**Final Project: Password Cracking**

**List of hashed passwords/time:**

Password is Z. It was found in 0.013797283172607422 seconds.

Password is AD. It was found in 0.017316102981567383 seconds.

Password is God. It was found in 0.04485583305358887 seconds.

Password is 1234. It was found in 1.2952075004577637 seconds.

Password is AbCdE. It was found in 112.74707770347595 seconds.

**Analysis:**

There are 26 uppercase letters, 26 lowercase letters, and 10 digits that can be used for each character of the password. The general mathematical formula for computing the possible number of passwords is 62^nth power, where n is the length of the password. For each password length, the number of passwords to check is:

1: 62

2: 3,844

3: 238,328  
4: 14,776,336

5: 916,132,832

6: 56,800,235,584

7: 3,521,614,606,208

8: 218,340,105,584,896

The times do not reflect this increase exactly, as there are some confounding factors. Each password is found at a different time within the combinations, and each level of computation takes a different amount of time due to the workings of the multiprocessing library. When using multiple cores, there is a cost to read, write, and combine the data for each core. The number of computations for each core is dictated by the chunk size, and when using chunks, jobs are not equally distributed (using an unordered map at least). The first password was likely using one core, the second two cores, and the rest using all 16 cores. Optimizing the chunk size could increase usage of each core when multiprocessing, but relies on some complex mathematical relationships and a whole lot of guesswork.

For the computed password lengths, the time to compute all password combinations was:

Length 1: 0.013796806335449219 seconds

Length 2: 0.016640424728393555 seconds

Length 3: 0.056014060974121094 seconds

Length 4: 2.783948659896850698 seconds

Length 5: 193.6247351169586216 seconds

Each increase is pretty close to 62 times the time it took to compute the previous length. Therefore, we can estimate that the remaining three passwords would be computed within:

Length 6: 12,004 seconds ~ 3.33 hours ~ 0.14 days

Length 7: 744,275 seconds ~ 206.75 hours ~ 9 days

Length 8: 46,145,067 seconds ~ 12818.1 hours ~ 534 days