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Department of Mathematics, Statistics and Computer Science — 2 December 2011

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This Week's Colloquium

Title: Undercover Symmetry

Speaker: Frank A. Farris-Santa Clara University/Carleton College

Date: Tuesday, December 6th

Time: 1:30pm

Location: RNS 310

About the Talk:

Spend some time with the images shown, which, according to the usual classification, have exactly the same symmetry type. Something seems different about the right-hand image: Why do the yellow/pink bowties seem to have mirror symmetry, which are not symmetries of the pattern as a whole? Why are they set at such strange angles relative to the orientation of the grid of red dots? These strange features led me to discover new types of symmetry in wallpaper patterns, with unexpected connections to such things as eigenvalues of a Laplacian and the length spectra of orbifolds.

REU at Valparaiso University

Do you not have summer plans yet? Would you like to spend your summer researching in mathematics at Valparaiso? VERUM (Valparaiso Experience in Research by Undergraduate Mathematicians) is looking exceptional students who want a research experience that will help them to decide if graduate studies in the mathematical sciences should be part of their future plans. The program is open for *rising sophomores and juniors*, so if you are currently a freshman and want research experience this summer, this would be a great program to apply to. First generation college students, minority students, and women are particularly encouraged to apply. This summer, the research will include: Quandles and Generalized Colorings of Knots, Vertical Transmission in Two-Sex Epidemic Models with Isolation from Reproductions, and Generalized Pattern Avoidance in Trees. For more details about the program and projects, please go to www.valpo.edu/mcs/verum.

Millennium Prize Problems

P = NP

The P versus NP problem is a problem from computer science dealing with quickly solvable (P) and quickly checkable (NP) problems in polynomial time. The problem was created independently by Stephen Cook and Leonid Levin in 1971. In general, P problems are considered "easy" while NP problems are considered “hard”. A problem is solvable in polynomial time if the time it takes to check the problem has an upper bound of a polynomial expression. All basic arithmetic operations are an example of problems that can be solved in polynomial time, so they are considered P. As an example for NP, imagine a lock with 20 numbers that needs an input of 4 numbers to be unlocked. Order matters here, so the number of possible lock combinations is 20!/(20-4)! = 116280. If you could input combinations at a rate of 1 per second, it would take 32.3 hours. However, if I give you the combination, you could check the solution rather quickly. This problem is called NP because it can be easily verified, but it cannot be solved “quickly” in polynomial time. There are also classes of problems called NP-hard and NP-complete. NP-hard problems are at least as hard as the “hardest” problems in NP, and NP-complete problems can be thought of the intersection of the set of NP-hard and NP problems. That is, NP-complete problems can be verified quickly and are as hard as the hardest problems in NP. There are some interesting consequences if this theorem is proven true or falsified. If P = NP, a proof could lead to an efficient method for solving important NP problems and would have consequences in Cryptography and Operations Research. However, if the theorem is falsified, it will have proven that difficult problems may not be solved efficiently, and researchers could instead focus on finding partial solutions. Though, since many computer scientists believe that the theorem does not hold true, they are already operating under the assumption that $P \neq NP$. For more information on this and other Millenium Prize Problems, please visit claymath.org/millennium/

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If you would like to submit an article or math event to be published in the Math Mess, e-mail jacobsoj@stolaf.edu.