

Designing of Image Processing Curriculum Considering Network Security

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Abstract

This research is to design a curriculum for the students who will be dealing with the image processing techniques, and at the same time, network security has been considered as well. The goal of this curriculum is to prepare the students attending higher education systems or the novice network engineers for a fundamental knowledge in network systems and required skills. As such a basic design has been common in other curriculums, this study will also add another critical issue to its contents; the problems associated with network security which is becoming more serious every year. The curriculum consists of 6-hour courses during which students can learn about some of the basic network configurations while experiencing typical operating processes where Java language skill is required. The introductory-level graphic processing techniques are provided in the curriculum through several case studies and some specific network attacking methods and their outcomes will be introduced and discussed. In each course, the communication protocols, available services and problem solving methods are described and explained and the students' level of understanding and final achievements will be measured based on the assignments given to them. For instance, in imaging process, the students are to classify applied protocols and services on the basis of individual definitions and port-numbers assigned, followed by image capturing and transferring of captured image to the text box for an image printing task. Meanwhile, the network security courses involve analyses of packet traffics which will allow the students to locate the host or origin of malicious attacks exploiting malignant packets to sever communications or shut down entire systems. In the future extended study the author will extend the courses to provide in-depth knowledges while transforming the curriculum to make it more adaptable to non-IT or non-science majors.

Keywords : Image Processing Curriculum, Network Security Curriculum, Computer Curriculum, Network Curriculum, NCS.

1. Introduction

Accessing to an internet network has never been easier. People can now stay connected 24 hours a day through their smart devices available in every corner of the world, either for their business or entertainment [1-6]. Due to the increased connection speed, a large volume of data packets can be delivered in just a few seconds and the speed is improving every year or less that people do not actually have time to stop and think about the what these packets can do

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to harm themselves. Faster speed and more data volume mean higher risk of unwanted attacks.

The proposed curriculum will acquaint the students with the risk of neglecting safety measures for their systems by teaching them how to analyze packets and their flows within a simply configured network. It will be possible to let them actually carry out some malicious network attacks by using a closed network in the future for better understanding.

2. Theoretical Background

2.1. Computer Curriculums of USA

Traditionally, 3Rs (i.e., Reading, wRiting and aRithmetic) have been emphasized in the USA education system [7][8] but the significance of the computer education is growing due to the development of information technology and ever increasing interest in computer education.

The characteristic of the USA's high school curriculum system is that the nation does not make national level curriculums but each state runs their own specialized educational systems. The same goes for computer education so that the national education project such as the establishment of the nationwide school network is carried out at national level, but curriculum development is exercised at each school district of respective states, where independent education is performed (Young-Kwon Bae, Jin-Sook Lim, Tae-Wuk Lee [8]). Most states include computer subjects in science and technology related courses rather than treating them separately [1][2].

2.2. Computer Curriculums of United Kingdom

A summary of 'A study of the United Kingdom (UK) computer curriculum' by Mi-Ryang Kim [9] is as follows: The computer courses in the early computer education system of the UK were also non-independently established and the learning contents were merely about information technology described in the technology-related subject which was just one of 10 relevant basic courses. However, technology was regarded as a major course along with mathematics, science and English and its importance had been emphasized in the national curriculums. In the UK, the infrastructure for computer education has been prepared by establishing the national learning network and by adopting ICT as an independent subject, they set the condition to be able to accomplish systemic education for all students up to 9th grade [1][2]. Information technology is not limited to ICT courses and the student can also access

independently established ICT education even after 9th grade by choice. They provide the systemic and active support for ICT education at the political level and such institutional/financial support is becoming a foundation for fostering outstanding individuals who are supposed to lead the UK's information-oriented society [1][2].

2.3. Computer Curriculums of India

A summary of the study relayed to the India computer curriculum Mi-Ryang Kim [9] is as follows: India has achieved recognition as an IT power in fact as well as in name. It produces about 30% of IT professionals in Silicon Valley and holds the second place following US in the world software market. Moreover, its competency is recognized widely so that 185 out of 500 Fortune companies entrust their software outsourcing work to it. Although information infrastructure in India is comparatively worse than that of most other advanced countries, the country is expected to overcome such a disadvantage with the development of its software-oriented IT industry. Excellent IT human resources, STP (Software Technology Parks) plan and strong software industry development policies largely contribute to the recognition of the India as the IT power [1][2].

