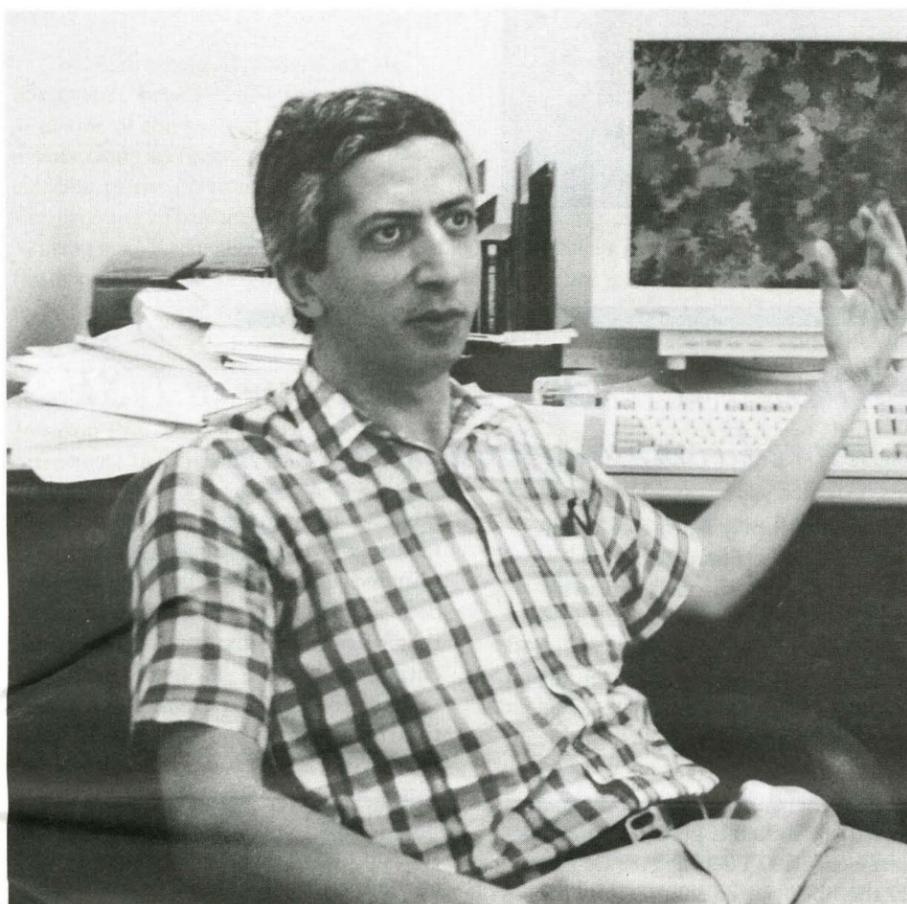


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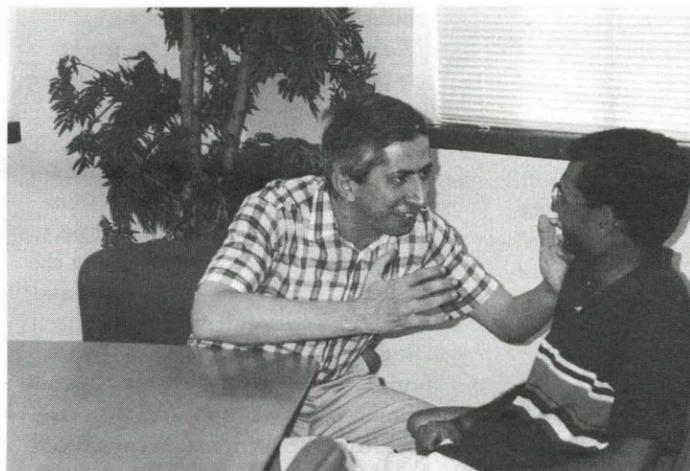
## *Gifted Teacher builds on the basics*

