

# In Search of the Intelligent Machine

“Daisy, Daisy, give me your answer do...” Who can forget the chilling scene from Stanley Kubrick’s film *2001: A Space Odyssey* as memory chips are removed from HAL’s room-size computer brain? As the astronaut removes each chip, HAL slowly regresses, all the while repeating the lyrics to the quaint song “Daisy”. Whether it’s *Star Trek’s* Data, the robot guardian from *Lost in Space*, or HAL9000, the idea of a thinking intelligent machine has fascinated us since the dawn of the machine age. Wasn’t it only a matter of time before real life finally caught up with science fiction?

## One Company Believes it Has

Unisys Corporation, known for its technological innovation and long history in the computer industry (dating back to UNIVAC, the first commercial computer in the 1950s), recently unveiled a new technology that some say is as revolutionary as the invention of the transistor. Called “UniGnome,” Unisys and its partner Autonomics are touting this new technology as the first computer to learn by observing its surroundings. Professor of linguistics and expert in intelligent machines, Andrew J.

Bradley, believes this to be the first fully automated learning machine, “UniGnome can take any body of information and determine the answers to the hundreds of potential questions that it might be asked—it even determines which questions to ask.”

For years researchers have tried to develop programs that mimic the way humans think. These artificial intelligence (AI) programs generally make the computer follow a set of predetermined human-made rules. However UniGnome, unlike other AI systems, doesn’t start with any explicit rules or expert knowledge. It acquires knowledge by observing its environment, asking questions, and making decisions about the information and situations with which it was presented. Allowed to continue learning over time, it can even increase its accuracy and efficiency.

To better understand what UniGnome does, assume that it was provided with the thousands of pages in the Internal Revenue’s regulation manuals and policy guidelines. After being introduced into this complex mass of information, experts estimate that UniGnome would formulate the answers to the thousands of potential questions that could be asked by taxpayers, tax preparers, and tax analysts.

In fact, the IRS might very well benefit from a learning machine. At present the IRS receives over 100 million calls per year from taxpayers, which range from simple questions to complex queries about tax rules and laws. Following President Clinton’s 1997 Executive Order, the IRS is engaged in an aggressive campaign to modernize its customer service by providing quicker, better, and more accurate answers to taxpayer questions.

According to Frank Schudde, Unisys marketing manager, if UniGnome were introduced into a database of IRS guidelines, tax rules, manuals, and forms, it would acquire the knowledge needed to correctly answer over 75% of the questions commonly posed by taxpayers and tax preparers. “If UniGnome were allowed to ask questions and obtain feedback, it might increase its correct responses to well over 90%. That’s a 50% increase over IRS help desk personnel. Besides improved taxpayer satisfaction, that would translate into a whopping savings for the American taxpayer.”

UniGnome is based on the research of the 19th century scientist and philosopher Charles Sanders Peirce. Peirce, (pronounced “*purse*”) the founder of the American philosophical movement called “Pragmatism,” was also a pioneer in the field of semiotics, the science of how the human mind uses signs, symbols, and icons to translate what we see into what we perceive as reality. From his work in semiotics, Peirce developed a new theory about how we gain knowledge. Until then, philosophers believed that we acquire knowledge from the facts and patterns we observe in our environment (called induction). For example, we believe it’s going to rain because we observe the dark sky and hear the thunder in the distance. They also believed that we acquire knowledge by deriving conclusions based on facts and information we already know or assume (called deduction). We know the rain comes from the dark clouds because we’ve previously experienced this phenomenon. Peirce believed that there was more; he hypothesized that when a person’s current knowledge and reality were not enough to construct a reliable answer, that another force, called abduction, was at work. He proposed that abduction assists the mind to form a hypothesis about new knowledge when it is presented with

reliable information gained through induction and deduction.

After his death in 1914, Peirce’s work was relegated to the domain of philosophers and mathematicians. In the 1950s, one of the inventors of UniGnome, Gene Pendergraft, joined an advanced research project at the University of Texas at Austin to develop a machine to translate written language. When funding for his work dried up in the 1970s, Pendergraft, seeing the potential of Peirce’s theories on his own work in learning, formed his own company, called Autognomics. Pendergraft, who died in 1997, was also an accomplished artist and used the profits from the sale of his art to fund the company during its lean years.

In 1997, Unisys Corporation and Autognomics formed a partnership to bring this new technology to market. Continuing with Pendergraft’s research, the artificial intelligence engineers at Unisys worked alongside Pendergraft’s staff to create what is now known as “UniGnome”, an automated tool that learns by observing its environment. To UniGnome, its environment can be a database filled with information or literally thousands of lines of computer code.

By most accounts the Year 2000 problem is a monumental challenge. Experts estimate that fixing it means that a programmer must read every line of code in all programs still in use, searching for all instances and calculations that use dates. UniGnome could dramatically simplify this process, using induction, deduction, and abduction. Potentially, UniGnome could locate and identify all date fields and date calculations, and then present its findings to a programmer, who would then know exactly where to correct each error—without having to read every line of computer code.

