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# Competition-level code generation with AlphaCode

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## Machine learning systems can program too

Computer programming competitions are popular tests among programmers that require critical thinking informed by experience and creating solutions to unforeseen problems, both of which are key aspects of human intelligence but challenging to mimic by machine learning models. Using self-supervised learning and an encoder-decoder transformer architecture, Li *et al.* developed AlphaCode, a deep-learning model that can achieve approximately human-level performance on the Codeforces platform, which regularly hosts these competitions and attracts numerous participants worldwide (see the Perspective by Kolter). The development of such coding platforms could have a huge impact on programmers’ productivity. It may even change the culture of programming by shifting human work to formulating problems, with machine learning being the main one responsible for generating and executing codes. —YS

## Abstract

Programming is a powerful and ubiquitous problem-solving tool. Systems that can assist programmers or even generate programs themselves could make programming more productive and accessible. Recent transformer-based neural network models show impressive code generation abilities yet still perform poorly on more complex tasks requiring problem-solving skills, such as competitive programming problems. Here, we introduce AlphaCode, a system for code generation that achieved an average ranking in the top 54.3% in simulated evaluations on recent programming competitions on the Codeforces platform. AlphaCode solves problems by generating millions of diverse programs using specially trained transformer-based networks and then filtering and clustering those programs to a maximum of just 10 submissions. This result marks the first time an artificial intelligence system has performed competitively in programming competitions.

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1

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