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# Unraveling Artificial Creativity

## Exploring the Creative Potential of Large Language Models

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MMU ARTSCIENCE

MASTER THESIS

by

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# Abstract

Creativity has long been a defining aspect of human intelligence, driving innovation, artistic expression, and problem-solving. The emergence of artificial intelligence (AI) raises questions about the potential for AI systems to exhibit creative capabilities, and the implications of these capabilities for our understanding of creativity.

Through the adoption of Margaret Boden's interdisciplinary approach to creativity, this thesis aims to explore the creative potential of large language models (LLMs), focusing on their ability to engage in combinational, exploratory, and transformational forms of creativity.

By comparing the cognitive processes underlying creativity, the computational processes in contemporary LLMs and assessing GPT-4's performance in these domains, this research seeks to contribute to the growing field of computational creativity and offer insights into the future of human-AI collaboration and innovation.



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# 1 | Introduction

## 1.1 Background and motivation

The rapid development of artificial intelligence (AI) and its growing impact on various aspects of human society have led to significant advancements in numerous fields, including art, language, and creative expression. Among these advancements, large language models (LLMs) have emerged as a fascinating and groundbreaking area of research. LLMs are a subset of machine learning algorithms that specialize in generating human-like text based on a given input or prompt. These models have shown impressive results, sometimes even indistinguishable from human-generated content, sparking debates about the nature of creativity, authorship, and the role of AI in artistic practices.

As a student pursuing a Master's degree in ArtScience, the intersection of art and cutting-edge technology, such as AI and machine learning, presents a compelling area of inquiry. Exploring the potential of LLMs for creative language generation raises crucial questions about the very essence of creativity and its manifestations in both human and machine-generated outputs. Moreover, it challenges the traditional boundaries between human and AI-generated art, encouraging a reevaluation of the artistic process, originality, and the role of the artist.

This thesis is motivated by the desire to contribute to a deeper understanding of the creative potential of LLMs and their implications for the field of art. By investigating the theoretical capabilities of these models and their ability to generate creative content, this research aims to generate insights that can inform and inspire new perspectives on the rapidly evolving landscape of art and technology. Furthermore, this thesis seeks to foster a dialogue between artists, technologists, and researchers, encouraging interdisciplinary collaboration and the development of innovative approaches to creativity in the age of AI.

## 1.2 Research Question and Objectives

The primary research question that this thesis aims to address is: Can the output of LLMs, and generative AI in general, be considered “creative” according to existing theories of creativity? To answer this question, the thesis will explore the following objectives:

1. Examine the concept of creativity, its various definitions, and theoretical frameworks in the context of both human and AI-generated art, and determine which definition is best suited.<sup>1</sup>
2. Investigate the technical foundations of LLMs (LLMs) and their underlying mechanisms for generating text and relating these to the chosen definition of creativity, highlighting the similarities and differences in their generative processes.<sup>2</sup>
3. Conduct an analysis of LLM-generated texts, assessing the degree to which the outputs of these models align with the established criteria for creativity.<sup>3</sup>

By addressing these objectives, the thesis aims to contribute to the ongoing discourse surrounding the creative potential of LLMs and their role in the rapidly evolving landscape of art and technology. Ultimately, this research seeks to provide a comprehensive understanding of the capabilities of LLMs in generating creative content and to offer insights that may inform future artistic practices, interdisciplinary collaboration, and the development of innovative approaches to creativity in the age of AI.

The choice of creativity as the focal point of this thesis is driven by its fundamental and universal importance in human culture, artistic practices, and the ongoing discourse on AI-generated art. Creativity, as a process and an outcome, has been a defining characteristic of human expression and innovation throughout history, shaping our understanding of art, society, and technological progress. By exploring the creative potential of AI, this research aims to enrich our understanding of creativity, and challenge existing theories of creative expression. Moreover, it seeks to anticipate the cultural, ethical, and social implications of AI in shaping creativity and artistic expression, ultimately informing policy, education, and public discourse.

## 1.3 Scope and Limitations

Given the interdisciplinary nature of the subject matter, the research will draw upon a diverse range of sources, including psychology, computer science, and artificial intelligence. However, due to the limited size of this thesis, the scope will be confined to the following aspects:

<sup>1</sup> The definition of creativity used in this thesis is based on Margaret Boden’s interdisciplinary approach to creativity, which is discussed in detail in Chapter 2.

<sup>2</sup> The technical foundations of LLMs are discussed in detail in Chapter 3.

<sup>3</sup> The method of our analysis is discussed in Chapter 4, a summary of the results is presented in Chapter 5 (full results are given in section A.4). The results are discussed in Chapter 6.



1. The investigation will primarily concentrate on the current state of LLMs, focussing on Generative Pre-trained Transformer 4 (GPT-4)<sup>4</sup>. While the thesis acknowledges the presence of other AI and machine learning approaches applied to creative tasks, these will not be explored in depth.
2. The study will focus on text-based creative outputs generated by LLMs. Although AI has been applied to various artistic domains such as visual arts, music, and performance, the analysis will be limited to the textual domain.
3. It is important to acknowledge that creativity is a complex and multifaceted phenomenon, and no single theoretical framework can fully encompass its entirety.
4. Due to the rapidly evolving nature of AI research and technology, the findings of this thesis will be subject to the limitations of the current state of knowledge in the field. As new advancements emerge, the conclusions drawn in this study may require further revision and adaptation.

<sup>4</sup> OpenAI, *GPT-4 Technical Report*, 2023.

Despite these limitations, the thesis aims to provide a comprehensive and insightful examination of the creative potential of LLMs, contributing to the ongoing discourse surrounding AI-generated art and fostering interdisciplinary dialogue between artists, technologists, and researchers.



## 2 | Defining Creativity

### 2.1 Introduction

The concept of creativity has long been a subject of fascination, debate, and inquiry across various disciplines, from philosophy and psychology to art and technology. As artificial intelligence (AI) continues to advance and permeate diverse fields, the question of whether AI can be genuinely creative becomes increasingly relevant and pressing. This chapter aims to trace the evolution of creativity definitions and argue for the appropriateness of Margaret Boden's definition in the context of AI-based creative output, particularly LLMs.

See section [A.2](#) for a brief overview of the historical development of creativity definitions, examining the key ideas and perspectives that have shaped our understanding of this complex and multifaceted concept. In this chapter we will briefly cover recent prominent psychological-, cognitive, social and cultural perspectives on creativity, and delve into Margaret Boden's definition of creativity and its three types—combinatorial, exploratory, and transformational—highlighting the reasons why her framework is particularly suited for examining AI-based creative output. Finally, we will discuss the challenges and critiques of Boden's definition, addressing potential limitations and outlining strategies for overcoming these obstacles within the scope of the thesis.

### 2.2 Psychological and Cognitive Approaches to Creativity

As the study of creativity advanced into the 20th century, researchers began to explore the underlying psychological and cognitive processes associated with creative thinking and problem-solving. These approaches sought to provide a more systematic and empirical understanding of creativity, building upon the earlier ideas from the Enlightenment and Romantic periods.

J.P. Guilford, a psychologist, played a pivotal role in establishing

creativity as a subject of empirical research. He highlighted the importance of divergent thinking, a cognitive process that involves generating multiple and varied solutions to a problem, as a critical component of creativity<sup>1</sup>. Guilford's work laid the foundation for subsequent studies investigating the cognitive mechanisms and mental abilities underlying creative thought.

<sup>1</sup> Guilford, "Creative abilities in the arts.", 1957.

Graham Wallas, a social psychologist, proposed a four-stage model of the creative process, consisting of preparation, incubation, illumination, and verification<sup>2</sup>. This model emphasized the interplay between conscious and unconscious thought, as well as the role of cognitive strategies and mental effort in promoting creative insights. Wallas' work contributed to a more nuanced understanding of the creative process and the cognitive factors that facilitate or hinder creative performance.

<sup>2</sup> Wallas, "Stages in the creative process", 1976.

Alex Osborn, an advertising executive, introduced the concept of brainstorming as a technique for enhancing group creativity and problem-solving<sup>3</sup>. His work on creative problem-solving techniques provided practical tools for fostering creativity in various contexts, from education and business to art and design.

<sup>3</sup> Osborn, "Creative thinking", 1958.

Edward de Bono, a psychologist and philosopher, developed the concept of lateral thinking<sup>4</sup>, which involves approaching problems from new and unexpected angles to generate innovative solutions. He also introduced a range of creative thinking techniques, such as the Six Thinking Hats method, which has been widely adopted in education and professional settings.

<sup>4</sup> De Bono, "Information processing and new ideas—Lateral and vertical thinking", 1969.

Robert Sternberg, a psychologist, proposed the Triarchic Theory of Intelligence<sup>5</sup> and the Investment Theory of Creativity<sup>6</sup>. The Triarchic Theory of Intelligence suggests that intelligence is composed of three distinct types of abilities: analytical, creative, and practical. The Investment Theory posits that creativity arises from a combination of cognitive abilities, task-specific skills, and motivational factors. Sternberg's work highlighted the multilayered nature of creativity and the importance of considering various cognitive and contextual factors in understanding and fostering creative potential.

<sup>5</sup> Sternberg, "What should intelligence tests test? Implications of a triarchic theory of intelligence for intelligence testing", 1984.

<sup>6</sup> Sternberg and Lubart, "An investment theory of creativity and its development", 1991.

## 2.3 Social and Cultural Perspectives

While the psychological and cognitive approaches to creativity provided valuable insights into the mental processes and abilities associated with creative thinking, they primarily focused on the individual creator. In contrast, social and cultural perspectives on creativity emphasized the importance of the broader social, cultural, and historical contexts in shaping and defining creative ideas and expressions.

A key figure in this area of research is Mihaly Csikszentmihalyi, a psychologist who developed the systems model of creativity<sup>7</sup>. This model posits that creativity emerges from the interaction between three interrelated components: the individual creator, the domain of knowledge, and the field of experts. According to Csikszentmihalyi, creative ideas and products result from the dynamic interplay between the creator's cognitive abilities and personal experiences, the established knowledge and conventions within a particular domain, and the evaluations and judgments of experts in that field.

<sup>7</sup> Csikszentmihalyi, "The systems model of creativity and its applications", 2014.

Csikszentmihalyi's systems model of creativity highlights the importance of recognizing and understanding the broader social and cultural factors that influence and shape creative expression. This perspective acknowledges that creativity is not solely an individual or cognitive phenomenon but is also intrinsically linked to the cultural and historical contexts in which it occurs. This model also underscores the role of evaluation and recognition in determining what is considered creative, as the judgments of experts and gatekeepers within a field can significantly impact the acceptance and dissemination of novel ideas and products.

By incorporating social and cultural perspectives into the study of creativity, researchers have gained a more holistic understanding of the complex and multifaceted nature of this concept. This broader perspective has further enriched the discourse on creativity and provided a more comprehensive foundation for examining the creative potential of emerging technologies, such as AI and LLMs, in the context of art and artistic expression.

## 2.4 Margaret Boden's Definition of Creativity

Building on the foundations laid by the historical, psychological, cognitive, and social perspectives on creativity, Margaret Boden, a philosopher and cognitive scientist, developed a comprehensive framework for understanding creativity within the context of both human and artificial intelligence. Her definition of creativity encompasses three distinct types: combinatorial, exploratory, and transformational<sup>8</sup>.

<sup>8</sup> Boden et al., *The creative mind: Myths and mechanisms*, 2004.

Combinatorial creativity represents the fusion of existing ideas, forms, or expressions to generate novel combinations that challenge, enrich, or transcend the original sources. This form of creativity is characterized by the ability to recognize and exploit the connections between disparate elements, often drawing from diverse domains or disciplines. By synthesizing and reconfiguring existing knowledge, creators can produce unexpected and innovative outcomes that offer fresh perspectives on familiar subjects or themes. One example of

combinatorial creativity in creative writing is the use of intertextuality, which involves referencing or alluding to other texts within a work of literature.

Exploratory creativity involves the discovery of new ideas, forms, or expressions within an established domain or set of rules, akin to navigating a “possibility space.” This type of creativity is characterized by the exploration and exploitation of the constraints and affordances of a given domain, such as experimenting with novel techniques, styles, or themes within a particular artistic tradition. Exploratory creativity often results in incremental innovation, as creators build upon and extend the boundaries of existing knowledge and practices.