### **But Is This Really Learning?**

Can we really call what UniGnome does learning? Unisys and Autognomics believe so, and they held a one-day conference to demonstrate and prove it. On January 15, UniGnome was announced, not at a major tradeshow as is common with most new software products, but at *Arisbe*, the Milford, Pennsylvania, home of Charles Sanders Peirce. Unisys representatives, scientists, educators, and futurists attended this event, among them Kenneth Deloplane, MIT educational psychologist and author of the best seller, *Understanding the Brain* and Kent Jacobs of an independent consulting firm. Jacobs attended as an impartial advisor for the demonstration. Weeks before, Jacobs and his team gathered their own policy guidelines and operating manuals into a database of word processing files. This database, consisting of over 5,000 pages, contained all the business-related information used to run their international consulting business.

UniGnome was introduced into this information and allowed to learn their business rules, procedures, and policies. During the demonstration, which lasted three hours, UniGnome “asked” seven questions. After conferring with team members, Jacobs typed a response to each of UniGnome’s questions. To UniGnome, Jacob’s feedback was another form of useful information—just another way to learn. At the end of the three hours, UniGnome presented its findings. It had developed 523 questions and answers. A review of these found that UniGnome was 98% accurate.

When asked if UniGnome was really acquiring knowledge or merely parroting back information, Deloplane replied that “learning is defined as the act of acquiring knowledge by systematic study and the modification of behavior through experience.” Deloplane

believes that UniGnome showed that it is able to build a body of knowledge from a complex mass of information. “By applying its computer logic, asking for feedback, modifying its questions, and changing its responses to reflect the feedback, it seems to indicate that by many definitions, UniGnome did acquire knowledge that it did not have at the start of the demonstration.”

### **A UniGnome in Every Computer?**

So will every computer be equipped with UniGnome in the near future? “Not quite so fast,” says Vern Blunk of Unisys. While Blunk believes that UniGnome is able to acquire knowledge, in his opinion that’s just the first step. “We want to identify companies that are leading-edge early adopters to implement practical uses for UniGnome.” Blunk believes that it is important to find clients who are willing to be partners. “We want to partner with companies that are willing to help us pioneer this amazing new technology by identifying valid and useful pilot projects that show the strength, flexibility, and adaptability of UniGnome.”

Toward that end, Blunk introduced Sandra D’Antonio, vice president of Customer Service at Online America (OLA). D’Antonio said she was intrigued after receiving a mysterious phone call from the firm that Unisys hired to survey companies that might be interested in piloting this new technology, and who were recognized as being forward-thinking and adventurous. Said D’Antonio, “While not giving away any secrets, they explained that they had made a breakthrough in artificial intelligence and self-learning software. I was intrigued and my interest was immediately piqued.”

OLA has an interesting problem. Each day they receive over twenty thousand e-mails from customers with questions as routine as asking how to address an e-mail message to

others with questions about current world events. D'Antonio explained that OLA uses "knowledge workers," people who answer customer questions based on their own personal knowledge and experience. "If one of our staff doesn't know an answer, they immediately learn as much as they can before answering the e-mail." Questions about current events are usually the most difficult to quickly answer, because the knowledge worker might not yet have had time to learn about the event. After customer satisfaction, D'Antonio's main concern is cost, "When a knowledge worker spends extra time researching an answer, our costs go way up."

After making contact with Unisys and learning more about UniGnome, D'Antonio decided to team with them on a pilot project. She explained that the team, composed of Unisys AI engineers and OLA e-mail experts, designed, managed, and monitored the six week project. When they were ready, the team introduced UniGnome into a copy of the e-mail database from which the OLA knowledge workers draw customer questions. "We let UniGnome learn about the information in the database and treated it as if it were another knowledge worker. We also assigned one OLA e-mail expert to answer UniGnome's questions," explained D'Antonio. UniGnome was allowed to then respond to hundreds of mundane e-mails (only after each was reviewed by the team to ensure its accuracy), allowing the knowledge workers to concentrate on more difficult questions. D'Antonio reflected that before UniGnome, the average cost to answer each e-mail was \$1.10. With UniGnome the cost dropped to \$.60 per e-mail, and the knowledge workers had time to answer questions more effectively. D'Antonio said that "this will result in an overall savings to OLA of \$3,650,000 per year."

## **HAL, Are You There?**

While not just ready to create HAL9000, Schudde believes that UniGnome is potentially as revolutionary a scientific development as that of the transistor. "Fifty years ago we couldn't see the tremendous impact that the transistor would have on society. As the integral component of a computer's brain, the transistor has made the information age possible." Blunk added that he believes UniGnome has the same evolutionary potential—to move computers to the next level. "We believe that UniGnome will be able to assist human beings with the task of developing and processing knowledge."

Who knows, your next computer might greet you by name, ask how it can help, and in a few minutes provide precisely the information you need. And, it may even know your tastes and preferences and ask if you'd like to hear some music while you work. Just remember that you were warned if you begin to hear soft music while your computer begins slowly crooning "Daisy".

John Zuchero