OpenAI GPT-3

A seminar report submitted to APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the degree of

Bachelor of Technology
in
Computer Science and Engineering

by

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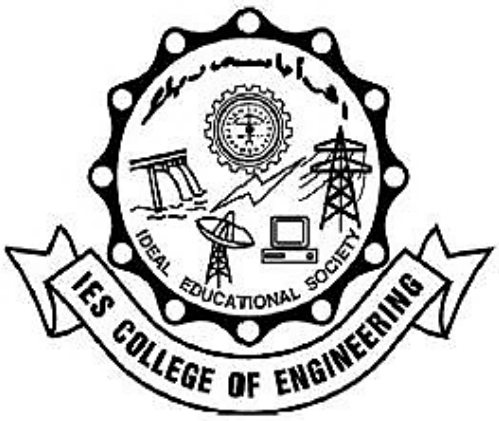
5th December 2020



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Certificate

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Place:	Thrissur	**Ms. Shejina N M**	**Dr. Kiruthiga G**
		Asst. Professor, CSE	Head of the Department
Date:		(Seminar Coordinator)	CSE

Acknowledgement

I'm excited as I present this report on *Open AI GPT-3* as part of the final year B.Tech Computer Science and Engineering seminar. Allow me to take this opportunity to first thank the God Almighty for providing His grace and guidance in this dispensation.

Sincere thanks to *Dr. Brilly S Sangeetha*, Principal, for providing all the required facilities to make this a great success. I acknowledge, with all respect, the encouraging presence of *Dr. Kriuthiga G*, Head of the Department, all along the way. I stand with unspeakable gratitude to my guide *Mr. Ebin P M*, Assistant Professor, for his motivation, attention, and support all time.

Last but not the least, I convey my warm regards to all the well wishers, family members and friends who have helped me during needed times.

May God bless us all.

Abstract

The word 'GPT-3' has brought the tech world to an unspoken frenzy. It seems to keep on appearing over and over again, all across the technical media corpus. GPT-3 stands for Generative Pre-trained Transformer, which is a language model, created by the engineers at OpenAI. A language model takes in sequences of text input and spits out another sequence of coherent text, which is in some way related to the input. Parameters in a machine learning models can be thought of as knobs and dials of a function which are continuously tweaked until an optimal desired response is obtained from the model. This model in massive, in the sense that it has huge number of these parameters. Even more interesting is its incredible capability to generate coherent literature. The media is hyped with the mind boggling, selected results of GPT-3. The report aims to delves deep into GPT-3 to realize its architecture and how it works. To be unbiased, this report also explores what some of the critiques has voiced. Finally it concludes with certain interesting remarks on GPT-3.

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Introduction

Generative Pre-trained Transformer 3 (GPT-3) is an autoregressive language model that uses deep learning to produce human-like text. It is the third-generation language prediction model in the GPT-n series created by OpenAI[1]. A May 28, 2020 arXiv preprint by a group of 31 engineers and researchers at OpenAI, described the development of GPT-3, a third-generation "state-of-the-art language model". In his July 29, 2020 review in The New York Times, Farhad Manjoo said that GPT-3 - which can generate computer code and poetry, as well as prose - is not just 'amazing', 'spooky', and 'humbling', but also 'more than a little terrifying'[2].

GPT-3's full version has a capacity of 175 billion machine learning parameters. GPT-3, which was introduced in May 2020, and is in beta testing as of July 2020[3]. One architecture used in natural language processing (NLP) is a neural network based on a deep learning model that was first introduced in 2017 - the Transformer[4]. GPT-3's higher number of parameters grants it a paramount level of accuracy relative to previous versions with smaller capacity. GPT-3's capacity is ten times larger than that of Microsoft's Turing NLG. On June 11, 2020, OpenAI announced that users could request access to its user-friendly GPT-3 API - a "machine learning toolset" - to help OpenAI 'explore the strengths and limits' of this new technology.

The invitation described how this API had a general-purpose 'text in, text out' interface that can complete almost any English language task, instead of the usual single use-case. GPT-3's mind-boggling performance has convinced many that super-intelligence is closer than we think - or at least, that AI-generated code is closer than we think. It generates creative, insightful, deep, and even breathtakingly beautiful content[3].

