

Using TTworbench in Networking Courses for Graduate Students at Tsinghua University

Education & Research – Protocol Testing – Communications Engineering

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 to „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. More information at www.tsinghua.edu.cn.

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 work. Protocol testing is the most important part of this course, so it is urgently required to provide respective tools to the students.

Why TTworbench

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, TTworbench 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, TTworbench has a friendly user interface, and is very easy to handle. So we chose TTworbench to use in our course projects.

TTworbench in Practice

During the autumn semester 2011/2012 totally 14 students took part in the course. The university applied an educational license of TTworbench 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 TTworbench 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 TTworbench 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.

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About Spirent Communications

Spirent Communications (LSE: SPT) is a global leader with deep expertise and decades of experience in testing, assurance, analytics and security, serving developers, service providers, and enterprise networks.

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Afterwards they executed and analyzed these test cases with TTworbench. 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 "modelbased testing". Another group tended to study the conformance testing of RPL (IPv6 Routing Protocol for Low-Power and Lossy Networks) protocol. They used TTworbench 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 (now Spirent). 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.



"TTworbench has become a key tool in our test automation project. After the initial learning ramp to integrate it in our own testing tools and team, clear benefits started to show. The reduction of the testing time quickly exceeded the cost, with a positive return of investment. Our experience with tools and company is consistently positive, making the investment in this test software definitely worth it."