for (i = 0; i < NTHREADS; i++) {
6       exitValue = thread_join(threads[i]);
7       printf("Thread %d returned with %ld\n", i, exitValue);
8    }
9    printf("Main thread done.\n");
10 }
11 void go (int n) {
12    printf("Hello from thread %d\n", n);
13    thread_exit(100 + n);
14 }
```

4. (2 points) For the threadHello program (above), what is the minimum and maximum number of times that the main thread enters the WAITING state (line 6)?

The minimum number of times is zero. All the children threads can all be created, and completed before the main thread reaches the call to thread_join. In this case the main thread would never wait.

The maximum number of times is ten. No child thread is finished before the main thread reaches the call to thread_join.

5. (2 points) For the thread Hello program (above), where is the parameter n (line 11) stored in the thread?

The parameter is stored in the Thread Control Block (TCB) stack or in the Thread Control Block (TCB) register set.