Practical IT Training Courses using Open-Source Software

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1 Introduction

There are many systems that highly depend on open-source software (OSS), as a part of infrastructure of recent information society. Especially, embedded systems, such as mobile phone, and audio-visual equipments, are using OSS components like Linux kernel. Meanwhile, it is considered that there is a lack of well-organized training courses on OSS utilization in higher educational institutes in Japan. In universities, courses in computer science do not tend to be practical, and courses in engineering cannot catch up with the-state-of-art information technologies including the latest OSS trends.

Information technology engineers who utilize OSS in their daily work often acquire their skills through on-the-job training (OJT), because they don't have enough knowledge for handling OSS appropriately when they graduated from university. Instead of learning through OJT, to increase the number of engineers who are knowledgable on OSS utilization, Information-technology Promotion Agency, Japan (IPA) prepared a curriculum, which provides practical information technology and OSS knowledge, for higher educational institutes. In their curriculum, case studies are presented by OSS, in which knowledges on data base and system security are explained using MySQL and SE-Linux.

After IPA designed the curriculum, it made a plan to enhance its curriculum by preparing some documents that explain important points of the courses, and to provide model courses in Japanese universities. Under the program of IPA, we compiled a series of guidance documents for OSS-based curriculum for basic information technology knowledge designed by IPA. We developed teaching materials for some courses at universities, and evaluated effectiveness and appropriateness of the OSS-based curriculum for understanding information technology.

In this paper, an overview of the curriculum provided by IPA and some lectures delivered in universities are presented.

2 Overview of the Curriculum

The curriculum consists of 27 courses, which are shown in Table 1.

Table 1. 27 courses in the curriculum

Category	Title
Basic	1. Knowledge of OSS 2. Legal Affairs 3. Computer System and Architecture 4. Distributed Architecture
System	5. Concept of Linux and Basic Operations 6. Kernel of Linux 7. Linux System Management 8. Linux System Programming 9. Network Server Management 10. Cluster System Architecture
Network	11. Network Architecture 12. Network Management
Programming	13. Java 14. C, C++ 15. Light Weight Language
Development System	16. Development Frameworks 17. Development Tools 18. Integrated Development Environment
Security	19. Encryption 20. Network Security 21. OS Security
RDB	22. Basic Skills in RDB 23. RDB system management
Embedded Software	24. Embedded System 25. Embedded Development Environment 26. Embedded Application Development 27. Embedded System Optimization

This curriculum is basically written in Japanese, however, it is translated into English, and sent to the second working group of North-East Asia (NEA) OSS Promotion Forum, which is in charge of human resource development for OSS technology engineering. Recently the result of their discussion based on this curriculum was published[1].

In order to provide effective training courses in universities, preparation of the curriculum alone is insufficient. Teachers are in need of some guidelines

and examples of course materials for their lectures. Therefore, we made a series of guidance documents for the curriculum. In addition, we reported the effectiveness and usefulness of the curriculum by comparing with that of CC2005.

3 Model Courses

IPA has been promoting practical course development along with the curriculum since 2008. With support of IPA, several educational institutes and enterprises have made their plans to develop training materials, and to deliver lectures using such materials.

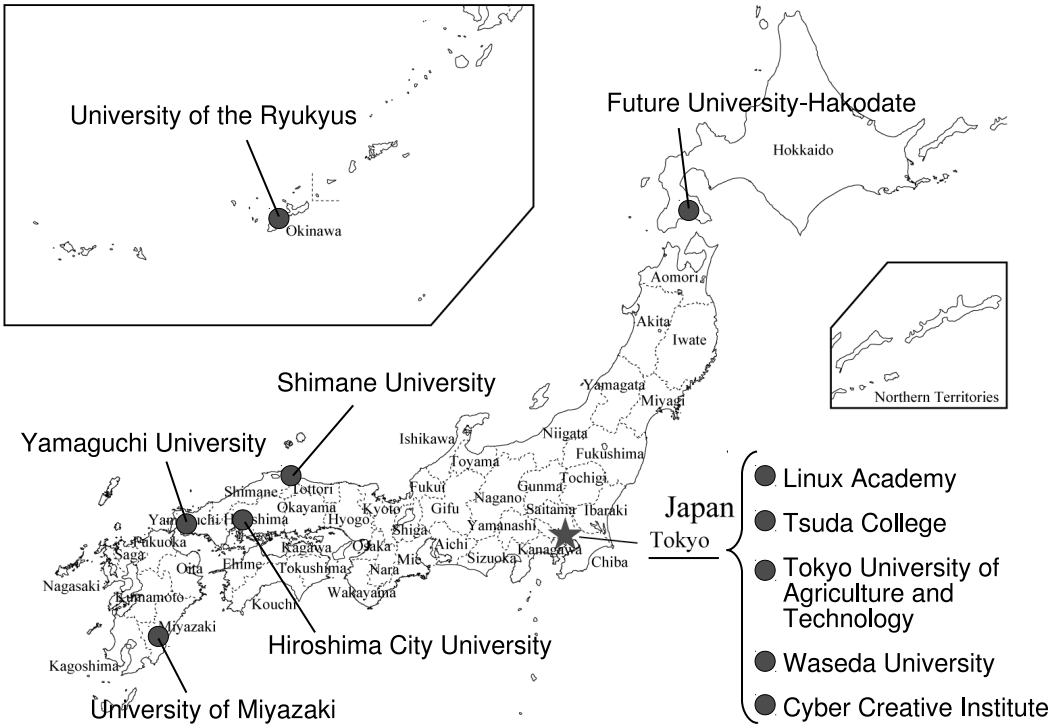

Fig. 1. Member universities participating in this program

Figure 1 shows the member universities that join in the program, and site where lectures were conducted (or are planned). Note that all of the curriculum is not covered with courses provided by these universities. Each university chooses and provides courses that fit into their own existing curriculum.