By Rebecca Rothenberg

**Yaser Abu-Mostafa, PhD '83, professor of electrical engineering and computer science, is a fundamentally reserved man who comes alive when teaching. (Here, his attentive audience is grad student Malik Magdon-Ismail.) He's won every major teaching award at Caltech.**

Let's say you've never seen snow in your life, you don't like the cold, and you're scared of heights—and one day someone drops you into three feet of powder at the top of a steep slope, straps skis to your feet, and gives you a nudge. You teeter, you flail in terror for a few yards—and then find to your delighted surprise that you can do it! You have the balance, reflexes, and nerve of a first-class skier. Who knew? When you arrive exhilarated at the bottom of the slope, the ski instructor rushes up and congratulates you on your performance.

This is the kind of story Yaser Abu-Mostafa, PhD '83, professor of electrical engineering and computer science and director of Caltech's Learning Systems Group, might use to describe his success as a teacher. Abu-Mostafa, whose areas of expertise are information theory, computational complexity, neural nets, and, appropriately, learning theory, has won nearly every teaching award at Caltech, a record that culminated in the third annual Feynman Teaching Prize in 1996. (The Feynman Prize, established by an endowment from Caltech Associates Ione and Robert E. Paradise, is awarded to a Caltech professor for "exceptional ability, creativity, and innovation in both laboratory and classroom instruction.") Prior to that he received the ASCIT Teaching



Excellence Award in 1986, '89, and '91; the Keck Foundation Teaching Award in '94, and the Caltech Graduate Student Council Teaching Award in 1995.

Clearly the man was born to teach; according to one student's evaluation, he has "the God-given ability to teach better than anyone I've ever known in my life." And yet this talent came as a "complete surprise" says Abu-Mostafa from behind the desk of his spacious pastel office in the brand-new Moore Laboratory. It was all the more unexpected since, like our hypothetical acrophobic skier, he might be assumed to have one strike against him as a teacher: he is quite shy. He's nervous about meeting new people, he notes, and "really very nervous" when he meets many new people all at once—say, 100 bright, restless Caltech students staring up at him expectantly from the lecture hall.

Abu-Mostafa received his B.Sc. in

1979 from Cairo University and his MS in electrical engineering from Georgia Tech in 1981. But it was at Caltech that he addressed an audience for the first time: in 1983 he presented a talk related to his doctoral research. Although he was "a nervous wreck," the talk, he says, "went quite well." (Quite well indeed, evidently, since he was awarded the Clauser Doctoral Prize for that year's most original doctoral thesis at Caltech.)

That same year he joined the Caltech faculty; ready or not, he was a teacher, about to be nudged down that steep slope. At this point his father, an aeronautical engineer and a fan of von Kármán's work—hence Yaser's original interest in attending Caltech—gave him "a very interesting piece of advice," one he would recommend to all aspiring teachers. "Just be yourself," his father told him. "If it works out, then it's great and effortless. If it doesn't work out, then you need to do something else. But at least explore the possibility that everything will go well."

And "being himself" has meant, for Abu-Mostafa, capitalizing on his own habits of mind. "I always like to understand things from first principles," he

says. "For me, understanding is black and white. When I see a new subject I am at a loss . . . I am at a loss . . . I am at a loss . . . and then I understand it very, very well indeed. There is very little in between for me." By the time he has prepared for a class, he says, his mastery of the material is so thorough that each lecture is a little story, a "focused performance with a clear goal," as former student Jack Lutz, PhD '87, describes it. The narrative is essentially memorized, since consulting notes disrupts his concentration and the flow of his story. (Because of this he prefers one-hour classes to longer sessions, an hour representing about the limit of what he can commit to memory.)

Lutz also calls Abu-Mostafa a dynamic and "very motivating speaker," both in class and in outside speeches. "Afterwards," Lutz says, "people are ready to sign on the dotted line." And Amir Atiya, PhD '91, who describes Abu-Mostafa as "a great teacher," also recalls his former adviser's ability to motivate and encourage his students.

