

Assignment Two for CS5223

July 2024

This assignment should be done in teams, where each team should have either 2 students or 3 students (i.e., no less than 2 and no more than 3). Throughout the document, “you” means “your team”.

1. Overview

The goal of this literature survey assignment is to train your ability in summarizing and judging research papers in the distributed systems area based your own understanding. For research-oriented Ph.D. students, this is a prerequisite for doing good research and writing your own research papers. For Master’s students, even though you will not write research papers yourself, you will still be expected to be able to follow new research results and research trends, and potentially adopt the research results in your company’s products. In fact, in many research conferences, many attendees are actually people who don’t write papers themselves -- they attend the conference to learn about new techniques.

2. Instructions

At the end of this document, you will find a list of topics (A through D). The topics will deepen your knowledge on some of the issues not covered in the lectures.

After you pick a topic, you should read all papers listed under that topic. It is your job to google those or to find those from various online digital library. This is part of the literature survey exercise as well. In particular, **ACM, IEEE, and Springer digital libraries can be accessed free of charge through NUS library web site.**

Make sure that you do not miss any paper under the topic. Different topics have different numbers of papers, which is intentional. Those papers under topics with fewer numbers of papers are harder to read. I intentionally adjusted the number of papers so that each topic will incur roughly the same load. You will most likely need to read quite a number of additional papers (cited by the papers listed) in order to better understand the papers listed.

3. General structure of the report

Overall, the report should summarize the techniques described in the papers listed under the given topic, and then present your subjective opinions about these techniques. You should try not to summarize each paper individually. Rather, whenever possible, you should provide a coherent overall summary, with proper comparisons. You may also decide to discuss more about some papers (because they have interesting techniques) and discuss less about other papers (because they don’t really propose many techniques).

Following is the general structure your report should follow:

- You should first provide a **self-contained** overview of all the techniques proposed in the papers. You need to describe the techniques **in your own words**, instead of repeating discussions from the papers. In particular, because each paper was written individually, it is your job to come up with a **unified way** of explaining the techniques from different papers. As a guideline, this part can be 9-12 pages (this is not a requirement though and you may use more or less pages for this part).

- You should then provide your own (subjective) opinion about the pros and cons of the techniques. Some questions you may choose to answer are: What are the nice properties of these techniques? What are potentially problems? How do the technique compare with each other? Is the technique revolutionarily novel or is it just some minor tweaks on existing techniques? Are the techniques practically feasible? Do they make unrealistic assumptions? You can cite results from the papers, or discussions from the papers to support your own arguments. As a guideline, this part can be 2-4 pages (this is not a requirement though and you may use more or less pages for this part).

- You should identify potential research problems that are still open. What do you see as the major drawbacks of all the techniques you have read so far? What would be a reasonable direction to eliminate these drawbacks? As a guideline, this part can be about 1 page (this is not a requirement though and you may use more or less pages for this part).

Following are some more specific requirements:

- Your report must be tutorial and self-contained. The intended audience is someone who already has taken a graduate-level distributed systems course (e.g., your classmates), but who hasn't investigated deep into that particular subject. Being self-contained is very important and will be an important evaluation criterion.

- It should show your understanding of the key concepts and methods within your topic.

- Throughout the survey, you **must use your own wording and formulation**, except when you directly quote sentences from other publications and put it in quotes. In particular, you should not copy the abstract of the paper you are surveying. Note that copying is considered plagiarism.

- I expect direct quoting of sentences from other publication to be rather rare (you seldom see this in real survey papers).

- Whether you subjective judgments are intelligent will be one assessment criteria.

- You should include references to all additional articles that you have used in preparing your report.

- It is perfectly ok if the paper has some details that you don't understand, but the important thing is that you get the main idea of the paper.

- Do **not** try to understand every sentence in the papers, otherwise it will take you a whole month just to read one paper. Instead, your goal is to get the main ideas and key techniques/insights/observations of the paper, while ignoring less important details.

4. Resources

ACM Computing Surveys usually have very good survey papers. You can look at those survey papers as models.

5. Do Not Plagiarize!!!

NUS takes a firm stand against plagiarism, and so does our module.

I want to particularly draw attention to students that **paraphrasing is plagiarism**. By ACM Policy on Plagiarism, Misrepresentation, and Falsification (<https://www.acm.org/publications/policies/plagiarism-overview>), “intentionally paraphrasing portions of another's work” is a form of plagiarism. To help you to understand, as an example, imagine that a student is writing a survey for the following example paper:

[1] Example author, "Title of example paper." Example Journal, volume XX, issue XXX, Sept 2020.