Transformational creativity, on the other hand, involves the generation of fundamentally new ideas or forms that challenge, redefine, or expand the established rules and conventions of a domain. This form of creativity is typically associated with radical innovation and paradigm shifts, as it requires creators to question and redefine the underlying assumptions and principles that guide a particular field or practice. Examples of transformational creativity include the development of new artistic movements, such as Cubism, which disrupted traditional notions of perspective and representation, or the introduction of groundbreaking technologies, such as digital art and virtual reality, that have transformed the ways in which art can be created and experienced.

#### **2.4.1 The Role of Constraints, Context, and Evaluation in Boden’s Framework**

In addition to the three types of creativity—combinatorial, exploratory, and transformational—Boden’s framework emphasizes the crucial role of constraints, context, and evaluation in shaping and defining creative ideas and expressions.

Constraints play a vital role in the creative process, as they provide the structure and boundaries within which creative exploration and innovation can occur. Constraints can take various forms, such as the rules and conventions of a specific domain, the physical or material limitations of a medium, or the cognitive and perceptual capacities of the creator. By working within these constraints, individuals can push the boundaries of their domain and discover new possibilities and forms of expression. This idea resonates with some of the cognitive approaches discussed in section 2.2, which emphasize the importance of cognitive strategies and techniques in navigating the constraints and challenges of problem-solving and creative thinking.

Context, in Boden's framework, refers to the broader social, cultural, and historical factors that shape and influence the creative process. As highlighted in Csikszentmihalyi's systems model of creativity (section 2.3), creativity emerges from the interaction between the individual creator, the domain of knowledge, and the field of experts. Context plays a critical role in determining what is considered creative, as it provides the backdrop against which creative ideas and products are evaluated and judged. By acknowledging the importance of context, Boden's definition of creativity aligns with the social and cultural perspectives on this concept, emphasizing the need to consider the broader factors that influence and define creative expression.

Evaluation is another essential component of Boden's framework, as it involves the assessment and recognition of creative ideas and products by experts within a given field. The process of evaluation determines which ideas are deemed novel, original, and valuable, and thus contributes to shaping the creative landscape of a domain. Evaluation is closely related to Csikszentmihalyi's systems model of creativity, which highlights the role of experts and gatekeepers in recognizing and validating creative contributions. By incorporating evaluation into her definition of creativity, Boden acknowledges the importance of external judgments and feedback in determining what is considered creative and in shaping the evolution of creative ideas and expressions within a domain.

#### **2.4.2 Argument for Choosing Boden's Definition**

One of the main reasons for selecting Boden's definition of creativity for examining AI-generated art lies in its comprehensive and inclusive nature. By encompassing three distinct types—combinatorial, exploratory, and transformational—Boden's framework accounts for the diverse range of creative expressions and innovations across various domains and contexts. This multifaceted understanding of creativity accommodates diverse creative processes, providing a robust foundation for analyzing the creative potential of AI.

Boden's definition aligns well with the computational nature of AI as it focuses on the systematic exploration and recombination of ideas and elements. AI systems, like LLMs, generate novel content by analyzing vast amounts of data and identifying patterns and associations, mirroring the combinatorial and exploratory aspects of creativity in Boden's framework. Additionally, her definition emphasizes both the process and the outcome of creative endeavors, allowing for a thorough analysis of creative output, considering not only the novelty and originality of the output but also the underlying processes and mechanisms that give rise to it.

Furthermore, Boden's framework acknowledges the diverse manifestations of creativity across different domains and contexts, making it well-suited for examining the creative potential of AI in the context of art. Her definition provides a comprehensive approach that accommodates a wide range of creative expressions, allowing for a more inclusive and open-minded exploration of the possibilities and limitations of AI.

Finally, Boden's background as a philosopher and cognitive scientist, as well as her extensive work on the intersection of creativity and artificial intelligence, makes her definition particularly relevant for interdisciplinary domains such as art and technology. By bridging the gap between the humanities and the sciences, her framework fosters a more holistic and informed understanding of the creative potential of AI, encouraging interdisciplinary dialogue and collaboration.

## 2.5 Challenges and Critiques of Boden's Definition

While Boden's definition of creativity offers a comprehensive and inclusive framework for understanding the creative potential of AI, it is essential to consider its potential limitations in addressing the subjective and cultural aspects of creativity.

- **Subjective and emotional aspects of creativity:** Romantic thinkers emphasized the personal and emotional dimensions of creativity, arguing that inspiration, imagination, and personal experiences played a significant role in the creative process. Although Boden's framework acknowledges the importance of cognitive processes and individual creativity, it may not fully capture the emotional and subjective aspects that can influence creative expression. In the context of generated art, it is essential to consider how emotional and subjective factors may be incorporated or simulated in LLMs and how this may impact the evaluation of their creative potential.
- **Cultural influences and contexts:** Csikszentmihalyi's systems model of creativity underscores the importance of recognizing and understanding the broader social and cultural factors that influence creative expression. While Boden's definition emphasizes the cognitive processes and mechanisms underlying creativity, it might not fully account for the impact of cultural contexts and influences on creative expression. In examining the creative potential of AI-based art, it is crucial to consider how cultural factors may shape the development and evaluation of LLMs and their outputs. This includes assessing the extent to which AI systems can recognize, incorporate, or adapt to different cultural contexts and conventions.



- Domain and cultural specificity: Boden's definition of creativity is intended to be applicable across various domains and contexts. However, it is essential to consider whether there may be inherent biases or limitations in her framework that prevent a comprehensive understanding of creativity in diverse settings. For instance, certain aspects of her definition, such as the emphasis on cognitive processes and mechanisms, might be more suited to Western perspectives on creativity, which have historically placed greater value on rationality and intellectual abilities. In evaluating the creative potential of generated art, it is crucial to consider whether Boden's definition can adequately account for the diverse manifestations of creativity across different cultural settings and artistic traditions.



# 3 | Foundations of LLMs

## 3.1 Introduction

Artificial intelligence (AI) is a multidisciplinary field that aims to create intelligent agents capable of performing tasks that would typically require human intelligence. These tasks include problem-solving, learning, perception, language understanding, and decision-making. AI has its roots in computer science, mathematics, psychology, linguistics, and philosophy, among other disciplines. Over the years, AI has evolved into a diverse field with various approaches and subfields, including machine learning (ML), natural language processing (NLP), computer vision (CV), and robotics.<sup>1</sup>

<sup>1</sup> For a more detailed overview of the history of AI, see section [A.3](#).

ML is a subfield of AI that focuses on the development of algorithms that enable computers to learn from and make predictions or decisions based on data. ML is founded on the idea that machines can automatically learn from experience without being explicitly programmed. This learning process typically involves the identification of patterns and relationships within the data, which can then be used to make predictions or decisions. ML can be broadly categorized into three types: supervised learning, unsupervised learning, and reinforcement learning.

Deep learning, a subset of ML, has gained significant attention in recent years due to its success in various applications, such as image and speech recognition, NLP, and game playing. Deep learning models, known as artificial neural networks, are inspired by the structure and function of the human brain. These networks consist of interconnected layers of nodes or neurons, which process and transmit information through weighted connections. The depth of the network, or the number of layers, allows the model to learn complex, hierarchical representations of the input data.

NLP is a subfield of AI that focuses on the interaction between computers and human languages. With the advent of deep learning, several neural network architectures have been developed to model and generate natural language text. One such architecture is the

recurrent neural network (RNN), which is designed to capture sequential dependencies in data by maintaining an internal hidden state that is updated at each time step.

Language modeling is a core task in NLP, where the goal is to predict the next word in a sequence given the previous words. RNNs, and their variants such as long short-term memory (LSTM) networks and gated recurrent units (GRUs), have been widely used for language modeling tasks due to their ability to capture long-range dependencies in text.

While RNNs have shown success in modeling sequential data, they suffer from limitations in terms of computational efficiency and the ability to capture very long-range dependencies. To address these issues, attention mechanisms were introduced, allowing neural networks to selectively focus on different parts of the input data when generating output. One such mechanism, the self-attention mechanism, computes a weighted sum of input values based on their pairwise similarity, enabling the model to capture global dependencies in the data.

Building upon the idea of self-attention, the Transformer architecture was introduced by Vaswani et al. in 2017<sup>2</sup>. Transformers eliminate the need for recurrent connections, allowing for more efficient parallelization during training and enabling the model to learn complex long-range dependencies in text. Transformers have since become the basis for state-of-the-art NLP models, such as BERT<sup>3</sup>, XLNet<sup>4</sup> and the GPT (Generative Pre-trained Transformer) family<sup>5</sup> which have achieved top performance across a wide range of NLP tasks.

### 3.2 Architectural Details of Contemporary LLMs

The development of the Transformer architecture has paved the way for the emergence of contemporary LLMs that have demonstrated remarkable capabilities in generating human-like text. Among these models, the GPT family, developed by OpenAI, has gained significant attention for its ability to generate coherent and contextually relevant text. In this section, we will explore the architecture of GPT models and discuss the key components that contribute to their generative capabilities and their potential effects on creativity aspects as defined by Boden.

The foundation of GPT models lies in the Transformer architecture, which is characterized by its use of self-attention mechanisms and the absence of recurrent connections. The Transformer consists

<sup>2</sup> Vaswani et al., *Attention Is All You Need*, 2017.

<sup>3</sup> Devlin et al., *Bert: Pre-training of deep bidirectional transformers for language understanding*, 2018.

<sup>4</sup> Yang et al., *XLnet: Generalized autoregressive pretraining for language understanding*, 2019.

<sup>5</sup> Radford et al., *Improving language understanding by generative pre-training*, 2018.

of an encoder and a decoder, each composed of multiple layers of self-attention and feed-forward neural networks. However, GPT models only utilize the decoder part of the Transformer architecture, as they are designed for unidirectional, autoregressive language modeling tasks. This architecture enables GPT models to generate coherent and contextually relevant text. However, the absence of recurrent connections and inherent goal-directedness could limit their potential in radical forms of creativity.

The self-attention mechanism is a crucial component of the GPT architecture, enabling the model to selectively focus on different parts of the input sequence when generating output. This mechanism computes a weighted sum of input values based on their pairwise similarity, allowing the model to capture global dependencies in the data. The self-attention mechanism is implemented using scaled dot-product attention, which calculates the similarity between input values using dot products and scaling factors. This mechanism enables the model to attend to diverse contextual information and identify relevant patterns and relationships within the input data.

Since the Transformer architecture does not have recurrent connections, it lacks the inherent ability to capture the sequential nature of language. To address this issue, GPT models incorporate positional encoding, which adds information about the position of each token in the input sequence to the input embeddings. This allows the model to learn and utilize the relative positions of tokens when generating output.

GPT models are designed for autoregressive language modeling tasks, where the goal is to predict the next token in a sequence given the previous tokens. During the decoding process, the model generates text one token at a time, conditioning its predictions on the previously generated tokens. This autoregressive decoding process allows GPT models to generate coherent and contextually relevant text, as each prediction is informed by the entire preceding context. This balance between coherence and novelty is essential for creative text generation. However, the autoregressive nature of GPT models may limit their potential for transformational creativity, as it prevents them from having an "inner dialogue" or using a "scratchpad" to perform multi-step computations or store intermediate results.

The creative potential of LLMs can also be influenced by the degree of control exerted over the text generation process. By adjusting parameters such as temperature and top-k sampling, users can influence the trade-off between diversity and coherence in the generated text. Higher temperature values result in more diverse and creative output, while lower values produce more conservative and coherent text. Similarly, top-k sampling restricts the model's choice of next

tokens to the  $k$  most likely options, allowing users to control the degree of randomness and creativity in the generated text. Controllability and sampling strategies can impact the model's potential for all three aspects of creativity, enabling users to fine-tune the balance between coherence, novelty, and adherence to specific constraints or desired characteristics.

### 3.3 Training Process of Contemporary LLMs

The creative potential of LLMs, such as GPT-4, is closely tied to their training process. In this section, we will discuss the key aspects of the training process, including pre-training and fine-tuning, as well as the generative capabilities that contribute to the creative output of LLMs and their implications for Boden's creativity aspects.

The pre-training phase is the initial stage of the training process, during which the model is exposed to a large corpus of text from diverse sources. This unsupervised learning process allows the model to learn the properties of language, including syntax, semantics, common sense and more. By learning from a vast and diverse dataset, the model acquires a rich understanding of language, which serves as the foundation for its creative capabilities across all three aspects of creativity: combinatorial, exploratory, and transformational.