Since Abu-Mostafa studies and teaches how computers learn, and is himself an outstanding teacher, is there a connection? Have his research and his teaching experiences influenced each other? There's an uncharacteristic pause as he considers the question. "I'm thinking about it in real time," he says apologetically, then continues fluently. "There is a connection: a general principle that in machine learning and in science in general, the simplest theory is the most plausible theory. If I can find a theory that explains what happens and someone else has a simpler theory that also explains, he wins. So

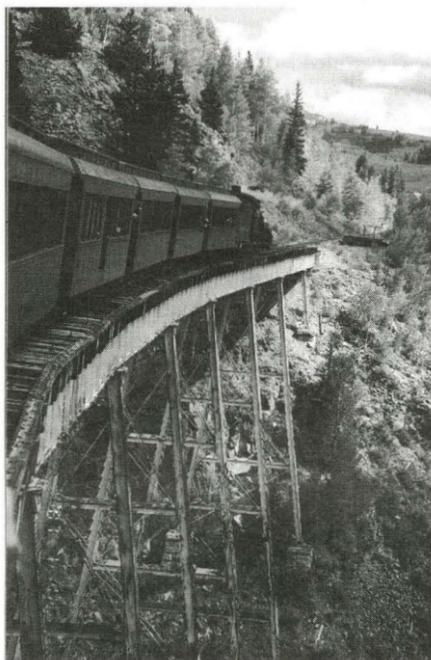
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## Join Alumni Association for grande tour

The Alumni Association invites you to participate this fall in *Rio Grande del Norte: Geology and Culture of the Rio Grande*, a travel/study program that follows the geology of the upper Rio Grande as it courses through Colorado and northern New Mexico. Led by Lee Silver, PhD '55, the W.M. Keck Foundation Professor for Resource Geology, Emeritus, the trip is scheduled for September 26–October 5, 1997.

Starting in New Mexico, Dr. Silver and the participants will explore the beautiful high country (7,000–12,000 foot elevations), valleys, volcanoes, and other major structures that define the Rio Grande rift, and will follow the river to its source. The program will begin and end in Santa Fe, with stops in Española, Chama, Creede, and Taos, and opportunities to visit Native American pueblos and Hispanic villages and churches, as well as some of artist Georgia O'Keeffe's favorite countryside. The spectacular Cumbres and Toltec Scenic Narrow-gauge Railway line from Chama, New Mexico, to Antonito, Colorado, will be explored for a day.

Early fall is a time of major waterfowl migration along the Rio Grande flyway, and we will travel through two major wildlife refuges, where we hope to catch glimpses of flocks of sandhill cranes and their rare traveling companions, whooping cranes. Professor Silver has selected some of his favorite dining spots for evenings in Santa Fe and Taos. Accommodations will range from rustic to deluxe and will be characteristic of the locales. The pleasant September weather and beautiful fall colors for which New Mexico and Colorado are known should make this trip particularly enjoyable.



**The highflying Cumbres and Toltec Railway will be a highlight of the Association's September trip to Colorado and New Mexico.**

The price per person of \$1800 double occupancy and \$2350 single occupancy includes all accommodations, transportation, and meals while with the group. The cost of transportation to and from Santa Fe is not included.

To take advantage of this special opportunity to explore the rich and varied geology, history, and topography along the Rio Grande, complete and return the form below. Detailed information will be sent to you upon receipt of your reservation with deposit. Space is limited to 40 participants, and **priority will be given to Alumni Association members who register by June 1, 1997.** If you have questions, please call Arlana Bostrom at 818/395-8363.

*Caltech Alumni Association Travel/Study Program  
Rio Grande del Norte: Geology and Culture of the Rio Grande  
September 26–October 5, 1997*

If we wish to participate in the *Rio Grande del Norte: Geology and Culture of the Rio Grande* Travel/Study program in New Mexico and Colorado for 1997. Enclosed is my deposit of \_\_\_\_\_ (\$200.00 per person), representing \_\_\_\_\_ participants.

