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Math whiz stamps profound imprint on computing world

Face of Business

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Cleve Moler, 69, says math always came naturally to him.

As a boy growing up in Salt Lake City, Moler delighted in seeking prime factors in street addresses and license plate numbers.

At 11, he won a local grocery store contest by calculating the length of kite string that store owners had stretched around the ceiling.

"I figured it out by counting the ceiling tiles and then computing the square roots of right triangles made by the string," Moler says. "I put entries for the whole family in the competition jar and won prizes for everybody. My mother was very embarrassed."

Today, Moler is known internationally as one of the founding fathers of numerical analysis and scientific computing whose imprint can be found in almost every field where computers help calculate mathematical problems.

The "Matrix Laboratory," or MatLab software that Moler created, is now used by more than a million engineers, scientists and academics worldwide, says Jack Little, president of **The MathWorks Inc.** — a Massachusetts company that Little and Moler launched in 1984 to sell MatLab.

"It's hard to overestimate his impact on the world," Little says. "Almost any computer calculations associated with matrices are done on the basis of what Cleve helped create. It's so widely used now that the car you drive in or the cell phone you talk on were likely designed by engineers who have done computations based on programs Cleve created."

Rob Schreiber, assistant director of the Hewlett Packard research lab in Palo Alto, Calif., says MatLab has greatly accelerated scientific discoveries and achievements.

"MatLab is revolutionary because it's made computational experiments 10 times easier than the programs that came before it," Schreiber says. "It's raised the productivity of researchers and software developers in practically every technical field."

Despite his achievements, Moler remains strikingly humble, retaining the demeanor of a dedicated math professor just solving some problems and providing a few modern tools to make learning easier.

Moler worked as a math and computer science professor for 20 years before entering the private sector, including a 13-year stint at the University of New Mexico.

"He created a product that virtually every engineer in the world uses, and yet he remains remarkably unchanged from when I first met him decades ago," says Ed Angel, director of the Art Research and Technology Laboratory at UNM. "He absolutely loves to talk to people about numerical analysis and he particularly enjoys meeting students and answering their questions."

As an undergraduate student in the 1950s, Moler first considered journalism before choosing a career in math. Both his parents were journalists, which influenced him.

He worked as a cameraman at a television station in Utah while in high school, and then joined the student newspaper at the California Institute of Technology.

However, a science writer for Fortune magazine advised Moler to study math and science and leave career decisions for later. He followed that advice and ended up becoming a math professor.

He earned a bachelor's degree from CalTech in 1961, and a doctorate in mathematics from **Stanford University** in 1965.

During his years at Stanford, the university created its first computer science department, allowing Moler to study numerical analysis and scientific computing under some of the early pioneers in those fields.

Following graduation, he received a one-year fellowship to research computer mathematics at the Swiss Federal Institute of Technology in Zurich. After that, he returned to the U.S. to teach math at the **University of Michigan**.

From his earliest days as a professor, Moler labored to develop mathematical software that would allow his students to work on computers.

"I created software for students to do simple calculations on Michigan's central mainframe computer," Moler says. "That software eventually evolved into MatLab. The first inklings of the program started there."

He also helped **Argonne National Laboratory** create public domain software to do computer analyses with matrices — arrays of numbers used in most engineering and scientific calculations.

That work led to the development of LINPACK and EISPACK software, which became widely used in industry, academia and government laboratories.

"Those programs became the de facto standards worldwide for doing computations with matrices," Moler says.

UNM recruited Moler in 1972. He taught math there for eight years, and from 1980-1985, he served as chair of UNM's computer science department.

During those years, he continued to develop software to allow his students to easily do matrix calculations on the university's mainframe computer. He eventually dubbed his software MatLab and incorporated it into all his classes, including a course he taught at Stanford while on sabbatical in 1979.

During his stint at Stanford, however, some of the engineering students began using MatLab for advanced matrix-based calculations to facilitate work on things such as auto-lock brakes and auto-pilot devices.

"They saw much bigger and more important applications for MatLab than just teaching math," Moler says. "It caught on, and a couple of companies started using it to develop commercial products for automobiles and planes."

Jack Little — then an electrical engineer at one of the companies using MatLab — saw the potential to commercialize the software.

In 1984, Little proposed forming The MathWorks with Moler.

"We formed a partnership to combine my math base with Little's engineering applications," Moler says. "Personal computers had just come out and Little anticipated eventual use of PCs in technical computing, so we evolved from campus time-sharing mainframes to the PC market."

Moler left academia in 1985. He did consulting for MathWorks while simultaneously working as chief mathematician at Intel Hypercube in Oregon. He later worked for Ardent Computer in California — a venture capital-backed startup that failed in 1989.

"By that time, MathWorks was five years old, so I went to work for my own company," Moler says.

As chief scientist, Moler continues to improve MatLab and create new products, such as simulation software called Simulink.

MathWorks has become a \$400 million company with 2,000 employees worldwide. The MatLab software is now used by engineers and scientists in virtually every technical field, and by math professors in hundreds of universities.

"It's a wonderful tool, not just for scientists and engineers, but to teach programming," says Stephanie Forrest, chair of UNM's Computer Science Department. "Two of our classes are currently based on the MatLab software."

After 14 years working at MathWorks headquarters in Massachusetts, Moler returned to New Mexico with his wife. He now works from his home office in Santa Fe, does frequent speaking tours as the company's scientific spokesman, and writes books on numerical analysis and scientific computing.

He was elected in 1997 to the prestigious National Academy of Engineering, and he currently serves as president of the Society for Industrial and Applied Mathematics.

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