For example, Mitsubishi Research Institute,Inc. (MIRI) developed 6 courses for 3 universities in FY2009, and now is planning to develop 3 courses for 2 universities in FY2010 (as shown in Table 2).

Table 2. Courses developed and managed by MIRI

FY2009	Miyazaki Univ.	C Programming (C,C++) Network Security
	Shimane Univ.	C Programming (C,C++) Development Tools / C,C++ Development Framework
	TUAT	Development Framework
FY2010	Waseda Univ.	Knowledge of OSS Legal Affairs
	Univ. of the Ryukyus	Knowledge of OSS

4 Evaluations

In our activity regarding the OSS curriculum promotion, we did not only develop course materials, but also evaluated the effectiveness and usefulness of the OSS-based curriculum. At the end of every lecture, we asked students to fill in a sheet of questionnaire, asking if they could understand issues discussed in the lecture, whether explanation of OSS in the lecture could help their understanding or not, and so on.

Figure 2 illustrates an interesting result of the questionnaire. These graphs show distribution of OSS contribution in understanding of information technology, judged by students who participated in the lectures.

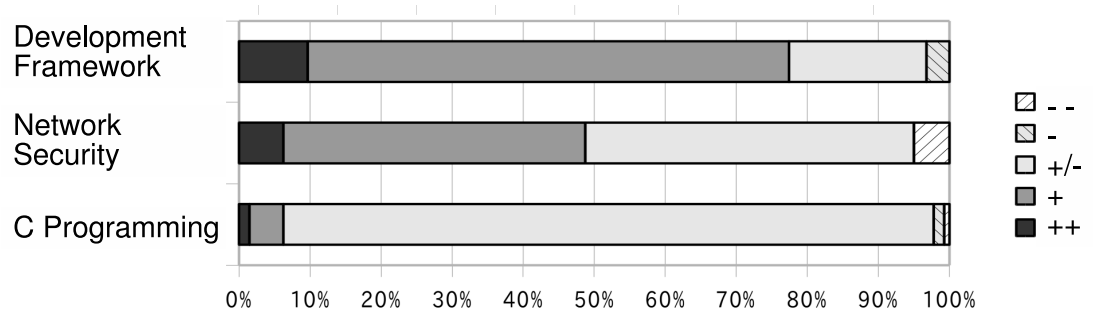

Fig. 2. How much does OSS-based explanation help to understand?

In the result of "Development Framework" course, more than half of answers say "OSS could be much help of understanding," and two thirds of answers say "OSS is helpful to understand subjects in the lecture." The result of "Network Security" course are similar. On the other hand, The last graph showing answers from "C Programming" course imply that OSS does not imply that OSS has effect to learn how to write C programs. Actually, in the "C Programming" course, although students tackled their courseworks on Linux platform and used gcc to build their works, they could not understand

its advantage to acquire techniques to build C programs, and we also could not explain it sufficiently. This result leads us to conclude that the curriculum should be modified focus on more advanced courses.

5 Related Works

Lots of cases that utilize OSS in engineering curriculum have been reported, especially in Europe[2, 3, 4, 5]. Furthermore, not a few classes of information technology education are adopting OSS to teach essential technologies in universities abroad. In addition, there is a unique approach to collect educational materials based on OSS into a repository[6].

However, such cases that OSS is used effectively in information technology education are still not reported in Japan, except for this program by IPA. Long[7] has discussed its effectiveness not only in technological aspect but also in management aspect. He presumed that an experience of software development practices using OSS was effective in fostering engineers, and confirmed it based on evaluations by executives and managers.

6 Conclusions

We show an overview of curriculum in OSS education and reported some model courses delivered at several universities in Japan along with the OSS-based information technology education material development program.

Well-organized learning of OSS can be help of understanding practical information technology, beyond simply acquiring skills in OSS. Raising an information technology engineer to be really competitive requires not only to learn a method to introduce proprietary software but also to acquire practical techniques in software development, such as ability in fundamental problem solving and capacity to adapt technology-innovation. The curriculum based on OSS can provide practical education materials quite efficiently in acquiring these capability. Therefore we expect that it is adopted in many engineering education institutes in Japan.

The education materials that were developed in this program are planned to be published under the Creative Commons Public License BY 2.1 Japan, in order to be used freely by anyone who wants to utilize them in his teaching activities. Regarding the 6 course materials developed by us, we have already prepared a web page[3] that is introducing them to the public. The other course materials are also set up to be published in the other developers' web site, in a similar way.

[3] `http://it-center.mri.co.jp/insights/itc/oss_curriculum/`

Acknowledgements

This study has been conducted as part of the Open-Source Software-Utilization Development Program, supported by the Information-technology Promotion Agency, Japan.

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