Math in motion

It may be a circus act to the rest of us, but for Ronald Graham it's a complex pattern

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D r. Ronald Graham's lecture on general mathematics Thursday became an impromptu lesson in the science of pattern and an art built of patterns. Using well-established mathematical logic and reasoning, he said, it is possible to transform movements like juggling into mathematical formulas. Why? To attempt to discover new and better ways of juggling.

Graham, professor of computer science and engineering at the University of California-San Diego, is thought to be one of the most honored living mathematicians. He is currently the chair of the Irwin and Joan Jacobs Professorship of Computer Science and Engineering at the University of California-San Diego and is chief scientist at the California Institute for Telecommunication and Information Technology. Graham is also a chief scientist emeritus at Bell Labs.

Graham said it is possible to model very complicated movements, aside from two significant restrictions: two balls cannot land in the same hand, but at the same time, movements of the hands, such as throwing overhand or underhand must be completely ignored. The act of juggling is abstracted to the hand that throws the ball and the length of time it spends in the air.

This type of advanced juggling, known as "site swaps," can be quite difficult to learn and to train hands to perform because it often does not conform to natural rhythms, Graham said. After a brief demonstration of the mathematical logic and graphing techniques used, Graham demonstrated how the two rules above could be used to construct juggling sequences with unexpected features. He also showed that the standard "three ball cascade" was a simple feat to perform.

"Anybody can juggle in about 20 minutes," Graham said, "at least a three ball cascade."

Lecture-goers learned the basic techniques of the practice relatively quickly, as Graham circulated through the crowd, showing people fine details of the mathe-
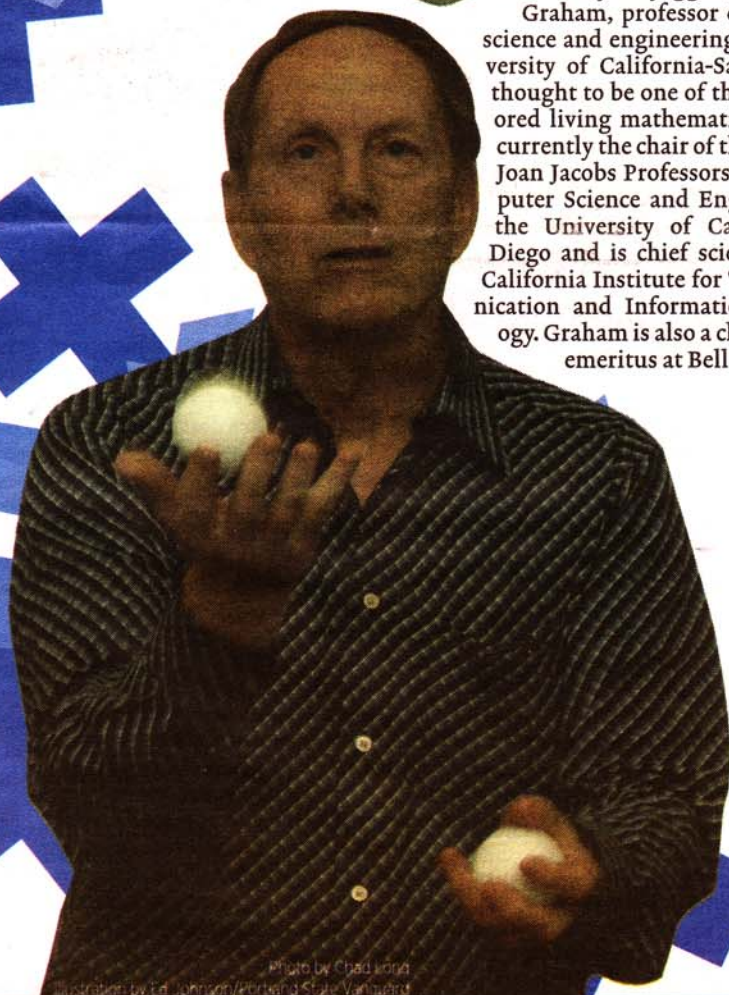
For visiting prof., juggling is a mathematical model

matical theory of juggling.

