Artificial Intelligence: Arrogance or Ignorance?

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Wojciech Cellary's remarks on decision making and intelligence in *Computer*'s September 2003 issue ("The Profession's Role in the Global Information Society," pp. 124, 122-123) brought to mind Bob Colwell's "Engineering Decisions" column (*Computer*, Aug. 2003, pp. 9-11) and my disappointment with Adrian Hopgood's article, "Artificial Intelligence: Hype or Reality?" (*Computer*, May 2003, pp. 24-28). Shortly afterward, under the Artificial Intelligence heading in the book review section of the May 2003 issue of *American Scientist*, I found descriptions of two books on the chess-playing computer, Deep Blue, as well as a book on the "sociable" robot, Kismet. When the September 2003 special issue of *Scientific American* titled "Better Brains: How Neuroscience Will Enhance You" arrived the same day, I felt pressed to move in a predestinate groove. Although I previously had resolved not to revisit the topic I covered in "The Myth of the Intelligent Computer" (*Computer*, July 1997, p. 8), the omens seemed to dictate an about-face.

What the computing profession names its endeavors can shape society's view of us.

ARTIFICIAL INTELLIGENCE

The term *artificial intelligence* suffers from many problems beyond the ugliness of its initialism. Hopgood found their nub with his observation "If AI were named 'nifty computer programs,' it would surely be hailed an unqualified success," but treated it as a mere throwaway line.

The term's adoption specifically implies that we see ourselves as creating in machines an intelligence roughly equivalent to *natural* intelligence. The many aspects of natural intelligence that dictionaries define boil down to its being an essential element of successful behavior, especially social behavior.

As computing professionals, we have a moral duty to maintain and promote a distinction between the machines we use as tools and the people whose purposes and well-being we support. People behave or misbehave. Machines function or malfunction. Functioning does not exhibit intelligence. Any inferred intelligence should be credited to the machine's designers.

Society judges our competence as computing professionals by the claims we make for ourselves. If we claim to be creating intelligence, people will assume we claim also to understand what intelligence is. Yet the evidence shows that we don't understand it.

This last point affects three groups of people differently. The computing profession in general, unsuspecting of its self-deceit, will have unrealistic expectations and transmit them to the other groups. People who have not thought much about intelligence will be led into unreasonable hopes and fears. People who have thought deeply about intelligence will consider the computing profession to be both arrogant and ignorant.

In the computing world, the phrase artificial intelligence has a long history, quite untinged with arrogance. But I can't help feeling that a great deal of ignorance has sustained its use.

NATURAL INTELLIGENCE

The misunderstanding of intelligence among computing people springs from the grossly simplified model we use. Hopgood opens his survey with a section titled "A Spectrum of Intelligent Behavior." The text bases this supposed spectrum on "level of understanding involved," while the accompanying figure shows the range, with *reaction* at one end and *expertise* at the other. This widely adopted model is uncompromisingly unidimensional. AI people measure its suc-

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cess by how far along that spectrum research has advanced.

But intelligence is not unidimensional. Harvard neuropsychologist Howard Gardner put forth a far more realistic, multidimensional view of intelligence 20 years ago in his book, *Frames of Mind* (Basic Books, 1983). His model remains widely accepted, if sometimes misunderstood. In the preface to his book's 1985 paperback edition, Gardner defined *an* intelligence as "the ability to solve problems, or to create products, that are valued within one or more cultural settings."

Using a variety of evidence, Gardner proposed seven relatively independent dimensions of intelligence, although he has since adopted an eighth and contemplates a ninth (www.pz.harvard.edu/pl/HG_MI_after_20_years.pdf). On the basis of rich evidence, he concludes that "all human beings possess not just a single intelligence (often called 'g' for general intelligence). Rather, as a species we human beings are better described as having a set of relatively autonomous intelligences."

The seven original intelligences comprise three "object-related" dimensions—spatial, logical-mathematical, and bodily-kinesthetic; two "object-free" dimensions—linguistic and musical; and two cultural dimensions—intrapersonal and interpersonal. The eighth is naturalist, which I would take to be object-related, although it might be considered cultural in that it focuses particularly on relations with animals.

IQ tests usually measure spatial and logical-mathematical intelligences. Artificial intelligence is primarily logical-mathematical.

INTELLIGENT MACHINES?

Cellary reviews the imminent global information society in terms of the preceding industrial and agrarian societies. We can extend this approach by looking at the different societies in terms of the intelligences most significant to them:

- The agrarian society exploits naturalist intelligence and concentrates on the production of food by workers using their bodily-kinesthetic intelligence. The adoption of agricultural machinery greatly diminished the role of agrarian workers.
- The industrial society exploits spatial intelligence and concentrates on the production of physical artifacts by workers using their bodily-kinesthetic intelligence. The adoption of digitally controlled machinery greatly diminished the role of industrial workers.
- The information society exploits logical-mathematical intelligence and concentrates on the production of representational artifacts by clerical and other office workers using their bodily-kinesthetic intelligence. The adoption of digital computers and telecommunications has already diminished the role of information workers.