Overview of GPT-3

Prerequisites to GPT-3

This seminar covers advanced topics under artificial intelligence. The following sections will engage the reader with some of the basics to AI and subfields such as machine learning, neural networks etc. Most of it will be as elucidation of terminologies. The reader is advised to follow up whatever is required for their understanding, please.

Machine Learning

Machine Learning is a sub field of Artificial Intelligence which is a new technique to solve complex problems. Factually the 'new technique' is/are set of algorithms which improve automatically through experience. In conventional programming the programmer is responsible for providing the machine with instructions to perform a certain task, as in figure (1). But in real world scenario problems are extremely complex to be solved with human generated rules.

Figure 1: Classical Programming

In machine learning the programmers supply the system with data and the expected output as input examples during training [5], as in figure (2). During training period the machine improves in the tasks at hand gradually.

Figure 2: ML Training

Figure 3: ML Testing

When the machine learning 'model' is ready to map similar input output without humans explicitly defining each and every one of them, it enters the testing phase. The models is tested on some data which it has never seen before and predicts the output as shown in figure (3). There are various types of machine learning algorithms like: Supervised, Unsupervised adn Reinforced learning. Deep Learning is a subset of Machine Learning and it is called so because of the deep structure of the underlying architecture.

Feed-forward Neural Networks

A feed-forward neural network is an artificial neural network wherein connections between the nodes do not form a cycle. The feed-forward neural network was the first and simplest type of artificial neural network devised. In this network, the information moves in only one direction—forward—from the input nodes, through the hidden nodes (if any) and to the output nodes. There are no cycles or loops in the network.

The simplest kind of neural network is a single-layer perceptron network, which consists of a single layer of output nodes; the inputs are fed directly to the outputs via a series of weights. The sum of the products of the weights and the inputs is calculated in each node, and if the value is above some threshold (typically 0) the neuron fires and takes the activated value (typically 1); otherwise it takes the deactivated value (typically -1) [6].

Activation Function

In artificial neural networks, the activation function of a node defines the output of that node given an input or set of inputs. A standard integrated circuit can be seen as a digital network of activation functions that can be 'ON' or 'OFF', depending on input. A single-layer neural network can compute a continuous output instead of a step function. A common choice is the so-called logistic function:

$$f(x) = \frac{1}{1 + e^{-x}}$$

The most common activation functions can be divided in three categories: ridge functions, radial functions and fold functions. Ridge functions are univariate functions acting on a linear combination of the input variables. Often used examples include, Linear: $\phi(v) = a + v'b$, ReLU $\phi(v) = max(0, a + v'b)$ etc. In multiclass classification the *softmax* activation is often used [7].

Natural Language Processing

Natural language processing (NLP) is concerned with the interactions between computers and human language, in particular how to program computers to process and analyze large amounts of natural language data. The result is a computer capable of 'understanding' the contents of documents, including the contextual nuances of the language within them. The technology can then accurately extract information and insights contained in the documents as well as categorize and organize the documents themselves.

Challenges in natural language processing frequently involve speech recognition, natural language understanding, and natural-language generation [8].

Language Models

A statistical language model is a probability distribution over sequences of words. Given such a sequence, say of length m, it assigns a probability $P(w_1, \ldots, w_m)$ to the whole sequence. The language model provides context to distinguish between words and phrases that sound similar. Data sparsity is a major problem in building language models. Most possible word sequences are not observed in *training*. One solution is to make the assumption that the probability of a word only depends on the previous n words. This is known as an n-gram model or unigram model when $n = 1$. The unigram model is also known as the *bag of words model* [9].

Transfer Learning

Transfer learning (TL) is a research problem in machine learning (ML) that focuses on storing knowledge gained while solving one problem and applying it to a different but related problem. For example, knowledge gained while learning to recognize cars could apply when trying to recognize trucks. This area of research bears some relation to the long history of psychological literature on transfer of learning.

From the practical standpoint, reusing or transferring information from previously learned tasks for the learning of new tasks has the potential to significantly improve the sample efficiency of a reinforcement learning agent. Given a source domain D_S and learning task T_S, a target domain D_T and learning task T_T, where $D_S \neq D_T$, or $T_S \neq T_T$, transfer learning aims to help improve the learning of the target predictive function $f_T(\cdot)$ in T_T using the knowledge in D_S and T_S [10].

GPT-3 : Part 1 - The Transformer

GPT-3 : Part 2 - Demonstration

GPT-3 : Part 3 - Issues and Critiques

Conclusion

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