Graham said that juggling patterns can be seen in anything, as long as a sequence of numbers is found.

"We can show that any sequence of numbers [which meets some conditions] can be arranged in a juggling pattern but the proof isn't easy," he said.

Graham also gave a lecture Wednesday night in Lincoln Hall focusing on the advancements in mathematics that have been made possible, or at least easier, by computers. Dr. Graham cited many examples of computer systems programmed to write mathematical proofs creating output with intelligible results and methods so complicated no human would understand.

Graham also spoke about problems where it is unlikely computers will provide any further assistance. Advanced mathematics requires a creativity and imagination that is not fully understood, much less able to be coded into a computer, he said.

With a focus on real-world applications, such as encryption and stone cutting, Graham spoke on a set of 23 problems proposed by mathematician David Hilbert in 1900, with the intention of setting up a kind of mathematical "to do" list for the next 100 years. Many of the 23 problems remain unsolved today.

While discussing problems solved with the assistance of computers, Graham explained that one can see that they have large computational components. It has become very easy for computers to check to see if a specific number is prime, for example. Other unanswered problems will either be shown to have no answer or require a complete shift in thought.

Graham is one of the most published mathematicians alive, often sharing authorship with his wife, Fan Chung, Akamai Professor in Internet Mathematics at UC San Diego. He has also been described as breaking the standard mathematician mold for serving as president of the International Juggler's Association, he has appeared on stage with Cirque de Soleil and he is also a widely recognized trampolinist.

Graham said his favorite reason for choosing a life in mathematics was more than what he does on a daily basis in the classroom: "Being able to lie down, close your eyes and still say you are working."
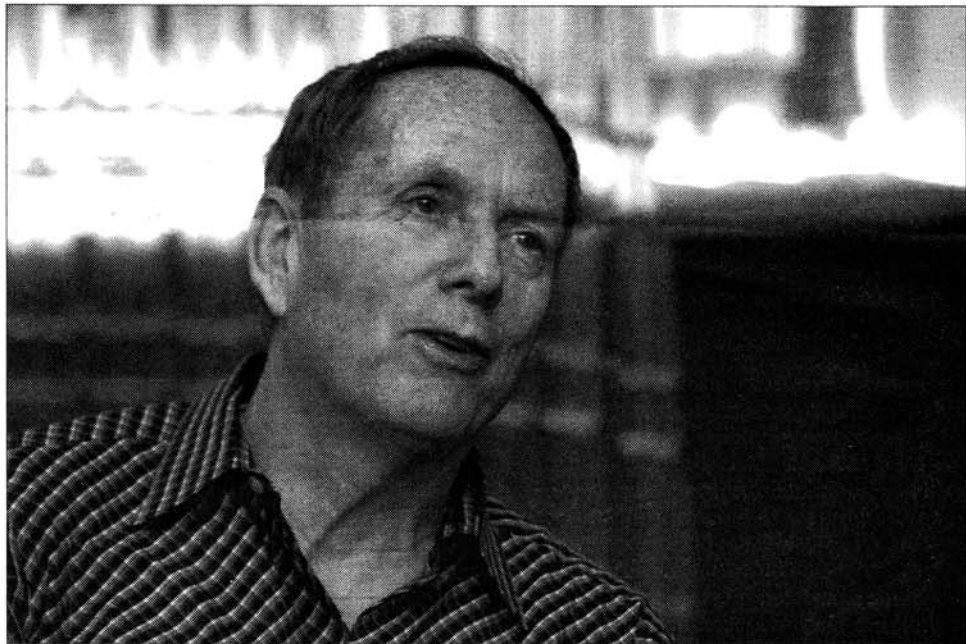
Chad Long/Portland State Vanguard

Prolific: Dr. Ronald Graham is one of the most published mathematicians alive.