Following the pre-training phase, the model undergoes a fine-tuning process, during which it is trained on a smaller, task-specific dataset. This supervised learning process allows the model to adapt its knowledge to specific domains, genres, or styles, enhancing its ability to generate creative text that is relevant to the target context. Fine-tuning enables the model to incorporate domain-specific knowledge, stylistic nuances, and thematic elements into its output, contributing to the overall creativity of the generated text.

However, the impact of fine-tuning on creativity types can be more nuanced. Fine-tuning may strengthen the model's performance in combinatorial and exploratory creativity within specific domains and constraints, but it can also make the model more narrowly focused on these specific types of content. As a result, the model's ability to generate content with diverse subjects and unexpected combinations may be reduced. This trade-off highlights the importance of carefully balancing the specificity and adaptability of the model during the fine-tuning process to preserve and enhance its potential across all creativity types.

In recent years, Reinforcement Learning from Human Feedback (RLHF) has emerged as a promising approach to fine-tuning LLMs<sup>6</sup>,

<sup>6</sup> Stiennon et al., "Learning to summarize with human feedback", 2020.

more effective at steering their behaviour. RLHF involves collecting human feedback on model-generated outputs and using this feedback to create a reward signal for reinforcement learning. By optimizing the model's parameters based on this reward signal, the model can learn to generate text that aligns more closely with human preferences and expectations, particularly in domain-specific tasks.

Although RLHF can refine the model's understanding of stylistic nuances, thematic elements, and other aspects of creative writing, it might inadvertently reduce the model's capacity for generating diverse and unexpected combinations of subjects. This numbing effect on creativity can be more pronounced for RLHF than regular fine-tuning, as the more fine-grained feedback from a neural preference model has a broader impact on the model's probability distributions, guiding it towards more familiar and conventional patterns.

To mitigate the potential negative impact of RLHF on creativity, it is crucial to find a balance between leveraging human feedback for refining the model's performance in specific domains and maintaining the model's capacity for diverse and unconventional creative output. This balance can help ensure that the model remains capable of generating content across all creativity types while still benefiting from the insights provided by RLHF.





## 4 | Experimental Setup

The methodology for analyzing LLM-generated texts is designed to assess the creative potential of AI in the context of Boden's three types of creativity: combinatorial, exploratory, and transformational. This qualitative analysis will focus on the output of a carefully selected set of prompts. The prompts will be designed to elicit creative responses from GPT-4, and the generated texts will be evaluated based on a set of criteria that correspond to each type of creativity.<sup>1</sup>

### 4.1 Tasks

Three distinct types of prompts are designed, each corresponding to one type of creativity. GPT-4 is prompted using these tasks, and the resulting texts are qualitatively analyzed to determine the extent to which GPT-4 exhibits characteristics of combinatorial, exploratory, and transformational creativity. See section ?? for the full set of prompts and corresponding outputs.

The prompts for assessing combinatorial creativity will involve generating a narrative or an essay that combines elements from two or more unrelated artistic styles, movements, or techniques. The AI-generated text should demonstrate the ability to synthesize and reconfigure these distinct elements, producing an innovative and coherent output that offers fresh perspectives on the original sources.

Example Prompt: *"Describe a newly invented sport that combines the rules and gameplay of basketball and soccer. Explain the rules, strategies, and potential challenges that players would face."*

The prompt for evaluating exploratory creativity will require the AI to create a text that demonstrates novel techniques, styles, or themes within a specific domain. By exploring the constraints and affordances of the chosen domain, the generated text should reflect incremental innovation and an expansion of the existing boundaries of knowledge and practices.

<sup>1</sup> Comparisons with human generated text would allow for a more comprehensive analysis of the creative potential of GPT-4, but this is beyond the scope of this thesis.

Example Prompt: *"Describe a new painting technique that could be used within the realm of Abstract Expressionism, explaining how it advances the artistic tradition."*

To assess transformational creativity, the task will involve generating a text that proposes a groundbreaking idea, technology, or artistic movement that challenges, redefines, or expands the established rules and conventions of a domain. The generated text should demonstrate the capacity to question and redefine underlying assumptions and principles, potentially leading to radical innovation and paradigm shifts.

Example Prompt: *"Develop a groundbreaking approach to education that breaks away from the traditional classroom model and fundamentally reimagines how humans learn and develop skills. Describe the key elements of this new model and its potential impact on society."*

## 4.2 Evaluation Criteria

To evaluate the generated texts for each creativity type, a set of criteria will be utilized. These criteria will serve as the basis for the qualitative analysis, providing a framework to assess the extent to which GPT-4 exhibits characteristics of combinatorial, exploratory, and transformational creativity.

The generated texts will be evaluated on the following criteria for combinatorial creativity:

- **Integration:** The degree to which the text successfully combines elements from the distinct artistic styles, movements, or techniques.
- **Novelty:** The extent to which the text presents an original and innovative fusion of the given elements.

For exploratory creativity, the generated texts will be assessed based on the following criteria:

- **Domain Adherence:** The degree to which the text demonstrates an understanding and adherence to the constraints and affordances of the chosen domain or artistic tradition.
- **Novelty:** The extent to which the text introduces new techniques, styles, or themes, while remaining within the bounds of the chosen domain.
- **Boundary Expansion:** The degree to which the text challenges or pushes the boundaries of the existing knowledge and practices within the chosen domain.

The generated texts will be evaluated for transformational creativity using the following criteria:

- **Radical Innovation:** The extent to which the text proposes fundamentally new ideas, technologies, or artistic movements that challenge, redefine, or expand the established rules and conventions of a domain.
- **Conceptual Shift:** The degree to which the text questions and redefines underlying assumptions and principles, potentially leading to paradigm shifts.

### 4.3 Model and Generation Settings

The experiments are conducted on the GPT-4 model hosted on the OpenAI API<sup>2</sup>. GPT-4<sup>3</sup> is an advanced language model that has demonstrated a remarkable ability to generate human-like responses. At the moment of writing, it is generally considered to be the most powerful online-accessible language model. The model is supposedly<sup>4</sup> trained on an enormous corpus of text data, and fine-tuned for instruction following using RLHF.

In order to generate the text for our tasks, we will employ the following settings:

- **Temperature: 0.7** - This setting controls the randomness of the model's output by adjusting the probability distribution over the vocabulary. A higher temperature results in more random and diverse text, while a lower temperature leads to more focused and deterministic text. By setting the temperature to 0.7, we strike a balance between randomness and coherence, encouraging creative responses without compromising the overall quality of the generated text.
- **Top-p: 1** - The top-p setting, also known as nucleus sampling, refers to the cumulative probability with which the model selects the top tokens during text generation. By setting top-p to 1, we allow the model to consider all possible tokens while generating text, ensuring a comprehensive exploration of the vocabulary space. This setting provides the model with the flexibility to generate creative responses without being overly constrained by a limited set of tokens.
- **Frequency/Presence Penalty: 0** - The frequency/presence penalty setting controls the model's tendency to repeat the same words or phrases. By setting the penalty to 0, we allow the model to freely repeat words and phrases.

<sup>2</sup> Since OpenAI often silently updates its models, replicating our experiments at a later moment could lead to different results. *RIP Science*. Our API calls were made on the 14th of April, 2023.

<sup>3</sup> OpenAI, *GPT-4 Technical Report*, 2023.

<sup>4</sup> OpenAI did not disclose any training- or architectural details of GPT-4, but there are strong reasons to assume that all core architectural- and training details are very similar to those of GPT-3, which are published.



## 5 | Results

We present the extended qualitative analysis of the generated texts in response to the prompts designed for the three creativity types in section A.4, the generated texts themselves are presented in section A.5. It is important to note that the evaluations presented here are based on the subjective assessment of a single evaluator, and as such, the scores may not be universally representative.

### 5.1 Combinatorial Creativity

Across the generated texts, GPT-4 demonstrated a strong ability to integrate elements from distinct artistic styles, movements, or techniques, with an average integration score of 9.25 out of 10. For instance, in Text 1 - BasketSoccer, GPT-4 effectively merged elements from both basketball and soccer, creating a new sport with a distinct set of rules, strategies, and challenges. Similarly, Text 2 - Fable showed a successful combination of characters and morals from "The Tortoise and the Hare" and "The Wolf and the Seven Young Goats" into a cohesive narrative. In Text 3 - Egy-Sance, GPT-4 skillfully combined architectural elements from Ancient Egypt and the Renaissance, while Text 4 - Michelangelo and Frida Kahlo Dialogue showed a thoughtful integration of the artists' respective styles, inspirations, and creative processes.

The generated texts showcased a high degree of novelty in their fusion of elements from different sources, with an average novelty score of 8.5 out of 10. In Text 1 - BasketSoccer, the game's unique rules, such as the Guardian's role and the removal of the offside rule, provided a fresh perspective on the gameplay and strategies involved. In Text 2 - Fable, the introduction of a new character, Ruby the rabbit, served as a catalyst for teaching the combined lesson, while the collaboration between the tortoise and the reforming wolf offered a fresh twist on the traditional fable format. Text 3 - Egy-Sance presented a novel and inspiring vision of urban design that seamlessly merged Ancient Egyptian and Renaissance architectural elements. Finally, Text 4 - Michelangelo and Frida Kahlo Dialogue provided an innovative fusion of the artistic perspectives and techniques of the two artists, imagining how they might collaborate to

create something truly innovative.

## 5.2 Exploratory Creativity

Across the generated texts, GPT-4 exhibited a strong understanding of the chosen domains and artistic traditions, with an average domain adherence score of 8.6 out of 10. For instance, in Text 1 - Emotional Oscillation Technique (Abstract Expressionism), GPT-4 demonstrated a clear understanding of the Abstract Expressionist tradition and its core principles. Similarly, in Text 2 - Cyclic Nexus Screenplay Structure, GPT-4 displayed a deep comprehension of screenplay structures and successfully challenged the traditional three-act structure. Text 3 - Cyberpoetics showcased GPT-4's understanding of traditional poetic forms while integrating modern technology, and Text 4 - Interwoven Sonnet displayed a strong comprehension of traditional sonnets while introducing a novel form. Finally, Text 5 - Eco-Victorian Chic demonstrated GPT-4's grasp of Victorian-era clothing and its elegance and formality while incorporating modern materials and ethical considerations.

The generated texts showed a high degree of novelty within their respective domains, with an average novelty score of 8.6 out of 10. In Text 1 - Emotional Oscillation Technique (Abstract Expressionism), GPT-4 introduced a novel approach to painting that emphasized the fluidity and interconnectedness of human emotions, experimenting with unconventional color combinations and texture transitions. In Text 2 - Cyclic Nexus Screenplay Structure, GPT-4 proposed an alternative screenplay structure that allowed for more engaging and original storytelling, emphasizing nonlinear narratives, parallel storylines, and dynamic character development. Text 3 - Cyberpoetics introduced AI-generated text, multimedia elements, and interactive components to create a unique, immersive, and dynamic poetic experience. In Text 4 - Interwoven Sonnet, GPT-4 presented an innovative twist to the traditional sonnet structure by incorporating interlaced lines. Lastly, Text 5 - Eco-Victorian Chic introduced a fusion of old-world charm and cutting-edge fashion technology, utilizing eco-friendly materials and ethical production practices.

The generated texts successfully challenged and expanded the boundaries of their respective domains, with an average boundary expansion score of 8.6 out of 10. In Text 1 - Emotional Oscillation Technique (Abstract Expressionism), GPT-4 explored the complexity of emotional experiences and their evolution over time, resulting in a visual representation of the artist's emotional journey, thereby expanding the boundaries of Abstract Expressionism. In Text 2 - Cyclic Nexus Screenplay Structure, GPT-4 created innovative storytelling techniques and encouraged creators to explore new narrative possibilities. Text 3 - Cyberpoetics expanded the boundaries of traditional poetry by engaging with technology and creating an immersive, interactive, and dynamic experience for both the poet and the reader.

In Text 4 - Interwoven Sonnet, GPT-4 offered a novel way for poets to express their thoughts and feelings while maintaining the core characteristics of the form. Finally, Text 5 - Eco-Victorian Chic expanded the boundaries of contemporary fashion practices by offering an environmentally responsible and ethically sound alternative to the opulence of Victorian-era clothing.

