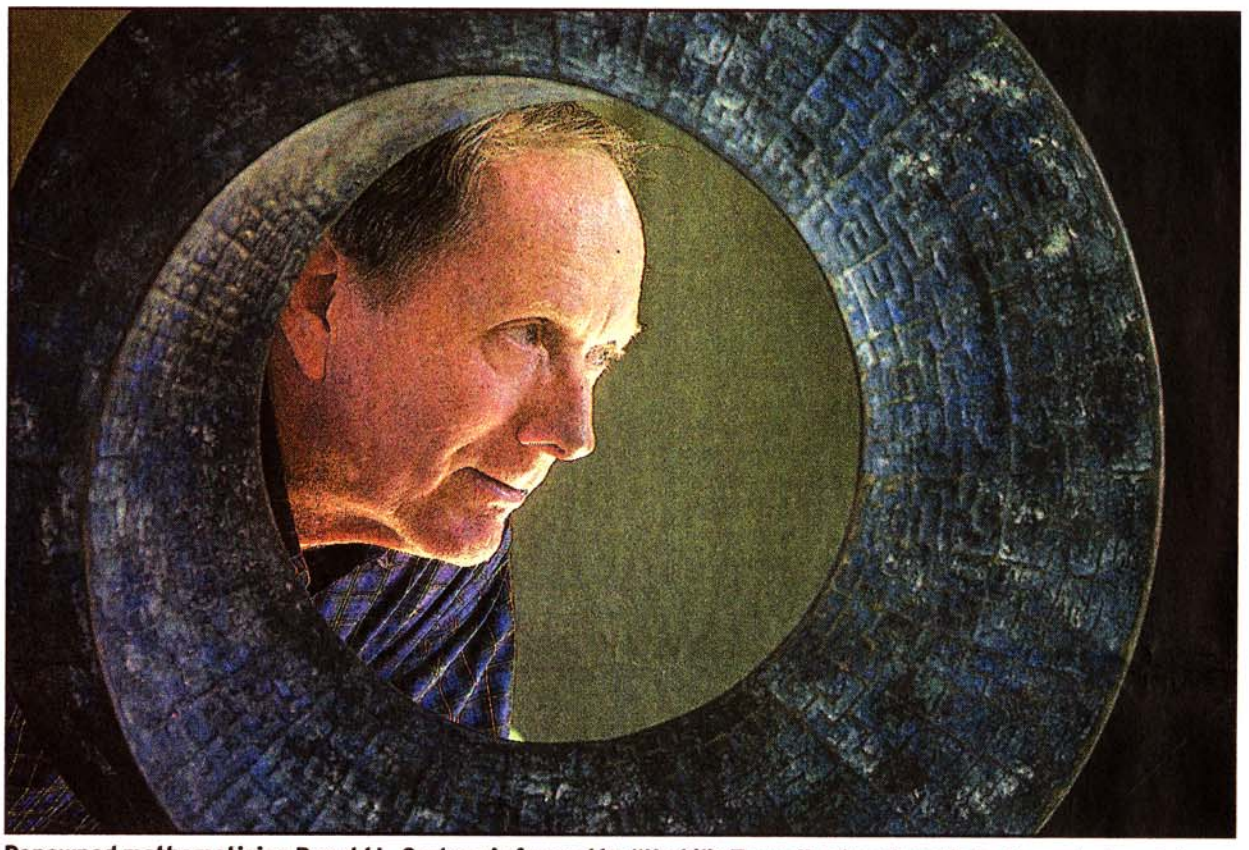

Renowned mathematician Ronald L. Graham is framed by "Umbilic Torus," artwork made by the noted sculptor and mathematician Helaman Ferguson. *Dan Trevan / Union-Tribune*

You can count on him

Math expert coolly juggles scientific puzzles and six or seven balls

By Bruce V. Bigelow,
STAFF WRITER

For Ron Graham, life is a balancing act.

