

## SUGGESTED PROJECT TOPICS

The following is a list of possible topics for the term project. The list is by no means exhaustive, and you are free to propose your own topic.

### 1. The Riemann Zeta Function

Two possible projects would be to give a proof of the prime number theorem or to prove the functional equation for the zeta function.

### 2. Fast Fourier Transforms and applications

FFT's are used to very efficiently multiply large numbers, as well as in various other applications such as image processing.

### 3. Error Correcting Codes and applications

These codes are used to ensure that information sent over networks does not get scrambled.

### 4. Primality testing and big primes

Describe the best known algorithms for testing if a number is prime. There are also algorithms used to determine whether numbers of a particular form are prime. What are some techniques for producing big primes ?

### 5. Fermat's Last Theorem

Fermat's Last Theorem is the claim that the equation  $x^n + y^n = z^n$  has no integer solutions for  $n > 2$ . A proof of the theorem was finally obtained in 1993-1994 by Andrew Wiles joint with Richard Taylor. This problem has a rich history, with many  $n$ 's ruled out over time. There are several possible projects focusing on various aspects of this story. For example, you could prove the  $n = 3$  case of the theorem.

### 6. Number Theory in Biology

The Golden Ratio arises in the growth patterns of plants and animals. Explain how and give examples.

**7. Elliptic Curves and Cryptography** These are algebraic curves described by equations of the form  $y^2 = x^3 + ax + b$ . Explain how the points on such a curve admit an abelian group structure, as well as how this is used in public-key cryptography.