CS305
Computer Networks

2023 Spring

Instructor: Zhuozhao Li

Lab: Qing Wang

Department of Computer Science and Engineering

Bilingual lectures

- Only involve basic everyday spoken English
- Translations provided when necessary
- Ask the instructors or student assistants (SAs) immediately when you have any questions
  - Feel free to ask in Chinese

Course information

Lecture:

- Zhuozhao Li, lizz@sustech.edu.cn
  - Office: RM 516, South Tower, CoE Building （工学院南楼516）
- Lectures: Wednesday 2:00 PM – 3:50 PM
- Location: Room 208, The Third Teaching Building

Lab:

- Qing Wang, wangq9@mail.sustech.edu.cn
  - Office: Room 110, South Tower, CoE Building
- Location: Room 504, The Third Teaching building

Introduction

- Zhuozhao Li, Ph.D.
- Assistant Professor, Department of Computer Science and Engineering
- Homepage: https://zhuozhaoli.github.io/
- Office hour: Friday 3-5pm or by email appointment
- Research interests:
  - Distributed systems and cloud computing

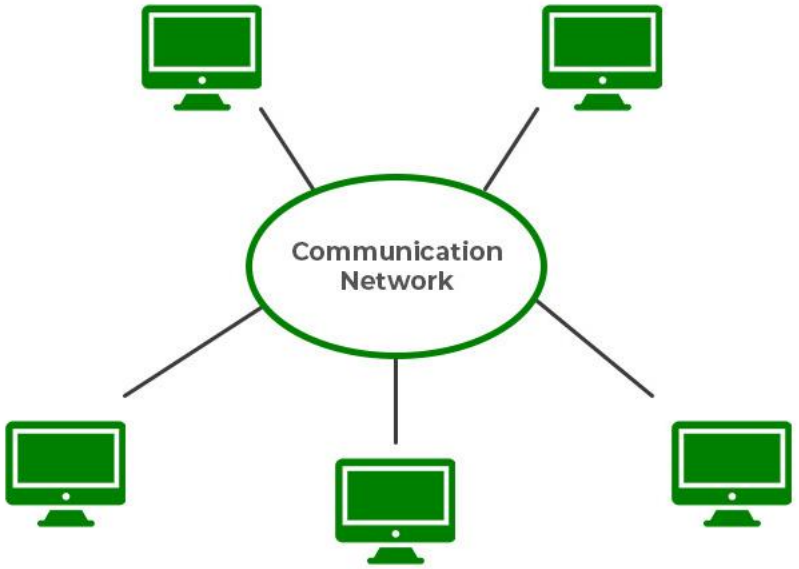
Distributed system

A system whose components are located on different networked computers, which communicate and coordinate their actions by passing messages to one another

- Computers
- Networks

Examples of distributed systems

- Internet, websites, video content services…
- Supercomputers, cloud datacenters…



Course information

- Sakai: https://sakai.sustech.edu.cn/portal/site/db0d4bc0-03ad-4b69-83bd-0dd2ec67c8d1
  - Name: CS305-spring2023
- QQ group: 181896966
- Syllabus (Tentative)
  - https://zhuozhaoli.github.io/courses/CS305A/2023Spring/

Grading policy

- Homework and programming assignments – 15%
- Attendance and lab practice – 10%
- Project – 15%
  - CS students
  - Non-cs students
- Midterm Examination - 30%
  - Closed book
- Final Examination - 30%
  - Closed book

Assignments

- No late assignment will be accepted
  - Unless some special situations (e.g., medical leave) which will be reviewed by all the instructors
- The following excuses will NOT be approved for late submissions: computer crashes, disk crashes, accidental file deletions, lab computer unavailability, and the like
- Linux, Python, Wireshark, possibly C/C++ for the project (CS students only)

Rules about plagiarism

- No plagiarism is allowed
  - If plagiarism on homework or project is found for the first time, the plagiaristic part is graded as 0 and warning is given to the students
  - If plagiarism is found for the second time, the course is graded as 0
  - For project report, any sentence that is copied from other paper or article should cite the original source as the reference. Otherwise, the report is considered as plagiarism
- Submit the commitment letter on Sakai system
- Don't put your assignments or projects on any open-source website (e.g., Github). Otherwise, you have the same responsibility in case of plagiarism

What will we learn in this course?

- What is network? What is communication?
  - Consider the analogy in practice: communication vs. social network
- What networks do we use in daily life? Any other network ever heard?
  - Mobile network, WWW, social network, etc.
- What applications require network access?
  - WeChat, games, websites, etc.

What network problems have you ever met?

