Laptop, Intel(R) Core(TM) i5-8265U CPU @ 1.60GHz   1.80 GHz,8.00 GB (7.85 GB usable)

Seconds/Parallel	6.321	3.116	2.37	2.606
Speed-up	1.14697041607341	1.25545571245186	3.8704641350211	0.81504221028396
Seconds/Series	7.25	3.912	9.173	2.124
Difference	0.929	0.796	6.803	-0.482

CS 218 - Assignment #12

Execution Time vs Thread Count
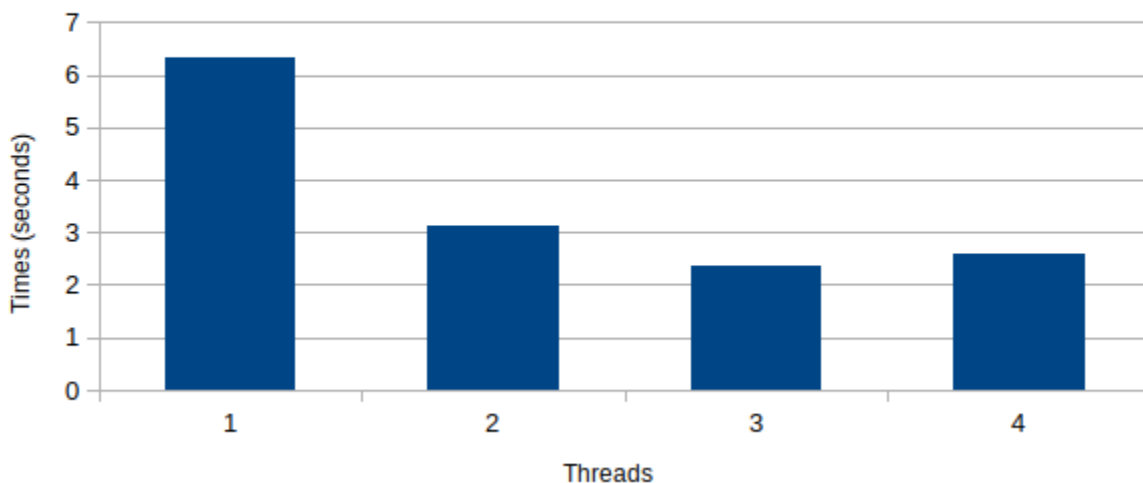
The results showed that the execution in series was significantly slower than when the execution occurred in parallel. Plus, the execution time was quicker when using multiple threads (parallel processing). This occurred because of the concept of parallel processing, which takes a large problem and divides it into various sub-problems and those sub-problems can be executed independently. In our assignment, the parallel execution takines the problem and generates subprocesses, threads, to execute the problem quicker. It is quicker than series because instead of waiting for a process to be complete and then proceeding, multiple threads can be solving different parts of the problem.

Confirmation of no race condition:

```
student@student-VirtualBox:~/Documents/ass12$ ./happyNums -t4 -lm 8396851
--------------------------------------------------------------
CS 218 - Assignment #12

Happy/Sad Numbers Program

Thread Count: 4
Numbers Limit: 40000000

   Start Counting...
     ...Thread starting...
     ...Thread starting...
     ...Thread starting...
     ...Thread starting...
     ...Thread starting...

Results:
--------
Happy Count: 5577647
Sad Count:   34422353
```

(matches pdf output)

```
with Spin Lock:
###########################################

-------------------
Timed Test (1 thread)

real    0m6.324s
user    0m6.267s
sys 0m0.016s

-------------------
Timed Test (2 thread)

real    0m3.116s
user    0m6.197s
sys 0m0.004s

-------------------
Timed Test (3 thread)

real    0m2.370s
user    0m6.540s
sys 0m0.047s

-------------------
Timed Test (4 thread)

real    0m2.606s
user    0m8.634s
sys 0m0.059s
```

```
Without spin lock:
###########################################

-------------------
Timed Test (1 thread)

real    0m7.250s
user    0m7.139s
sys 0m0.028s

-------------------
Timed Test (2 thread)

real    0m3.912s
user    0m7.703s
sys 0m0.016s

-------------------
Timed Test (3 thread)

real    0m3.173s
user    0m9.300s
sys 0m0.012s

-------------------
Timed Test (4 thread)

real    0m2.124s
user    0m7.814s
sys 0m0.032s
```