- Imagine that following is some text from [1]: “We use a technique called X to accelerate the processing of individual data items. Despite the large size of the data items, we can use a data structure called Y, so that each time we only need to sample a few bits from each data item. In some cases, this approach may incur significant communication overhead on the network. To resolve that, we use another technique Z.”
- The student’s submission contains a paragraph, which is the paraphrased version of the above text: “They use the X technique to speed up the processing of various data items.[1] Due to the large size of the data, they further use a technique called Y, so that each time only a few bits from each data item are sampled. In some cases, their approach could incur much overhead on the network. They use another technique Z to resolve that.[1]”

The above submission would be viewed as plagiarism for the purpose of this assignment, since it copied and then paraphrased the text from [1]. This is despite that the above submission does cite [1]. To avoid plagiarism, the student needs to write all the text, from scratch, all by himself/herself.

6. Prohibition on the Use of Generative AI (such as ChatGPT)

For all assignments in this course, including this assignment, you are strictly NOT allowed to use generative AI tools such as ChatGPT. Any violation of this policy will be viewed the same as plagiarism (which has SERIOUS consequences!).

7. Report Submission Instructions

You will be penalized if you don't stick to these instructions. The report should be no more than 15 pages, and must use 11-pt Times New Roman font, single spacing, and single column. **All pages must be numbered, starting from 1. Sections must be numbered as well.** The 15-page limit **includes** the title page and the references. It is ok to include an appendix, which will not count toward the 15-page length limit.

Page 1 of your report should be the title page, which should **contain and only contain** the following table filled with proper information:

	<i>Fill in all the entries below</i>		
Topic of the survey (the topic should be one of the topics listed at the end of this document)			
Length of the survey in number of pages (excluding appendix)			
<p>We do not want other students (either this year or in future years) to copy your survey. We hence need all team members to sign the following declaration.</p> <p>Declaration by all team members:</p> <ul style="list-style-type: none">We (i.e., the team members) certify that this survey (or any part of it) has not been put online on the Internet.We further undertake to never put online this survey (or any part of it) in the future.			
Date of declaration:			
	Member #1	Member #2	Member #3
Team Member's student number (not nusnetid!)			
Team Member's name			
Team Member's signature			

Page 2 should directly begin with Section 1 of your survey. There should be NO table of contents, table of figures, or anything like that. Also, do not list authors etc. on Page 2.

Submission file name: The only acceptable format is PDF. Other formats will be discarded. Your report should be a **single file** with a .pdf suffix. The file name must be in the following form (if your team has 2 members):

[Team member 1's student #]_[Team member 2's student #].pdf

For example, if the student numbers of team member 1 is A111111, and the student number of team member 2 is A222222, then the file name should be

A111111_A222222.pdf

Deviation from such naming scheme may cause mistakes when processing your submission, and may result in the loss of your submission.

No multiple submissions allowed: Each team should make sure that the team **only submit exactly once**. If a team submits two versions, we will **retain the earliest version and discard all later versions**. The team will then be grade on the earliest version. For such a reason, if you want to update your submission, you should delete your old submission first and then submit a new one.

How to submit: Your report should be uploaded to Canvas.

Timeline:

Monday 14 Oct 2024: Assignment starts.

11:59pm, Friday 15 Nov 2024: Assignment due. You should upload your report to Canvas. Electronic submissions will, among other things, facilitate our checking for plagiarism in the submissions. Note that we will do extensive plagiarism check, **which includes, but is not limited to, checking against all resources on the web and checking against student submissions in both this semester and in all previous years. Do NOT try your luck!**

Policy on late submission: Reports submitted after the deadline but no more than 48 hours after the deadline will still be graded, with a penalty of 20%. Namely, I will first grade the report normally, and then multiple the mark by 80% to get the final mark for that report. **Reports submitted more than 48 hours after the deadline will not be accepted and will get 0 mark.**

Policy on "fair share" contribution: Given that this is a team assignment, each team member should contribute his/her "fair share" to this assignment. In the event that a team member is found to have contributed a much smaller amount than his/her "fair share", then the following policy applies: I will first grade the report normally and determine a temporary mark x . For all team members who have contributed roughly a fair share, their final mark will be x . For any team member who has contributed a much smaller amount than his/her "fair share", his/her final mark will be $c*x$, where c is the penalty factor. Depending on the severity of the problem, c can be 0.75, 0.5, 0.25, or 0.

List of topics

A. Replication Systems (more on crash failures)

[1] Remzi Can Aksoy and Manos Kapritsos. "Aegean: Replication Beyond the Client-Server Model". In Proceedings of the ACM Symposium on Operating Systems Principles, 2019.

[2] Seo Jin Park and John Ousterhout. "Exploiting Commutativity For Practical Fast Replication". In Proceedings of the USENIX Symposium on Networked Systems Design and Implementation, 2019.