- The bits travel in the form of electromagnetic signals
- Perimeter of the Equator :

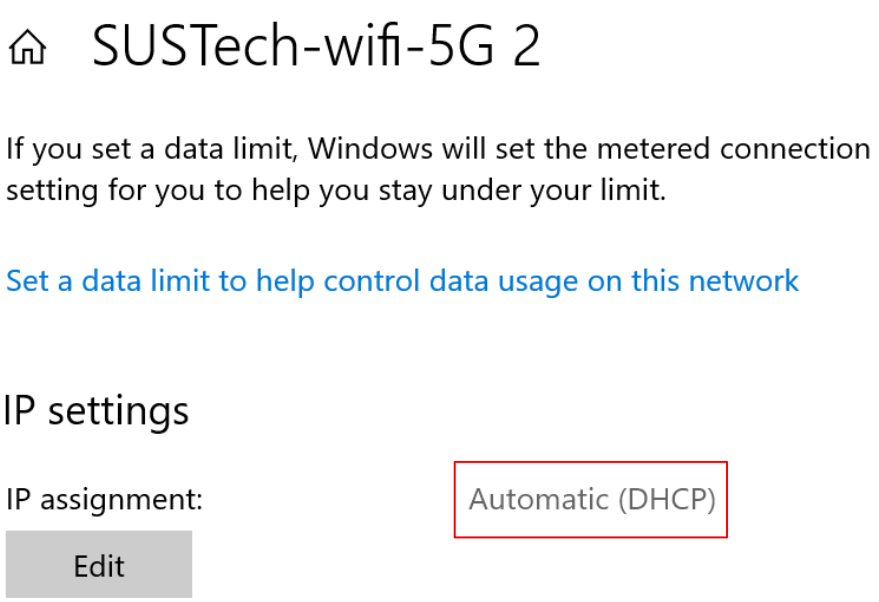
$$4 * 10^7 \text{ meters}$$

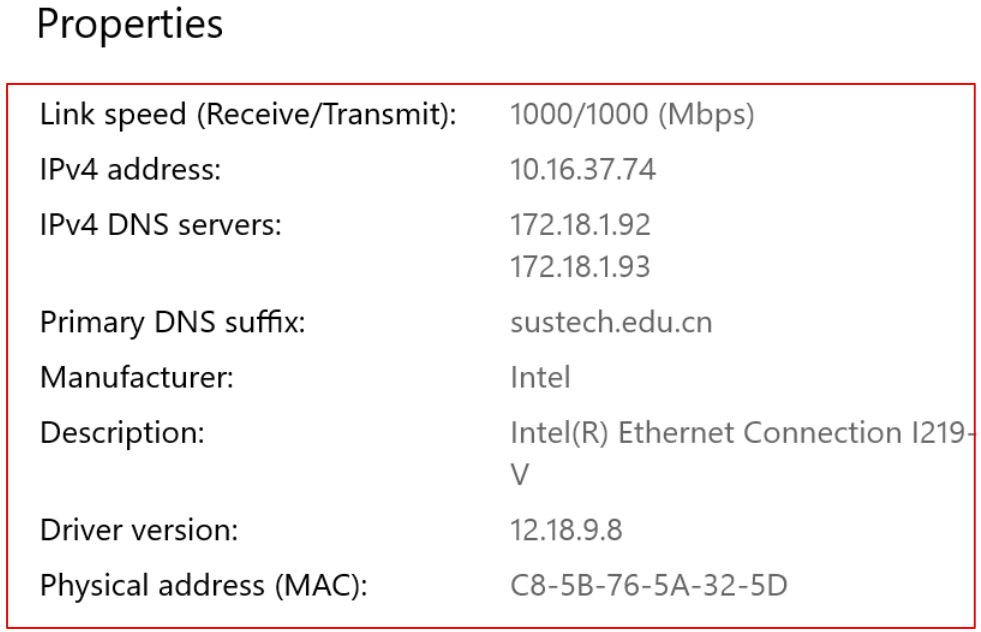
- Speed of signal in fiber:

$$2.14 * 10^8 \text{ m/s}$$

- Delay = 187 ms

What network problems have you ever met?





