DOI:10.1145/3352690

Vinton G. Cerf

Polyglot!

Google speaks 106 languages—or at least can understand queries in written form if not also oral form. When I watch someone interacting verbally with Google Assistant

in languages other than English (my native tongue), I realize Google's language ability vastly exceeds my own. I have a modest ability to speak and understand German. I know a few phrases in Russian and French. But it suddenly strikes me that Google is usefully dealing with over 100 languages in written and oral form. Assistant is responding to queries by recognizing speech input, searching the Web, and voicing the answers in multiple languages. Google Lens is translating text seen in photos into the viewer's preferred language. Google Translate is converting text and speech in one language into another with increasing quality. The quality varies, of course, depending on the volume of training material available to configure deep neural machine learning networks, but the fact that it works at all across so many languages is nothing short of astonishing and even daunting.

It is examples like these that reinforce my impression machine learning has taken over the computer science world as the tool of choice for a great many applications. As I write this, I am in the middle of judging the Google Science Fair where a good many of the projects on display have their roots in machine learning and recognition or identification of various signals. One project is detecting and amplifying the presence of DNA in river waters to identify species found in or near the river. Another is trying to detect plant diseases by recognizing images of various forms of leaf blight. Another is recognizing sign language by sensing the muscles of the arm as they direct finger movement.

Another is trying to sense whether a person is talking, singing, drinking, coughing, or choking by using a sensor taped to the throat; think about its potential uses in remote patient monitoring in an intensive-care facility. Another application is the analysis of heart sounds to detect anomalous valve conditions. A recurrent theme throughout the fair is a desire to apply technology to improving living conditions and, more generally, people's lives.

Given the increasing availability of platforms for implementing machine learning algorithms, it is perhaps not surprising there is rapid exploration of this method for local data analysis and filtering. The term "edge computing" is creeping into the vocabulary with expectations, for example, that machine learning algorithms can be built into mobiles or local processors. I recently installed a device that clamps onto the electrical mains of my house that tries to recognize the signatures of various electricity-consuming devices so as to develop a profile of energy use. As it recognizes new devices, I get excited

The potential for real-time translation between spoken languages is becoming a feasible reality.

email messages titled "I've found a new device!" like a school child coming home with a story of discovery from science class. There is something charming and refreshing about this behavior (if I can anthropomorphize a little).

Where is all this taking us? For one thing, the potential for real-time translation between spoken languages is becoming a feasible reality. Think of the Star Trek universal translator and its arrival three centuries ahead of time! Unsupervised learning is taking us closer to discovery as the algorithms discover patterns we might, ourselves, not detect. The recent results of Deep Mind's AlphaZero machine learning system showing it discovering chess moves and tactics never before seen in human play hints at the possibility of new discoveries in other fields. We are collectively exploring vast territories of data like an army of digital Lewises and Clarks. What will be important is deeper understanding of what works and what doesn't and why. When these methods fail there can be catastrophic consequences, so getting this right is a challenge worth meeting.

I am reminded of a grook on problems by Piet Hein:^a

"Problems worthy of attack
Prove their worth by hitting back!" ☐

^a [https://en.wikipedia.org/wiki/Piet_Hein_\(scientist\)](https://en.wikipedia.org/wiki/Piet_Hein_(scientist))

Vinton G. Cerf is vice president and Chief Internet Evangelist at Google. He served as ACM president from 2012–2014.

Copyright held by author.