

1. Course Code

2222

2. Course Title

G61e: Advanced Information Network

3. Teacher

YOKOYAMA, Teruaki

4. Term

Fall 1

5. Course Requirements (Courses / Knowledge for this course) and Important Information

Fundamentals of Computer Systems

Fundamentals of Information Networks

6. Course Overview and Objectives

In this course the students study the advanced technologies for constructing and operating computer network on the Internet infrastructure. The aim is to gain an understanding and knowledge of the Internet technologies. The course consists of lectures along with the layered network technologies that are the essential structure of the Internet technologies and changing of them in future. The lectures contain the content about the link technology, IP/TCP/UDP technologies, some network applications and investigation how they are changed in future.

7. Course Outline

- 1 Introduction
- 2 Link Layer technologies (1)
- 3 Link Layer technologies (2)
- 4 Network Layer technologies (1)
- 5 Network Layer technologies (2)
- 6 Transport Layer technology
- 7 Feedback report / Share knowledge
- 8 Review learned topics
- 9 DNS service
- 10 Application Layer
- 11 WWW service architecture
- 12 IoT, other related technologies
- 13 Feedback report / Share knowledge
- 14 Review learned topics
- 15 Conclusion
- 16

8. Textbooks (Required Books for this course)

None

9. Reference Books (optional books for further study)

None

10. Course Goals (Attainment Targets)

- (1) To know how the Internet works.
- (2) To know how the elements of the Internet will be changed.
- (3) To know modern networked application design.

- (4)
- (5)
- (6)
- (7)
- (8)

11. Correspondence relationship between Educational goals and Course goals

Educational goals of the school		Course Goals	
High level ICT skills	Basic academic skills		
	Specialized knowledge and literacy	(1),(2),(3)	
Human skill (Tankyu skill)	Ability to continually improve own strengths		
	Ability to discover and resolve the problem in society	Problem setting	
		Hypothesis planning	
		Hypothesis testing	
		Practice	
	Fundamental Competencies for Working Persons	Ability to step forward	
		Ability to think through	
Ability to work in a team			
Professional ethics			

12. Evaluation

Goals	Evaluation method & point allocation					
	examination	Quiz	Reports	Presentation	Deliverables	Other
(1)			○	○		
(2)			○	○		
(3)			○	○		
(4)						
(5)						
(6)						
(7)						
(8)						
Allocation			80	20		

13. Evaluation Criteria

Examination	
Quiz	
Reports	Check understanding for the network technologies learned at lectures
Presentation	Check understanding for the network technologies learned at lectures
Deliverables	
Other	

14. Active Learning		
Hourly percentage of active learning within the whole class time		0%
1	Active learning such as problem solving assignment using the knowledge and skills acquired in class.	Not at all
2	Active learning such as group works and discussions.	Not at all
3	Outcome presentations and feedbacks.	Sometimes
4	Students actively make decisions on how the class should be conducted.	Not at all

15. Notes

16. Course plan

(Notice) This plan is tentative and might be changed at the time of delivery

Lesson 1: Introduction (Lecture 90 min)

This lesson explains an outline of the course and a brief summary of the Internet technologies. The Internet consists of stacked multiple protocols, which is called “layered network architecture”. As a beginning of the Internet studying, students learn the layered network architecture of the Internet communication to help them to obtain the perspective view how the Internet communication mechanism works.

1. Orientation (learning objectives, schedule, evaluation)
2. A summary of the present Internet technologies and applications
3. An introduction of the layered network architecture

Lesson 2: Link-layer technology (1) (Lecture 90 min)

This lesson explains the function of the link layer and the physical layer mechanisms. The link layer deals with a reliable data transmission between pairs of nodes that connected with same link media. The lesson introduces current major link technologies, e.g. the Ethernet, the WiFi, the LTE and so on, to help students to judge appropriate link technologies for their demanding.

1. A brief summary of the link layer mechanism
2. An introduction of the major link technologies

Lesson 3: Link-layer technology (2) (Lecture 90 min)

This lesson continues to explain the link layer mechanism. Students learn fundamental functions about the link layer mechanism, e.g. media access control and network topology creation with link connection. They experience the link layer functions through practical exercises. The aim is to understand the link layer communication capabilities and limitations.

1. A study of the link layer functions (MAC, Addressing, Topology)
2. Practical exercises (check MAC address, ARP table)

Lesson 4: Network-layer technology (1)**(Lecture 90 min)**

This lesson explains the function of the network layer mechanism. The network layer is responsible for a data transmission over the multiple link media. This lesson introduces the Internet Protocol (IP) as the representative network layer protocol of the current Internet and its related technologies. Students learn the fundamental of the IP technologies first, e.g. the IP address, the addressing assignment rules, the IP packet structure. Then students learn additional IP related technologies, such as Dynamic Host Configuration Protocol (DHCP) and Network Address Translation (NAT) mechanisms.

