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Factoring Large Numbers

In this assignment we were tasked with factoring large numbers into two large prime numbers. These large numbers were taken from a list of over 4000 integers provided to the class. When it came to factoring the numbers I decided to use the Trial Division method. This is not the most efficient algorithm, but it's one that I understand very well and found it to be the easiest for me to implement effectively in python.

In my code I have three major functions: `primeFactor()` which actually performs the factorization, `averageCalculator()` which calculates the average time it takes for the code to factor integers of a given integer length, and `digitCounter()` which counts the number of digits in a given integer. I chose to analyze this by taking the average time needed to factor each integer because the time it took to factor integers of the same length varied greatly. Some integers could be factored in a fraction of a second, while others of the same length could sometimes take 30 to 45 seconds. Because the basics of the assignment only mentioned 20-digit integers being factored in under 30 seconds, I only had my code run for integers of 20 digits or less to save time; however, just to make sure that the code still functioned adequately for larger values, I also ran it one last time for the 37 digit integers at the end of the list. Below is a table that shows the results from the program.

| Number of Digits | Average Factorization Time (seconds) |
|------------------|--------------------------------------|
| 10 | 0.03798 |
| 11 | 0.03767 |
| 12 | 0.22112 |
| 13 | 0.09198 |
| 14 | 0.41514 |
| 15 | 4.14924 |
| 16 | 12.12563 |
| 17 | 2.66715 |
| 18 | 4.75036 |
| 19 | 3.78726 |
| 20 | 3.34538 |
| 37 | 3.78726 |

The most interesting thing from this data is that the 15 digit integers began to see a serious jump in average time from the previous integers. I was surprised because this wasn't a particularly significant jump in the size of the integers. It's not like the size jumped from a 32-bit integer to a 64-bit integer. And then there was another significant jump again when moving to the sixteen digit integer, but down again from then on, so I'm not entirely sure why this was the case given the consistency of the remaining trials.