

The BIG SIGMAA News

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**Business, Industry, and Government Special Interest Group
of the Mathematical Association of America**

JMM 2021 Will Be Virtual

The 2021 Joint Mathematics Meetings will not be held in Washington, DC, as originally planned. Instead, the meetings will be held virtually. The dates of the meetings have not changed, January 6-9, though the times of the sessions will be based on Mountain Standard Time to better accommodate attendees on the west coast.

Registration is still required to attend sessions; details can be found on the meetings' website,

jointmathematicsmetings.org

The JMM program has been described as a "streamlined" version of the usual JMM programs. There will be the usual MAA, AMS, and joint invited addresses, the AMS will sponsor special sessions, though not contributed paper sessions, and the MAA will sponsor invited paper sessions and contributed paper sessions.

The BIG SIGMAA is sponsoring a contributed paper session on "Mathematical Experiences and Projects in Business, Industry, and Government." The session will be held on Wednesday

morning, beginning at 9:00. Six speakers are scheduled; the program can be found on the JMM website. There will also be a BIG SIGMAA guest lecture on Thursday afternoon at 5:00; the speaker will be Geoffrey West, a theoretical physicist and the Distinguished Shannon Professor at the Santa Fe Institute. Dr. West was also president of the Santa Fe Institute from July 2005 through July 2009. The title of his talk is "Universal laws of life, growth, and death in organisms, cities, and companies". The BIG SIGMAA business meeting will be held on Friday at 5:00 MT. The zoom link for this meeting is

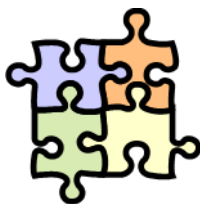
<https://leeuniversity.zoom.us/j/92141254086>

Several of the MAA invited addresses may also be of interest to BIG SIGMAA members: Nathan Kaplan will talk about error-correcting codes that come from families of polynomials over finite fields, Angela Sheffield will talk about next-generation artificial intelligence, and Stephanie Singer will talk about detecting anomalies in elections.

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Puzzle Corner (*from Nick's Mathematical Puzzles*)



The Pythagorean equation $3^2 + 4^2 = 5^2$ is well-known. Are there any other positive integers x , y , and z such that $3^x + 4^y = 5^z$?

Solution on page 3.

Richard E. Bellman

The year 2020 marks the one-hundredth anniversary of the mathematician Richard E. Bellman's birth (August 26, 1920 – March 19, 1984). Bellman introduced dynamic programming and the Bellman equation, and he coined the term curse of dimensionality. Over the course of his career, he published 619 papers and 39 books. Here are three quotations from his works:

Mathematics makes natural questions precise.

If we do not wish to suffer the usual atrophy of armchair philosophers, we must occasionally roll up our sleeves and do some spadework.

From a paper on the birth of dynamic programming:

What is worth noting about the foregoing development is that I should have seen the application of dynamic programming to control theory several years before. I should have, but I didn't. It is very well to start a lecture by saying, "Clearly, a control process can be regarded as a multistage decision process in which ..., " but it is a bit misleading. Scientific developments can always be made logical and rational with sufficient hindsight. It is amazing, however, how clouded the crystal ball looks beforehand. We all wear such intellectual blinders and make such inexplicable blunders that it is amazing that any progress is made at all.

Finally, here is a quote from Donald Knuth that concludes with a (possibly apocryphal) quote of Bellman:

The book Dynamic Programming by Richard Bellman is an important, pioneering work in which a group of problems is collected together at the end of some chapters under the heading "Exercises and Research Problems," with extremely trivial questions appearing in the midst of deep, unsolved problems. It is rumored that someone once asked Dr. Bellman how to tell the exercises apart from the research problems, and he replied: "If you can solve it, it is an exercise; otherwise it's a research problem."

A Limerick (from the Fall 2013 newsletter)

An Englishman living in Bree
 Can't solve an equation for π .
 When asked why, he said
 "I solve it for π .
 That's how I do math," answered he.

