NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

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An Analysis of Differentiable Sorting and Ranking operators

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Problem

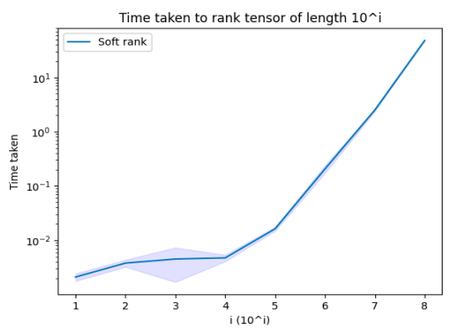
- Sorting and Ranking has the potential to be incorporated into useful objective functions
- Current implementation of Sorting and Ranking is non-differentiable
- Past solutions are too Niched and not applicable to broader field of problems
- Other solutions are too slow and not useful when give large datasets which is common in todays' context

Project Objective

- Provide an intuitive understanding for the methodologies used in Blondel et al., 2020
- Conduct experiments to test claims made and explore various possible areas of implementation for differentiable Sorting and Ranking

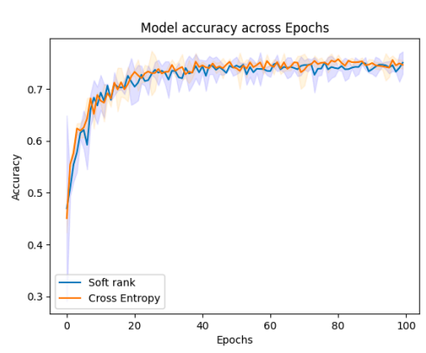
Experiment Results

Time Complexity Test



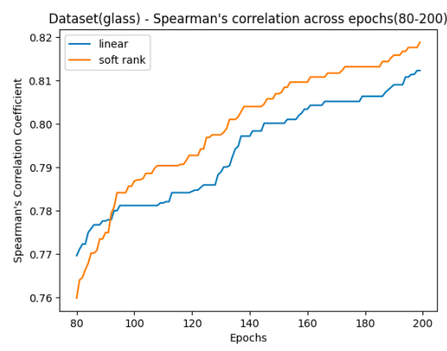
Algorithm completes sorting 10^{10} length tensor in less than a minute.

Top-k classification loss



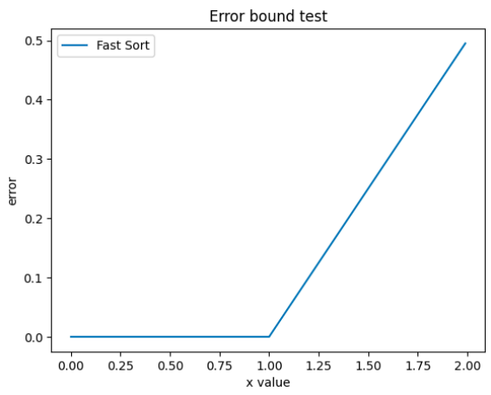
Achieving maximum effectiveness and performance requires problem-specific tuning.

Spearman's rank



Addition of FastRank outperform when given more time to train

Criticism



x value	Min(0,x)	Max(0,x)
10e-2	0	10e-2
10e-1	0	10e-1
10e-0	4.5	5.5
10e1	49.5	50.5
10e2	499.5	500.5
10e3	4999.5	5000.5
10e4	49999.5	50000.5
10e5	499999.5	500000.5
10e6	4999999.5	5000000.5
10e7	50000000.0	50000000.0

The error is upper bounded by $k\epsilon$ where ϵ is the error bound of a single swap. Error is unbounded as it increases linearly with x when x > 1 such that The error becomes so large that the output is virtually unsorted

Conclusion

- Regularization technique is applicable to "smoothen" different types of non-differentiable functions
- Issue of Unbounded error results in area of vulnerability
- Application of differentiable operators might require problem specific tuning for improvement in results to be seen