## Course Description

This is an introductory graduate course on advanced algorithms. It covers most of the classical advanced topics in algorithm design, as well as some recent algorithmic developments, in particular algorithms for "big data".

Students <u>must</u> have taken COMP3711 or its equivalent before taking this course. A good grasp of discrete mathematics and probability is also required.

## Staff

Instructor: **Ke Yi (http://www.cse.ust.hk/~yike)**
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## Time and Place

MoWe 12:00PM - 01:20PM, Rm 2503

## Reference Books

[KT] *Algorithm Design,* by Jon Kleinberg and Eva Tardos.
[CLRS] *Introduction to Algorithms (3rd edition),* by T. Cormen, C. Leiserson, R. Rivest, and C. Stein.
[MR] *Randomized Algorithms,* by Rajeev Motwani and Prabhakar Raghavan.
[CY] *Small Summaries for Big Data,* by Graham Cormode and Ke Yi. **[pdf]** **(http://dimacs.rutgers.edu/~graham/ssbd.html)**
[BM] *Parallel Algorithms,* by Guy E. Blelloch and Bruce M. Maggs. **[pdf]** **(https://www.cs.cmu.edu/~guyb/papers/BM04.pdf)**

## Syllabus and Notes

1. Introduction. **[ppt] (https://course.cse.ust.hk/comp5711/intro.pptx)**
2. Parameterized algorithms. [KT 10.1~10.4] **[ppt] (https://course.cse.ust.hk/comp5711/FPT.pptx)**
3. Approximation algorithms. [KT 11.1~11.4, 11.6, 11.8] **[ppt] (https://course.cse.ust.hk/comp5711/approx.pptx)**
4. Amortized analysis. [CLRS 17, 19] **[ppt] (https://course.cse.ust.hk/comp5711/amortized.pptx)**
5. Randomized algorithms. [CLRS 5, KT 13.1~13.5, MR 8.3] **[ppt] (https://course.cse.ust.hk/comp5711/random.pptx)**
6. Hashing. [CLRS 11, KT 13.6, 13.7, MR 8.4, 8.5, 9.1, 9.2, CY 9.1] **[ppt] (https://course.cse.ust.hk/comp5711/hashing.pptx)**
7. Tail inequalities and random sampling. [KT 13.9, MR 3.2, 4.1] **[ppt] (https://course.cse.ust.hk/comp5711/tail.pptx)**
8. Online algorithms. [KT 13.8] **[ppt] (https://course.cse.ust.hk/comp5711/online.pptx)**
9. Streaming algorithms. [CY 2.2, 2.5, 2.6, 2.7, 3.2, 3.4] **[ppt] (https://course.cse.ust.hk/comp5711/stream.pptx)**
10. Parallel/distributed algorithms. [BM] **[ppt] (https://course.cse.ust.hk/comp5711/parallel.pptx)**

**Lecture videos (https://canvas.ust.hk/courses/52294/pages)**

## Grading Scheme:

Assignments: 10%
Midterm exam: 30%
Final exam: 60%

The exams will be open-book. You can bring laptops/tablets to the exam for reading lecture notes and e-books, but you will not be allowed to access the internet.

## Notes on writing down algorithms and proofs:

Your solutions will be judged not only for correctness but also for the clarity and simplicity of your presentation. For questions that involve designing an algorithm, you should typically (i) give an overview of the main ideas, (ii) present

pseudocode or plain language description of the algorithm, (iii) present an analysis (usually, of the running time) of your algorithm, and (iv) provide a proof or justification of correctness when correctness is not obvious.

## Assignments:

The assignments are meant to help you prepare for the exams, because exam questions are often variants of assignment problems. For this reason I encourage you to spend time alone thinking about each problem and your approach in solving it. If, having spent enough time on a problem, you still have trouble solving it, you may discuss with others or search for solutions on the Internet, but you must write down the solutions in your own words.

Late policy for the assignments: 2% deduction for each hour late.

## Mark Appeals:

For the midterm and final exam, appeals must be made during the exam paper checking session. If you cannot attend the checking session, please inform the instructor for special arrangement.

## Past exam papers

- 2021 **Final exam and solutions (http://course.cse.ust.hk/comp5711/finalsol21.pdf)**
- 2021 **Midterm exam and solutions (http://course.cse.ust.hk/comp5711/midsol21.pdf)**
- 2020 Final exam **part 1 (http://course.cse.ust.hk/comp5711/final20-1.pdf)** , **part 2 (http://course.cse.ust.hk/comp5711/final20-2.pdf)** , and **Solutions (http://course.cse.ust.hk/comp5711/finalsol20.pdf)**
- 2020 **Midterm exam (http://course.cse.ust.hk/comp5711/midterm20.pdf)** and **Solutions (http://course.cse.ust.hk/comp5711/midsol20.pdf)**
- 2019 **Midterm exam (http://course.cse.ust.hk/comp5711/midterm19.pdf)** and **Solutions (http://course.cse.ust.hk/comp5711/midsol19.pdf)**
- 2018 **Final exam (http://course.cse.ust.hk/comp5711/final18.pdf)** and **Solutions (http://course.cse.ust.hk/comp5711/finalsol18.pdf)**
- 2018 **Midterm exam (http://course.cse.ust.hk/comp5711/midterm18.pdf)** and **Solutions (http://course.cse.ust.hk/comp5711/midsol18.pdf)**