Name: \_\_\_\_\_ Class year: \_\_\_\_\_

Spouse/guest(s): \_\_\_\_\_

Home address: \_\_\_\_\_

Daytime phone: \_\_\_\_\_

\_\_\_\_ I'm traveling alone and interested in sharing a room with another participant.  
 Smoking  Non-Smoking

\_\_\_\_ Please reserve a single room (subject to availability).

Please make check payable to the Caltech Alumni Association and return by June 1 to: Rio Grande del Norte, Caltech Alumni Association, Mail Code 1-97, Pasadena, CA 91125

## Gifted teacher

*Continued from page 1*

what I teach in the course is that if you have two models, you pick the smaller."

And, by extension, in his teaching he tries to find "the simplest way that actually captures the material." Sometimes what not to include is more important than what to include, he says, "because too much material distracts people. If you say ten things, the audience will give one-tenth of their attention to each thing you said, and if five of them don't matter, then you've wasted half of their concentration." People listen to you, he adds, when they know that what they are listening to matters. "In the first couple of lectures you say only things that are important . . . and the chemistry of the class changes. People listen to you."

Former student Ruth Sivilotti, PhD '91, agrees that one of the hallmarks of a lecture by Abu-Mostafa is its lack of clutter, its "clarity and brevity. Yaser



**"The one unbreakable appointment." That's how Abu-Mostafa describes the teaching experience. Another appointment he kept was for the dinner honoring his 1996 Feynman Teaching Award. Here Associate Ione Paradise (who, with husband Robert Paradise established the prize at Caltech) seems as rapt as one of Abu-Mostafa's EE 156 students.**

always tries to make things as clear as possible," she says. "He doesn't try to get in everything there is. You walk away from his class thinking, 'Wow! I learned something!' With some instructors who pack in everything, you feel trampled on." To maintain this clarity and focus, both for himself and his class, Abu-Mostafa employs a trick he learned from one of his own teachers at Caltech, the late Herb Ryser, professor of mathematics. Before class begins, he writes on the board the highlights of the previous class, and begins his lecture with a short review. Sivilotti remembers these "roadmaps," as she calls them, saying they "gave students something to think about" while they were waiting for class to start, and former student Lutz, now a professor of computer science at Iowa State, comments

that he's incorporated this technique into his own teaching. "I always try to begin each class with a clear summary," he says.

So Abu-Mostafa's thorough, orderly thought processes, along with a proclivity to approach subjects from a basic, almost childlike level—to ask the question, "Why are we studying this and not something else?", for example—all serve him well as a teacher. So does his voice, which can race along at breathtaking speed without sacrificing clarity of enunciation. But so, oddly enough, does his one apparent liability, his shyness. Like other performers, he's found that stage-fright raises the emotional stakes. "This is why I make the effort to perfect my teaching," he says, "because I know that if I do it badly I'll feel terrible." So that while teaching is on average extremely rewarding for him, "the fluctuations," he observes, "can be too much for me." He wishes he could average his performance, he says, and "leave every class with a small smile instead of euphoria or misery."

It's particularly stressful to teach a new class, such as Learning Systems, which he taught for the first time this semester. (He has also taught Introduction to Linear Systems, and Information and Complexity; and Information Theory and Pattern Recognition jointly with other people.) And yet the new courses are the most exciting; by the time he has taught something several times he is relatively at ease, but bored. For someone of Abu-Mostafa's temperament, teaching may always be something of a "love-hate" relationship.

What is the greatest honor he has received as a teacher? The Keck Award? The Feynman Prize? The glowing student evaluations? Actually, says Abu-Mostafa, it's an experience he had while he was teaching an undergraduate course early in his Caltech career. And undergraduates—"Let's put it this way," he says delicately, "they don't often go to class." He covered the course material in the first nine weeks, and then told them, "This is the last homework, everything has already been covered." What he was going to do during the tenth week was to cover an altogether different subject—stochastic processes—because he felt that everyone needed to understand the fundamentals of that field, and that he could bring a fresh approach to teaching it. But it would not be on the final exam.

The result? "The last week was a full house," he says, and smiles. "Very complimentary."