

Results + Discussion & Conclusion / Contribution outline prep

Summarizing key results and implications of your research

Instructions

1. Answer the following questions as notes (doesn't need full sentences)
 - a. If you don't have results yet, use the Contribution outline on the second page (as a component of a "research proposal")
2. Use the notes to start one paragraph (5-10 sentences)

Results + Discussion & Conclusion Brainstorming Notes

Question	Notes
Recall/list your major research goal (s)	<ul style="list-style-type: none"> • Coordinate tradeoff relationships between complexity and performance. • Apply pruning to channel coding
Based on these goals, summarize your key results in 2 to 3 sentences.	<ul style="list-style-type: none"> • Through pruning, the number of weights are reduced to reduce amount of computation. • Maintain(keep) performance similar to prior methods.
List which figures / tables / equations do you need to visually support these key results?	<ul style="list-style-type: none"> • Bit Error Rate(BER) graph <ul style="list-style-type: none"> - BER is an indicator of performance of decoding. It will show the superiority of the proposed method compared to performance of prior research. • Table : To show the number of parameters.
How does your work compare to prior studies? (include citation)	<ul style="list-style-type: none"> • Using BER. Compared to [1] prior research. <ul style="list-style-type: none"> - [1] : Wang, Qing, et al. "A model-driven deep learning method for normalized min-sum LDPC decoding." 2020 IEEE International Conference on Communications Workshops (ICC Workshops). IEEE, 2020. - It is a prior paper that applied deep learning to Normalized min-sum(NMS) LDPC decoding.
Describe a limitation or boundary of your research	<ul style="list-style-type: none"> • Due to exponential increase in amount of computation, it will not be able to perform many iterations. (ex) iteration 3~5 • Since it is a novel(newly) proposed one, there may be questions about performance.
What is the impact of your research on the research field?	<ul style="list-style-type: none"> • It is first method that pruning was applied to NMS for the first time.
Pick one of the following (as appropriate): <ul style="list-style-type: none"> • Recommendation for future research OR <ul style="list-style-type: none"> • Outside application of research 	<ul style="list-style-type: none"> • Outside application of research <ul style="list-style-type: none"> - What I recently learned through an interview with a semiconductor company "samsung" was that even if it was a good algorithm, it could not be applied to "hardware" such as a semiconductor if complexity was high. - Therefore, goal is to reduce complexity and apply it to semiconductor DRAM.

Research Contribution Brainstorming Notes
 (ONLY for students **without results** just starting their research)
 (Don't do this if you have results to write about)

Question	Notes
Recall/list your major research goal (s)	•
Explain the significance of your research work and experimentation (how it will add knowledge to the research field)	•
Describe any efforts you will take to distribute this field of knowledge (research journal publishing, conference presentations, etc.)	•
Describe any practical, interdisciplinary or commercial applications of your research when it is successfully completed.	• •
Provide a rough timeline of your major experimentation steps (how long do you estimate will each component take)	

Conclusion/Contribution Paragraph starting draft

*In the space below write at least **one paragraph** using the notes from whichever section you completed above. Please be sure to follow appropriate paragraph formatting. Consider use of passive voice and modals as we discussed in class.*

Conclusion

With recent application of deep learning in a variety of areas, it has shown remarkable results. It has been applied to channel coding since 2017 [1], and proposed method used to optimize correction factor value of Normalized Min-Sum(NMS) through deep learning. The newly proposed method used a method called "pruning" to improve complexity rather than performance in previous research[2]. The reason is that if the complexity is too high, it cannot be applied to hardware. The proposed method's results were applied to "LDPC code" and conventional neural normalized min-sum (NNMS) optimized 'alpha' and 'beta' values, but alpha values were set to 0.8 which is the optimized value from previous research, and then pruning was applied to beta values. Proposed method used a method of reducing the amount of computation by pruning the smallest value in each weight. As a result, I confirmed that the proposed method had similar results and improved complexity. Although method results in a slight loss in performance compared to NNMS, it is noteworthy that I have confirmed that complexity is improved, and that I applied pruning to NMS for the first time, unlike previous research[4]. This makes it easier to apply to HW, and I will see if it will perform same for other code, i.e. BCH, polar code in the future.

[1] Nachmani, Eliya, Yair Be'ery, and David Burshtein. "Learning to decode linear codes using deep learning." *2016 54th Annual Allerton Conference on Communication, Control, and Computing (Allerton)*. IEEE, 2016.

[2] Wang, Qing, et al. "A model-driven deep learning method for normalized min-sum LDPC decoding." *2020 IEEE International Conference on Communications Workshops (ICC Workshops)*. IEEE, 2020

[3] Chen, Jinghu, et al. "Reduced-complexity decoding of LDPC codes." *IEEE transactions on communications* 53.8 (2005): 1288-1299.

[4] Buchberger, Andreas, et al. "Pruning neural belief propagation decoders." *2020 IEEE International Symposium on Information Theory (ISIT)*. IEEE, 2020.