India's computer education, which has been enhanced much further than in any other country, is the foundation of its growth. Compared to the fact that other nations are giving weight to the utilization of computer functions, India's computer curriculums emphasize algorithms and applied mathematics. Also, it's possible to observe that they are introducing programming languages in early stages but lessons for software applications and network use come in later compare to the other nations.

In our country, we encounter programming languages when in colleges but in India, they can be learned at the elementary school level through regular curriculums, with C++ or Java languages introduced at middle and high schools, revealing that students in India are receiving high-level programming education [10][11].

3. Port Number-Based Classification of Protocols and Services

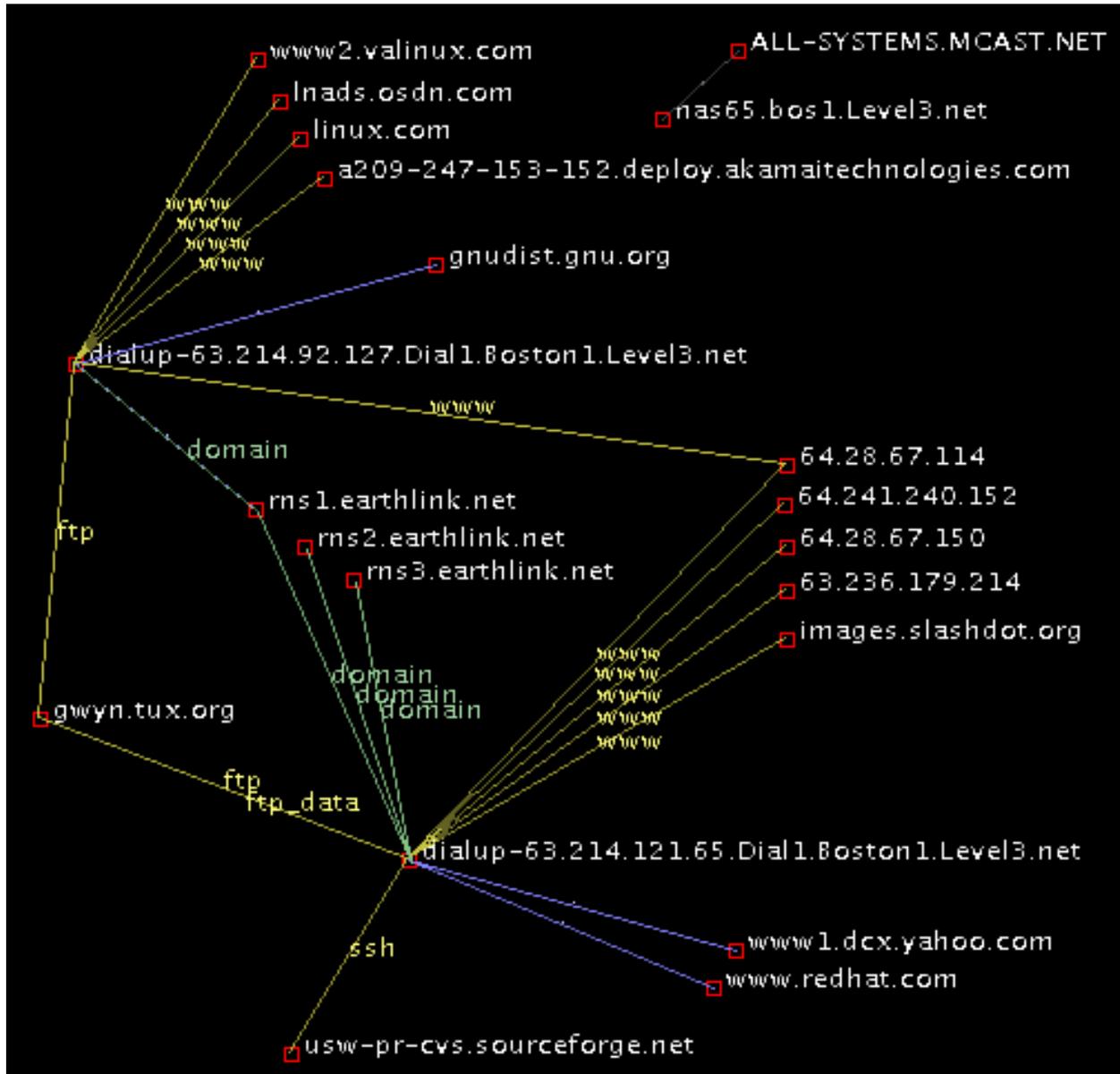
To describe a packet traffic, the initial point of packet flow, destination (address) and the protocol and service used for such a transmission should be identified and provided. That is, the graphic presentation of a certain packet flow should position a client at the center point of a drawing and indicate individual packets' starting points (initial departure point) and