[3] Jialin Li, Ellis Michael, Naveen Kr. Sharma, Adriana Szekeres, and Dan R. K. Ports. "Just Say NO to Paxos Overhead: Replacing Consensus with Network Ordering." In Proceedings of the USENIX conference on Networked Systems Design and Implementation, 2016.

[4] Pasindu Tennage, Cristina Basescu, Lefteris Kokoris-Kogias, Ewa Syta, Philipp Jovanovic, Vero Estrada-Galinanes, and Bryan Ford. "QuePaxa: Escaping the tyranny of timeouts in consensus". In Proceedings of the Symposium on Operating Systems Principles, 2023.

B. Replication Systems (more on byzantine failures)

[1] Dahlia Malkhi, Kartik Nayak, and Ling Ren. "Flexible Byzantine Fault Tolerance". In Proceedings of ACM Conference on Computer and Communications Security, 2019.

[2] Ittai Abraham, Dahlia Malkhi, Kartik Nayak, Ling Ren, and Maofan Yin. "Sync HotStuff: Simple and Practical Synchronous State Machine Replication". In Proceedings of the IEEE Symposium on Security and Privacy, 2020.

[3] Yossi Gilad, Rotem Hemo, Silvio Micali, Georgios Vlachos, and Nickolai Zeldovich. "Algorand: Scaling byzantine agreements for cryptocurrencies". In Proceedings of the Symposium on Operating Systems Principles, 2017.

[4] Shengyun Liu, Wenbo Xu, Chen Shan, Xiaofeng Yan, Tianjing Xu, Bo Wang, Lei Fan, Fuxi Deng, Ying Yan, and Hui Zhang. "Flexible Advancement in Asynchronous BFT Consensus". In Proceedings of the Symposium on Operating Systems Principles, 2023.

C. Blockchains

- [1] Eleftherios Kokoris-Kogias, Philipp Jovanovic, Linus Gasser, and Nicolas Gailly. "OmniLedger: A Secure, Scale-Out, Decentralized Ledger via Sharding". In Proceedings of the IEEE Symposium on Security and Privacy, 2018.
- [2] Mahdi Zamani, Mahnush Movahedi, Mariana Raykova. "RapidChain: Scaling Blockchain via Full Sharding". In Proceedings of ACM Conference on Computer and Communications Security, 2018.
- [3] Jiaping Wang and Hao Wang. "Monoxide: Scale out Blockchains with Asynchronous Consensus Zones". In Proceedings of the USENIX Symposium on Networked Systems Design and Implementation, 2019.
- [4] Ruomu Hou, Haifeng Yu, and Prateek Saxena, "Using Throughput-Centric Byzantine Broadcast to Tolerate Malicious Majority in Blockchains." Proceedings of the IEEE Symposium on Security and Privacy, May 2022.
- [5] M. Fitzi, X. Wang, S. Kannan, A. Kiayias, N. Leonardos, P. Viswanath, and G. Wang. "Minotaur: Multi-resource blockchain consensus." In Proceedings of ACM SIGSAC Conference on Computer and Communications Security, 2022.

D. Cloud Computing

- [1] J. Dean and S. Ghemawat. "MapReduce: Simplified data processing on large clusters". In Proceedings of the Usenix Symposium on Operating Systems Design and Implemenetation, 2004.
- [2] Jiaxing Zhang, Hucheng Zhou, Rishan Chen, Xuepeng Fan, Zhenyu Guo, Haoxiang Lin, Jack Li, Wei Lin, Jingren Zhou, and Lidong Zhou. "Optimizing Data Shuffling in Data-Parallel Computation by Understanding User-Defined Functions". In Proceedings of the USENIX Symposium on Networked Systems Design and Implementation, April 2012.
- [3] Carlos Teixeira, Alexandre J. Fonseca, Marco Serafini, Georgos Siganos, Mohammed J. Zaki, and Ashraf Aboulnga. "Arabesque: a system for distributed graph mining." In Proceedings of the ACM Symposium on Operating Systems Principles, 2015.
- [4] Rishabh Iyer, Musa Unal, Marios Kogias, and George Candea. "Achieving Microsecond-Scale Tail Latency Efficiently with Approximate Optimal Scheduling". In Proceedings of the Symposium on Operating Systems Principles, 2023.
- [5] Alireza Sahraei, Soteris Demetriou, Amirali Sobhgoi, Haoran Zhang, Abhigna Nagaraja, Neeraj Pathak, Girish Joshi, Carla Souza, Bo Huang, Wyatt Cook, Andrii Golovei, Pradeep Venkat, Andrew Mcfague, Dimitrios Skarlatos, Vipul Patel, Ravinder Thind, Ernesto Gonzalez, Yun Jin, and Chunqiang Tang. "XFaaS: Hyperscale and Low Cost Serverless Functions at Meta". In Proceedings of the Symposium on Operating Systems Principles, 2023.