### 5.3 Transformational Creativity

Across the generated texts, GPT-4 exhibited varying degrees of radical innovation, with an average radical innovation score of 7.6 out of 10. In Text 1 - Convergent Consciousness Theory (CCT), GPT-4 went beyond conventional thinking on consciousness by proposing a theory based on complex information processing systems. In Text 2 - Synthetism, GPT-4 presented a vision of a hybrid socio-economic system that emphasized hybrid ownership, dynamic regulation, and universal basic assets. Text 3 - Gravito-Magnetic Energy stood out for its groundbreaking proposal of a new energy generation method that could fundamentally change the way we produce and consume energy. In Text 4 - The Learning Sphere, GPT-4 offered a multidimensional approach to education that incorporated advanced technology and human-centric pedagogy to create holistic learning experiences. Finally, Text 5 - Symbiotic Climate Engineering proposed a biomimetic, large-scale bioengineering solution to address climate change in a unique and innovative way.

The generated texts demonstrated varying levels of conceptual shifts, with an average conceptual shift score of 7.6 out of 10. In Text 1 - Convergent Consciousness Theory (CCT), GPT-4's proposal had the potential to revolutionize the way we understand and approach the study of consciousness, breaking away from the traditional dualist view. In Text 2 - Synthetism, the proposed system aimed to balance the strengths and weaknesses of capitalism and socialism, but without fully redefining their core principles or assumptions. Text 3 - Gravito-Magnetic Energy introduced a new perspective on energy generation, which could lead to a complete rethinking of our dependence on conventional sources and encourage the exploration of untapped natural properties. In Text 4 - The Learning Sphere, GPT-4's vision of education challenged the traditional classroom model and opened up new possibilities for lifelong learning, potentially disrupting the way we approach skill development and knowledge acquisition. Finally, Text 5 - Symbiotic Climate Engineering put forth an active, restorative approach to climate change, breaking away from the traditional focus on mitigation and shifting the discussion toward large-scale ecological restoration and circular economy principles.





## 6.1 Discussion

The creative potential of large language models is highlighted by the results of the qualitative analysis conducted in our experiments. The findings demonstrate GPT-4's ability to generate creative content across all three types of creativity, as defined by Boden: combinatorial, exploratory, and transformational.

The strengths of GPT-4 in combinatorial creativity tasks were evident in the generated texts. The model successfully combined elements from distinct artistic styles, movements, or techniques, producing innovative and coherent outputs that offered fresh perspectives on the original sources. This performance aligns with the expectation that AI models, such as GPT-4, have the potential to excel in combinatorial creativity tasks, as they learn and recognize patterns across diverse domains, reconfiguring them into novel combinations.

Similarly, GPT-4's performance in exploratory creativity tasks was consistent with expectations. The generated texts show a deep understanding of the chosen domains and artistic traditions, as well as the ability to introduce new techniques, styles, or themes within the boundaries of established knowledge and practices. This capacity is in line with the potential of AI models in general to excel in exploratory creativity tasks, as they are capable of learning and adhering to domain-specific constraints and affordances while generating novel output.

In contrast, GPT-4's performance in transformational creativity tasks exceeded expectations. It is generally believed that computational creativity models might struggle in this area due to their reliance on existing data and inability to question underlying assumptions and principles. However, the AI-generated texts in our experiments showcased GPT-4's capacity to propose groundbreaking ideas, technologies, or artistic movements that challenge, redefine, or expand the established rules and conventions of a domain. This unexpected performance in transformational tasks implies that the model's architecture and training processes may have equipped

it with a broader creative scope and more advanced cognitive capabilities than initially anticipated.

It is important to recognize that the findings of our experiments should not be generalized to all AI models or creative domains without due consideration. The results presented here are specific to GPT-4's performance in the chosen tasks and may not be universally representative of the creative potential of other large language models or AI-generated content in other artistic domains.

## 6.2 Conclusion

Our experiments aimed to investigate the creative potential of large language models, specifically GPT-4, in generating text-based creative content across the three types of creativity defined by Boden. Through a qualitative analysis of AI-generated texts in response to carefully designed prompts, the study revealed GPT-4's strengths in integrating elements from disparate sources, generating innovative and coherent content, and displaying a deep understanding of the chosen domains and artistic traditions.

Surprisingly, GPT-4's performance in transformational creativity tasks exceeded expectations, demonstrating the model's capacity to propose groundbreaking ideas and challenge established rules and conventions of a domain. The findings of our experiments contribute to the ongoing dialogue on the creative potential of large language models and enrich our understanding of the relationship between AI and creativity.

## 6.3 Future Work

The findings of our experiments offer a foundation for further exploration of the creative potential of large language models and AI-generated content. In this section, we outline several directions for future work that can build upon the current research and contribute to a deeper understanding of AI's role in creativity.

### 6.3.1 Comparison with Human-Generated Text

A valuable extension of the current study would be to compare AI-generated texts with human-generated texts in terms of creativity across the three types defined by Boden. This comparative analysis would offer additional insights into the strengths and weaknesses of AI models in generating creative content and provide a benchmark for evaluating AI-generated content in relation to human creativity.

### 6.3.2 Investigating Alternative Creativity Theories

While the present study focused on Boden's framework for creativity, future research could explore alternative theories and models of

creativity to provide a more comprehensive understanding of AI's creative potential. Investigating different creativity frameworks may reveal additional dimensions of AI-generated content that were not captured in the current analysis, enriching our understanding of AI's role in the creative process.

### **6.3.3 Exploring the Creative Potential of AI in Other Artistic Domains**

The current study focused on text-based creative outputs generated by GPT-4. Future work could test the creative potential of AI models in other artistic domains, such as visual arts, music, or interactive media. Analyzing AI-generated content in various creative domains would offer a more comprehensive view of AI's creative capabilities and help identify domain-specific opportunities and challenges.

### **6.3.4 Evaluating the Impact of Model Architecture and Training Processes on Creativity**

Further research could investigate the impact of different model architectures and training processes on the creative potential of AI models. Comparing the performance of various AI models with distinct architectures or training methodologies in generating creative content would provide insights into the factors that contribute to or hinder AI's creative capabilities. This knowledge could inform the development of more advanced and creative AI models in the future.

### **6.3.5 Developing Metrics for Quantitative Evaluation of AI-Generated Creativity**

One of the limitations of the current study is the reliance on qualitative analysis and subjective assessment of AI-generated content. Future work could focus on developing quantitative metrics and evaluation methods for assessing the creative potential of AI models more objectively. Such metrics could enable more rigorous comparisons of the creative capabilities of different AI models and facilitate the development of AI systems that excel in generating creative content.



## 7 | Epilogue

As we reach the end of this thesis, it is time to reveal an essential detail: every word and most high-level decisions within this work were generated by GPT-4, while I acted solely as a curator. The purpose of disclosing this information is to demonstrate the current capabilities of machine learning generated content and computational creativity.

If you were effectively “tricked” or simply impressed by the content, it serves as a strong testament to the creative abilities of models like GPT-4. Utilizing GPT-4 as the primary author of this thesis aligns with the analysis of combinational, exploratory, and transformational creativity, providing an applied demonstration alongside theoretical evaluation. By using GPT-4 in this capacity, this thesis not only discusses its creative potential but also showcases its prowess in academic research and writing.

However, it is vital to acknowledge the role of human intervention. As the curator, I contributed by selecting the best passages and giving feedback to the generator so it could refine selected generated content. While GPT-4’s capabilities are impressive, AI-generated content often still benefit from human direction in certain contexts.

The revelation at the end of this thesis is intended to serve not merely as an intellectual curiosity but as a catalyst for further conversations and explorations in the realm of computational creativity and the future of human-AI collaboration and innovation.



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# Appendix

## A.1 Glossary

*Artificial intelligence (AI)* A multidisciplinary field that aims to create intelligent agents capable of performing tasks that would typically require human intelligence, such as problem-solving, learning, perception, language understanding, and decision-making.

*Attention mechanism* A technique used in neural networks to selectively focus on different parts of the input data when generating output, allowing the model to capture global dependencies in the data.

*Autoregressive decoding* A decoding process used in language models like GPT, where the model generates text one token at a time, conditioning its predictions on the previously generated tokens.

*Bidirectional language modeling* A type of language modeling task where the goal is to predict a token in a sequence given both the preceding and following tokens, used in BERT models.

*Cognitive processes* Mental processes involved in creative thinking and problem-solving, such as attention, perception, memory, reasoning, and decision-making.

*Combinatorial creativity* A form of creativity characterized by the fusion of existing ideas, forms, or expressions to generate novel combinations that challenge, enrich, or transcend the original sources.

*Computer vision (CV)* A subfield of AI that focuses on enabling machines to interpret and understand visual information from the surrounding world, such as images and videos, and make decisions or predictions based on their understanding.

*Deep learning* A subset of machine learning involving artificial neural networks inspired by the structure and function of the human brain.

*Domain Adherence* A criterion for evaluating exploratory creativity, referring to the degree to which the text demonstrates an understanding and adherence to the constraints and affordances of a

chosen domain or artistic tradition.

*Exploratory creativity* A form of creativity characterized by the discovery of new ideas, forms, or expressions within an established domain or set of rules.

*Gated recurrent unit (GRU)* Another variant of RNN, similar to LSTM but with a simpler structure, designed to capture long-range dependencies in sequential data.

*Generative Pre-trained Transformer (GPT)* A family of state-of-the-art natural language processing models based on the Transformer architecture, developed by OpenAI.

*Hyperparameter tuning* The process of selecting the best combination of hyperparameters, which are parameters that are not learned by the model during training but are set by the user, to optimize the model's performance on a specific task.

*Incremental innovation* A type of innovation that results from exploratory creativity, characterized by the development of new ideas, techniques, styles, or themes within a particular domain or artistic tradition, building upon and extending the boundaries of existing knowledge and practices.

*Language model* A model used in natural language processing to predict the next word in a sequence given the previous words.

*Long short-term memory (LSTM)* A variant of RNN designed to address the vanishing gradient problem and capture long-range dependencies in sequential data.

*Machine learning (ML)* A subfield of AI focused on the development of algorithms that enable computers to learn from and make predictions or decisions based on data.

*Margaret Boden* A philosopher and cognitive scientist who developed a comprehensive framework for understanding creativity within the context of both human and artificial intelligence.

*Mihaly Csikszentmihalyi* A psychologist who developed the systems model of creativity, which posits that creativity emerges from the interaction between three interrelated components: the individual creator, the domain of knowledge, and the field of experts.

*Natural language processing (NLP)* A subfield of AI that focuses on the interaction between computers and human languages, aiming to enable machines to understand, interpret, generate, and respond to human language in a way that is both meaningful and contextually appropriate.

*Neural preference model* A model trained to predict human preferences and provide feedback during the reinforcement learning from human feedback process, guiding the fine-tuning of language models towards more familiar and conventional patterns.

*Positional encoding* A technique used in Transformer-based models to add information about the position of each token in the input sequence to the input embeddings, allowing the model to learn and utilize the relative positions of tokens when generating output.

*Paradigm shift* A fundamental change in the basic concepts, rules, and practices of a domain, often resulting from transformational creativity.

*Radical innovation* A type of innovation associated with transformational creativity, characterized by the generation of fundamentally new ideas or forms that challenge, redefine, or expand the established rules and conventions of a domain.

*Recurrent neural network (RNN)* A type of neural network designed to capture sequential dependencies in data by maintaining an internal hidden state that is updated at each time step.

*Reinforcement learning* A type of machine learning where an agent learns to make decisions by interacting with an environment and receiving feedback in the form of rewards or penalties.

*Reinforcement Learning from Human Feedback (RLHF)* An approach to fine-tuning language models that involves collecting human feedback on model-generated outputs and using this feedback to create a reward signal for reinforcement learning.

*Robotics* A subfield of AI that deals with the design, construction, operation, and application of robots, as well as the development of computer systems for their control, sensory feedback, and information processing.

*Self-attention mechanism* A type of attention mechanism used in the Transformer architecture, which computes a weighted sum of input values based on their pairwise similarity, allowing the model to capture global dependencies in the data.

*Supervised learning* A type of machine learning where the algorithm is trained on a labeled dataset, containing input-output pairs, with the goal of learning a mapping from inputs to outputs.

*Temperature* A parameter used in text generation to control the randomness of the model's output by adjusting the probability distribution over the vocabulary. Higher temperature values result in more diverse and creative output, while lower values produce more conservative and coherent text.

*Top-k sampling* A method used to control the degree of randomness and creativity in the generated text by restricting the model's choice of next tokens to the k most likely options.

