# CS3236 (Spring 2020) – Project Instructions

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In this project, you will write a report on a topic of your choice in information theory (suggestions below) that we did not directly cover in the lectures, but for which we did cover the necessary background to be able to learn the topic via additional reading. This assessment will comprise **25% of your final grade**.

The rules/guidelines are as follows:

- All students are to work **individually**.
- You should submit a report of **6 to 8 pages** using similar font, margins, and spacing to the present document. This page limit **excludes** the cover page, references, and figures/tables (e.g., the body of the report may be up to 12 pages if the total space of the figures/tables included adds up to 4 pages). You may also choose to put 1 or 2 proofs in an appendix that is not counted in the page limit.
- Your report should be clearly written in a manner that would be accessible/understandable to other CS3236 students. You may assume that the reader is familiar with the material covered in the lectures (e.g., you can use notation like $H(X)$ and $I(X;Y)$ without defining it).
- Writing should be in an academic style, such as that you would see in a textbook, research paper, etc. There is no fixed structure to the report, but you may wish to initially briefly introduce the background, then spend the bulk of the report including details of the relevant techniques, discussions, theorems, proofs, etc., and then end with a brief conclusion. **A sample report has been uploaded.**
- If you want to write on a topic not listed in the suggested topics below, please first check with me via email (`scarlett@comp.nus.edu.sg`) for approval.
- The due date is **Friday April 3rd** (Week 11) at 5:30pm. You should submit **both a hard copy and a soft copy** as follows:[1]
  - For the hard copy, you should submit your report at the end of any lecture/tutorial up to and including the due date, or in my office COM2 #03-46 from **4pm–5:30pm** on Friday April 3rd.
  - For the soft copy, you should upload your report (ideally in PDF format) and any supplementary files (if any) to IVLE → Files → Project Submission. (To be created later)
- Your report must be **entirely written in your own words**. Any reports too similar to the textbook, to another students' report, or to other existing tests may be (potentially significantly) penalized. If you use any images from existing sources, please make sure they are clearly cited.
- Please contact me at `scarlett@comp.nus.edu.sg` if you have any questions.

[1] Subject to change depending on the coronavirus situation.

## Suggested Topics

If you would like to write on a topic not listed here, please first email me for approval. It is suggested that students only choose an advanced topic if they feel confident.

All chapter references below are to the textbook by Cover/Thomas, but students are encouraged to read on their topic in more than one source. Feel free to email me if you need suggestions for such sources. Note that both Cover/Thomas and MacKay's textbooks in PDF format can be found easily via a Google search.

**Recommended topics:**

- Sources with memory and entropy rate (Chapter 4)
- Information theory and gambling (Chapter 6)
- Lempel-Ziv codes (Chapter 13) **(no Arithemitic Coding, as it is the topic of the sample report)**

**Slightly advanced topics:**

- Lossy compression and rate-distortion theory (Chapter 10)
- Information theory and statistics (Chapter 11)
- The maximum entropy principle (Chapter 12)
- Kolmogorov complexity (Chapter 14)
- Network information theory problem(s), such as multiple-access or Slepian-Wolf (Chapter 15)

**Advanced topics (please email to discuss first):**

- Advanced practical channel coding technique(s), such as Reed-Solomon codes or polar codes (e.g., see the textbook "Modern Coding Theory")
- Zero-error capacity (e.g., see Shannon's 1956 paper "The Zero-Error Capacity of a Noisy Channel")
- Information-theoretic aspects of theoretical computer science, cryptography, machine learning, or another area of your choice

**Whichever topic you choose, please focus on the information theory aspects/viewpoint. Other perspectives "far" from information theory could be mentioned for comparison purposes, but should not be the main focus.**

## Assessment Criteria *(Rough Guide Only)*

The assessment criteria are roughly as follows (25 marks total):

1. **Material and its presentation [approx. 12 Marks]**
    - Material presented is correct and clear
    - Report shows a good understanding of the topic
    - Report would be accessible to other students
    - Appropriate balance of breadth and depth
    - Interesting discussions and connections with other topics (when suitable)

2. **Writing quality [approx. 8 Marks]**
    - Suitable academic writing style
    - Appropriate report structure
    - Logical/pedagogical flow of material
    - Grammatical correctness
    - Clear notation and definitions

3. **Effort [approx. 5 Marks]**
    - Depth of material
    - Evidence of diligence in reading, ideally from more than one source
    - Quality of figures, tables, etc. (if any)
    - (Optional) Selection of an advanced topic
    - (Optional) Inclusion of suitable algorithm implementations, numerical findings, etc. If you do this, please include both the code and the report in a single .zip file when you upload to IVLE, and clearly state in your report that you have included code. You should not expect me to necessarily run the code (its output/findings, and possibly implementation details, should be in the report).