After a 37-year career at Bell Labs in New Jersey, Graham joined the University of California San Diego in 1999 as the Jacobs-endowed Professor of Computer and Information Science.

Aside from teaching and publishing research (about 300 academic papers and five books so far), Graham carries a top-heavy load of other professional commitments.

He is the chief scientist at Cal-(IT)², the vaunted California Institute for Telecommunications and Information Technology established at UCSD and UC Irvine. He is the treasurer of the National Academy of Sciences, president of the Mathematical Association of America and he sits on the editorial boards of more than 40 mathematics and computer science journals.

As chief scientist at Cal-(IT)², Graham oversees research into optical computing and next-generation networking technologies — work that is followed closely by Ericsson, Broadcom, SAIC and other telecommunications giants. With his extensive industry contacts, Graham also has been helpful rounding up corporate support for the new center for network engineering that Cal-(IT)² hopes to announce this year.

It can all be a bit unwieldy at times.

Graham often fields calls on his cell phone as he walks across campus and responds to e-mails

SEE **Graham, E5**

Ronald L. Graham

Age: 67.

Birthplace: Taft, Calif.

Education: Ph.D. in Mathematics, 1962, University of California Berkeley.

Family: Married to Fan Chung Graham, also a renowned mathematician. Has two children from a previous marriage, daughter Che, and son Marc.

Personal: Graham learned to speak Mandarin so well that he can pass himself off as Chinese in telephone conversations. A 1979 paper by Graham described the concept of an "Erdos number," showing how closely a mathematician was tied to the Hungarian genius Paul Erdos. Graham's concept was later popularized by a game, "Six Degrees of Kevin Bacon," that tests players' ability to tie any actor to the star of "Diner," "A Few Good Men" and "Hollow Man."

Graham has received numerous awards for his research in mathematics, including this mention in Ripley's Believe it or Not. Graham also has an entry in the Guinness Book of Records for the largest number ever used in a mathematical proof. The number — so long that it can't be written out — is known today as "Graham's number."

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He focuses on applying math in new ways

with a wireless hand-held device. Yet the tall sandy-haired professor remains unflappable, even serene, amid the cacophony of demands that he juggles each day.

He is fond of saying, "Juggling is a metaphor." Yet, as an expert juggler and erstwhile magician, Graham also takes his juggling literally.

He can juggle six balls consistently, sometimes seven. The world record is 12, although that was for only a dozen catches. Only an elite group of jugglers has mastered nine.

Juggling, at any rate, is an important part of Graham's identity.

He was quick to mention in a recent interview that he is a past president of the International Juggling Association, though that was years ago. The renowned mathematician and computer scientist also is known for his acrobatic feats, which include a triple-back somersault on trampoline and one-handed handstand on a swiveling pedestal.

"Juggling is sometimes called the art of controlling patterns, controlling patterns in time and space," Graham said. "Math is sometimes called the science of patterns."

Understanding patterns has been helpful in his career as a mathematician and computer technology visionary.

