Combinatorial Mathematics

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Monday 18:30 – 21:20

Final Report

- Please consider this **_as a replacement of <u>our final exam</u>_**.

- Deadline – June 23rd, 2025.
  - It's Monday of the 19th week,
    approximately two weeks after your final exam week

- Topic – Pick one from the following two topics
  1. <u>Algorithmic Lovasz Local Lemma</u> (content from 14th week)
  2. <u>Expander & Expander Decomposition</u> (extended content from 13rd week)

Topic 1 – Algorithmic Lovasz Lemma

■ Refer to Lecture Note #14 for this topic.

■ Make a report that describes & explains the followings.

1. Introduce (describe) the Algorithmic Lovasz Local Lemma.

2. Introduce & explain the proof for the correctness and
   the expected time complexity of the algorithm.

■ You must submit HW #6 if you choose this option.
   If you haven't submitted it, you can submit it along with your report.

■ The credit you get will be calculated based on
   the quality of your report and *your answers for HW#6*.

Topic 2 – Expander & Expander Decomposition

■ Read the following lecture notes.

1. Lecture note #13 for expanders.

2. The lecture note due to Sepehr Assadi on <u>expanders and expander decomposition</u>
   https://sepehr.assadi.info/courses/cs860-w24/Lectures/lec6.pdf

   You may also *make cross refererences* to the notes due to Huacheng Yu, so that the concepts will be more clear to you.

   <u>Max Flow & Expander decomposition</u>
   https://www.cs.princeton.edu/~hy2/teaching/fall24-cos597B/files/lecture3.pdf

Topic 2 – Expander & Expander Decomposition

■ For this topic, once you read the notes and acquire adequate understandings, compile a report on the followings.

1. Explain the concept of <u>graph expansion</u> (<u>*graph conductance*</u>).

2. Describe & explain <u>*the expander decomposition theorem*</u> and explain (<u>*in details*</u> or <u>*in sketch*</u>) how the theorem is proved.

3. Describe & explain <u>*the application to minimum cuts in general graphs*</u>.

■ The credits you get will be calculated based on <u>*the quality of your report*</u>.

Things to Note

- As noted, please consider the report you submit *as a replacement for your final exam*.

- Hence, please do read the notes and compile your report based on your understandings.

  - The credits you get *depends on the quality of your report*.