Department of Mathematics

March 8, 2021

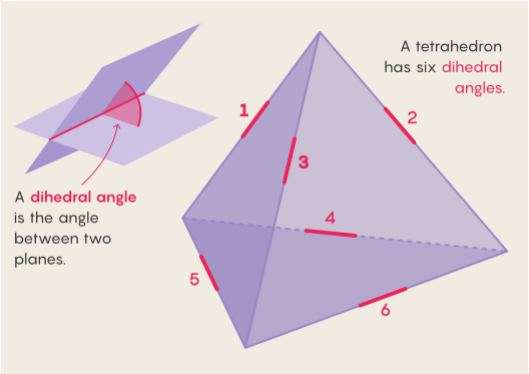
What's New in Math (and Physics, Biology, and Computer Science)? Read Quanta Magazine!

Do you enjoy kicking back and reading about recent results in math (and other sciences)? One of the best online sources is Quanta magazine, quantamagazine.org, an "independent online publication launched by the Simons Foundation to enhance public understanding of science." The articles there extraordinarily well written and engaging: Quanta's description of its approach is "[o]ur work often resembles journalistic alchemy – we mash together the complexities of science with the malleable art of storytelling in an attempt to forge a precious new alloy."

In two recent articles, Quanta reported on solutions to two long-standing problems in geometry. One problem is about slicing high-dimensional convex shapes and was solved by a statistician, and the other problem concerns the classification of tetrahedra with rational angles and was solved by mathematicians using techniques from number theory.

The first problem, formulated in the 1980s by Fields medalist Jean Bourgain is roughly stated as the following: "Suppose a convex shape has volume 1 in your favorite choice of units. If you consider all the ways to slice through the shape using a flat plane one dimension lower, could these slices all have extremely low area, or must at least one be fairly substantial?" Yuansi Chen, a postdoc in Zurich who will be joining the statistics faculty at Duke, "gets at the Bourgain slicing problem via an even more far-reaching question about convex geometry called the KLS conjecture. This 25-year-old conjecture, which asks about the best way to slice a shape into two equal portions, implies Bourgain's conjecture. What's more, the KLS conjecture lies at the heart of many questions in statistics and computer science, such as how long will it take for heat to diffuse through a convex shape, or how many steps a random walker must take from a starting point before reaching a truly random location."

The second problem concerns tetrahedra. A tetrahedron has a triangular base and three triangular sides that form a pyramid. The problem, first stated in a 1976 paper by John Conway and Antonia J. Jones and motivated by a broader "scissors congruence" problem, is to identify all tetrahedra with rational dihedral angles, the angles at which each pair of faces of the tetrahedra meet. It turns out that there are two infinite families of such tetrahedra, as well as 59 isolated examples. These solutions were known, essentially by a guess-and-check method in solving a polynomial equation with six variables and over 100 terms; however, that this list was a *complete* list of solutions was only proved in 2020 by Kiran Kedlaya, Alexander Kolpakov, Bjorn Poonen, and Michael Rubinstein. To do this, they needed to invent a new way of solving equations!



For more about these two problems, and much more about math and science, read Quanta magazine!

Mark your Calendar: Undergraduate Math Conference, HRUMC – April 10

This year's Hudson River Undergraduate Mathematics Conference (HRUMC) is scheduled for **Saturday, April 10**. Due to ongoing COVID-19 restrictions, the conference will be held virtually over Zoom. Stay tuned to this newsletter for more announcements as conference day approaches.

Math Club: Next meeting – Thursday, March 11 at 5:30 via Zoom.

Email club president, **Lily Dong** (dongl@union.edu) for the Zoom link and to get on the mailing list.