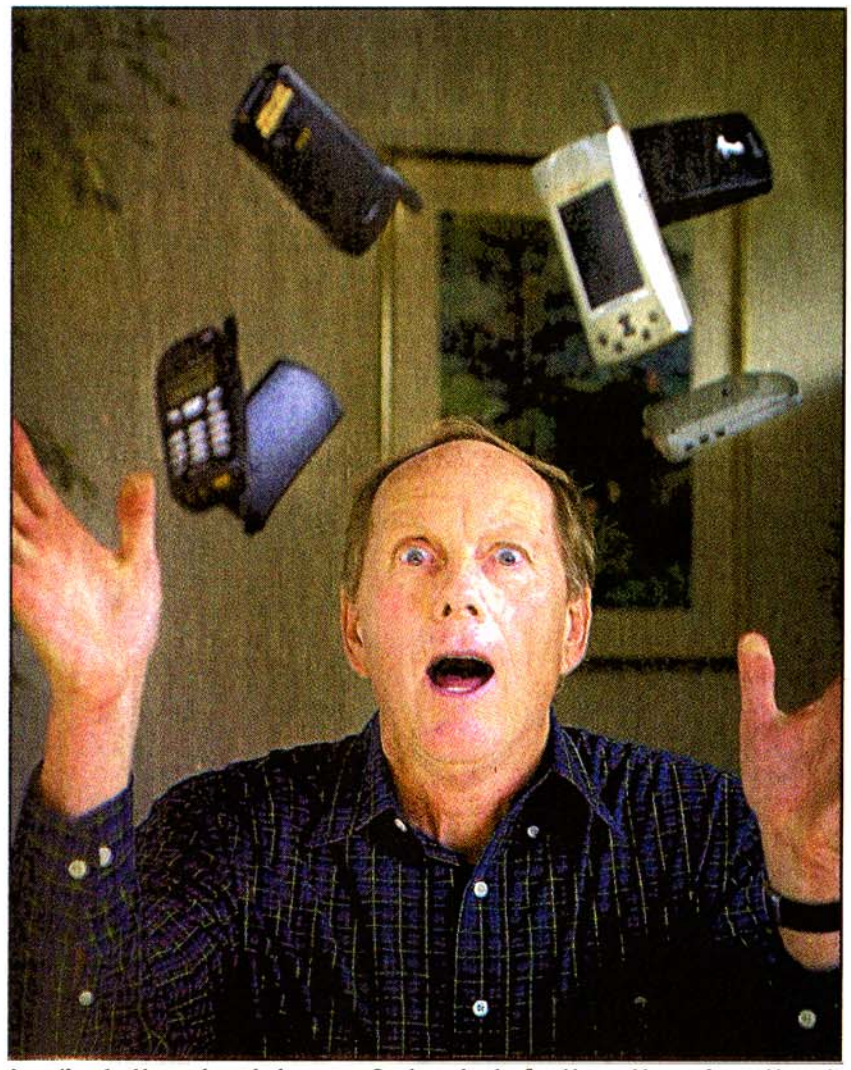
Much of his work has focused on applying mathematics in new ways to optimize communications networks. The scope of his career has spanned the days of analog telephony, when voice signals were sent over wires, to the digital age, with ordinary calls and data both transmitted as bits across packet-switched networks.

"At AT&T, we looked at questions like how do you route long-distance calls to take advantage of the fact that there are different time zones in different parts of the country," Graham recalled. "If it's 9 a.m. in New York City and 6 a.m. in Los Angeles, it might be easier to route long-distance calls from New York to Washington, D.C., through L.A."

Today, Graham added, "There are a lot of mathematical questions that come up when you're driving around, and you're leaving one cell site and connecting to another."

The field of discrete mathematics, which has evolved to address a host of problems in networking, is also used now to design the microcircuitry for components on VLSI (very large scale integration) computer chips, Graham said. It has even been applied to create 3-dimensional designs of shafts and tunnels in complex mining operations and in designing the complex network of heating and air-conditioning ducts in high-rise buildings.

In January, the American Mathematical Society cited Graham's work in discrete mathematics when it awarded him the 2003 Steele Prize for Lifetime Achievement. Graham has also received the Polya Prize, Euler medal and other awards for his work in combinatorics, number theory, graph theory, algorithms and combinatorial geometry.



Juggling both work and pleasure, Graham looks for the patterns in math and other endeavors to maintain a sense of balance. In this case, however, he was merely tossing cell phones and digital devices into the air. The varying weight and center of gravity for each device made it too difficult to juggle.
Dan Trevan / Union-Tribune

Graham's accomplishments have been extraordinary, perhaps even more so because his origins are so humble.

He was born in Taft, Calif., southwest of Bakersfield, where his father worked in the oil fields. The family moved frequently between California and Georgia as his father switched jobs, often working in shipyards. Eventually Graham's father joined the Merchant Marine, and he and Graham's mother divorced.

"In spite of everything, nothing can hide (Ron's) brilliance," said Fan Chung Graham, his second wife.