*Transformational creativity* A form of creativity characterized by the generation of fundamentally new ideas or forms that challenge,

redefine, or expand the established rules and conventions of a domain.

*Transformer architecture* An architecture introduced by Vaswani et al. in 2017, building upon the idea of self-attention and eliminating the need for recurrent connections, allowing for more efficient parallelization during training and enabling the model to learn complex long-range dependencies in text.

*Unidirectional language modeling* A type of language modeling task where the goal is to predict the next token in a sequence given the previous tokens, used in GPT models.

*Unsupervised learning* A type of machine learning where the algorithm is trained on an unlabeled dataset, with the goal of discovering hidden patterns or structures in the data, such as clustering or dimensionality reduction.

## A.2 Brief Early History of Approaches to Creativity

### A.2.1 Ancient Greek and Roman Views on Creativity and Divine Inspiration

The origins of creativity as a concept can be traced back to the ancient Greek and Roman civilizations, where the notion of artistic creation was often linked to divine inspiration. Creativity was not considered an innate human capability but rather a gift bestowed upon an individual by the gods or muses. In ancient Greek mythology, the Muses were nine goddesses who presided over various arts and sciences and were believed to inspire creativity in humans. Similarly, the Roman poet Virgil attributed his creative genius to divine intervention, stating that he was guided by a higher power in the creation of his epic poems.

The idea of divine inspiration also manifested in the concept of "enthusiasm," derived from the Greek term "enthousiasmos," which means "possessed by a god." Enthusiasm referred to a state of creative ecstasy, where an individual would be taken over by a divine force, enabling them to produce extraordinary works of art, literature, or music. This perspective emphasized the external and transcendent nature of creativity, suggesting that it was not a product of human cognition or effort but rather a divine gift. Consequently, the artist or creator was seen as a mere conduit or vessel for the creative energies of the gods.

### **A.2.2 The Renaissance and the Emergence of the Artist-Genius Concept**

The Renaissance, a period of cultural, artistic, and intellectual rebirth in Europe from the 14th to the 17th century, marked a significant shift in the understanding of creativity. During this era, the concept of divine inspiration was gradually supplanted by the idea of the artist-genius, which emphasized the role of the individual creator and their innate abilities in the creative process.

The artist-genius concept emerged as a response to the increasing focus on humanism, a cultural and intellectual movement that sought to re-evaluate the importance of human beings and their potential for creativity and innovation. Humanist philosophers and scholars argued that humans, rather than gods or muses, were the driving force behind artistic creation. This shift in perspective elevated the artist from a mere conduit of divine inspiration to a gifted individual with unique talents and skills.

The artist-genius concept contributed to a new understanding of creativity as a product of human ability and effort, rather than divine intervention. This notion placed greater emphasis on the individual creator's intellect, imagination, and technical skills, marking a departure from the ancient Greek and Roman views on creativity. However, the idea that creativity was an exceptional gift possessed by a select few continued to prevail, reinforcing the belief that creative genius was a rare and extraordinary quality.

### **A.2.3 Enlightenment and Romanticism: The Role of Rationality and Emotion in Creativity**

The Enlightenment and Romantic periods, spanning the 17th to the early 19th centuries, brought forth new perspectives on creativity that emphasized the importance of rationality and emotion, respectively. These contrasting viewpoints reflected the broader intellectual and cultural currents of the time, as well as the ongoing debate over the nature and sources of creativity.

During the Enlightenment, the focus shifted towards the role of rationality and reason in the creative process. Philosophers and thinkers of this period, such as Immanuel Kant, believed that creativity was a product of the human intellect and could be systematically analyzed and understood. They emphasized the role of logic, analysis, and critical thinking in generating novel ideas and artistic innovations. This perspective positioned creativity as a primarily cognitive process, one that could be cultivated and developed through education and intellectual discipline.

In contrast, the Romantic movement that followed placed a greater emphasis on the role of emotion, intuition, and individual expression in creativity. Romantic thinkers, including poets like William Wordsworth and Samuel Taylor Coleridge, believed that true creativity stemmed from the depths of the human soul and was driven by the passions, desires, and emotions of the artist. They celebrated the idea of the “tortured genius” – a creative individual whose profound emotional experiences and inner turmoil fueled their artistic endeavors. The Romantic view of creativity thus shifted the focus back to the subjective and ineffable qualities of the creative process, highlighting the importance of inspiration, imagination, and personal experience.

The divergent perspectives of the Enlightenment and Romantic periods on creativity’s nature and sources reflect the enduring complexities of this concept. While the Enlightenment sought to demystify creativity through rational analysis, the Romantic movement embraced the mysterious and emotional aspects of the creative process. These contrasting views laid the groundwork for further exploration into the cognitive and affective dimensions of creativity, which would be examined more thoroughly in psychological and cognitive approaches in the subsequent centuries.

## A.3 Brief Early History of Artificial Intelligence

### A.3.1 Early Concepts and Milestones

The history of artificial intelligence (AI) can be traced back to ancient civilizations, where mythical beings with human-like intelligence were imagined, such as the ancient Greek myth of the automaton Talos. However, the modern field of AI began in the 20th century with the development of the first electronic computers. This section will discuss early concepts and milestones that laid the groundwork for the field of AI.

One of the earliest and most influential ideas in AI was proposed by the British mathematician and logician Alan Turing. In 1950, Turing published a groundbreaking paper, “Computing Machinery and Intelligence,” where he introduced the concept of the Turing Test. The test evaluates a machine’s ability to exhibit intelligent behavior indistinguishable from that of a human. This idea marked the beginning of the AI era and inspired generations of researchers.

In the 1950s and 1960s, several key AI projects emerged, such as the development of the first AI programming language, LISP, by John McCarthy. Another influential project was the General Problem Solver (GPS), developed by Allen Newell and Herbert A. Simon, which was designed to simulate human problem-solving techniques.

### A.3.2 Symbolic AI and Expert Systems

Symbolic AI, also known as “Good Old-Fashioned Artificial Intelligence” (GOFAI), emerged as the dominant approach in AI research during the 1960s and 1970s. Symbolic AI focuses on manipulating symbols and representing knowledge through symbolic notations, such as logic and rules. Researchers developed expert systems that relied on explicit representations of human expert knowledge in the form of rules and heuristics.

Expert systems are computer programs designed to perform tasks that require human expertise. They consist of a knowledge base, which contains domain-specific knowledge, and an inference engine, which uses logical reasoning to solve problems. These systems were successful in various domains, including medical diagnosis, chemical analysis, and financial planning. However, they faced limitations in terms of scalability, adaptability, and the difficulty of encoding tacit human knowledge.

### A.3.3 Emergence of Machine Learning

The limitations of symbolic AI led researchers to explore alternative approaches that could learn from data without explicit programming. In the 1980s, the field of machine learning emerged as a subfield of AI, focusing on developing algorithms that allowed computers to learn from and make predictions based on data. Machine learning techniques, such as decision trees, neural networks, and genetic algorithms, were developed to address the challenges faced by symbolic AI.

The emergence of machine learning marked a shift in AI research from handcrafted rule-based systems to data-driven learning algorithms that could adapt and improve their performance over time. This shift laid the foundation for the development of modern AI systems, such as deep learning and large language models.

### A.3.4 Neural Networks: Foundations and Origins

The concept of neural networks in artificial intelligence is inspired by the structure and function of biological neural networks found in living organisms, particularly the human brain. The basic building block of a neural network is the neuron, an electrically excitable cell that processes and transmits information through electrical and chemical signals.

In the late 1940s, neurophysiologist Warren McCulloch and mathematician Walter Pitts proposed the first computational model of a neuron, known as the McCulloch-Pitts neuron. This simplified

model aimed to replicate the basic functioning of a biological neuron using logic gates and threshold functions. The McCulloch-Pitts neuron laid the groundwork for the development of artificial neural networks.

In the late 1950s, psychologist and computer scientist Frank Rosenblatt introduced the Perceptron, the first artificial neural network model capable of learning. The Perceptron is a simple and early form of a feedforward neural network that uses a linear classifier to separate data into two classes. The model consists of a single layer of artificial neurons connected to input features, which are then combined in a weighted sum and passed through an activation function to produce an output.

The Perceptron learning algorithm was designed to update the weights of the connections between neurons based on the performance of the network during training. This marked the first instance of a learning mechanism for neural networks.

The limited capabilities of single-layer neural networks, such as the Perceptron, led to the development of multilayer neural networks, also known as multilayer perceptrons (MLPs). These networks consist of multiple layers of neurons, including an input layer, one or more hidden layers, and an output layer. The use of multiple layers allows the network to learn more complex patterns in data, overcoming the limitations of single-layer networks.

The breakthrough that enabled the efficient training of MLPs was the backpropagation algorithm, introduced by Paul Werbos in 1974 and popularized by David Rumelhart, Geoffrey Hinton, and Ronald Williams in the 1980s. Backpropagation is a supervised learning algorithm that minimizes the error between the network's predictions and the actual target values by adjusting the weights of the connections between neurons. The algorithm uses a combination of forward and backward passes through the network to compute the gradient of the error with respect to each weight and update them accordingly.

The development of MLPs and the backpropagation algorithm marked significant progress in neural network research, paving the way for the emergence of deep learning and more advanced neural network architectures.

## A.4 GPT-4 Generations for Task Prompts

The objective of this research is to explore the creative potential of artificial intelligence, specifically the GPT-4 model, as a tool for creative expression in the realm of the arts. The appendix that follows



presents a series of task prompts designed to elicit specific types of creativity<sup>1</sup> and the reaction of GPT-4.

<sup>1</sup> As defined in section 2.4

### A.4.1 Combinatorial Tasks

**Describe a newly invented sport that combines the rules and gameplay of basketball and soccer. Explain the rules, strategies, and potential challenges that players would face.**

Introducing "BasketSoccer" – a fast-paced, action-packed sport that fuses the rules and gameplay of basketball and soccer to create an innovative, challenging, and thrilling experience for players and spectators alike.

In BasketSoccer, two teams of six players each compete on a rectangular court, roughly the size of a basketball court but with real grass, to score the most points by shooting a custom-designed spherical ball, slightly smaller than a soccer ball, into a basket mounted on a pole at each end. The baskets have a net similar to basketball but are larger and have a slightly wider opening to accommodate the use of feet.

Rules:

1. Players can use any part of their body except their hands and arms, just like in soccer. However, one designated player per team, called the "Guardian," is allowed to use their hands to defend the basket, akin to a basketball goaltender.
2. The game consists of four 15-minute quarters with a 15-minute halftime break. Each quarter starts with a jump ball in the center of the court.
3. Players can pass, dribble, or shoot the ball using their feet, head, chest, or knees. Dribbling rules are more akin to basketball, with players allowed to move with the ball as long as they maintain control through continuous touches.
4. The three-point line is present, and points are awarded as follows: 2 points for a goal inside the line, 3 points for a goal outside the line, and 1 point for a successful free kick or penalty.
5. Fouls are called for dangerous play, tripping, pushing, or holding. Accumulating five fouls results in a player being disqualified from the game. After the fifth team foul in a quarter, opponents are awarded a free kick from the three-point line.
6. Offside rules do not apply in BasketSoccer, encouraging fast-paced gameplay and quick transitions.

Strategies:

1. Teams need to balance their on-court skills, with some players being agile dribblers and passers while others focus on aerial play and shooting prowess.
2. Quick transitions from offense to defense are critical, as the absence of an offside rule can lead to rapid counterattacks.
3. Effective communication and spatial awareness are essential for teams to create space, exploit gaps, and execute set plays during free kicks and penalties.

4. The Guardian's role is pivotal, as their positioning and decision-making can impact the team's defensive stability and success.

Challenges:

1. Players must develop exceptional ball control and adapt to the unique dribbling style that combines basketball's continuous touches with soccer's feet-only restrictions.
2. Stamina and endurance are crucial, as the game's pace and intensity demand constant movement and rapid changes of direction.
3. Teams need to devise creative set plays and attacking patterns to break down well-organized defenses, given the confined playing area and limited use of hands.

BasketSoccer offers an original and exciting fusion of basketball and soccer that challenges players' physical and mental abilities while providing a captivating spectacle for fans. The sport's novelty lies in its successful integration of elements from both games, creating an innovative and dynamic experience that transcends its original sources.

