Xie's Collaboration on Pex Benefits Microsoft and CS Education

BY TOM MOONE

Since the mid-2000s, CS Professor Tao Xie has been working with Microsoft Research to develop more effective software testing methods, helping the company improve the utility and impact of its software development tools. At the same time, Microsoft Research has facilitated the development of educational resources for use in teaching computer science. Xie's collaboration is an excellent example of how interactions between industry and academia can provide benefits to both spheres.

Professor Tao Xie

Developing Pex

Xie's relationship with Microsoft Research started in 2005, when he was a PhD student at the University of Washington examining ways to improve automated software testing. In fact, Wolfram Schulte, a researcher at Microsoft Research, served as a member of his thesis committee.

Because of these connections and his research interest, Xie was invited to consult with Microsoft Research on a new project: Pex (Program Exploration) in 2007. He subsequently spent several summers at Microsoft Research as a consulting researcher on the project.

The technique that underlies Pex is dynamic symbolic execution. In dynamic symbolic execution, potential paths of a given program are systematically explored by generating test data. Yet, for object-oriented software, the search space can be huge, making automated testing difficult. Xie developed a key algorithm, called Fitnex, to guide path exploration. "The algorithm I helped design and implement allowed us to cover more portions of the code and have a higher chance of finding bugs in the software program," Xie said.

Xie's partnership has provided benefits to Microsoft Research, but he also believes that he gained insights applicable to his university job. For Xie, an important benefit was that he was able to closely interact with his Microsoft collaborators and see what their interests and challenges were. "We could leverage the very powerful infrastructures developed by industrial labs, particularly the Pex infrastructure," Xie said. "My students could come up with innovative ideas for improving the infrastructure to deal with various complicated situations in the real world software programs." Such industry-academia collaborations have enabled the university research to focus on the most relevant and important problems in practice, and to develop innovative solutions that can be feasibly and efficiently built, thanks to the powerful infrastructure developed by the industrial labs.

CODE HUNT

Visual Studio 2015

In July 2015, Microsoft released Visual Studio 2015, the latest version of one of the most widely-used software development environments today. Contained in that release is the IntelliTest unit testing tool, which is, essentially, Pex. The tool's inclusion in Visual Studio brings automatic test generation to average software engineers, alleviating time-consuming manual test data generation.

"It has been a wonderful journey of collaborating with Microsoft Research on Pex," Xie said. "In the future, besides continuing our collaboration on Pex and Code Hunt, we are expanding the collaboration scope, recently working with the Software Analytics group at Microsoft Research, to continue producing high impact in the software industry."

Pex for Fun & Code Hunt

Pex for Fun was started by Nikolai Tillmann and Peli de Halleux, Xie's collaborators from the Pex team at Microsoft Research, who wanted a way for participants of Pex-training workshops to experience features of Pex without needing to download the entire software package.

At its launch in 2010, the interactive website was quite basic. "Although the name of the website is Pex for Fun, it was not a whole lot of fun," Xie said. "You would type in code, and get the testing results. People may not come back to try the website again and again."

Xie suggested developing something that could be used as a teaching tool, and that could incorporate more fun elements. It was his idea to introduce Coding Duels: interactive puzzle games where the user has to create code with the same behavior as another, hidden method. Since its release, players have made close to 1.7 million game interactions in Pex for Fun.

After Pex for Fun had proven to be a popular tool, Judith Bishop, Director of Computer Science in Microsoft Research Outreach, joined the Pex team to design a site especially for use by students and educators that would be even more appealing. That was the genesis of Code Hunt, which was launched in 2014. Designed to be effective in running coding contests, Code Hunt adds a friendly interface, an interactive tutorial, hint generation, and the ability to work with Java, a popular language for introductory computer science courses.

Code Hunt provides a learning experience targeted at educators and students.