

# CSC0056 Data Communication

## Course Introduction

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Department of Computer Science and Information Engineering  
National Taiwan Normal University

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**NATIONAL TAIWAN NORMAL UNIVERSITY**

# Agenda

Links to the lecture recording will be posted on the Moodle.

## 1 Introduction

- Essence
- Grading policy
- Academic integrity

## 2 A tour de course

- Systems
- Theory
- Literature study

## 3 Recap

# Course information

- Instructor: Chao Wang 王超
  - cw@ntnu.edu.tw
  - Office hours: Wednesdays and Thursdays, 2–4PM, or by appointment
- Teaching assistant: Cheng-Hsun Chuang 莊承勳
  - 60947063s@ntnu.edu.tw
- Course webpage: <https://wangc86.github.io/csc0056/>
  - An one-page summary of this course
- Course Moodle: <https://moodle.ntnu.edu.tw/>
  - Course slides, homework assignments, discussions, etc.
- Students taking this course should already have some working experience in both C and Linux

# This course is offered in English

- Offered in English  $\neq$  An English course
- EMI: English as a Medium of Instruction
  - promote online/offline discussion and conversation
  - make a liberal use of time to expound key ideas
  - use homework assignments as a crucial part of the learning process

# Topics this course will *NOT* cover

- Common computer network concepts, protocols, and algorithms
  - TCP/IP, link state routing, OSPF, Ethernet, physical layer, ...
- Wireless communication standards
  - Wi-Fi, Bluetooth, ZigBee, 5G, ...
- Related courses in the CSIE department:
  - CSU0019 Introduction to Computer Networks
  - CSU0038 Local Area Networks
  - CSC0010 Wireless Communication
  - CSC0052 Queueing Theory
  - CSC9004 Introduction to Internet of Things

# Topics this course will cover

- Analytical and empirical skillset to design, build, and evaluate data communication systems
- The MQTT protocol and its implementation
- Amazon AWS cloud platform (EC2 in particular), via AWS Academy
- Selected topics in data communication and their recent advances
  - real-time data communication
  - fault-tolerant data communication

# Textbooks and additional references

- Harchol-Balter, Mor. *Performance modeling and design of computer systems: queueing theory in action*. Cambridge University Press, 2013. ISBN 9781107027503.
  - Our library has both a hard-copy and an e-copy; you may access the e-copy via campus network.
- Bertsekas, Dimitri and Gallager, Robert. *Data networks (2nd edition)*. Prentice Hall, 1992. ISBN 0132009161.
  - Our library has a hard-copy; also, you may get a copy of the text from the author's webpage.
- Tarjan, Robert Endre. *Data Structures and Network Algorithms*. Society for Industrial and Applied Mathematics, 1983. ISBN 0898711878.
- More references will be posted on the Moodle (also, see page 15)

# Grading policy

- Homework assignments 50% (five assignments in total)
- Midterm exam 20%
- Final exam 25%
- Participation 5%
- All homework assignments are to be submitted via Moodle.
  - Submitting with the 24 hours past the deadline your score for that assignment will be deducted by 40%; after 24 hours, score = zero.
- There will be no make-up exam.



# Academic integrity



Figure: NTNU's motto.

- Sincerity
  - No hypocrisy. No cheating.
- Integrity
  - Walk in the light.
- Diligence
  - Preserverence and patience.
- Simplicity
  - Keep it simple but no simpler.

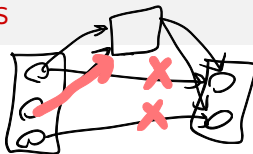
# The rest of today's lecture

- A course preview from the following three aspects:
  - systems
  - theory
  - literature study



**Figure:** A garden. (photo adapted from [Wikimedia](#) under the Creative Commons Attribution-Share Alike 2.5 Generic license)

# Data communication systems



- Peer-to-peer communication vs. broker-based communication

- ✓ Scheduled communication vs. free-for-all communication

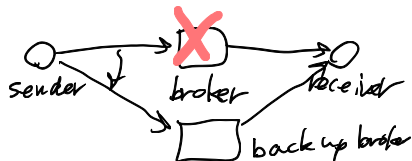
- TDMA scheduling in wireless sensor networks
- the Aloha system

- Performance metrics

- ✓ throughput
- ✓ timeliness
- ✓ fault tolerance ✓
- ✓ energy efficiency

data rate

Megabits per second  
 ↳ Mbps    Gbps  
 Gigabit



# The MQTT protocol

- A broker-based, lightweight, widely used messaging protocol
  - support three levels of Quality-of-Service (QoS)
- Eclipse Mosquitto
  - an open source implementation of the MQTT protocol, supported by the Eclipse Foundation

# Linux programming environment

- Some examples of Linux shell commands:

```
1 $ ls                # what about 'ls -lh'?
2 $ grep keyword *    # what about 'grep -R keyword *'?
3 $ tail someFile     # what about 'head someFile'?
4 $ cat someFile
5 $ ping www.google.com
6 $ man top
7 $ touch testFile
```

- An example Bash script:

```
1 #!/bin/bash
2 for idx in `seq 5 2 10`; do
3     echo idx
4     echo $idx
5 done
```

- <https://www.gnu.org/software/bash/manual/bash.html>
- Code tracing (we will learn to use Cscope)

# Theories for data communication

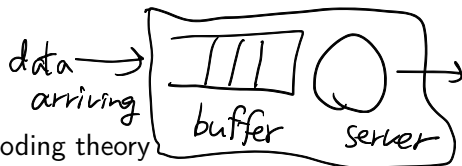
## ✓ Centralized algorithms vs. distributed algorithms

- ✓ the network flow problem
- ✓ distributed collision-free scheduling algorithm

## • Queueing theory




- Little's law
- Poisson process
- Markov chains

## • Error detection/correction coding theory



# Why literature study?

- Objectives

-  Catch up with the cutting-edge research findings
-  Learn from the original text
-  Trace and compare a school of thoughts

- Some online gateways to find research papers:

- Google Scholar
- ACM Digital Library
- IEEE Xplore

# Demo: using the Google Scholar

- Search by keywords
  - specific technology
  - conference/journal names
  - author names
- Forward references
- Building your own research library



# Elements in a CS systems research paper

- Typical sections include
  - Abstract
  - Introduction
  - Related work
  - System model
  - System design and implementation
  - Experimental results
  - Conclusions
  - References
- Example
  - C. Wang, C. Gill and C. Lu, "FRAME: Fault Tolerant and Real-Time Messaging for Edge Computing," 2019 IEEE 39th International Conference on Distributed Computing Systems (ICDCS), 2019, pp. 976-985, doi: 10.1109/ICDCS.2019.00101.

# Takeaway today

- Remember to check out both the course webpage and Moodle!
- Three aspects of this course: systems, theory, and literature study
- **Homework 1 will be available this evening**
  - Keshav, S. (2007). How to read a paper. ACM SIGCOMM Computer Communication Review, 37(3), 83-84.
  - Ho, Yao-Hua; Tai, Yun-Juo; Chen, Ling-Jyh. 2021. "COVID-19 Pandemic Analysis for a Country's Ability to Control the Outbreak Using Little's Law: Infodemiology Approach" Sustainability 13, no. 10: 5628. <https://doi.org/10.3390/su13105628>
  - You will have about 2.5 weeks to complete Homework 1
  - see the instruction posted on the Moodle.