

Paper: *A gentle introduction to Quantum Natural Language Processing*

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Quote *“... We will discuss the advantages and drawbacks of the quantum algorithms as compared to their classical counterparts. Finally, we will discuss the open challenges and perspectives for the field of QNLP.”*

Overview This paper in discussion introduces Quantum Natural Language Processing (QNLP) for the text processing engineer and the researchers of quantum computing. Recently interdisciplinary research in these two fields is getting attention of many scientific communities. One of the recent applications of QNLP is sentence representation as encoded vectors in quantum computer. To represent the sentences, the distributional meaning of the words in a sentence is extended using the compositional context of the sentences. This model is known as DisCoCat model where the word meanings are represented using the syntactic structure present in the sentence. This model is based on the algorithm which used tensor products. These tensor products are faster calculated in quantum circuits compared to classical computers. The authors claimed that sentence similarity tasks can be implemented using the quantum nearest neighbor algorithm. However, this implementation requires quantum RAM which is not yet available. Using hamming distance and bitstring mapping, this limitation can be addressed. Another application of QNLP is in binary sentence classification. Quantum circuits with rotation gates can be utilized to achieve this classification task.

Moreover, authors obtained better results in several tasks including sentence entailment prediction. This performance improvement was possible when used with DisCoCat framework.

Intellectual Merit This thesis is an interdisciplinary study to utilize the capabilities of Quantum Computing in Natural Language Processing. This coagulation of fields will produce substantial improvement to the natural language processing tasks by quantum algorithms. Algorithms like quantum nearest neighbor algorithm improves performance of sentence similarity task. The authors used Wonderland dataset and they obtained 80% accuracy. The researchers of these paper are well versed with the concepts of both natural language processing and quantum computing. The presentation of ideas and methodologies were well reasoned and formatted clearly.

Broader Impact The authors of this paper aimed to utilize the capabilities of the quantum computing in the field of natural language processing to improve on existing NLP tasks. The authors found applications of such methods which improve the state-of-the-art performance obtained in classical computers. Moreover, the authors outlined the limitations of this interdisciplinary research like- quantum RAM, number of qubits and fault tolerant universal quantum machine etc.

Keywords Natural Language Processing, Quantum Computing, QNLP, DisCoCat

- Discussion • The algorithms mentioned in the thesis, were not intensively analysed in terms of scalability and feasibility. More discussion is necessary to better understand the usability in the industries.
- Questions • The authors mentioned about the limitation of quantum RAM and proposed a solution too, but is the solution equally scalable as quantum solution?

Table 1: Grade deductions by section

Overview	Intellectual M.	B. Impact	Keywords	Questions	Is Online?