Using Patterns Found in the Distribution of Prime Numbers to Assist in Writing a Very Efficient Prime Sieve

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Prime numbers are integers that only have 2 factors, one and themselves. The sequence of prime numbers are very strange, with no known formula to predict or calculate prime numbers without running primality tests. New aspects of prime numbers are being discovered constantly – it wasn't until 1896 that the prime number theorem, a theorem concerning the density of the primes, was proven. There still remains much controversy over an elementary proof today. Just earlier this year a new pattern in the primes was discovered, concerning the ending digits of primes and how that effects the ending digit of the next occurring prime. In short, the primes are very mysterious and have lots of unsolved and unexplored properties. In my project, I examined various prime spirals, or graphical representations of the sequence of primes, (notably Ulam spirals and Sacks spirals) and conjectured some possible explanations for the previously unexplained patterns that appear in these prime spirals. I also implemented the characteristics of the primes that were used in these explanations in the writing of a prime number sieve. My prime number sieve is very efficient, and requires less calculations to return a list of primes than any other existing prime number sieve for upper limits below ~40,000. After ~40,000 the sieve of Eratosthenes becomes slightly more efficient than it, but it still remains far more efficient than other prime number sieves. The prime number sieve gives my project a practical application, as prime numbers are used as the basis of computer encryption, and my sieve can find larger prime numbers.

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