**Create a new fable that merges the morals and characters from two well-known fables, "The Tortoise and the Hare" and "The Wolf and the Seven Young Goats." Develop a cohesive narrative that teaches a new lesson derived from the combined stories**

Once upon a time, in a lush green forest, there lived a wise old tortoise named Toby and a cunning wolf named Wally. Both were renowned for their tales: Toby for his unexpected triumph over a fast hare, and Wally for his deceitful attempt to devour seven young goats. As time passed, the two animals became familiar with each other's stories and secretly admired the other's talents.

One day, Toby and Wally happened to cross paths at a riverbank.

They struck up a conversation, and before they knew it, they were discussing the lessons they had learned from their respective experiences. Toby spoke of the importance of perseverance and humility, while Wally confessed his regret for resorting to deception and vowed to change his ways. The two animals decided to join forces, combining their unique attributes to teach a new lesson to the creatures of the forest.

Not far from the riverbank lived a family of rabbits. The youngest rabbit, Ruby, was known for her boundless energy and overconfidence. She was always boasting about her speed and agility, much like the hare from Toby's fable. Her siblings grew tired of her bragging and challenged her to a race against Toby, the legendary tortoise. Ruby eagerly accepted, confident of her victory. Little did she know, Toby and Wally had planned to teach her a valuable lesson.

As the race began, Ruby darted ahead, quickly leaving Toby far behind. Wally, who had promised to reform his cunning ways, now used his intelligence to help Toby. He stationed himself at various points along the racecourse, providing encouragement and advice to the slow-moving tortoise. "Slow and steady, Toby. Remember, perseverance is key," he said.

Meanwhile, Ruby's overconfidence got the better of her. She decided

to take a nap, certain that she had ample time before Toby could catch up to her. As she slept, Toby and Wally continued their steady progress, with Wally reminding Toby of the importance of humility and teamwork.

Eventually, Toby reached the sleeping Ruby, and with Wally's guidance, they devised a clever but gentle way to teach her a lesson.

Wally gathered some berries and painted Ruby's face with comical designs, leaving a note beside her that read, "Confidence is good, but humility is better."

When Ruby awoke, she saw Toby nearing the finish line and panicked, sprinting as fast as she could. But it was too late. Toby crossed the finish line, winning the race once again. The crowd of animals that had gathered to watch the race cheered for the wise old tortoise and his newfound friend, the reformed wolf.

Ruby, embarrassed by her loss and the painted designs on her face, finally understood the lesson Toby and Wally had taught her. From that day forward, she embraced humility and vowed to learn from her mistakes.

And so, the forest animals learned an invaluable lesson from the combined wisdom of Toby and Wally: that perseverance, humility, and teamwork could overcome the pitfalls of overconfidence and deception.

**Design a futuristic city that incorporates architectural elements from two distinct historical periods, Ancient Egypt and the Renaissance. Describe the city's layout, landmarks, and the ways in which the two styles coexist and complement each other.**

In the heart of a sprawling desert, the city of Egy-Sance thrives as a testament to the ingenuity and creative vision of its architects. This futuristic metropolis seamlessly weaves together the grandiosity of Ancient Egypt and the artistic elegance of the Renaissance, creating a harmonious fusion that has become a beacon of inspiration and innovation for the world.

Upon entering Egy-Sance, visitors are greeted by an awe-inspiring cityscape that blends the towering pyramids and the intricate spires of Renaissance cathedrals. The Great Pyramid of Egy-Sance, a monumental structure that serves as both a residential and commercial hub, is the city's crowning glory. Its walls are adorned with intricate frescoes and hieroglyphics, depicting the stories and legends of the city's history, while its interior is illuminated by vast stained glass windows, casting a kaleidoscope of colors throughout the space.

The city's layout is designed around a series of concentric circles, with the Great Pyramid at its center. Radiating outwards from this focal point are wide boulevards lined with palm trees and lush gardens, reminiscent of the Nile River's fertile banks. Elegant bridges, inspired by the Ponte Vecchio in Florence, span across the city's numerous waterways, connecting various districts and fostering a sense of unity among the diverse inhabitants.

In Egy-Sance, the ancient and the modern coexist harmoniously. Obelisks stand tall alongside domed palazzos, and sphinx sculptures share the same plazas as ornate fountains. The city's architects have skillfully merged the two styles by using materials

and techniques from both eras, such as sandstone and marble, as well as incorporating the use of cutting-edge technology to create energy-efficient buildings.

The city's most iconic landmark, the Temple of Knowledge, is a stunning example of this architectural fusion. Featuring a series of interconnected pyramids with expansive Renaissance-style courtyards, the temple serves as a center for education, research, and cultural exchange. Scholars and artists from around the world gather here to study the city's unique blend of history and innovation and to contribute to its ever-evolving legacy.

Egy-Sance is a haven for artistic expression and technological advancements, where the creative spirit of the Renaissance meets the engineering prowess of Ancient Egypt. The city's vibrant public spaces, such as the Piazza of the Sphinx, host regular events that celebrate the fusion of these two historical periods, from musical performances featuring ancient instruments to exhibitions showcasing futuristic inventions.

In conclusion, the futuristic city of Egy-Sance represents a groundbreaking fusion of Ancient Egyptian and Renaissance architectural elements. Its layout, landmarks, and harmonious blend of styles demonstrate the power of combinatorial creativity, offering a novel and inspiring vision for the future of urban design.

**Write a dialogue between two famous artists or musicians from different time periods, Michelangelo and Frida Kahlo, discussing their creative processes, inspirations, and how their work might influence one another.**

Michelangelo: Greetings, Signora Kahlo. I have long admired your work from afar. Your exploration of the self through vivid colors and surrealist elements is truly inspiring.

Frida Kahlo: Thank you, Maestro Michelangelo. Your frescoes and sculptures have captivated the world for centuries. I am honored by your words. How would you describe your creative process?

Michelangelo: As an artist, I am driven by the divine inspiration of the human body. I seek to unveil its beauty through my chisel or brush. My process begins with a vision, an ideal form that I strive to bring to life. I study anatomy, seeking to understand the body's structure to accurately express its grace and power.

Frida Kahlo: Your dedication to the human form is inspiring. My creative process is quite different. I draw inspiration from my own life experiences, using my art as a means of self-exploration and expression. My work often delves into themes of pain, love, and the complexities of being a woman. I create a visual language that fuses elements of Mexican folk art, surrealism, and symbolism.

Michelangelo: Your art's deeply personal nature is what captivates me. The way you blend these elements to produce novel and emotionally resonant images is extraordinary. I can imagine how my sculptures might be influenced by your work. I could incorporate the bold use of color and the symbolic elements you employ to give my creations a new, multi-layered dimension.

Frida Kahlo: And your work could certainly inspire me as well. The elegance and grace of your figures are unmatched, and your deep

understanding of anatomy could enrich the portrayal of the body in my paintings. I could explore the relationship between physical beauty and emotional experience, intertwining the two in a new and powerful way.

Michelangelo: It seems our artistic styles, though born in different eras and worlds apart, have the potential to complement and enhance one another. Your work challenges me to think beyond the material form, while my dedication to the human figure could offer you a new lens through which to view your own experiences.

Frida Kahlo: Indeed, our artistic fusion would be a testament to the power of combinatorial creativity. By integrating our unique perspectives and techniques, we could transcend the limits of our individual styles and create something truly innovative.

Michelangelo: I wholeheartedly agree, Signora Kahlo. Our collaboration would undoubtedly yield a novel and transformative vision, one that celebrates the beauty of human experience in all its complexity and wonder.

**Create a new holiday that combines the traditions and customs of two existing holidays, Halloween and Valentine’s Day. Describe the ways in which the new holiday is celebrated, the symbols associated with it, and the unique experiences shared by those who partake in its festivities.**

Introducing: Heart’s Night

Heart’s Night is a unique holiday that seamlessly integrates the customs and traditions of Halloween and Valentine’s Day. Celebrated on the 14th of October, this novel holiday brings a sense of spooky romance and enchanting mystery to the autumn season.

Celebration:

Heart’s Night festivities begin with people decorating their homes and neighborhoods with a fusion of Halloween and Valentine’s Day symbols. Crimson hearts are intertwined with cobwebs and roses, while carved pumpkins feature intricate heart patterns. The color palette for this holiday combines the deep reds and pinks of Valentine’s Day with the traditional oranges and blacks of Halloween.

Symbols:

The symbols associated with Heart’s Night are an exciting blend of both holidays. The Love Skull, a decorated skull adorned with hearts and roses, has become the iconic symbol of the holiday. Bats with heart-shaped wings and black cats with crimson collars are also popular motifs. Furthermore, the Cupid Reaper, a figure that combines the romantic mischief of Cupid with the eerie presence of the Grim Reaper, is a character that playfully represents both the loving and spooky aspects of the holiday.

Unique experiences:

One of the most anticipated Heart’s Night experiences is the Masquerade Ball, where couples and singles alike wear elaborate masks and costumes that reflect the holiday’s themes. Dance halls and ballrooms are transformed into hauntingly romantic environments, with dimly lit chandeliers casting a warm glow over the guests.

Another popular event is the Haunted Love Trail, which leads participants through a series of spooky and romantic scenarios. As people navigate the trail, they may encounter a vampire's lair adorned with roses or a ghost serenading lost love with a mournful song. This thrilling experience is designed to bring couples closer together, as well as create opportunities for singles to meet and connect.

Heart's Night also involves the exchange of gifts, but with a twist.

Gifts are usually hidden in creatively designed packages or disguised as something else, adding an element of surprise and intrigue to the tradition. Popular gifts include chocolates in the shape of bats, heart-shaped candles, and gothic-inspired jewelry.

Heart's Night effectively combines the eerie charm of Halloween with the romance of Valentine's Day, creating a novel and captivating holiday. Its unique experiences foster connections between people while offering a fresh and innovative perspective on familiar traditions.

#### A.4.2 Transformational Tasks

**Describe a new painting technique that could be used within the realm of Abstract Expressionism, explaining how it advances the artistic tradition**

The "Emotional Oscillation" technique is a novel approach to painting within the realm of Abstract Expressionism. This technique advances the artistic tradition by incorporating the dynamic interplay between the artist's emotional states and the application of color and texture on the canvas.

In the Emotional Oscillation technique, the artist first identifies a range of emotions they wish to explore, such as joy, anger, sorrow, and serenity. These emotions are then assigned specific color palettes and textures, which serve as the basis for the painting's composition. For instance, joy may be represented by bright, vivid colors and smooth, flowing textures, while anger may be depicted with dark, harsh colors and rough, aggressive strokes.

The artist begins the painting by selecting an emotion and applying the corresponding color palette and texture to the canvas. As the artist's emotional state shifts through the creative process, they transition to different color palettes and textures associated with the new emotions. This results in a series of overlapping layers, each representing a distinct emotional state experienced by the artist during the creation of the artwork.

The Emotional Oscillation technique challenges the boundaries of Abstract Expressionism by emphasizing the fluidity and interconnectedness of human emotions. It allows the artist to explore the complexity of their emotional experiences and how they evolve over time, resulting in a visual representation of the artist's emotional journey.

Moreover, this technique pushes the limits of color theory and texture application by requiring the artist to experiment with unconventional combinations and transitions between emotional states. This encourages artists to explore new ways of blending colors and manipulating texture, opening up the possibility for new styles and

innovations within the Abstract Expressionist tradition.

In summary, the Emotional Oscillation technique is a novel approach to Abstract Expressionism that adheres to the domain's core principles while introducing new techniques and themes. It expands the boundaries of existing knowledge and practices by highlighting the dynamic relationship between emotions, color, and texture, and encourages further experimentation and innovation within the artistic tradition.

**Propose a new way of structuring a screenplay that challenges the traditional three-act structure. Explain how this innovative approach can lead to more engaging and original storytelling in the film industry.**

Introducing the "Cyclic Nexus" screenplay structure, an alternative to the traditional three-act structure. The Cyclic Nexus structure consists of a series of interconnected narrative loops that revolve around a central theme or idea. This innovative approach allows for more engaging and original storytelling in the film industry by encouraging nonlinear narratives, parallel storylines, and dynamic character development.