destination points with dots around the client. The dots are then connected with straight direct lines which carry the names of used protocols and services alongside of them. For example, if a packet has been transmitted by using TCP, an indication 'HTTP' should be marked alongside of the relevant connecting line. Likewise, the port numbers for the packet can be assigned and marked. The same process will be applied to other packets as well. The picture below shows the final results. One can check each packet to determine whether the packet has been transmitted under the appropriate protocol used by using an operator 'instanceof'. For this task check the corresponding port numbers and output relevant contents of the targeted packet such as addresses of starting and destination points. The overall results are represented in [Fig. 1].

```
HTTP
/192.168.52.101 --> /216.34.181.96
=====
HTTP
/192.168.52.101 --> /216.34.181.96
=====
DNS
/192.168.52.101 --> /192.168.52.254
=====
DNS
/192.168.52.254 --> /192.168.52.101
=====
HTTP
/192.168.52.101 --> /216.34.181.96
```

[Fig. 1] Resulting Screen.

Eventually, the packet traffic will be subjected to analysis with the data collected in this process. [Fig. 2] shows the example of such an analysis using the Jpcap packet capturing (sniffing) tool.



[Fig. 2] A Jpcap Traffic Analysis Tool.

The major problem in this case is that various overlappings could appear in the contents captured as there are numerous number of dots (points) and lines in the graphic presentation [Fig. 3]. This makes it very difficult to comprehend the picture, and to circumvent the problem, indicate those overlapping points as a single same data after simplifying (solving) overall overlapping problems in the transaction.

4. Printing Out Captured Contents in Text Area

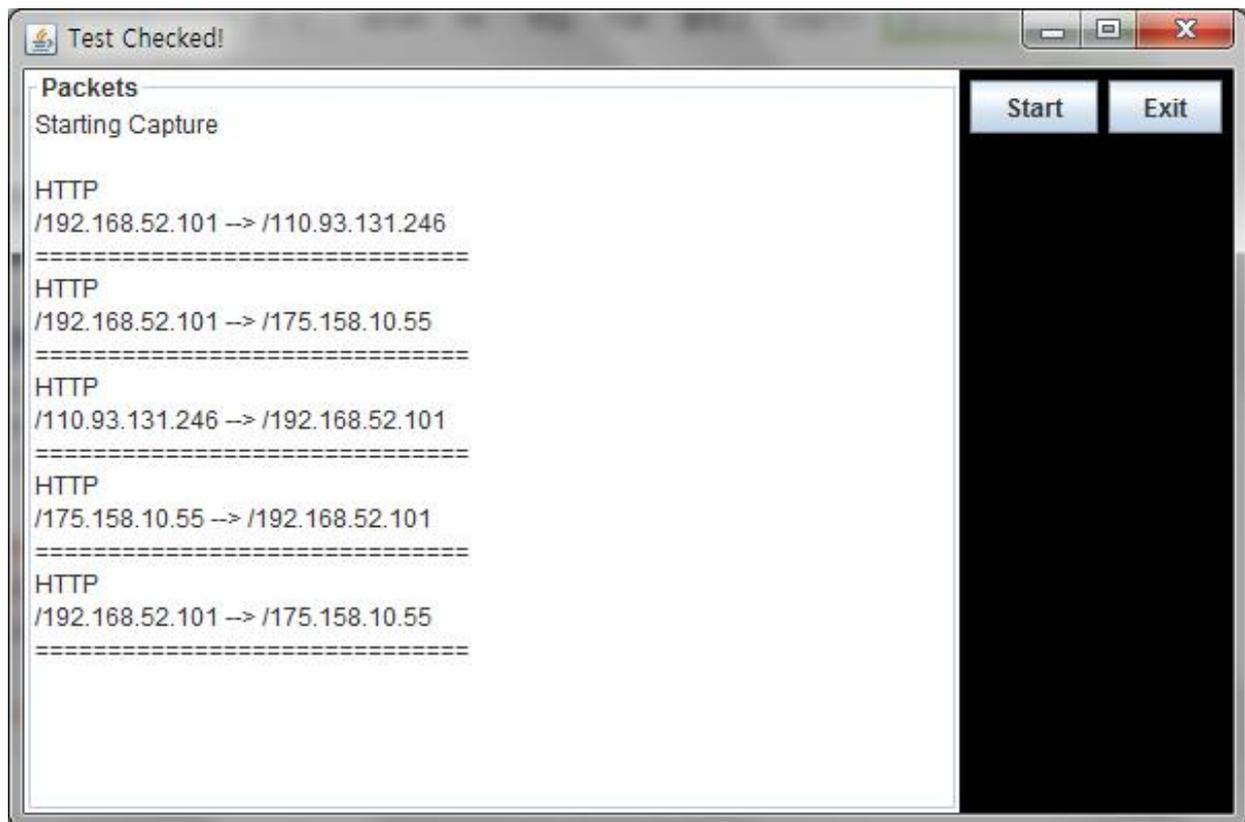
The author finds that it is better to indicate the captured contents in a text form before

```
HTTP
/192.168.52.101 --> /216.34.181.96
=====
DNS
/192.168.52.101 --> /192.168.52.254
=====
DNS
/192.168.52.254 --> /192.168.52.101
=====
HTTP
/192.168.52.101 --> /216.34.181.96
=====
HTTP
/216.34.181.96 --> /192.168.52.101
=====
```

