Machine learning will change jobs—impact on economy could surpass that of previous AI applications

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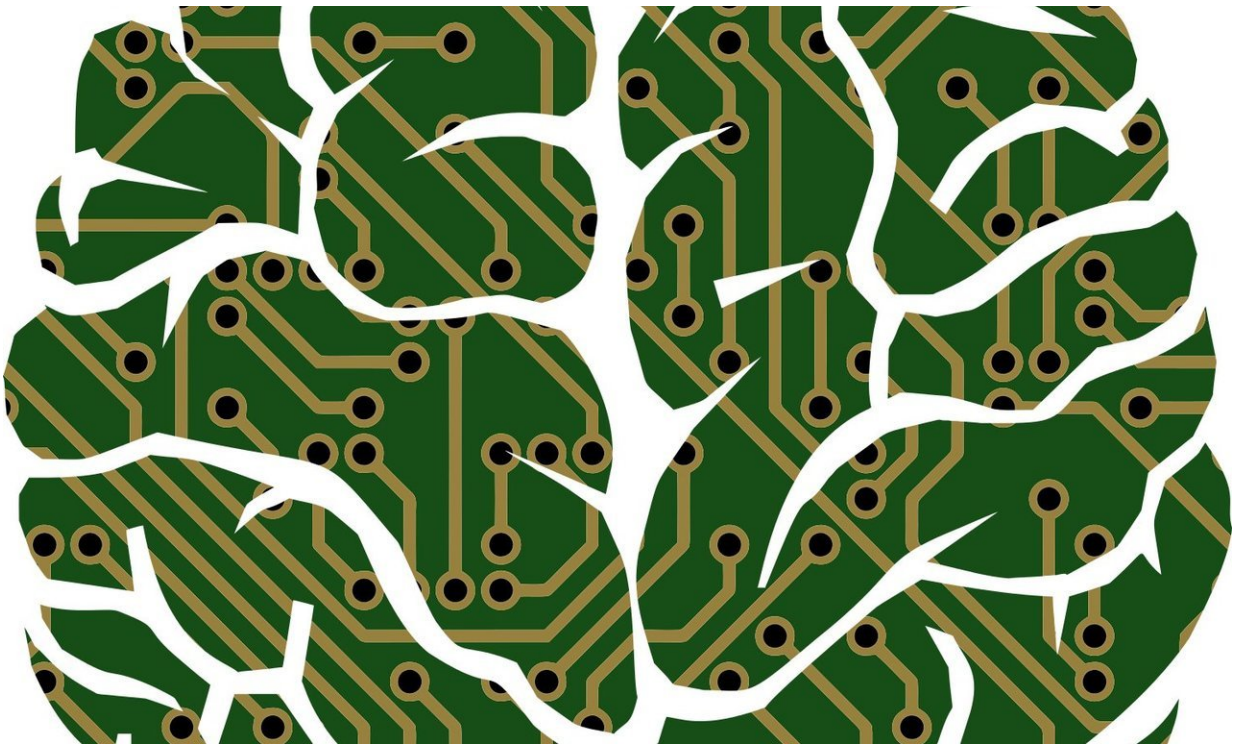

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Machine learning computer systems, which get better with experience, are poised to transform the economy much as steam engines and electricity have in the past. They can outperform people in a number of

tasks, though they are unlikely to replace people in all jobs.

So say Carnegie Mellon University's Tom Mitchell and MIT's Erik Brynjolfsson in a Policy Forum commentary to be published in the Dec. 22 edition of the journal *Science*. Mitchell, who founded the world's first Machine Learning Department at CMU, and Brynjolfsson, director of the MIT Initiative on the Digital Economy in the Sloan School of Management, describe 21 criteria to evaluate whether a task or a job is amenable to machine learning (ML).

"Although the economic effects of ML are relatively limited today, and we are not facing the imminent 'end of work' as is sometimes proclaimed, the implications for the economy and the workforce going forward are profound," they write. The skills people choose to develop and the investments businesses make will determine who thrives and who falters once ML is ingrained in everyday life, they argue.

ML is one element of what is known as artificial intelligence. Rapid advances in ML have yielded recent improvements in facial recognition, natural language understanding and computer vision. It already is widely used for credit card fraud detection, recommendation systems and financial market analysis, with new applications such as medical diagnosis on the horizon.

Predicting how ML will affect a particular job or profession can be difficult because ML tends to automate or semi-automate individual tasks, but jobs often involve multiple tasks, only some of which are amenable to ML approaches.

"We don't know how all of this will play out," acknowledged Mitchell, the E. Fredkin University Professor in CMU's School of Computer Science. Earlier this year, for instance, researchers showed that a ML program could detect skin cancers better than a dermatologist. That

doesn't mean ML will replace dermatologists, who do many things other than evaluate lesions.

"I think what's going to happen to dermatologists is they will become better dermatologists and will have more time to spend with patients," Mitchell said. "People whose jobs involve human-to-human interaction are going to be more valuable because they can't be automated."

Tasks that are amenable to ML include those for which a lot of data is available, Mitchell and Brynjolfsson write. To learn how to detect skin cancer, for instance, ML programs were able to study more than 130,000 labeled examples of skin lesions. Likewise, credit card fraud detection programs can be trained with hundreds of millions of examples.

ML can be a game changer for tasks that already are online, such as scheduling. Jobs that don't require dexterity, physical skills or mobility also are more suitable for ML. Tasks that involve making quick decisions based on data are a good fit for ML programs; not so if the decision depends on long chains of reasoning, diverse background knowledge or common sense.

ML is not a good option if the user needs a detailed explanation for how a decision was made, according to the authors. In other words, ML might be better than a physician at detecting skin cancers, but a dermatologist is better at explaining why a lesion is cancerous or not.

Work is underway, however, on "explainable" ML systems.

Understanding the precise applicability of ML in the workforce is critical for understanding its likely economic impact, the authors say. Earlier this year, a National Academies of Sciences, Engineering and Medicine study on information technology and the workforce, co-chaired by Mitchell and Brynjolfsson, noted that information technology

advances have contributed to growing wage inequality.

"Although there are many forces contributing to inequality, such as increased globalization, the potential for large and rapid changes due to ML, in many cases within a decade, suggests that the economic effects may be highly disruptive, creating both winners and losers," they write. "This will require considerable attention among policy makers, business leaders, technologists and researchers."

More information: E. Brynjolfsson at Massachussetts Institute of Technology in Cambridge, MA el al., "What can machine learning do? Workforce implications," *Science* (2017). science.sciencemag.org/cgi/doi … 1126/science.aap8062

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