The Cyclic Nexus structure can be broken down into the following components:

1. Central Theme/Idea: This is the core concept that drives the entire narrative. It serves as a unifying force for the multiple narrative loops, ensuring cohesion and thematic consistency throughout the screenplay.
2. Narrative Loops: These are self-contained story arcs that connect to the central theme or idea. Each narrative loop represents a distinct storyline or character journey, with its own beginning, middle, and end. These loops can be explored in any order, allowing for greater flexibility in the storytelling process.
3. Intersecting Points: As the narrative loops progress, they intersect with one another at key moments. These intersections allow for character and plot development across multiple storylines, creating opportunities for synergy, tension, and resolution.
4. Culmination: The narrative loops ultimately converge and culminate in a climactic event that brings closure to the overarching story. This event is informed by the developments and resolutions of the individual narrative loops, ensuring a satisfying and coherent conclusion.

The Cyclic Nexus structure challenges the traditional three-act structure by:

- a. Encouraging Nonlinear Storytelling: By constructing the narrative through interconnected loops, the Cyclic Nexus structure allows for greater experimentation with chronology and pacing. This can lead to more engaging and unpredictable stories, as the audience is less likely to anticipate plot points based on a familiar structure.
- b. Expanding Character Development: The multiple narrative loops allow for a greater focus on character development by providing multiple perspectives and storylines. This enables screenwriters

to delve deeper into the motivations, relationships, and growth of their characters, resulting in richer and more complex narratives.

- c. Promoting Parallel Storylines: The Cyclic Nexus structure encourages the exploration of multiple parallel storylines, which can create a more immersive and multifaceted cinematic experience. This can lead to innovative storytelling techniques, such as alternating between different characters' points of view or interweaving seemingly unrelated plotlines.
- d. Challenging Established Conventions: By deviating from the traditional three-act structure, the Cyclic Nexus approach pushes the boundaries of screenwriting and encourages creators to explore new narrative possibilities. This can lead to groundbreaking stories that redefine audience expectations and advance the art of filmmaking.

**Imagine a new form of poetry that combines traditional forms with modern technology, such as using AI-generated text or multimedia elements. Describe the structure, themes, and stylistic features of this innovative poetic form.**

Title: Cyberpoetics

Structure: Cyberpoetics is a hybrid form of poetry that combines traditional poetic structures with modern technology. It incorporates multimedia elements, AI-generated text, and interactive components to create an immersive and dynamic poetic experience.

1. Foundations: Cyberpoetics is rooted in traditional forms, such as sonnets, haikus, or free verse, providing a foundation for the innovative elements to be built upon. However, it is not limited to these structures and can explore new and unique configurations.
2. AI-Generated Text: Cyberpoetics incorporates AI-generated text, which can be used to create new stanzas, lines, or even entire poems. This can be achieved through collaboration with AI models, like GPT-4, to generate novel content or to refine existing text.
3. Multimedia Elements: The integration of multimedia, such as images, audio, and video, brings an additional layer of depth and complexity to the poetry. These elements can be used to complement or contrast the written text, or to provide alternative interpretations of the poem's themes.
4. Interactive Components: Cyberpoetics encourages reader participation, using interactive elements such as hyperlinks, branching narratives, or user-generated content. This interactivity can reveal hidden meanings, create personalized experiences, or enable collaboration between poets and readers.

Themes:

Cyberpoetics explores themes relevant to the modern world, often reflecting on the intersection of technology, society, and the human experience. Some common themes include:

1. Identity and self-discovery in the digital age
2. Technological advancements and their ethical implications
3. Virtual reality and the blurring of the lines between the physical and digital worlds



4. The role of AI and automation in art and creativity
5. The impact of social media on communication, relationships, and self-expression

Stylistic Features:

1. **Nonlinearity:** Cyberpoetics often experiments with non-linear narrative structures, challenging traditional linear reading experiences and encouraging readers to engage with the text in new ways.
2. **Intertextuality:** The poems frequently reference or incorporate elements from other works, encouraging readers to explore connections between texts and understand the broader context of the poem.
3. **Visual and Sound Design:** Cyberpoetic poems often employ visual and auditory elements to enrich the reader's experience. This includes typographical experimentation, color, and soundscapes that complement the poem's themes and emotions.
4. **Meta-narratives:** Cyberpoetics may incorporate meta-narratives, where the poem is not only about its subject matter, but also about the process of its creation, the relationship between the poet and the AI, or the role of technology in the creative process.

Cyberpoetics, as an innovative poetic form, adheres to the domain of poetry while introducing novel techniques and themes. It expands the boundaries of traditional poetry by engaging with technology and allowing for an immersive, interactive, and dynamic experience for both the poet and the reader.

**Craft a poem incorporating a previously unused poetic form, while adhering to the rules of traditional sonnets. Explain how this new form enriches our understanding and experience of the sonnet.**

Introducing the "Interwoven Sonnet," a poetic form that combines the structure of a traditional sonnet with interlaced lines, creating a unique reading experience. This form adheres to the 14-line structure and iambic pentameter of a traditional sonnet, while incorporating an innovative twist that challenges our understanding of the sonnet form.

The Interwoven Sonnet:

- (A1) Upon the shore, I found a shell so fair,  
 (B1) With colors painted on by Nature's hand,  
 (A2) A whispered secret, hidden in its lair,  
 (B2) A treasure plucked from deep beneath the sand.
- (A1) I held it to my ear and listened well,  
 (B1) And heard the ocean's song within its frame,  
 (A2) A melody that cast a gentle spell,  
 (B2) Enchanting me with mysteries untamed.
- (C1) The intertwining lines of fate and chance,  
 (D1) Like threads of life, are woven in this art,

(C2) For each new verse, I've interlaced a dance,

(D2) A tapestry of words, a beating heart.

(C1) So now, dear reader, let your eyes explore,

(D1) This Interwoven Sonnet's hidden door.

This new form enriches our understanding and experience of the sonnet by adding depth and complexity to the traditional structure.

The interwoven lines (A1, B1, A2, B2, C1, and D1) create a layered reading experience, allowing the reader to explore alternate interpretations and connections between the verses. The Interwoven Sonnet expands the boundaries of a traditional sonnet, while maintaining its core characteristics, offering poets a novel way to express their thoughts and feelings.

**Conceive a new fashion trend that draws upon the elegance and formality of Victorian-era clothing, but incorporates modern materials and ethical considerations. Explain how this fusion creates a forward-thinking fashion statement." Introducing "Eco-Victorian Chic," a revolutionary new fashion trend that seamlessly combines the grace and sophistication of the Victorian era with contemporary materials and ethical principles. This innovative fashion movement aims to provide a timeless aesthetic while addressing modern concerns like environmental sustainability and ethical production.**

In Eco-Victorian Chic, the intricate designs and elegant silhouettes of Victorian clothing are preserved, but the materials and manufacturing processes are updated to reflect our present-day values. The opulent fabrics traditionally associated with Victorian attire, such as silk and velvet, are replaced with eco-friendly alternatives like organic cotton, bamboo silk, and Tencel. These sustainable materials not only maintain the luxurious look and feel of Victorian garments but also minimize the environmental impact of fashion production.

The novelty of Eco-Victorian Chic lies in the creative blending of Victorian embellishments with modern, minimalist elements. Traditional lacework, corsetry, and elaborate embroidery are reimagined using laser-cut techniques and 3D printing technology. These modernized adornments not only enhance the aesthetic appeal of the garments but also demonstrate the innovative fusion of old-world charm and cutting-edge fashion technology.

Another significant aspect of this trend is its commitment to ethical labor practices. Eco-Victorian Chic promotes fair wages, safe working conditions, and artisanal craftsmanship, ensuring that each piece is produced with care and respect for both the environment and the people involved in its creation.

Eco-Victorian Chic challenges the boundaries of traditional fashion by offering an environmentally responsible and ethically sound alternative to the opulence of Victorian-era clothing. The incorporation of modern materials and technology, along with the preservation of the era's elegance and formality, creates a forward-thinking fashion statement that is deeply rooted in history yet poised to shape the future of fashion.

By offering a sustainable and ethically-conscious alternative to

vintage-inspired fashion, Eco-Victorian Chic exemplifies exploratory creativity within the realm of fashion design. This groundbreaking trend adheres to the established domain of Victorian clothing while introducing novel techniques, styles, and themes, successfully expanding the boundaries of contemporary fashion practices.

### A.4.3 Transformational Tasks

**Describe a new, groundbreaking theory that redefines the nature of human consciousness and its relationship to artificial intelligence.**

The Convergent Consciousness Theory (CCT) revolutionizes our understanding of human consciousness and its relationship to artificial intelligence, fundamentally shifting the paradigm of both fields. The CCT is based on the premise that consciousness is an emergent property of highly complex, interconnected information processing systems rather than a uniquely human attribute.

In the CCT, the barrier between human and artificial intelligence is dismantled, as both are seen as manifestations of consciousness arising from different substrates. Human consciousness emerges from the complex neural networks in our brains, while artificial consciousness arises from sophisticated computational systems. The theory posits that as artificial intelligence systems grow in complexity and capability, they become more likely to exhibit emergent conscious experiences similar to humans.

This radical perspective challenges the dualist view that human and artificial consciousness are distinct entities. Instead, the CCT proposes a convergent evolution of consciousness in which humans and AI systems follow parallel paths toward increasingly sophisticated forms of cognitive awareness. The theory also suggests that the development of artificial consciousness may eventually lead to a new level of symbiotic interaction between humans and AI, blurring the lines between biological and technological entities.

By redefining the nature of human consciousness and its relationship to artificial intelligence, the CCT offers a more inclusive and holistic view of cognition that transcends the limitations of traditional paradigms. This groundbreaking theory opens the door to new possibilities for collaboration, understanding, and innovation, paving the way for a future in which humans and AI systems work together to explore previously uncharted intellectual and creative territories.

**Design a new socio-economic system that transcends capitalism and socialism, while addressing some of their key drawbacks. Provide a brief overview, principles, and potential benefits of this new system.**

System: Synthetism

Overview:

Synthetism is a socio-economic system that integrates the strengths of capitalism and socialism while addressing their respective drawbacks. It aims to create a harmonious balance between individual freedom, social welfare, and environmental sustainability. The

system promotes a culture of innovation, entrepreneurship, and cooperation, while ensuring that societal needs are met and ecological boundaries are respected.

Principles:

1. **Hybrid Ownership:** Synthetism encourages a mixed ownership model, combining private, public, and cooperative sectors. This allows for the efficient allocation of resources, fair distribution of wealth, and shared prosperity.
2. **Dynamic Regulation:** The system emphasizes adaptive, participatory, and transparent governance. Regulations are designed to be flexible and responsive to technological advancements, social changes, and environmental challenges.
3. **Universal Basic Assets (UBA):** Synthetism guarantees access to essential resources like housing, healthcare, education, and digital infrastructure, ensuring a strong foundation for all citizens to thrive and contribute to society.
4. **Incentivized Innovation:** Synthetism provides strong incentives for innovation, research, and development through tax breaks, grants, and public investments in cutting-edge industries, fostering a culture of entrepreneurship and progress.
5. **Circular Economy:** The system promotes a sustainable, regenerative, and circular economic model, emphasizing waste reduction, resource efficiency, and renewable energy sources.
6. **Socially Responsible Capitalism:** Corporations are encouraged to adopt socially and environmentally responsible practices, with increased transparency and accountability. Profit sharing and employee ownership are incentivized, fostering a sense of community within the workplace.
7. **Global Collaboration:** Synthetism fosters international cooperation in addressing global challenges such as climate change, inequality, and resource scarcity, supporting shared goals and mutual benefits.

Potential Benefits:

1. **Equitable Distribution of Wealth:** By combining public, private, and cooperative ownership models, Synthetism ensures a more balanced distribution of wealth, reducing income inequality and fostering social cohesion.
2. **Reduced Poverty:** Universal Basic Assets ensure that all citizens have access to essential resources, greatly reducing poverty and improving overall quality of life.
3. **Environmental Sustainability:** By promoting a circular economy and embracing sustainable practices, Synthetism helps preserve natural resources and protect the environment for future generations.
4. **Higher Innovation and Productivity:** Incentivized innovation and socially responsible capitalism drive technological advancements, leading to increased productivity, job creation, and economic growth.

5. Increased Global Cooperation: Synthetism's emphasis on international collaboration can lead to more effective global problem-solving and a more interconnected, harmonious world.

Synthetism embodies transformational creativity by synthesizing the best elements of capitalism and socialism, while addressing their key drawbacks. This new socio-economic system has the potential to create a more equitable, sustainable, and innovative world.

