Comparing Hyperdimensional Computing to Deep Learning for Natural Language Processing Tasks

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Abstract—In this project, we will compare the performance of deep learning models (e.g. Transformers, Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM) models) to HDC models on a variety of NLP tasks using a range of metrics and evaluate their relative strengths and weaknesses.

Index Terms—hyperdimensional computing, HDC, deep learning, natural language processing, NLP

I. Introduction

[1]

II. Results

TABLE I
HDC accuracy scores by dataset size.

Examples	Dataset Pct.	Accuracy
21	0.0001	0.2682
210	0.0010	0.8375
2100	0.0100	0.9593
4200	0.0200	0.9659
10501	0.0500	0.9700

TABLE II
Deep learning accuracy scores by dataset size.

Examples	Dataset Pct.	Accuracy
21	0.0001	0.0476
210	0.0010	0.0541
2100	0.0100	0.7886
4200	0.0200	0.8629
10501	0.0500	0.9513
21003	0.1000	0.9652
42006	0.2000	0.9793
105016	0.5000	0.9855
210032	1.0000	0.9898

TABLE III
Deep learning speed analysis.

Model	Training-Time	Testing-Time
HDC	10.881010	7.538139
distilbert-base-uncased	1426507.625000	77738.898438

TABLE IV
Deep learning FLOP analysis.

Model	Parameters	FLOPs
HDC	0	0
distilbert-base-uncased	43135509	936371712

References

[1] N. Thakur, N. Reimers, A. Rücklé, A. Srivastava, and I. Gurevych, "BEIR: A heterogenous benchmark for zero-shot evaluation of information retrieval models," *CoRR*, vol. abs/2104.08663, 2021. [Online]. Available: https://arxiv.org/abs/2104.08663