# CS410 – Technology Review

# TensorFlow and its uses in NLP

## Abstract

TensorFlow provides you with a rich collection of ops and libraries to help you work with input in text form such as raw text strings or documents. These libraries can perform the preprocessing regularly required by text-based models and includes other features useful for sequence modeling.

You can extract powerful syntactic and semantic text features from inside the TensorFlow graph as input to your neural net.

This paper is a review of TensorFlow in NLP. Why TensorFlow is used in most of the NLP tasks and why it’s preferred over other machine learning libraries.

## Introduction

According to IBM, 2.5 exabytes (1 exabyte = 1,000,000,000 gigabytes) of data were generated every day in 2017, and this is growing every day. To put that into perspective, if all the human beings in the world were to process that data, it would be roughly 300 MB for each of us every day to process. Of all this data, a large fraction is unstructured text and speech as there are millions of emails and social media content created and phone calls made every day. These statistics provide a good basis for us to define what NLP is.

Natural Language Processing (NLP) is an important tool for understanding and processing the immense volume of unstructured data in today's world. Recently, deep learning has been widely adopted for many NLP tasks because of the remarkable performance that deep learning algorithms have shown in a plethora of challenging tasks, such as, image classification, speech recognition, and realistic text generation.

TensorFlow, in turn, is one of the most intuitive and efficient deep learning frameworks currently in existence. Created by Google Brain Team, TensorFlow is an open-source library for numerical computation and large-scale machine learning. It uses Python to provide front-end API for building applications with the framework, while executing those applications in high performance C++. Google’s TensorFlow is known to ease the process of acquiring data, training models, serving predictions, and refining future results.

## Why TensorFlow?

TensorFlow is one of the earliest frameworks open sourced and has lot of documentation and examples. TensorFlow has compatibility with Keras, which allows its users to code some high-level functionality sections in it. Keras provides system-specific functionality to TensorFlow, such as pipelining, estimators, and eager execution. The Keras functional API supports a variety of topologies with different combinations of inputs, output, and layers. For an expert or a beginner, TensorFlow is an end-to-end platform that makes it easy to build and deploy ML models.

TensorFlow offers multiple levels of abstraction to choose from. Build and train models by using the high-level Keras API, which makes getting started with TensorFlow and machine learning easy.

For more flexibility, eager execution allows for immediate iteration and intuitive debugging. For large ML training tasks, we can use the Distribution Strategy API for distributed training on different hardware configurations without changing the model definition.

It is compatible with many languages such as C++, JavaScript, Python, C#, Ruby, and Swift. This allows a user to work in an environment they are comfortable in.

TensorFlow is scalable. Since it's backed by Google and readily available to be used in Google cloud infrastructure scalability is guaranteed.

TensorFlow also has its architecture TPU, which performs computations faster than GPU and CPU. Models built using TPU can be easily deployed on a cloud at a cheaper rate and executed at a faster rate.

## TensorFlow & Real-World Applications

Text based applications like text messages, reactions, comments, tweets, stock results are all processed using TensorFlow for analysis purpose. Also, Google uses it for translation purposes. It uses its neural networks to translate one language into another language using TF library. Looking for patterns in images by processing them is made possible by using the computer vision algorithm – DeepDream. TensorFlow is used in implementing RankBrain, an AI system part of the core Google algorithm that is used to sort search results.

TensorFlow Time Series algorithms are used for analyzing time series data to extract meaningful statistics. This is extremely important for companies like Amazon, Google, Facebook, Netflix, etc., that analyze customer activity and use that data to compare it to millions of other users to determine what the customer might like to purchase or watch. This kind of contribution in the field of AI has helped many companies to execute such tasks efficiently. This algorithm is also used in other fields like Security, IoT, Finance, Accounting, Predictive Analysis, etc.

Text Classification is used when we need to classify a text fragment into one of several predefined classes. Examples include e-mail spam detection, news categorization, assigning a support request to a category, and more.

Intent Classification is one specific case of text classification, where we want to map an input utterance in the conversational AI system into one of the intents that represent the actual meaning of the phrase, or intent of the user.

Sentiment Analysis is a regression task, where we want to understand the degree of positivity of a given piece of text. We may want to label text in a dataset from most negative (-1) to most positive (+1), and train a model that will output a number representing the positivity of the input text.

Named Entity Recognition (NER) is the task of extracting entities from text, such as dates, addresses, people names, etc. Together with intent classification, NER is often used in dialog systems to extract parameters from the user's utterance.

A similar task of Keyword Extraction can be used to find the most meaningful words inside a text, which can then be used as tags.

Text Summarization extracts the most meaningful pieces of text, giving the user a compressed version of the original text.

Question Answering is the task of extracting an answer from a piece of text. This model takes a text fragment and a question as input, and finds the exact place within the text that contains the answer. For example, the text "John is a 22-year-old student who loves to use Microsoft Learn", and the question How old is John should provide us with the answer 22.

## Conclusion

Given the above advantages and open-source availability TensorFlow has become the de facto for deep learning. Natural Language Processing (NLP) has experienced fast growth and advancement primarily because the performance of the language models depends on their overall ability to "understand" text and can be trained using an unsupervised technique on large text corpora. Additionally, pre-trained text models coming with TensorFlow gives a great starting point and gives good performance.

## References

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