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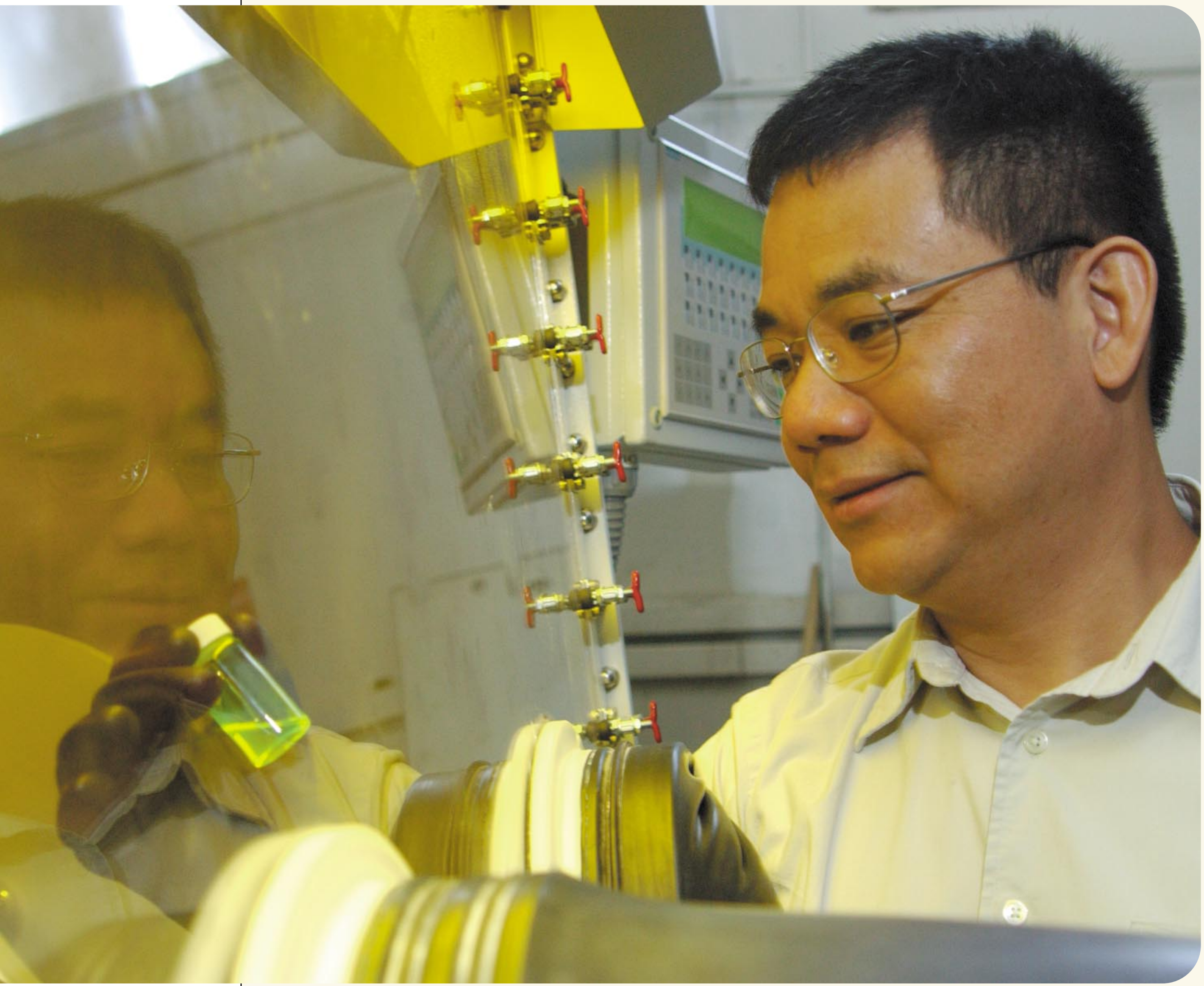

Going Organic

Building Next Generation Electronic Devices

Alternative Transportation
UCLA Partners on Hydrogen Fueling Station

Technology in the Classroom
Automated Testing Tools for Teachers

Novel Energy Source for BioNano Devices
Proton Pump Encapsulated in Sol Gel

LETTER FROM THE DEAN

As we welcome another class of incoming students, we reflect again on our responsibilities as educators and our larger responsibilities as engineers and scientists.

