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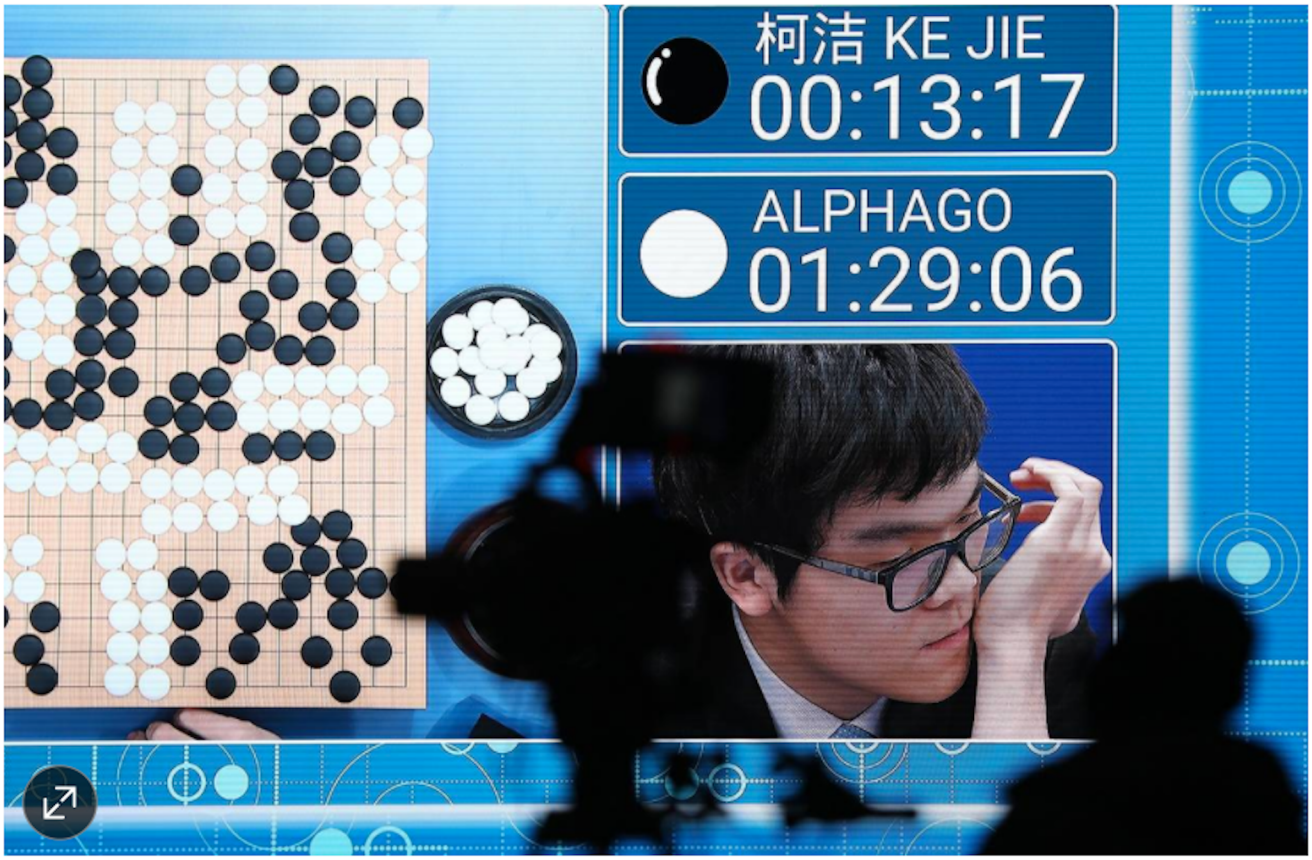
The Robot-Human Alliance

Call it Multiplicity: diverse groups of people and machines working together.



Chinese Go player Ke Jie after he lost a match to Google's artificial intelligence program AlphaGo, May 23. PHOTO: EUROPEAN PRESSPHOTO AGENCY

By Ken Goldberg

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55 COMMENTS

Humans have been beaten by a machine again. Last month the world's top-ranked player of Go, an abstract strategy board game, lost to Google's AlphaGo program. This marked a major achievement for machine learning, given the game's complexity.

What might be more important, though, went less noticed: Around the same time, some of the world's top Go players began competing alongside the AlphaGo program in human-machine teams. The players learned new strategies by studying AlphaGo's previous games and said working with the program gave them new confidence. This suggests a different way to think about the coming era of artificial intelligence.

Most computer scientists agree that predictions about robots stealing jobs are greatly exaggerated. Rather than worrying about an impending Singularity, consider instead what we might call Multiplicity: diverse groups of people and machines working together to solve problems.

Multiplicity is not science fiction. A combination of machine learning, the wisdom of crowds, and cloud computing already underlies tasks Americans perform every day: searching for documents, filtering spam emails, translating between languages, finding news and movies, navigating maps, and organizing photos and videos.

Consider Google's search engine. It runs on a set of algorithms with input from a large number of human users who share valuable feedback every time they click on or skip over a link. The same is true for spam filters. Every time someone marks an email as spam or overrides a filter, it helps fine-tune the system for determining what is relevant.

Multiplicity allows Amazon to recommend books, Netflix to suggest movies, and Facebook to organize newsfeed posts. Millions of people show their preferences by clicking, and that data is used to build and maintain statistical models that predict what users want. The key is clustering people and products, which allows the algorithm to make recommendations under the assumption that similar people have similar tastes. A continuing stream of human interaction ensures that the system evolves as new items are introduced and as tastes change.

While scientists still don't understand Multiplicity very well, they are discovering clear benefits to machine diversity. Researchers have developed a family of techniques known as "ensemble learning," in which a set of specialized algorithms work together to produce a single result. One variant, known as "random forests," was developed by Leo Breiman and Adele Cutler at the University of California, Berkeley. They proved that in complex problems with noisy data, a group of "decision trees" will always outperform a single tree—so long as the trees are sufficiently diverse.

By the same token, the benefits and challenges of human diversity have been recognized for centuries in political science, economics and sociology. Experiments on group problem-solving show that the diversity of the people involved is more important than their total IQ. Perhaps the most exciting area of machine learning is deep learning, in which millions of parameters are tuned based on diverse training examples of speech or images that have been labeled by people.

In robotics, too, the exciting progress, especially in autonomous driving, can be characterized in terms of Multiplicity. Data from a varied group of human drivers is combined to demonstrate appropriate responses to varying conditions, and to train multiple statistical machine-learning algorithms that run on distributed hardware. The systems must be continuously updated and fine-tuned based on changes in road, weather and traffic conditions, and as human expectations evolve. All this requires a continuing feedback cycle with people at the core.

Collective intelligence with AI enables many of the most sophisticated and effective systems in use today. If people stopped providing input, these systems would quickly become outdated and would deteriorate. Despite years of experience in human factors and human-machine interfaces, more research is needed on the best ways to combine diverse groups of people with diverse groups of machines. The important question is not when machines will surpass human intelligence, but how humans can work together with them in new ways.

Multiplicity is collaborative instead of combative. Rather than discourage the human workers of the world, this new frontier has the potential to empower them.

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