Fuzzy Logic
and smooth applications

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The Battalion

Computers speak in the clear, pristine language of basic logic, where subject matter is black or white, true or false, one or zero. Humans, on the other hand, speak in a language that is as garbled as Bobcat Goldthwaite on a CB radio.

In this world where interconnection among humans and computers is becoming increasingly important, this language barrier has become a target for Texas A&M researchers who realize that, since there is little chance that humans will become adept at speaking in the digital language of ones and zeros, computer logic must become a little "fuzzy."

"The idea behind it is to generalize some of the science and technology concepts that have black and white notions into areas of gray," John Yen, a professor of computer science and director of the Center for Fuzzy Logic, said.

Yen said the purpose behind this blurring of logical results is to allow researchers to design technology that takes the nuances of human actions and other highly variable activities into account so that the technology can function more effectively.

The "fuzzification" of computer logic is being used to improve interaction in technologies ranging from voice and handwriting recognition to safety at nuclear power plants.

How it works

Computer programming typically uses a form of logic called Boolean logic, which assigns a zero for false and a one for true. Yen said fuzzy logic seeks to allow a range between zero and one.

"For example, you could assign a man who is completely bald as zero and a man who has a full head of hair as one," he said. "But what if the man has some hair? Fuzzy logic could allow you to say that a man is .25 hairy, or a little hairy, instead of trying to fit him in one category or another."

Using this kind of logic, technology can be adapted to receive input, use the fuzzy logic to determine what action it should take and then perform the action or produce output in a logical manner.

For example, when a person using handwriting-recognition technology writes a word on a touch pad, the computer reads the input, allowing for small variations in letter formation.

No one writes a letter the same way twice, regardless of how much his first-grade teacher made him practice. This is where the fuzzy part comes in.

The computer then determines what letters were intended and records the digitalized word.

Tweaking the search engine

Anyone who has ever tried to use a common search engine, only to get so many erroneous results that a trip to a public library would be faster, may appreciate the center's work on building a search engine that uses fuzzy relationships.

Using more advanced techniques, fuzzy logic has been applied to numerous technologies in a variety of fields.

"I have heard of a car that had six features which used fuzzy logic," Yen said. "Along with things like better braking and fuel efficiency, it also had a windshield tint controlled by fuzzy logic."

Common applications of fuzzy logic include automated controls for dam gates at hydroelectric plants, simplified controls for robots, improved safety regulators for nuclear power plants, voice recognition for computers, automated camera aiming for telecasts of sporting events and even software designed to help interpret activity on the stock exchange.

At A&M's Center for Fuzzy Logic, Yen and his fellow researchers are adding to the growing list of fuzzy applications.

Currently, search engines work by matching exact words entered by the user with words found on Websites. The center's engine uses additional background information about subject matter, either provided by the user or stored by the engine, to find additional sites with information related to that subject matter.

"Relationships between subjects can be fuzzy," Yen said. "An example of this is whether a term is general or specific. 'A&M' is more specific than 'university' and the 'Big 12 Conference' is more specific than 'sports conference.' And the results for searches for these terms should be more specific. Results for 'Big 12' could include players and other related subjects."

Yen said the search engine is currently exclusively for researchers, but he hopes similar techniques will soon be used by public search engines.

Fuzzy feelings

While fuzzy logic does not make an electronic pet any furrier than a toaster, the center is conducting research to make electronic pets more emotionally textured.

Yen said PETEEI, which stands for a "PET with Evolving Emotional Intelligence," seeks to simulate emotional dynamics of a household pet by giving it the ability to recognize and cope with the various moods and emotional responses of its owner.

Just as the handwriting recognition tool interprets variations in handwriting, PETEEI can observe the actions of its owner and respond accordingly.

"It will get upset and moody if it is not fed or if its battery is low," Yen said. "But much of an emotional response is the anticipation of an action."

Thus the pet would be affectionate if it anticipated that it would be receiving affection.

A similar emotional response system is being developed to construct a simulation of a baby's face, which would produce appropriate facial expressions for changing environments.

Go team!

In October, professor of engineering Richard Volz, professor of computer science Thomas Ioerger and Yen, along with two professors from Wright State University in Dayton, Ohio, were awarded a $4.3 million grant from the Department of Defense to develop intelligent computer software that will help soldiers learn how to perfect teamwork.

"Modeling human teamwork is another application where expectations of reactions is an important factor that can help to be understood by fuzzy logic," Yen said.

The software will be designed to allow soldiers to interact with virtual team members and coaches in settings such as a flight control deck in hazardous weather.

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