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A Simple Survey of AIGC

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Abstract—AIGC refers to Artificial Intelligence Generated Content, which is generated automatically or collaboratively using artificial intelligence techniques in response to user input or demand, including text, images, audio, video, and other forms of content. In this survey, the basic principles of Transformer and diffusion models are presented. The GPT and BERT models based on Transformer are introduced, as well as three different types of diffusion models and their practical applications. Finally, the security and robustness issues of AIGC models are discussed.

Index Terms—AIGC, Transformer, Diffusion, Security, Robustness $\,$

I. Introduction

This survey will cover the following sections: In the first part, we will focus on explaining the basic principles of the Transformer, followed by a discussion of the details of language models (LLMs) that use the Transformer, such as BERT, GPT, etc. We will also cover some techniques for training and optimizing these models. In the second part, we will provide a comprehensive introduction to diffusion models, starting with three different forms of diffusion models and showcasing various architectures that utilize diffusion models, as well as different variants of diffusion models. In the final section, we will discuss the security and robustness of GPT models and diffusion models, respectively, based on recent research findings.

II. Transformer

Generative models have a long history in artificial intelligence, dating back to the 1950s with the development of Hidden Markov Models (HMMs) [20] and Gaussian Mixture Models (GMMs) [21]. These models generated sequential data such as speech and time series. However, it wasn't until the advent of deep learning that generative models saw significant improvements in performance. In early years of deep generative models, different areas do not have much overlap in general. In natural language processing (NLP), a traditional method to generate sentences is to learn word distribution using Ngram language modeling [22] and then search for the best sequence. However, this method cannot effectively adapt to long sentences. To solve this problem, recurrent neural networks (RNNs) [23] were later introduced for language modeling tasks, allowing for modeling relatively long dependency. This was followed by the development of Long Short-Term Memory (LSTM) [24] and Gated Recurrent Unit (GRU) [25], which leveraged gating mechanism to control memory during training. These methods are capable of attending to around 200 tokens in a sample [26], which marks a significant improvement compared to N-gram language models.

Meanwhile, in computer vision (CV), before the advent of deep learning-based methods, tra- ditional image generation algorithms used techniques such as texture synthesis [27] and texture mapping [28]. These algorithms were based on hand-designed features, and were limited in their abil- ity to generate complex and diverse images. In 2014, Generative Adversarial Networks (GANs) [29] was first proposed, which was a significant milestone in this area, due to its impressive results in various applications. Variational Autoencoders (VAEs) [30] and other methods like diffusion generative models [31] have also been developed for more fine-grained control over the image generation process and the ability to generate high-quality images.

The advancement of generative models in various domains has followed different paths, but eventually, the intersection emerged: the transformer architecture [32]. Introduced by Vaswani et al. for NLP tasks in 2017, Transformer has later been applied in CV and then become the dominant backbone for many generative models in various domains [9, 33, 34]. In the field of NLP, many prominent large language models, e.g., BERT and GPT, adopt the transformer architecture as their primary building block, offering advantages over previous building blocks, i.e., LSTM and GRU. In CV, Vision Transformer (ViT) [35] and Swin Transformer [36] later takes this concept even further by combining the transformer architecture with visual components, allowing it to be applied to image based downstreams. Except for the improvement that transformer brought to individual modalities, this intersection also enabled models from different domains to be fused together for multimodal tasks. One such example of multimodal models is CLIP [37]. CLIP is a joint vision-language model that combines the transformer architecture with visual components, allowing it to be trained on a massive amount of text and image data. Since it combines visual and language knowledge during pre-training, it can also be used as image encoders in multimodal prompting for generation. In all, the emergence of transformer based models revolutionized AI generation and led to the possibility of large-scale training.

- A. Model Architecture
- B. Training
- C. Optimizing

III. Diffusion Model

- A. Foundations of Diffusion Models
- B. Applications of Diffusion Models
- C. Optimizing

IV. Security and Robustness

V. Ease of Use

A. Maintaining the Integrity of the Specifications

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- Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as "3.5-inch disk drive".
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Number equations consecutively. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

$$a + b = \gamma \tag{1}$$

Be sure that the symbols in your equation have been defined before or immediately following the equation. Use "(1)", not "Eq. (1)" or "equation (1)", except at the beginning of a sentence: "Equation (1) is . . ."

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E. Some Common Mistakes

- The word "data" is plural, not singular.
- The subscript for the permeability of vacuum μ_0 , and other common scientific constants, is zero with subscript formatting, not a lowercase letter "o".
- In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or

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- In your paper title, if the words "that uses" can accurately replace the word "using", capitalize the "u"; if not, keep using lower-cased.
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a) Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation "Fig. 1", even at the beginning of a sentence.

TABLE I Table Type Styles

| Table | Table Column Head | | |
|--|------------------------------|---------|---------|
| Head | Table column subhead | Subhead | Subhead |
| copy | More table copy ^a | | |
| ^a Sample of a Table footnote. | | | |

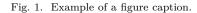


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References

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