Bonakdarian shows **evolutionary computation** provides flexibility

A recently developed, evolutionary computation approach offers researchers an alternative approach to search for models that can best explain experimental data derived from applications such as economics. Esmail Bonakdarian, Ph.D., a Franklin University assistant professor of computing sciences and mathematics, leveraged Ohio Supercomputer Center resources to test the underlying algorithm.

"Every day, researchers are confronted by large sets of survey or experimental data and faced with the challenge of 'making sense' of this collection and turning it into useful knowledge," Bonakdarian said. *"This data usually consists of a series of observations over a number of dimensions, and the objective is to establish a relationship between the variable of interest and other variables, for purposes of prediction or exploration."*

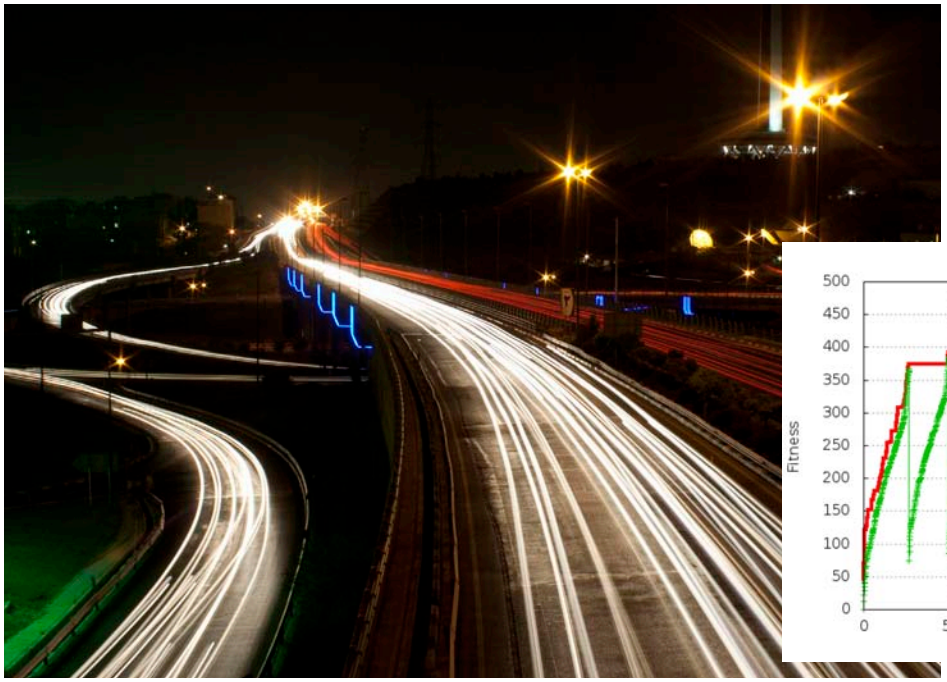
Bonakdarian applied the approach to two classical 'public goods' problems from economics: When goods are provided to a larger community without required individual contributions, it often results in 'free-riding,' while people also tend to show a willingness to cooperate and sacrifice for the good of the group.

"Evolutionary algorithms are inherently suitable for parallel or distributed execution," Bonakdarian said. *"Given the right platform, this would allow for the simultaneous evaluation of many candidate solutions in parallel, greatly speeding up the work."*

Regression analysis has been the traditional tool for finding and establishing relationships in research projects, such as for the economics examples Bonakdarian chose. When the number of independent variables is relatively small, or the experimenter has a fairly clear idea of the possible underlying relationship, it is feasible to derive the best model using standard software packages and methodologies.

However, Bonakdarian cautioned, if the number of independent variables is large, and there is no intuitive sense about the possible relationship between these variables and the dependent variable, *"the experimenter may have to go on a 'fishing expedition' to discover the important and relevant independent variables."* Using an evolutionary algorithm to "evolve" the best minimal subset with the largest explanatory value offers the analyst one more data analysis tool in addition to the standard automated approaches.

"This approach offers more flexibility, as the user can specify the exact search criteria on which to optimize the model," he said. *"The user can then examine a ranking of the top models found by the system. In addition, the algorithm can also be tuned to the number of variables in the final model. This ability to direct the search provides flexibility to the analyst and results in models that provide additional insights."* ■



below: A chart shows that optimization of the search over subsets of the maximum model proceeds initially at a quick rate and then slowly continues to improve over time until it converges.

above: Based on two classic public goods problems from economics, Franklin's Esmail Bonakdarian developed an evolutionary computation approach using Ohio Supercomputer Center systems. Public goods include such things as public roads, bridges and lighting.

Project lead: Esmail Bonakdarian, Franklin University
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