East China Normal University
GEC International Summer School

CPP21: Data structures and Algorithms 1

Term: June 16th to July 18th, 2025
Class Hours: Monday through Friday, 110 minutes each day (2,750 minutes in total)
Instructor: Sihao Chen, Kailin Zheng
Home Institution: TBD
Office hours: TBD
Email: TBD

Course Description

This is the first course in the series of data structures and algorithms, that involves introduction to algorithm design and analysis. Specifically graph algorithms, greedy algorithms, data structures, dynamic programming, maximum flows. We study hash tables, tree ADT, greedy algorithms, graph algorithm, algorithm design, algorithm analysis and randomized algorithms. By the end of the course, you should have the ability to apply those data structures and algorithms in relevant problems, construct proofs related to those algorithms and effectively use those algorithms to improve the efficiency of calculation.

Prerequisite: CPP 13 Introduction to Computer Science

Learning Objective

Upon completion of this course, students should be able to:

1. Become familiar with heap and different tree structures and their related functions and running times
2. Understand operations with disjoint sets and greedy algorithm
3. Experience handling elementary graph algorithms and construct minimum spanning tree and finding shortest path, learn specification of bipartite graphs
4. This course also equips the student with knowledge about network flow and dynamic programming

5. Experience solving problems more efficiently and effectively using divide-and-conquer and randomized algorithm, analyze with amortized analysis and probabilistic analysis

Required Text

1. Introduction to Algorithms, 3rd Edition, by T. H. Cormen et al, MIT Press, 2009.

2. Algorithm Design, 2nd Edition, by Jon Kleinberg, Eva Tardos

Course Hours

The course has 25 class sessions in total. Each class session is 110 minutes in length, for a total of 2750 minutes of in-class time. The course meets from Monday to Friday. ECNU awards 3 credits for this course. Different universities may count course credits differently. Consult officials at your own home institution.

Attendance

Summer school is very intense and to be successful, students need to attend *every class*. Occasionally, due to illness or other unavoidable circumstance, a student may need to miss a class. ECNU policy requires a medical certificate to be excused. Any absence may impact on the student's grade. Moreover, ECNU policy is that a student who has more than 3 absences will fail the course. Arriving late or leaving early will count as a partial absence.

Grading Policy

ECNU awards grades of A, A-, B+, B, B-, C+, C, D, and F. Most colleges and universities do not award transfer credit for grades of D or F.

In this course, grading will be based on the following:

Quizzes*5	20%*5=100%
Bonus:	
- Optional assignments*5	2%*5=10%

General Expectations

Students are expected to:
- Attend all classes and be responsible for all material covered in class and otherwise assigned. Any unexcused absence may impact a student's grade.
- Arrive to class on-time: Late arrivals are disruptive to your fellow students and to the conduct of the class.
- Complete the day's required reading and assignments before class
- Review the previous day's notes before class; make notes about questions you have about the previous class or the day's reading
- Refrain from texting, phoning or engaging in computer activities unrelated to class during class (不要用手机) It is highly disrespectful to the professor and to the class.
- Participate in class discussions and complete required written work on time.

Course Schedule

The planned schedule sketched out below may be modified to suit the interests or abilities of the enrolled students or to take advantage of special opportunities or events that may arise during the term.

Week 1

- *Day 1*
    - *Course outline*
    - *Analysis*
- *Day 2*
    - *Big-oh notation*
- *Day 3*
    - *Asymptotic analysis of algorithms*
- *Day 4*
    - *Review of Abstract data structures*
    - *Optional HW Assignment 1 due for extra credit*
- *Day 5*
    - *Lab/Tutorial*
    - *HW Assignment 1 solution released*

Week 2

- *Day 1*
    - o *Quiz 1*
- *Day 2*
    - o *Heaps and Heapsort*
- *Day 3*
    - o *Hashing*
- *Day 4*
    - o *Universal and Perfect Hashing*
    - o *Optional HW Assignment 2 due for extra credit*
- *Day 5*
    - o *Lab/Tutorial*
    - o *HW Assignment 2 solution released*

Week 3

- *Day 1*
    - o *Quiz 2*
- *Day 2*
    - o *BST and AVL Trees*
- *Day 3*
    - o *Red Black Trees*
- *Day 4*
    - o *Divide and Conquer & Master's Theorem*
    - o *Optional HW Assignment 3 due for extra credit*
- *Day 5*
    - o *Lab/Tutorial*
    - o *HW Assignment 3 solution released*

Week 4

- *Day 1*
    - o *Quiz 3*
- *Day 2*
    - o *Elementary Graph Algorithms*
- *Day 3*
    - o *Greedy Algorithms*
- *Day 4*
    - o *Quiz 4*
    - o *Optional HW Assignment 4 due for extra credit*
- *Day 5*

- o *Lab/Tutorial*
- o *HW Assignment 4 solution released*

Week 5

- *Day 1*
  - o *Dynamic Programming*
- *Day 2*
  - o *Bellman Ford Algorithm*
- *Day 3*
  - o *Ford Fulkerson Algorithm*
- *Day 4*
  - o *Concluding lecture*
  - o *Optional HW Assignment 5 due for extra credit*
- *Day 5*
  - o *Quiz 5*
  - o *HW Assignment 5 solution released*

Academic Honesty

Students are expected to maintain high standards of academic honesty. Specifically, unless otherwise directed by the professor, students may not consult other students, books, notes, electronic devices or any other source, on examinations. Failure to abide by this may result in a zero on the examination, or even failure in the course.