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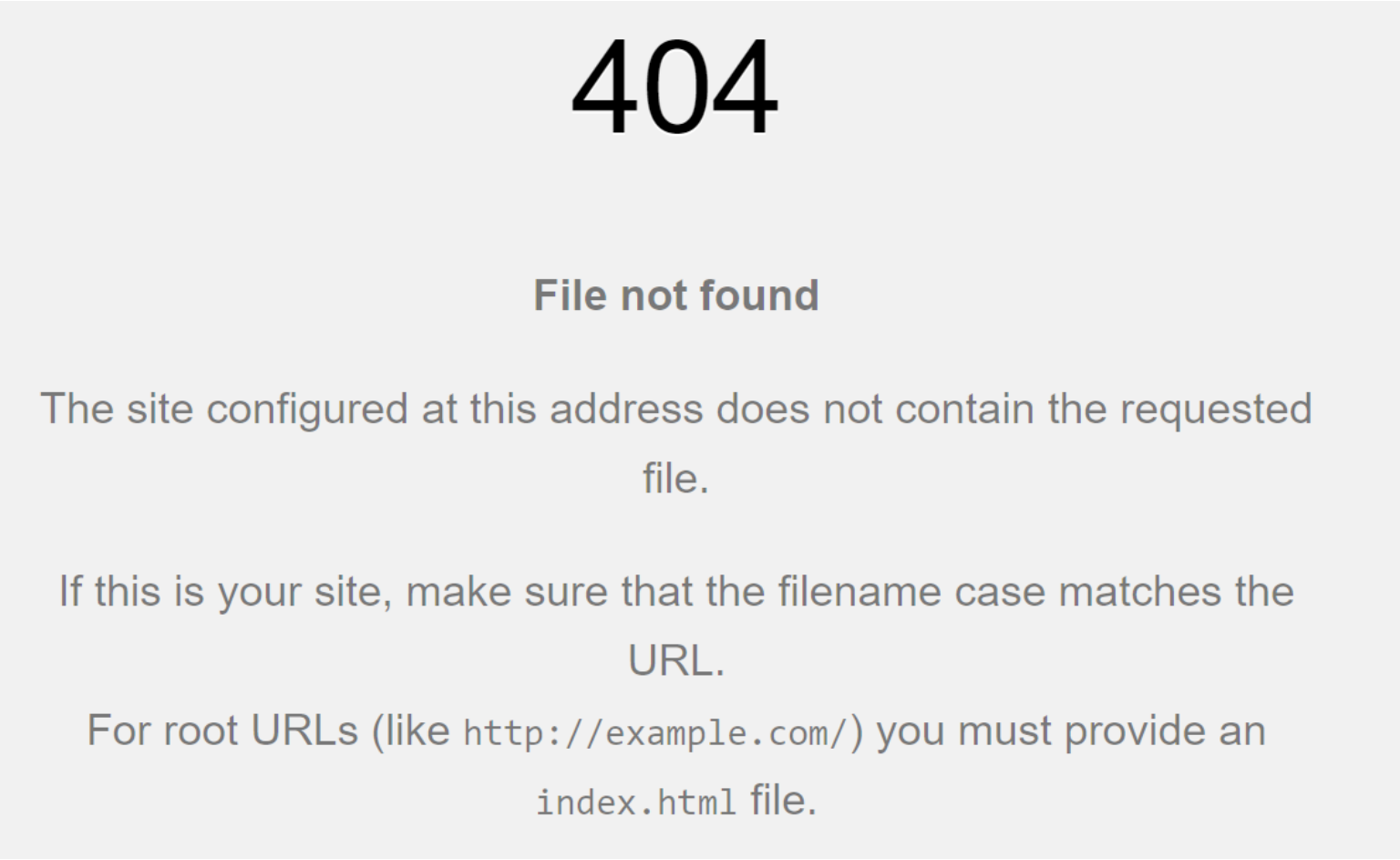


What network problems have you ever met?

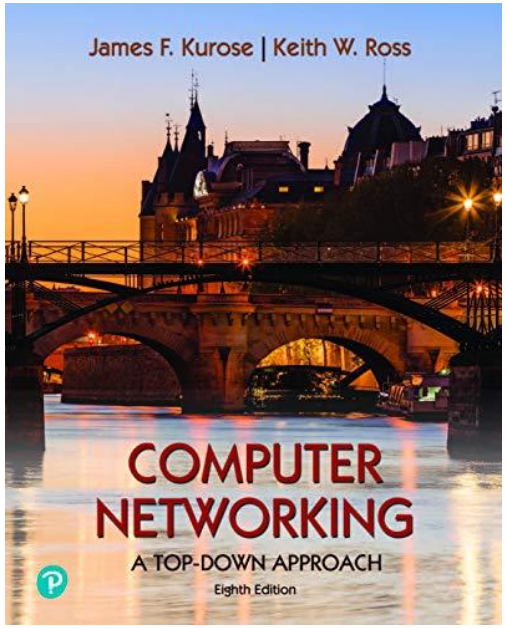
What is this course about?