[Fig. 3] Overlapped Contents.

presenting them graphically. Thus, a port number-based classification program developed in advance has been linked with the system GUI (Graphical User Interface) such that capturing of packets and presentation of its contents can be performed by clicking the 'Start' button to print them in a text box.

A function button 'Append' was used to output the target address in the text box while InnerClass was created to additionally output 'rs' (string form) which contains the address value. InnerClass was not used for this process in the beginning stage of implementation as it was not decided how to deliver the value until then but in the later stages, creating the InnerClass to guarantee stable packet capturing process seemed logical. The other class added was the EventListener for 'Start' and 'Exit' buttons. A network device can initiate its operation with the Start button and the program will be executed with 'looppacket'. Afterwards, the UI (User Interface) resembling [Fig. 4] will be in action.



[Fig. 4] Output Screen.

5. Conclusion and Future Works

The contents related to the basic network configuration and packet traffic flows are included in the proposed curriculum for the college students, novice network operators/designers and security staffs. This short 6-hour curriculum can be used by both science and non-science majors as the consisting courses cover basic subjects so that the students can go through them without much problem as long as they are willing to spend a fraction of their entire time in the university.

Among other things, the author has focused on tracking the host who are transmitting the malicious packets by analyzing each relevant packet with his packet analysis algorithm. The results of analysis then can be used to decide whether to block the suspected host or not. The future plan for this curriculum is to make it more adaptable to the non-science or non-engineering majors. His additional plan is to check and analyze the students' achievements through a formulaic survey.

Although this curriculum focuses on providing a basic knowledge of network configuration

and packet traffic analysis, improved scenario designing, programming and operation skills can be expected additionally.

Appendix

The first part of this paper was presented in Poster Session at 2016 Spring Conference of the Korea Multimedia Society, May 27-28, 2016 [10]. The main topic of this academic conference is The Convergence of 4th Industrial Revolution and ICT: Computer Education, Artificial Intelligence, and others. This study is a pedagogical paper for the conference [10]. I am grateful to 2 anonymous commentators who have contributed to the enhancement of the paper's completeness with their valuable suggestions at the conference. The author would like to thank Emeritus Professor Hong-Wook Huh (Former Dean of the College of Education, Pusan National University; Major of Biology Education, Busan, Republic of Korea).

The second part of this paper was presented in Oral Session at 2016 Winter Conference of the HSST, Jan 20, 2017 [11]. I am grateful to 2 anonymous commentators who have contributed to the enhancement of the paper's completeness with their valuable suggestions at the conference.

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