At UCLA, we have a compact with our graduates to ensure they are not only well prepared for their careers as engineers, but also as communicators, managers and as ethical members of society. In our fast-moving world, companies are looking for employees who are adaptable and comfortable operating outside their primary area of expertise. Our graduates, among the best and brightest in the world, are California's most valuable intellectual capital and the scientific leaders of tomorrow.

The work of engineers and computer scientists touch every aspect of our lives, in ways many of us never consciously notice. In this issue of *UCLA Engineer* you will read about the impact of our research on education; alternative, cleaner transportation solutions; and faster, more flexible organic memory devices.

You will also read about computer science professor Judea Pearl's seminal research on probability and causality, which has had a tremendous impact on many fields outside of engineering. From economics to philosophy to medicine his work has literally transformed the way people in these disciplines think about their world and their work.

We also have an obligation to our society. Earlier this year, the School hosted 25 high school computer science teachers for a weeklong seminar as part of the UCLA/LAUSD Advanced Placement Computer Institute. These teachers, as they return to the classroom this fall, will create advanced placement courses at their respective schools and they will reach hundreds of students, inspiring them to consider careers in technology.

Over the summer, a group of students from UCLA's chapter of Engineers Without Borders traveled to Thailand where they helped build a health clinic in a remote hillside village. They worked long days to provide the village and surrounding communities with a ten-room health clinic, the first of its kind in the area.

The university is a vital part of California's success, and I know our alumni and friends share our steadfast commitment to our mission of education, research and service. To fully meet our responsibilities, though, we must strengthen and form new partnerships to connect our School with our world.

Sincerely,

Vijay K. Dhir
Dean

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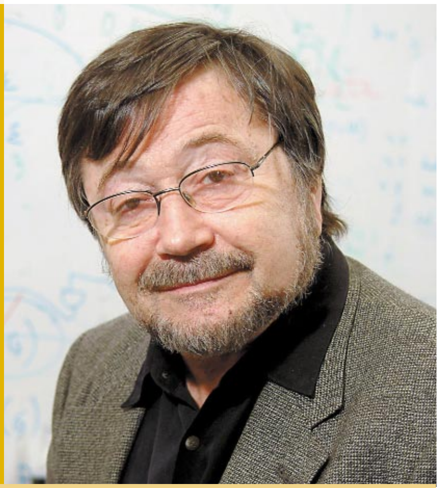
A Profile of Judea Pearl – Computer Science Pioneer, Visionary

By Marlys Amundson



Professor Judea Pearl

A friendly, unassuming man, computer science professor Judea Pearl seems more willing to talk about his special coffee than his seminal contributions to artificial intelligence and computer science. And yet his research not only revolutionized artificial intelligence, but has also had an enormous impact on many areas outside of computer science.

"Judea Pearl is one of the giants in the field of artificial intelligence," commented UCLA computer science professor Richard Korf. "He's not one of the founders, but his contributions to the field are on par with theirs."

The influence of Pearl's research extends well beyond computer science, which is relatively rare in this age of specialization. His theories have fundamentally changed the way experts in disciplines as diverse as philosophy, medicine, statistics, epidemiology and psychology think about their work.

"Judea Pearl is one of the most remarkable people we have in the School," said Milos Ercegovac, chair of the computer science department. "He is widely known for his pioneering scientific contributions to the field of artificial intelligence in the areas of probabilistic and causal reasoning."

Since the early days of the field, researchers in artificial intelligence have used classical logic as a foundation for commonsense reasoning – as a way to teach computers to think the way humans do. The use of classical logic, however, has encountered some key difficulties, and there was a major wave of attempts in the early 1980s to address them by providing more refined logical formalisms, such as non-monotonic logic. Pearl, on the other hand, took a different approach where he proposed probability as a foundation for commonsense reasoning, and established a workable framework.

"The research, which was conducted over a period of several years at UCLA, caught everyone by surprise," explained computer science professor Adnan Darwiche. "The theories and methods laid out by Judea Pearl spread rapidly through the community, and his formalization of commonsense reasoning has become the basis for modern courses on the subject."