Fan, a frequent collaborator and renowned mathematician in her own right, said: "Many people who meet Ron for the first time guess he's from some big high society or something because he's so good at dealing with people."

Yet neither of his parents finished college, Fan said, and they couldn't help him much financially. He often took jobs delivering newspapers.

Although this young Ron Graham never stayed longer than two years at any school, his aptitude for math and science was obvious. He enrolled at the University of Chicago at age 15, the beneficiary of a Ford Foundation scholarship for gifted youth.

At Chicago, he also enrolled in a school program called Acrotheater, which ignited his lifelong passion for gymnastics, juggling and trampolining.

In 1955, Graham transferred to UC Berkeley, where he majored in electrical engineering. After a year at Cal, Graham was eligible for the draft so he enlisted in the Air Force and was sent to Alaska. He finally got his undergraduate degree in physics at the University of Alaska in Fairbanks.

Graham returned to Berkeley for his doctorate in mathematics, working his way through graduate school by performing with the "Bouncing Bears," a circus troupe's trampoline act.

Today Graham still relishes the balance and interplay between his mental interests and physical prowess.

"A lot of the high-level sports are really in your mind," he said.

That might sound like a sports cliche coming from anyone else, but it acquires a deeper meaning coming from him.

When Graham learned to bowl, for example, he soon rolled a couple of perfect games. He took up Ping-Pong and was crowned the champion of Bell Labs. He also became a better-than-average tennis player and is now a "bogey" golfer who's happy to break 90.

At Bell Labs, where other scientists walked the hallways in a collegial quest for hard problems to tackle, Graham went upside-down, walking on his hands.

"Mathematicians are not usually celebrated for their physical coordination, 'Good Will Hunting' notwithstanding," said Robert Calderbank, a longtime colleague who is now vice president of research at AT&T Labs, successor to Bell Labs. "Ron is exceptional in that regard."

It is worth interjecting at this point that Graham is still juggling — both literally and metaphorically — at 67, an age when many people would be happy to recline into elder statesman status.

That is not Graham's way, however.

"Ron is a unique character, to say the least," said UCSD Chancellor Robert C. Dynes, who recruited Graham to San Diego after working with him in the 1980s when Dynes was Bell Labs' director of chemical physics research.

When a problem looks especially daunting, Graham is fond of saying, "Well, as you know, there are 24 hours in every day. And if that's not enough, you've always got the nights!"

AT&T's Calderbank said Graham's solution to solving complex math problems is similar to the way he mastered juggling and many other endeavors.

"He works at it systematically," Calderbank said. In juggling, for example, "he takes a maneuver and breaks it down into component parts and practices each component until he masters it. Then he reassembles each part and works at that until he can accomplish the whole maneuver."

When Graham began at Bell Labs in the early 1960s, "the partial differential equation was the important thing," Calderbank said. "Today, it's the representation of that equation in the computer that's important. Ron really led that transformation."

It sounds esoteric, but Graham faced some practical problems at the time.

For example, AT&T was required to set tariffs for "private lines" (which typically connected one corporation's various operations) on the most efficient route possible instead of the route that was most convenient to the phone company.

Such problems are variations of mathematics' infamous "traveling salesman problem," which seeks to find the most-efficient route through 50 cities. The possible combinations are astronomical.

Graham found inspiration in a quiet, 70-year-old corner of pure mathematics known as "Ramsey theory" that has to do with identifying unexpected patterns in apparently random mathematical situations.

For example, if someone arranges the numbers 1 through 101 in any random order, Ramsey theory guarantees there will always be at least 11 numbers in an order of some kind, either increasing or decreasing.

Ramsey theory desn't necessarily provide a single solution to complex networking problems. Yet it can provide a solution that falls within the optimal range of possible answers.

Using Ramsey theory to solve networking problems is not something Graham has been doing much lately.

Still, he says there are more than enough important math problems to go around. The hard part these days is deciding which problems are the best ones to work on.

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