- Introductory (first) course in computer networking
  - learn principles of computer networking
  - learn practice of computer networking
  - Internet architecture/protocols as case study

- Goals:
  - learn a lot (not just factoids, but principles and practice)
  - have fun (well, it should be interesting, at least)

Course materials

- Course materials:
  - Textbook: Computer Networking: A Top-Down Approach
    - J. Kurose & K. Ross, Pearson, 8th ed., 2020
  - Slides
- Online resources:
  - https://sakai.sustech.edu.cn
  - Textbook in pdf
  - Homework and assignments
  - Projects
  - Search



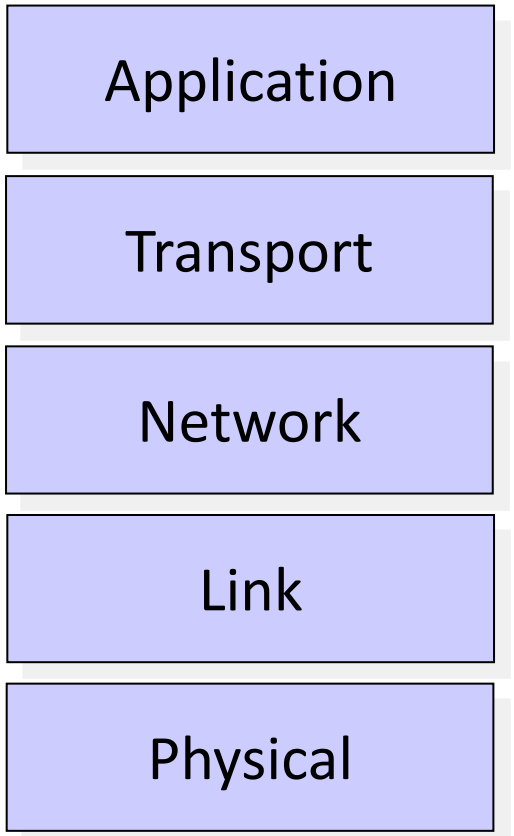
How to use the textbook?

- For each lecture:
  - Read corresponding content after class
  - Go through the review questions
  - Finish homework

- After each chapter
  - Read summary and interview if interested

Textbook information

- Computer Networking: A Top-Down Approach, James Kurose and Keith Ross, Pearson (8th Ed.)



- **Bottom Up**: Start with physical (e.g., wires) layer and move up to applications (e.g., mail, web browsers) layer explaining how functions are implemented
- **Top Down**: Start with application layer and move down to physical layer, explaining what expectations from applications, and how such services are implemented

Course overview:

Introduction *(2 classes, text: Chapter 1)*

- what is the Internet, what is a protocol?
- network edge, network core, network access
- physical media
- delay, loss, throughput in packet-switched networks
- protocol layers, service models
- Internet backbones, ISPs, IXPs
- brief history of networking, Internet

https://zhuozhaoli.github.io/courses/CS305A/2023Spring/#schedule

Course overview:

Application layer *(3 classes, text: Ch. 2)*

- principles of application-layer protocols
- World Wide Web: HTTP
- video streaming and content distribution networks
- electronic mail in the Internet
- the Internet's directory service: DNS
- P2P: Skype
- socket programming

Course overview:

Transport layer *(3 classes, text Ch. 3)*

- transport-layer services and principles
- multiplexing and demultiplexing applications
- connectionless transport: UDP
- principles of reliable of data transfer
- TCP case study
- principles of congestion control
- TCP congestion control

Course overview:

Network layer *(4 classes, text: Ch. 4-5)*

- introduction and network service model
- what's inside a router?
- routing principles (algorithms)
- hierarchical routing
- IP: the Internet Protocol
- Internet routing: RIP, OSPF, BGP

In Textbook 8th edition：

Network layer – Data Plane

Network layer – Control Plane

- Software defined network （SDN）

Course overview:

Link layer, LANs *(2 classes, text: Ch. 6)*

- introduction, services
- error detection, correction
- multiple access protocols, LANs
- LAN addresses, ARP
- Ethernet
- network as a link layer: MPLS
- a day in the life of a web request (synthesis)

We will add more physical layer content in this chapter

Course overview:

Wireless and mobile networks (1 class, Ch 7)

- wireless link characteristics
- the wireless link:
- 802.11
- cellular Internet access
- mobility principles
- mobility in practice:
- mobile IP
- mobility in cellular networks

Lab

Basic content:

- Basic network commands
- Packet capture using Wireshark
- Protocol analysis
- Socket programming

Make your hands dirty!

- Setup switch and router
- Setup wireless networks
- Analyze network performance

Tips for attending lectures

- Having around 100 students in one room is difficult
- To get the best use of lectures
  - Interactive
  - Interrupt and ask whenever you have any question
  - Ask immediately after the class if you are shy
  - Give me suggestions and feedback frequently
- Get the main ideas in class, read the details after class

Tips for this course

- Computer network is a human-invented object
  - No strict right or wrong, science vs. technology
  - limited by many factors -> trade-off
- We can meet almost all the content in our daily life
  - Think about: where do we use it when we learn a new application or protocol? What's your own experience?
- Take yourself as the designer of the internet
  - Think how to design the protocol before learn it
  - Try every idea out
- Computer network often mimics social network
  - Computer vs. people
  - Protocol vs. people communication

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Be active!
You can change the world!