Case Study

Using TTworkbench in Networking Courses for Graduate Students at Tsinghua University, China

About the University

Tsinghua University was established in 1911 and has evolved into a comprehensive research university at a breathtaking pace. At present, the university is maintaining 14 schools and 56 departments with faculties in science, engineering, humanities, law, medicine, history, philosophy, economics, management, education and art. The university educates over 25,900 students, including 13,100 undergraduates and 12,800 graduates. As one of China’s most renowned universities, Tsinghua has become an important institution for fostering talent and scientific research. The educational philosophy of Tsinghua is “train students with integrity.” Among over 120,000 students who have graduated from Tsinghua since its founding are many outstanding scholars, eminent entrepreneurs and great statesmen remembered and respected by their fellow Chinese citizens.

Course Description

The graduate course on formal methods in computer networks and protocol engineering covers the whole process of protocol engineering including protocol specification, protocol verification and protocol testing. It also introduces some important formal methods used in protocol engineering e.g. FSM, LTS, SPIN, SDL, and TTCN-3. The course requires student's active participation in the form of presentations and practice-oriented projects. Related commercial or academic tools are to be used by the students in their project works. Protocol testing is the most important part of this course, so it is urgently required to provide respective tools to the students.

Why TTworkbench

Network protocol testing is one of the crucial research directions in our research group. We have conducted many research projects on protocol testing and TTCN-3. We realized that TTCN-3 is a standard, abstract, powerful and extensible testing language, so we widely use TTCN-3 technology in our research projects. As we know, TTworkbench is one of the most popular commercial software tools of TTCN-3, and we had already checked out its evaluation version before. In our impressions, TTworkbench has a friendly user interface, and is very easy to handle. So we chose TTworkbench to use in our course projects.

Working with TTworkbench

During the autumn semester 2011/2012 totally 14 students took part in the course. The university applied an educational license of TTworkbench Basic use of six months. We established a license server that enabled 20 users to work with the test automation platform simultaneously. This way, students could use the software in their homes or dormitories, sparing them the way to lab.

It took about half of the course to introduce theories of protocol testing. After teaching the basics of protocol testing for two classes (one class equals about two hours), students were introduced to basic concepts of TTCN-3. They dealt with the design of TTCN-3 test systems and illustrated how to perform TTCN-3 based testing with an example test case in BGP-4 protocol conformance testing. After this class, we also spent one hour to show how to download, install and use the TTworkbench tool. Besides, the course also addressed model-based testing, FSM-based testing, LTS-based testing, and test engineering for about 5 classes.
For the course project, students were divided into 4 groups of 3 to 4 students. Each group selected one course related topic to conduct their project. Out of 4 groups, 2 groups selected topics related to protocol testing and TTCN-3.

One group used both TTIworkbench and the model-based testing tool Conformiq Designer to perform conformance testing of an FTP protocol. At first, they designed a model and generated TTCN-3 test cases automatically with the Conformiq Designer. Afterwards they executed and analyzed these test cases with TTworkbench. Within their work, the students implemented a small part of a simple model for FTP protocol to generate related TTCN-3 test cases. They also implemented a test adapter for testing FTP protocol and finally performed practical testing. Thus, they performed a complete process of so called “model-based testing”.

Another group tended to study the conformance testing of RPL (IPv6 Routing Protocol for Low-Power and Lossy Networks) protocol. They used TTIworkbench to write some test cases, but did not perform testing eventually.

Our Plans for the Future

We hope to continuously participate in the educational program of Testing Technologies. For the autumn semester of 2012/2013 we are planning to design a course project to test some new network protocols, e.g. OpenFlow. From the perspective of research we want to find out whether current formal methods and tools can be used in testing future Internet protocols.

Instructors of the Course

Mrs. Xia Yin, Professor

Mrs. Yin has received the B.E., M.E. and Ph.D. degrees in computer science from Tsinghua University, China in 1995, 1997 and 2000 respectively. Currently she is a Professor in the Department of Computer Science and Technology of Tsinghua University. Her research interests include next generation Internet, formal methods and protocol testing, as well as network measurement.

Mr. Zhiliang Wang, Associate Professor

Mr. Wang has received the B.E., M.E. and Ph.D. degrees in computer science from Tsinghua University, China in 2001, 2003 and 2006 respectively. Currently he is an Associate Professor in the Institute for Network Sciences and Cyberspace at Tsinghua University. His research interests include formal methods and protocol testing, next generation Internet, and network measurement.

“Seeing these students experiment and work with the test automation platform TTIworkbench, we recognize how helpful “real-life” tools are for them to practice protocol testing and TTCN-3. They give them such a better understanding of taught concepts and technologies. We highly appreciate the cooperation with Testing Technologies and the opportunity for our students to work with their user-friendly TTIworkbench.”