Although it's appropriate to use machines simply because they're more effective, this doesn't make the machines intelligent.

These generalizations display a pattern in which successive reformations of society change the role that many of its members play within it. These reformations hinge on the increasing importance of the artifacts that new technology enables the new society to produce.

Two kinds of representational artifacts characterize the information society: those for sale as goods and those used in the production of goods. This is why the commercial world so eagerly seeks and defends copyright and patent monopolies in our information age.

Thus, all the most significant intelligences in the pageant of societies are of the object-related kind. When, in one society, many workers need to use such intelligences, in the next society machinery and technology hugely amplify the object-related capabilities of such workers. For example, it once took hundreds of agrarian workers to do by hand what one driver can do now with a tractor and harvester. Likewise, it once took hundreds of industrial workers to machine the engine block castings that one machine supervised by two or three people can now do. Today, machines built with credit card, barcode, and related technologies have already taken over many of the information workers' tasks.

Although it's appropriate to use machines in this way simply because they're more effective, this doesn't make the machines intelligent. Cellary disagrees, defining human intelligence "as the ability to use accrued knowledge to make correct decisions." This leads him to the following observations regarding the information society: "Computers deprived humans of their monopoly on intelligence. Although they can only capture a fraction of their programmers' real intelligence, computers make correct decisions based on the knowledge encapsulated in the programs they run."

I contend that computers don't make decisions, they compute results by deterministic logical-mathematical means. Deep Blue could play chess better than almost everyone, but it didn't make decisions, it computed moves. Granted, this is only a technical point, but Colwell makes a more fundamental point about logical decisions, computer-aided or otherwise: "Do not apply your outstanding logic deduction talents to a problem involving other people and expect to be thanked for it. Personal relationships are in a special category in which your hard-won engineering skills are a severe liability."

SOCIAL MACHINES?

We benefit from applying our object-related intelligences. Machines can carry out many object-related tasks

much better than we can, but that doesn't make the machines intelligent.

What about the other intelligences that characterize humans? The two object-free intelligences, linguistic and musical, are especially interesting because they focus on representations—as does digital technology. The success of digital speech recognition and digital music might suggest that computers have object-free intelligences. But the roles of humans and machines in these areas differ markedly. People use language and music to communicate their beliefs, ideas, and emotions; machines can't communicate beliefs, ideas, or emotions because they don't have any. They have only digital representations, that is, data.

The two cultural dimensions, intrapersonal and interpersonal, lie at the heart of human intelligence because they play the most important role in our being effective members of society and interacting beneficially with other people. Where in this picture does Kismet, the sociable robot, fit?

Kismet consists of a head covered by something that looks a bit like a face. A computer can move the face's features to make "eye contact" and display a variety of emotions, its developers claim. Yet Kismet can't have emotions, so its display is mere mimicry. This is not to say that such robots might not be useful to us. Robotic pets of various kinds are already popular, and social mimicry can be highly effective. For example, during artificial intelligence's early days, a program called Eliza became popular. A Teletype terminal served as Eliza's interface, and the program appeared to engage in conversation by giving simple greetings and asking extremely simple questions, based on keywords selected from what the user typed in. Back then, some people found "talking" to Eliza a compelling experience.

Yet decades later, machines still have far to go before they truly can interact with people intelligently. Our intelligence reflects our cultural and social experiences and the events that shape our daily lives. Machines belong to people and don't have lives. Maybe in a century or two we will craft Asimov-style androids that truly deserve the adjective *intelligent*. But why would we want them?

Whether the computing profession is ill-informed about *natural intelligence* or not, there are good arguments for dropping the term *artificial intelligence* as a name for the nifty programming field. The *Oxford English Dictionary*, second edition (www.oed.com), defines *algorist* as a descriptor for a nifty programmer, but deems the word obsolete.

Here, then, we have a word ripe for reanimation. The derived term, *algoristics*, would make a highly suitable replacement for artificial intelligence, being more correct historically than the corrupt *algorithmics*.

Placing this renamed field alongside statistics and logistics, as a branch of mathematics, would benefit the computing profession greatly. Given that algoristic techniques are highly mathematical and require a much greater degree of mathematical knowledge than ordinary programming, they should be taught and studied primarily by mathematicians.

Further, a detailed knowledge of algoristics offers no particular benefit to the computing profession at large: The advanced and intricate algorithms professional algorists will discover could easily be coded into software as calls to library subprograms or, in the Java jargon, classes. We should, therefore, bequeath algoristics to the mathematicians and be done with it. ■

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