A Winter Fib (from the Fall 2019 newsletter)

In
 the
 Vermont
 winter cold,
 Wilson Bentley found
 a way to photograph snowflakes.
 He made over five thousand images of snowflakes,
 all with a perfect, delicate, crystal-clear six-fold symmetry and no two alike.

Puzzle Corner Solution

Let x , y , and z be positive integers such that $3^x + 4^y = 5^z$. Considering this equation modulo 3, we have $1 \equiv (-1)^z \pmod{3}$, and hence z is even. Letting $z = 2w$ and writing 4 as 2^2 , we can write $3x$ as a difference of two squares:

$$3^x = 5^{2w} - 2^{2y} = (5^w + 2^y)(5^w - 2^y).$$

Since the left-hand side of the above equation is a power of 3, each factor of the right-hand side must also be a power of 3. But 3 cannot divide each factor, because if it did, then it would divide their sum, which it does not. Hence one of the factors must equal $3^0 = 1$; therefore $5^w - 2^y = 1$, and hence $5^w + 2^y = 3^x$.

Considering these two equations modulo 3, we have

$$(-1)^w + (-1)^y \equiv 0 \pmod{3}$$

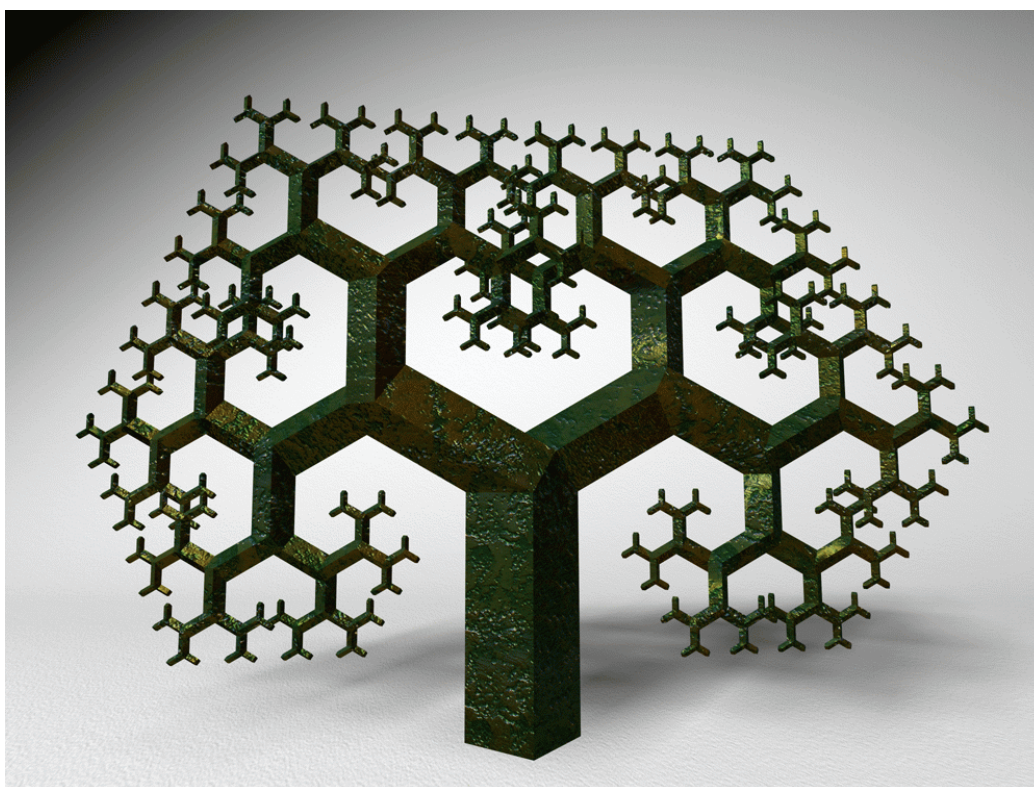
$$(-1)^w - (-1)^y \equiv 1 \pmod{3}.$$

Adding these two equations, we have $2 \times (-1)^w \equiv 1 \pmod{3}$ and therefore $(-1)^w \equiv -1 \pmod{3}$; hence w is odd. Similarly, by subtracting the two equations we see that y must be even.