1. A brief summary of the IP mechanism.
2. A study of the network layer functions (IP address, IP packet)
3. A study of the network layer related mechanisms (DHCP, NAT)

Lesson 5: Network-layer technology (2)**(Lecture 90 min)**

The network layer deals with packet forwarding and routing functions. The router is a computer to support the IP packet transmission over different link media. While the transmission, the routers have to decide an appropriate route sender node to receiver node. This lesson introduces the principle of the routing mechanisms. The aim is to understand the network layer communication capabilities and limitations. Moreover, this lesson explains Internet Communication Message Protocol (ICMP) that is used for control message transmission with IP mechanism.

1. A study of the routing mechanism (IP forwarding, Static/Dynamic routing)
2. A study of the ICMP protocol (ICMP message type, ICMP applications)
3. Practical exercises (check routing table, check dynamic routing function, traceroute, ping)

Lesson 6: Transport-layer technology**(Lecture 90 min)**

This lesson explains the function of the transport layer mechanism. The transport layer deals with logical units of a data transmission. The major transport layer protocols are Transmission Control Protocol (TCP) and User Datagram Packet (UDP). TCP provides error-free data transmission with their packet retransmission mechanism. TCP also regulates bandwidth usage of the transmission for keeping fair use and avoiding congestion at the link media. Meanwhile, UDP does not provide any reliable control for data transmission. In this lecture, students learn TCP and UDP mechanisms and their works. The aim is to understand the transport layer communication characteristics.

1. A study of the transport layer functions (TCP, Flow control, Congestion avoidance, UDP)
2. Practical exercises (monitor TCP/UDP transmission, check TCP flow control)

Lesson 7: Presentation and discussion**(Lecture 90 min)**

In this lesson, students have to present their presentation. The presentation must include the situation of the Internet deployment in student's country. Otherwise, the interested link-layer technologies and its usage are acceptable as the presentation. Students have 15 minutes for their presentation and discussion.

1. Presenting student's presentation.
 2. Having discussion based on their presentations.
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Lesson 8: Review for lectures**(Lecture 90 min)**

In this lesson, students have an opportunity to clear their doubts and to demand an additional lecture about the things they want to know more.

1. A review of the previous lectures
2. An opportunity for having questions
3. An opportunity for demanding an additional lecture

Lesson 9: Domain Name technology**(Lecture 90 min)**

This lesson explains the concept of domain name on the Internet and how the naming space is operated. Domain name is one of the significant technologies for the ordinary users. It is operated with DNS (Domain Name System) as the huge scale distributed databases. With the DNS, the ordinary users can access to the host on the Internet without any concern for IP addresses and physical location. Students learn the divide-and-conquer operation of the domain name and how the DNS supports the operation. The aim is to understand the principle of the naming function on the Internet and its application.

1. A study of the concept of domain name on the Internet (Structure and Management)
2. A study of the mechanism of DNS (divide-and-conquer strategy, distributed operation)

Lesson 10: Application-layer technology**(Lecture 90 min)**

This lesson explains the function of the application layer abstraction. The application layer is an abstraction layer providing communication methods designed for process-to-process data transmission across an IP network. As hiring communication on the application layer function, Socket API is provided for network programming. Students learn the abstraction of the layer and some examples for network application. The aim is to understand the method to use communication functions for their demand.

1. A study of the concept of the application layer
2. Practical exercise (Socket programming examples)

Lesson 11: WWW technology**(Lecture 90 min)**

This lesson explains World Wide Web technology as a representative application on the Internet. WWW is a major application on the Internet. WWW can support various kinds of services. WWW technology consists of three technologies such as HTTP, URL and HTML. Through the lecture of the technologies, students learn how to make WWW technology with them. Students also learn about the possible applications on the Internet from some examples. The aim is to understand WWW capability and to become able to design WWW services.

1. A study of the summary for the WWW technology
 2. A study for key technologies of WWW (HTTP, URL, HTML)
 3. A study of the typical examples of the application on WWW
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Lesson 12: Other technologies**(Lecture 90 min)**

This lesson explains network related important technologies, Public key cryptosystem, Virtualization and Distributed computing. Public key cryptosystem is one of the most significant techniques against security concerns on communication via the Internet. Virtualization is expected that it may contribute to give more flexibility and more controllability to networking by software-based network control. Distributed Computing provides powerful and interesting services based on communication on the Internet. Students learn these technologies for understanding more about applications and the capabilities in future.

1. A study of Public key cryptosystem
2. A study of Virtualization technologies (Virtual Machine, Virtual Network, Cloud Computing)
3. A study of Distributed Computing (Server-Client, Clustering, Distributed Computing, P2P)

Lesson 13: Presentation and discussion**(Lecture 90 min)**

In this lesson, students have to present their presentation. Students are required to choose the technical mechanisms or the services. And students investigate them and present their presentations. Students and teacher have a discussion with their presentations.

1. Presenting student's presentation.
2. Having discussion based on their presentations.

Lesson 14: Review for lectures**(Lecture 90 min)**

In this lesson, students have an opportunity to clear their doubts and to demand an additional lecture through about the things they want to know more.

1. A review of the previous lectures
2. An opportunity for having questions
3. An opportunity for demanding an additional lecture

Lesson 15: Conclusion**(Lecture 90 min)**

In this lesson, the course content from the 1st up to 14th is reviewed briefly for confirming and supporting student's understanding.

1. A summary of the whole course content
 2. Presentation
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