McCarthy, 'great man' of computer science, wins major award

BY DAWN LEVY

John McCarthy, professor emeritus of computer science and pioneer in artificial intelligence (AI), received the Benjamin Franklin Medal in Computer and Cognitive Science on April 24. The Franklin Institute in Philadelphia bestowed the award, lauding McCarthy for "multiple contributions to the foundations of artificial intelligence and computer science including the development of the LISP language, the invention of time-sharing interactive programming, and key developments in the application of formal logic to commonsense reasoning."

"John McCarthy is one of the great men of computer science," Michael Genesereth, associate professor of computer science, wrote in an e-mail. "He helped to invent the field of artificial intelligence and, over the years, has been one of its most significant contributors. His quest for computers capable of 'human-level' intelligence has been a source of inspiration for generations of students and researchers."

McCarthy's goal of teaching computers to perform a variety of tasks with "intelligence" necessitated developing a computer language that would manipulate symbols for objects, rather than just...
perform arithmetic on numbers. To that end, in 1958 he invented LISP, now the second-oldest surviving programming language after Fortran. Besides performing symbolic computations using calculus, algebra and differential equations, LISP also deals with logical expressions and is used in programs that prove math theorems. Today LISP is used in many expert systems and natural language programs, especially in research.

McCarthy was among the first to propose and design time-sharing computer systems, which allow machines to switch their attention back and forth between a large number of tasks. This time-sharing technology is found in all computers today. McCarthy also pioneered the application of mathematical logic to prove the correctness of computer programs.

Researchers in AI have approached the challenge of making machines smart with diverse strategies, including probabilistic approaches and neural networks. "My approach is the logical approach -- using mathematical logic about what the AI system knows about the world and what it decides to do about its goals," explained McCarthy during an interview in his office in the Gates Computer Science Building.

Some current AI applications include game playing, computer vision and expert systems in which a so-called "knowledge engineer" has interviewed experts and programmed their knowledge into a computer to perform a task, such as medical diagnosis.

Some of McCarthy's recent work involves programs that reason using the simplest explanation, unless told that a complication exists. Say you want to know if a penguin can fly, McCarthy posited. The computer has been programmed to know that birds fly. It also has been programmed to know that a penguin is a bird. Using the simplest logic -- a penguin is a bird, and a bird can fly -- the computer would erroneously conclude that a penguin can fly. Because penguins are abnormal with respect to other birds in regard to flight, the program has to be able to address this complication to reason correctly. McCarthy's work uses mathematical logic to formalize the context of complex situations such as this one.

Tens of thousands of researchers currently work in AI, some with aspirations of creating machines with human-level intelligence and others with more limited goals. There are still some tasks that humans can do that computers can't. One
big remaining challenge, McCarthy says, is getting machines to act in a spatial, or 3-D, world.

"Nobody has a computer that could describe the mess on this desk," McCarthy tells a visitor to his office. "If you asked a robot to find a stapler amidst the clutter and then have a robot arm pick it up, that's a bit beyond the current state of the art." Computers can recognize patterns and conclude "this is a stapler," but humans can one-up computers because they are not limited to the sense of sight to understand the 3-D world. McCarthy described an experiment he does in which he puts a statuette in a paper bag and asks his experimental subject to draw the object in the bag without looking in the bag. The test subject can stick his or her hand into the bag to feel the object but cannot squash the bag around the statuette. It turns out people do remarkably well at drawing an object they can't see. McCarthy would like to see researchers in haptics -- the science of touch -- get involved in making computers do tasks in which information comes from touch, such as picking one's car keys from one's pocket.

Nowadays, McCarthy has turned his attention to the sustainability of human progress. An optimist armed with statistics, he believes the whole world can reach and maintain an American standard of living even if the global population reaches 15 billion (it is currently about 6.3 billion). His website, www-formal.Stanford.EDU/jmc/progress/, provides thought-provoking fodder about the availability of food, energy and other resources. McCarthy says important policies hinge on the belief that progress is sustainable, such as decisions of whether to conserve resources and whether to help poor countries develop along similar paths as rich ones.

A senior fellow by courtesy at the Hoover Institution, McCarthy is a member of the National Academy of Sciences, the National Academy of Engineering and the American Academy of Arts and Sciences. He received the Association for Computing Machinery's A. M. Turing Award in 1971, the first Research Excellence Award of the International Conference on Artificial Intelligence in 1985, the Kyoto Prize in 1988 and the National Medal of Science in 1990.

McCarthy earned his bachelor's degree in mathematics from the California Institute of Technology in 1948 and his doctorate in mathematics from Princeton in 1951. He came to
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Stanford in 1953, then taught at Dartmouth and MIT before returning to Stanford in 1962 as a professor of computer science. He directed the Artificial Intelligence Laboratory here from 1965 to 1980 and was the Charles M. Pigott Professor in the School of Engineering from 1987 to 1994.

The Franklin Institute was founded in 1824 in honor of America's first scientist, Benjamin Franklin. The Franklin Institute Awards recognize preeminent accomplishment in science and technology on an international level. Previous winners of the Franklin Medal in Computer and Cognitive Science include Noam Chomsky, Douglas C. Engelbart, John Cocke and Marvin Minsky.