

# The Almagest

The bi-weekly newsletter of the Alma College Department of Mathematics and Computer Science. Your trusted source for news.

Volume 12 No. 6

November 22, 2019



## Final Colloquium – Tuesday, Nov. 26<sup>th</sup>

The final Math & C.S. colloquium of the Fall semester will be given by Dr. Andrew Thall.

Dr. Thall is an associate professor of computer science here at Alma. Dr. Thall's presentation is entitled "Why does Dr.T run amok? Arithmetic with 'modestly large' numbers."

We all know Professor Thall likes big numbers. We mean BIG numbers, like numbers with 10 million digits! He likes to square 'em, he likes to add 'em, he likes to divide 'em by 243,112,609 – 1 and find the remainder! Why, we already know: it's his lucrative Mersenne prime testing business. But how he does it has some interesting angles for both math and computer science folks. Why does he use balanced integers, like base-10 numbers with digits [-5, -4, -3, -2, -1, 0, 1, 2, 3, 4] instead of [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]? And what's all this about irrational bases; how can you have a number with an irrational base and irrational digits? Come help us deal with this irrational guy and bring some reason to it all.

~ Dr. Thall

### **"Why does Dr.T run amok?"** **Arithmetic with 'modestly large' numbers**

Date: **Tuesday, November 26<sup>th</sup>**

Time: 4:00

Place: SAC 113

**Refreshments at 3:50.**

## Math Club

The Math Club meets **EVERY TUESDAY** at 9:00 pm in Dow 132. *Everyone is welcome!*



## Tutoring for Calculus and Elementary Stats

The tutor for Calculus I and II this semester is **Brianne Giddis**. Brianne has office hours from 7-9pm every Monday and Wednesday night in SAC 216.

The tutor for Elementary Statistics is **Morgan Mydloski**. Morgan's office hours are from 7-9pm every Tuesday and Thursday night in SAC 216.

Please see our tutors if you have questions on course material, homework, or while studying for exams!

## Math Honorary

Math students: did you know that that Alma College has a chapter of Pi Mu Epsilon, a national mathematics honor society? Well, we do, and you could be invited to join. To find out about the requirements for membership, please visit the PME website at [pme-math.org](http://pme-math.org).



## Math and C.S. Senior Projects

A note to math and C.S. students graduating this Spring: please meet with your faculty mentor for the senior comprehensive project before the end of this semester! It is a very good idea to settle on a topic soon, so you will have time over the holidays to work on it.

## Happy Thanksgiving!

The Math and C.S. faculty are thankful to all our students for their hard work and excitement for learning. Best wishes and safe travels for Thanksgiving!

## The Riemann Zeta Function

The Riemann zeta function,  $\zeta(s) = \sum_{n=1}^{\infty} \frac{1}{n^s}$ , is the analytically continued function of the Dirichlet series  $\sum_{n=1}^{\infty} \frac{a_n}{n^s}$  where  $a_n = 1$ . This series converges when the real part of  $s > 1$ . The Riemann zeta function was first studied by Leonhard Euler who studied it as a function of a real variable, specifically positive integers. Euler's work with the function helped to discover that a connection existed between the zeta function and the distribution of primes as discussed earlier. Euler also helped to explore the concept that the zeta function could be used to assign values to otherwise divergent infinite series. While he did explore this idea, it is unclear how far he actually pushed this topic, although some still credit him with the discovery that  $\sum_{n=1}^{\infty} \frac{1}{n-1} = 1 + 2 + 3 + 4 + \dots = -1/2$ . It is important to note that this is a way to assign values to a divergent series, and does not mean that the series is convergent.

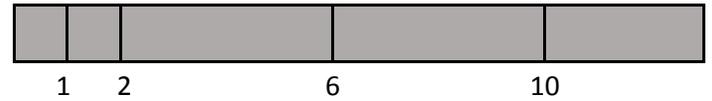
After Euler's work with the zeta function, Chebyshev extended the definition of the zeta function to include all numbers whose real part was greater than 1. In 1859, Bernhardt Riemann published "On the Number of Primes Less Than a Given Magnitude" in which he showed that the zeta function's half-plane of convergence could be analytically continued to all complex values of  $s$ . The only exception is  $s = 1$ , which is the harmonic series. The full zeta function takes the form  $\zeta(s) = \frac{1}{\Gamma(s)} \int_0^{\infty} \frac{x^{s-1}}{e^x - 1} dx$ , where  $\Gamma(s)$  is the Gamma function.

One of the more fascinating aspects of the zeta function, and perhaps its most important when it comes to discussing the prime numbers, is the location of its zeros. First off, the zeta function has zeros at the negative even integers such as  $-2, -4, -6$ , etc. These are known as the trivial zeros because they can be found and proved easily. The non-trivial zeros is where things get interesting. In his paper, Riemann proposed that all of the non-trivial zeros of the zeta function have a real part between 0 and 1. This section is known as the critical strip. More specifically he believed that all zeros of the function had a real part of  $1/2$ , which is known as the critical line. This conjecture that Riemann made is known as the Riemann Hypothesis. ~ *Brandon Hart*

## Solution to Previous Puzzle

Can you find a way to mark a 13-inch ruler with only 4 lines so that that all measurements from 1 to 13 inches are possible?

Isabelle Esch submitted a correct solution and earned the **\$2.00** prize. Her solution was: put marks at the 1, 2, 6, and 10 inch locations.



## Puzzle of the Bi-week

If  $1 \leq n \leq 9$ , define the super-sum  $S(n)$  to be the sum of all  $n$ -digit numbers with distinct non-zero digits. So,  $S(1) = 1$ ,  $S(2) = 12 + 21$ , and  $S(3) = 123 + 132 + 213 + 231 + 312 + 321$ .

Find  $S(5)$ . A **\$2.00** prize will be given to the first student to submit the correct answer to Dr. Molina.

An additional prize of **\$2.00** will be given to the first student to submit a closed formula (no summations) that makes finding  $S(n)$  easy with a basic calculator.

Student assistant:	Brandon Hart
Faculty advisor:	Brad Westgate
Distribution:	Jackie Gage SAC 224

If you would like to submit an announcement or a short article, please send it via e-mail to Brad Westgate ([westgatebs@alma.edu](mailto:westgatebs@alma.edu)).



ALMA COLLEGE