Pearl helped shape the theory and practice of knowledge-based systems, and his book, Probabilistic Reasoning in Intelligent Systems, published in 1988, remains one of the most influential in the field. His theoretical framework and algorithms based on probability theory are the basis for models that account for uncertainty in real-world systems.

His early work on search algorithms advanced the field through his rigorous analysis of the power behind heuristic knowledge and problem-solving strategies. Pearl's research in this area and reputation were a major factor in Korf's decision to join the faculty at UCLA.

"The computer science department has been fortunate to have Judea as a long-time member. Everyone who interacts with him feels privileged to have him around," noted Ercegovac. "He's made it possible for artificial intelligence to truly flourish at UCLA."

More recently, Pearl has turned his interest to causality – an area many viewed as controversial and non-scientific. Pearl has demonstrated that causality can be mathematically defined and applied to many areas of research. The mathematical methods developed by Pearl also allow scientists to prove that certain desired conclusions cannot be derived from the available data and assumptions – similar to solving two equations with three unknowns.

"Causality is primarily useful in areas where you contemplate change – areas such as statistics, medicine, economics or law," explained Pearl. "In probability there are good mathematical notations to calculate the consequences of seeing. From causality come solid, mathematical models to calculate the consequences of doing."

Pearl speaks teasingly of statisticians' unwillingness to accept causality as a valid system, but it has proven useful to experts in many related disciplines that rely on statistical models. In just the last six months, Pearl's book Causality: Models, Reasoning and Inference was cited more than 300 times by other researchers.

"Judea is extremely intuitive," Darwiche said. "I learned from him to apply both intuition and common sense to problems. To be successful in artificial intelligence, one must complement formalism with intuition, and I do find this to be one of Judea's main strengths."

Reed Hutchinson, UCLA Photographic Services

Pearl's research has been recognized by his peers around the world. Earlier this year, he was one of two researchers who received the 2003 Allen Newell Award from the Association for Computing Machinery. Pearl was honored for his seminal contributions to artificial intelligence and for "demonstrating the remarkable influence that computer science and artificial intelligence can have on other sciences, on practical tools and on human thought."

In 1995, Pearl was elected to the National Academy of Engineering for developing the foundations for reasoning under uncertainty, and he is one of the few recipients of the International Joint Conference on Artificial Intelligence Award for Research Excellence. The IJCAI honored Pearl for his "fundamental work on heuristic search, reasoning under uncertainty, and causality." And in 2001, the London School of Economics and Political Science presented him with the Lakatos Award, which honors outstanding contributions to the philosophy of Science, to honor the impact of his book on causality.

He received his BS in electrical engineering from the Technion in Israel in 1960. After moving to the United States, he finished his master's degree in physics at Rutgers University in 1965 and a PhD in electrical engineering from the Polytechnic Institute of Brooklyn in the same year.

Before joining the computer science faculty at UCLA in 1970, he enjoyed a successful career in physics and engineering. Pearl worked at the RCA Research Laboratories on superconductive parametric and storage devices and at Electronic Memories on advanced memory systems.

"Judea has always been very single-minded in focusing on his research – sort of the classic researcher at a university," noted Korf, who first collaborated with Pearl while an assistant professor at Columbia University. "All else was a distraction."

"Pearl is a very inspiring person. He's very passionate about what he does and very dedicated to truth," said Darwiche, who has been motivated by Pearl's example. "It takes that kind of passion to make breakthroughs like Judea has done."

That focus and drive have recently shifted to problems outside of artificial intelligence. In 2002, Pearl and his wife established the Daniel Pearl Foundation (www.danielpearl.org) to honor the memory and life of their son. The Foundation's mission is to promote cross-cultural understanding through journalism, music, and innovative communications.

"On a personal level, Judea showed remarkable strength during a difficult time," added Ercegovac, "and he has a genuine interest in improving the world through true understanding."

For more on Professor Judea Pearl's research, please visit http://www.cs.ucla.edu/~judea/.

"Judea Pearl is one of the most remarkable people we have in the School."

Milos Ercegovac