

# Transforming, self-learning software could help save the planet

November 2 2016

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Artificially intelligent computer software that can learn, adapt and rebuild itself in real-time could help combat climate change.

Researchers at Lancaster University's Data Science Institute have developed a software system that can for the first time rapidly self-assemble into the most efficient form without needing humans to tell it what to do.

The system – called REx – is being developed with vast energy-hungry data centres in mind. By being able to rapidly adjust to optimally deal with a huge multitude of tasks, servers controlled by REx would need to do less processing, therefore consuming less energy.

REx works using 'micro-variation' – where a large library of building blocks of software components (such as memory caches, and different forms of search and sort algorithms) can be selected and assembled automatically in response to the task at hand.

"Everything is learned by the live system, assembling the required components and continually assessing their effectiveness in the situations to which the system is subjected," said Dr Barry Porter, lecturer at Lancaster University's School of Computing and Communications. "Each component is sufficiently small that it is easy to create natural behavioural variation. By autonomously assembling systems from these micro-variations we then see REx create software designs that are automatically formed to deal with their task."

"As we use connected devices on a more frequent basis, and as we move into the era of the Internet of Things, the volume of data that needs to be processed and distributed is rapidly growing. This is causing a significant demand for energy through millions of servers at data centres. An automated system like REx, able to find the best performance in any conditions, could offer a way to significantly reduce this energy demand," Dr Porter added.

In addition, as modern software systems are increasingly complex – consisting of millions of lines of code – they need to be maintained by large teams of software developers at significant cost. It is broadly acknowledged that this level of complexity and management is unsustainable. As well as saving energy in [data centres](#), self-assembling software models could also have significant advantages by improving our ability to develop and maintain increasingly complex software systems for a wide range of domains, including operating systems and Internet infrastructure.

REx is built using three complementary layers. At the base level a novel component-based programming language called Dana enables the system to find, select and rapidly adapt the building blocks of software. A perception, assembly and learning framework (PAL) then configures and perceives the behaviour of the selected components, and an online learning process learns the best software compositions in real-time by taking advantage of statistical learning methods known as 'linear bandit models'.

**More information:** Barry Porter and Matthew Grieves and Roberto Rodrigues Filho and David Leslie; REX: A Development Platform and Online Learning Approach for Runtime Emergent Software Systems; 12th USENIX Symposium on Operating Systems Design and Implementation (OSDI 16); Nov 2016; isbn = 978-1-931971-33-1; [www.usenix.org/conference/osdi ... /presentation/porter](http://www.usenix.org/conference/osdi.../presentation/porter)

Provided by Lancaster University

Citation: Transforming, self-learning software could help save the planet (2016, November 2)  
retrieved 17 July 2024 from <https://phys.org/news/2016-11-self-learning-software-planet.html>

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