

Chapter 10

Modern Applications With a Focus on Training ChatGPT and GPT Models: Exploring Generative AI and NLP

Isha Kondurkar

VIT Bhopal University, India

Akanksha Raj

VIT Bhopal University, India

D. Lakshmi

 <https://orcid.org/0000-0003-4018-1208>

VIT Bhopal University, India

ABSTRACT

Generative AI (GAI) and natural language processing (NLP) have emerged as the most exciting and rapidly growing fields in artificial intelligence (AI). This book chapter provides a comprehensive exploration of the advanced applications of GAI and NLP models, with a specific focus on the renowned ChatGPT model. The chapter commences by offering a concise historical overview of the development of GAI and NLP, highlighting crucial milestones and advancements in the field over the period. In order to understand the workings of the current technology sensation, we will take a brief look at the basic building blocks of GPT models, such as transformers. Subsequently, the chapter delves into the introduction of ChatGPT, presenting an extensive overview of the model, elucidating its underlying architecture, and emphasizing its unique capabilities. Furthermore, it will illustrate the training process of the GPT model followed by a fine-tuning process to deal with the current model's shortcomings.

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1. INTRODUCTION

Natural language processing (NLP) and Generative Artificial Intelligence (GAI) are two linked fields that are revolutionizing language comprehension and content creation. While generative AI focuses on developing systems that can produce original and creative material, NLP focuses on teaching computers to understand and interpret human language. The subsequent subsections shall explain in detail more about these two fields and also tell us about their correlation and convergence.

1.1 NLP

NLP is a field of Artificial Intelligence (AI) and computational linguistics that focuses on enabling computers to understand, interpret, and generate human language. As per Johri et al. (2021), it has a rich history dating back to the 1950s when researchers created the first machine translation system, known as the Georgetown-IBM experiment, which translated Russian sentences into English in 1954. In the 1960s and 1970s, rule-based systems for language understanding emerged. These systems relied on handcrafted linguistic rules and grammatical structures to process and analyze text. However, they often struggled with the complexity and variability of natural language, limiting their practical applicability. The 1980s marked a shift towards statistical and probabilistic approaches in NLP. Researchers began exploring the use of machine learning algorithms to automatically learn patterns and structures from large datasets. This approach allowed for more accurate and robust language processing, particularly in tasks such as part-of-speech tagging and syntactic parsing. With the advent of the internet and the availability of vast amounts of textual data, NLP advanced further, aided by deep learning algorithms.

NLP emerged to address the human desire for seamless communication with computers in their native language, thereby enhancing user workflow efficiency. It can be categorized into two primary domains: Linguistics and Natural Language Generation (NLG) or Natural Language Understanding (NLU). These divisions encapsulate the processes involved in comprehending and generating textual content according to Khurana et al. (2022). Figure 1 represents NLP and its various components.

Presently, Natural Language Processing (NLP) encompasses a diverse array of tasks and applications. Among the foundational tasks within NLP are Text Classification, involving the assignment of predefined categories or labels to text documents, encompassing sentiment analysis, topic classification, and spam detection. Named Entity Recognition (NER) involves the identification and classification of named entities, including individuals, organizations, locations, and dates within text. Machine Translation facilitates the automatic translation of text from one language to another. Question Answering entails the automatic discovery and provision of responses to questions presented in natural language. Sentiment Analysis involves determining the sentiment or emotion expressed in a given text, categorizing it as positive, negative, or neutral. Text Generation encompasses the creation of human-like text based on provided prompts or conditions. Finally, Part-of-Speech (POS) Tagging involves assigning each word in a sentence a specific part of speech, such as a verb, noun, adjective, or adverb. These core NLP tasks are visually represented in Figure 2.

As we progress through this chapter, we will explore the variety of techniques including computational linguistics, machine learning, and statistical modeling in NLP, and the models used to accomplish them. NLP continues to evolve rapidly, driven by advancements in deep learning, the availability of large-scale datasets, and the increasing demand for intelligent language processing systems.

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