Suppose $y > 2$. Since w is odd, $5^w \equiv 5 \pmod{8}$, and since $y > 2$ and y is even, $2^y \equiv 0 \pmod{8}$. It follows that $5^w + 2^y \equiv 5 \pmod{8}$. But $3^x \equiv 3 \pmod{8}$ when x is odd and $3^x \equiv 1 \pmod{8}$ when x is even. This contradicts the fact that $5^w + 2^y = 3^x$. Therefore $y = 2$.

Since $5^w - 2^y = 1$, it follows that $5^w - 4 = 1$, and therefore $w = 1$ and hence $z = 2$. From the original equation it then follows that $3^x + 16 = 25$, and therefore $x = 2$.

Thus the only solution is $x = y = z = 2$.



Business, Industry, and Government Special Interest Group of the Mathematical Association of America

Caroline Maher-Boulis, Chair
Vinodh Chellamuthu, Vice Chair for Programs
Gregory Coxson, Vice Chair for Membership
James H Fife, Vice Chair for Services
Aaron B Luttmann, Secretary/Treasurer



from the MAA Website:

BIG SIGMAA serves as a unifying link between business, industry, and government mathematicians, academic mathematicians, and mathematics students. The SIGMAA provides resources and a forum for MAA members who share an interest in mathematics used in business, industry, and government, aids in professional development, helps build partnerships between industry and academics, and increases awareness of opportunities for mathematicians in business, industry, and government.

Time to Say “Goodbye” A Word from James H Fife, Vice Chair for Services

I became Vice Chair for Services in January 2013. I produced my first BIG SIGMAA newsletter the following spring. This newsletter will be my last. I retired from my day job at Educational Testing Service this past May, after nearly 25 years at ETS, and I have decided to retire from the MAA and the BIG SIGMAA after the Joint Mathematics Meetings in January. In the eight years that I have been producing the newsletter, I have enjoyed writing articles about BIG events, soliciting articles from members, finding interesting puzzles, and even sometimes writing limericks and fibs.

(My favorite limerick and my favorite fib from past issues are reprinted in this issue.)

Currently there is no BIG SIGMAA Vice Chair for Services to take office when my current term ends after JMM. Greg Coxson’s term as Vice Chair for Membership also expires at the end of JMM, and there is no one to take that office, either. The main duties of the VC for Services are serve as webmaster for the BIG SIGMAA website and to produce the semiannual newsletter. Both officers also participate in Executive Council meetings

with the other BIG SIGMAA officers and attend the annual BIG SIGMAA business meeting, held each year at the MAA annual meeting. In the past the MAA annual meeting was part of JMM but beginning in 2022 the MAA annual meeting will be in the summer at MathFest. If you are interested in serving the BIG SIGMAA in either capacity, please contact the BIG SIGMAA Chair, Caroline Maher-Boulis

cmaherboulis@leeuniversity.edu

In the meantime, I hope you have a good holiday season and a prosperous new year.

A Message from Caroline Maher-Boulis, BIG SIGMAA Chair

JMM 2021 marks the end of the terms for BIG SIGMAA’s Vice Chair for Services, James Fife, and Vice Chair for Membership, Greg Coxson. These two long-serving officers have been very dedicated to BIG SIGMAA’s purpose and sustenance. We have all enjoyed the guest speakers that were brought to our annual meetings, the periodic newsletters, the JMM Contributed Paper Sessions and the website that has been kept up-to-date. We are very thankful for Greg and Jim and we hope that they enjoy their time outside the responsibilities of BIG SIGMAA. Best wishes to both of them.