

15 POINTS

2. The following simple program (headers not shown) named `th_run` compiles and links (using `-lpthread`) with no errors, but on one particular execution on a multi-core Linux machine it produced the following output but **never completed** (i.e. no shell prompt ever prints again until a **ctrl C** is typed in):

```
bash-3.00$ ./th_run
THREAD 1 IS RUNNING
THREAD 5 IS RUNNING
```

SOURCE CODE FOR `th_run`:

```
#define N 5
pthread_mutex_t lock;
void *th(void *arg){
    pthread_mutex_lock(&lock);
    printf("THREAD %d IS RUNNING\n", *((int *)arg));
    return NULL;
} // end th

int main(int argc, char *argv[]){
    pthread_t      thread_id[N];
    int            arg[N];
    int            i;
    pthread_mutex_init(&lock, NULL);
    pthread_mutex_lock(&lock);
    for(i=0; i<N; i++){
        arg[i] = i + 1;
        if(pthread_create(&thread_id[i], NULL, th,
                        (void*)(&arg[i]))!=0){
            perror("thread create failed ");
            exit(1);
        }
    }
    for(i=0; i<N; i++){
        pthread_mutex_unlock(&lock);
        pthread_join(thread_id[i], NULL);
    }
    printf("\nProgram with %d threads is done\n", N);
} // end main
```

Problem 2 continued on next page: