00. Introduction

Data Structure and Algorithms

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Compiler **O**ptimization **Re**search **Lab**

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Who am I?

- Hanjun Kim
  - Associate Professor
  - School of Electrical and Electronic Engineering
  - hanjun@yonsei , C415
  - Office Hour: T/Th after class or by appointment

- Research Area
  - Compiler Optimization for Heterogeneous and Distributed Systems
  - Compiler Optimization for Deep Learning Applications
  - Compiler Optimization for Secure Program Execution

- Research Framework
  - LLVM C/C++ Compiler Framework

TA

- Dongkwan Kim
    - Compiler Optimization Research Lab.
    - Email: dongkwan@yonsei
    - Office Hours: TBA or by appointment

질문 캔스

Course Goals

- Goal 1: Algorithms and data structures in computer science
  - Help you survey various algorithms and data structures in computer science and understand their performance characteristics

- Specifically, help you learn how to:
  - Apply algorithms and data structures to your programs
  - Understand their performance characteristics
  - Calculate performance of your programs

Course Goals

- Goal 2: Improves your programming skills
  - Help you learn how to write computer programs with algorithms and data structures

- Specifically, help you learn how to:
  - Write object oriented programs 으앗
  - Test and debug your code
  - Improve your code's performance
  - Use tools to support those activities

  $\rightarrow$ 숙제

- Goal 2 supports Goal 1
  - Implements many algorithms and data structures

Why Programming?

- Need to tell a computer what you want it to do.

- Programming gives you more opportunities!
  - Broaden your research area: Computers are everywhere!

  - Help develop better hardware (details in next slide)
  - More job opportunities:
    From 4% to 4+51.3% (H-1B visa)

	Review of Positions Certified FY 2018 YTD (% of total certified FY 2018 YTD)		
Top 10 Occupations (based on SOC Codes)	Computer Systems Analysts	48,578	19.9%
	Software Developers, Applications	31,643	12.9%
	Computer Occupations, All Others	22,583	9.2%
	Accountants and Auditors	21,925	9.0%
	Management Analysts	18,393	7.5%
	Software Developers, System Software	12,915	5.3%
	Financial Specialists, All Others	10,202	4.2%
	Computer Programmers	9,750	4.0%
	Electronics Engineers, Except Computer	9,697	4.0%
	Operations Research Analysts	6,461	2.6%

Why Programming in EE?

- Understanding applications makes <u>HW design</u> better

- Vertical integration
    - Hardware/software cooperative systems become crucial
        - Better performance improvement
        - Embedded/mobile platforms require HW/SW optimization together
    - Hardware becomes programmable
        - Reduce development burden

HC 30 Presentations

Why C++?

- C++ is one of the most popular programming languages
- An object oriented programming language *C는 뭘까요*
  - Easy to encapsulate algorithms and data structures in a class
- Easy to learn C++ if you know "C language"
- Easy to learn other languages if you know C++ language

Language Types (click to hide)

Web | Mobile | Enterprise | Embedded
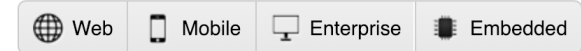
Language Rank	Types	Spectrum Ranking
1. Python		100.0
2. C++		99.7
3. Java		97.5
4. C		96.7
5. C#		89.4
6. PHP		84.9
7. R		82.9
8. JavaScript		82.6
9. Go		76.4
10. Assembly		74.1
11. Matlab		72.8
12. Scala		72.1
13. Ruby		71.4
14. HTML		71.2
15. Arduino		69.0

Why Linux?

- Linux is good for education and research
  - Linux is open-source and well-specified

    그리고 가볍습니다

- Linux is good for programming
  - Linux is a variant of Unix
  - Unix has GNU, a rich open-source programming environment

Course Schedule

- This course covers three parts
  - Linux Basic (Backup Material) 오늘 + 동영상
  - C++ & Object Oriented Programming (3 Weeks)
  - Data structure and algorithms
    - Performance: Time & Space Complexities
    - Basic data structures
      - Array, Vector, Linked List, Stack, Queue
    - Sorting algorithms
    - Trees
      - Binary Search Tree, AVL Tree, 2-3-4 Tree, Red-Black Tree, B-Tree
    - Heap: Priority Queue, Heap sorting
    - Hash & Map
    - Graph
      - Graph traversal, MST, Shortest Path

Evaluation

- Evaluation
  - Exams: 50% (Midterm 20%, Final 30%)
  - Programming Assignments: 40%
  - Class participation: 10%

- Exam
  - Exams cover concepts presented in the lecture material, assignments, and required readings
  - Midterm Exam 4/27 1~3 pm
    - 2 hours
    - Time/Place will be announced
  - Final Exam 6/15 1~3pm
    - 2 hours, cumulative exam
    - Time/Place will be announced

Assignments

- 4~5 Programming Assignments
  - Due date: 11:00pm on Mondays
  - Can be delayed up to 2 days with 10%/day penalty
  - g++ on linux will be used for grading (서바 기준)
  - **The assignments will be updated!** + 학평가

- This is a programming 이게 다 course. Assignments are very important!!
  - **Stay true to yourself!**
  - Assignments should not be derived from or influenced by the work of others (including webpages)
  - Do your own thinking, your own design, your own coding, and your own debugging
  - Use the course Q&A webpage or Visit the TA if you do not know how to do it
  - All the submissions are subject to plagiarism detection tools
  - Any violation will not be allowed! (F grade will be given)
  - **Assignments might be difficult. Again, if you do not know how to do it, use the course Q&A webpage or Visit the TA**

ㅗ 인공지능 ㅗ

Backup Materials

- Lecture videos
  - Recorded in 2020. They cover almost all the lectures.
  - <u>Not mandatory.</u> Watch them if you need.
  - Linux basic: If you do not know how to use Linux, please watch it! Since all the assignments will be graded on Linux, knowing how to use Linux is crucial.
  - Sorry for slightly bad sound quality ☹