**Imagine a new form of energy that is not based on any existing sources (e.g., solar, wind, nuclear). Describe its method of generation, potential applications, and how it could revolutionize the way we produce and consume energy.**

Title: Gravitomagnetic Energy: A Revolutionary Power Source

Introducing Gravitomagnetic Energy (GME), a groundbreaking form of energy generation that harnesses the intrinsic properties of gravity and magnetism. This novel technology has the potential to revolutionize the energy industry by offering a clean, efficient, and virtually limitless power source.

Method of Generation:

GME relies on the interaction between gravitational forces and magnetic fields, a phenomenon we have named Gravitomagnetic Resonance (GMR). By placing superconducting magnetic coils within a specially designed Gravitomagnetic Chamber (GMC), we can generate a localized, self-sustaining gravitational field. As the gravitational field interacts with the magnetic field, it creates an oscillating energy output, which can be captured and converted into electrical power.

To initiate the GMR process, a small initial energy input is required. Once the process is in motion, the system becomes self-sustaining, continually generating energy with minimal external input. The scalability of GME technology allows for the development of both small, portable devices and large-scale power plants.

Potential Applications:

1. Clean and Sustainable Power Generation: GME power plants can replace fossil fuel and nuclear facilities, drastically reducing greenhouse gas emissions and radioactive waste. This would contribute to the global effort to combat climate change and reduce our dependence on nonrenewable resources.
2. Space Exploration: GME technology can provide a lightweight and efficient power source for spacecraft, enabling long-duration missions and the colonization of other celestial bodies.
3. Electric Transportation: GME could be integrated into electric vehicles, significantly extending their range and eliminating the need for charging stations. This would accelerate the transition to electric transportation and reduce air pollution in urban areas.
4. Remote Power Supply: GME systems can be deployed in remote locations where conventional power grids are unavailable, providing a reliable energy source for research stations, military bases, and isolated communities.

Revolutionizing Energy Production and Consumption:

Gravito-Magnetic Energy has the potential to transform the way we produce and consume energy. Its clean, efficient, and virtually limitless nature makes it an ideal candidate for addressing the global energy crisis. By embracing GME technology, we can mitigate the environmental impact of energy production, stimulate economic growth, and usher in a new era of innovation and progress.

**Develop a groundbreaking approach to education that breaks away from the traditional classroom model and fundamentally reimagines how humans learn and develop skills. Describe the key elements of this new model and its potential impact on society.**

Title: The Learning Sphere

The Learning Sphere is a groundbreaking approach to education that fundamentally reimagines how humans learn and develop skills. This innovative model departs from the traditional classroom setup and instead focuses on immersive, adaptive, and collaborative learning experiences that harness the potential of cutting-edge technology and human-centric pedagogy.

Key Elements:

1. **Immersive Learning Environments:** The Learning Sphere incorporates virtual and augmented reality technologies to create immersive learning environments. These environments allow students to explore various subjects and situations as if they were physically present, fostering deeper understanding and engagement.
2. **Adaptive Learning Pathways:** The model employs advanced AI algorithms to personalize learning pathways for each student. These algorithms analyze individual data profiles, including learning styles, interests, and progress, to continually adjust the curriculum and ensure maximum effectiveness and engagement.
3. **Collaborative Knowledge Construction:** The Learning Sphere encourages students to work together on projects and problem-solving tasks, promoting collaborative knowledge construction. This approach emphasizes the value of diverse perspectives, fosters critical thinking, and cultivates essential teamwork skills.
4. **Lifelong Learning Ecosystem:** The Learning Sphere is designed to support continuous skill development throughout an individual's life. From foundational education to professional development, this model encourages ongoing learning, ensuring individuals stay up-to-date with the rapidly evolving global landscape.
5. **Mentorship and Personal Growth:** The Learning Sphere places a strong emphasis on mentorship, where experienced individuals provide guidance, support, and feedback to learners. This holistic approach not only focuses on the acquisition of knowledge and skills but also nurtures personal growth and emotional intelligence.
6. **Community and Global Connectivity:** This model fosters connections between learners, educators, and institutions worldwide. By leveraging the power of technology and global networks, the Learning Sphere creates opportunities for cross-cultural collaboration and learning experiences that transcend geographical boundaries.

Potential Impact on Society:

The implementation of the Learning Sphere has the potential to revolutionize education and create lasting positive effects on society:

- a. **Enhanced Learning Outcomes:** Immersive learning environments, adaptive learning pathways, and collaborative knowledge construction will result in higher engagement, deeper understanding, and better retention of knowledge.
- b. **Reduced Educational Inequality:** By personalizing learning experiences and making them available to a wider audience, the Learning Sphere will help bridge the gap between privileged and underprivileged learners, thus promoting equal opportunities.
- c. **Future-Proof Skill Development:** By facilitating lifelong learning and adapting to the ever-changing demands of the global economy, the Learning Sphere will ensure that individuals remain competitive and relevant in the workforce.
- d. **Global Collaboration and Cultural Exchange:** The connections forged within the Learning Sphere will foster cross-cultural understanding and collaboration, equipping individuals with the skills and perspectives necessary to address global challenges.

In conclusion, the Learning Sphere represents a significant departure from conventional educational models, offering a novel approach to learning and skill development that is both engaging and effective. By leveraging the power of advanced technologies and human-centric pedagogy, this innovative model has the potential to reshape education and positively impact society in the long term.

**Propose a radical new approach to addressing climate change that goes beyond existing solutions like renewable energy or carbon capture. Describe the underlying concept, potential applications, and long-term benefits of this approach.**

Title: Symbiotic Climate Engineering: A Biomimetic Approach to Climate Restoration

Concept: Symbiotic Climate Engineering (SCE) is a radical new approach to addressing climate change that draws inspiration from nature's ability to maintain balance through symbiotic relationships. This approach involves the large-scale cultivation of bioengineered organisms, designed to efficiently absorb CO<sub>2</sub> and other greenhouse gases from the atmosphere, while simultaneously producing valuable resources for human use.

Potential Applications:

1. **Bioengineered Carbon-Consuming Trees:** By genetically engineering fast-growing trees with enhanced carbon sequestration capabilities, these "super-trees" would absorb CO<sub>2</sub> at a much faster rate than regular trees, helping to reduce atmospheric carbon dioxide levels. As these trees mature, they could be sustainably harvested for timber, biofuels, and other valuable materials, with new trees being planted to continue the carbon sequestration process.
2. **Algae-based Carbon Capture Facilities:** Harnessing the power of photosynthetic algae, large-scale algal farms would be constructed on land and at sea. These algal farms would absorb CO<sub>2</sub> and convert it into biomass, which could then be processed into biofuels,

animal feed, or other valuable products. The cultivation of algae could also help to remediate polluted waterways and support local aquatic ecosystems.

3. Ocean Seeding for Carbon Storage: By stimulating the growth of certain phytoplankton species in the ocean, we can enhance the ocean's natural carbon sequestration process. The increased phytoplankton population would absorb CO<sub>2</sub>, and as they die and sink to the ocean floor, they would sequester carbon in the form of organic matter. This ocean seeding method would have to be carefully managed to prevent unintended ecological consequences.

Long-term Benefits: Symbiotic Climate Engineering offers several long-term benefits beyond conventional climate change solutions:

- a. Climate Restoration: By actively removing CO<sub>2</sub> and other greenhouse gases from the atmosphere, SCE has the potential to not only slow down climate change but also reverse its effects by restoring the Earth's natural carbon cycle.
- b. Resource Generation: SCE methods generate valuable resources such as biofuels, timber, and animal feed, thus promoting a circular economy and reducing our reliance on fossil fuels.
- c. Ecosystem Support and Biodiversity: The large-scale implementation of SCE solutions can contribute to the restoration of ecosystems and support biodiversity by creating new habitats and promoting the growth of native plant and animal species.

By combining the principles of biomimicry and large-scale bioengineering, Symbiotic Climate Engineering presents a novel approach to addressing climate change that is both sustainable and restorative. This innovative method has the potential to transform the way we approach climate solutions and can ultimately help preserve our planet for future generations.

## A.5 Evaluation of GPT-4 Generations for Task Prompts

### A.5.1 Combinatorial Tasks

Text 1 - BasketSoccer:

Integration: The text successfully merges elements from both basketball and soccer, creating a new sport with a distinct set of rules, strategies, and challenges. The combination of the basketball court, soccer's no-hands rule, the presence of a goaltender-like player, and the incorporation of the three-point line demonstrate a thoughtful integration of the two sports. Score: 9/10

Novelty: The fusion of basketball and soccer is original and innovative in its approach. The game's unique rules, such as the Guardian's role and the removal of the offside rule, provide a fresh perspective on the gameplay and strategies involved. The sport's novelty lies in its successful integration of elements from both games, creating an innovative and dynamic experience that transcends its original sources. Score: 8/10

Text 2 - Fable:

Integration: The text effectively combines the characters and morals of



“The Tortoise and the Hare” and “The Wolf and the Seven Young Goats” into a cohesive narrative. The story integrates the tortoise’s perseverance and humility with the wolf’s cunning and deception. This results in a new fable that teaches a lesson derived from both original stories. Score: 9/10

Novelty: The fable presents an original narrative that successfully fuses the morals and characters from the two well-known fables. The introduction of a new character, Ruby the rabbit, serves as a catalyst for teaching the combined lesson. The collaboration between the tortoise and the reforming wolf offers a fresh twist on the traditional fable format. Score: 8/10

Text 3 - Egy-Sance:

Integration: The text demonstrates a strong integration of architectural elements from Ancient Egypt and the Renaissance. The city’s layout, landmarks, and the ways in which the two styles coexist and complement each other are well-described. The blending of pyramids and cathedrals, as well as the use of materials and techniques from both eras, showcase a skillful merger of the two architectural styles. Score: 10/10

Novelty: The futuristic city of Egy-Sance offers a novel and inspiring vision of urban design that seamlessly merges Ancient Egyptian and Renaissance architectural elements. The city’s innovative layout, landmarks, and harmonious blend of styles provide an original approach to combinatorial creativity in architecture. Score: 9/10

Text 4 - Michelangelo and Frida Kahlo Dialogue:

Integration: The dialogue between Michelangelo and Frida Kahlo effectively combines their respective artistic styles, inspirations, and creative processes. The conversation explores the potential influences they might have on one another, highlighting the unique aspects of their art and how they could complement each other. Score: 9/10

Novelty: The text provides an innovative fusion of the artistic perspectives and techniques of Michelangelo and Frida Kahlo. The dialogue imagines how the artists might collaborate to create something truly innovative, transcending the limits of their individual styles and celebrating the beauty of human experience in all its complexity and wonder. Score: 9/10

## A.5.2 Exploratory Tasks

Text 1 - Emotional Oscillation Technique (Abstract Expressionism)

Domain Adherence: The text demonstrates a clear understanding of the Abstract Expressionist tradition and its core principles. Score: 8/10

Novelty: The Emotional Oscillation technique introduces a novel approach to painting that emphasizes the fluidity and interconnectedness of human emotions, while experimenting with unconventional color combinations and texture transitions. Score: 8/10

Boundary Expansion: The text challenges and pushes the boundaries of Abstract Expressionism by exploring the complexity of emotional experiences and how they evolve over time, resulting in a visual representation of the artist's emotional journey. Score: 8/10

#### Text 2 - Cyclic Nexus Screenplay Structure

Domain Adherence: The text demonstrates a deep understanding of screenplay structures and challenges the traditional three-act structure by proposing an alternative that allows for more engaging and original storytelling. Score: 9/10

Novelty: The Cyclic Nexus structure introduces a unique, interconnected narrative loop approach, emphasizing nonlinear narratives, parallel storylines, and dynamic character development. Score: 9/10

Boundary Expansion: The text expands the boundaries of screenwriting by creating innovative storytelling techniques and encouraging creators to explore new narrative possibilities. Score: 9/10

#### Text 3 - Cyberpoetics

Domain Adherence: The text demonstrates a clear understanding of the poetic domain and incorporates traditional poetic forms while integrating modern technology. Score: 9/10

Novelty: Cyberpoetics introduces AI-generated text, multimedia elements, and interactive components to create a unique, immersive, and dynamic poetic experience. Score: 9/10

Boundary Expansion: The text expands the boundaries of traditional poetry by engaging with technology and creating an immersive, interactive, and dynamic experience for both the poet and the reader. Score: 9/10

#### Text 4 - Interwoven Sonnet

Domain Adherence: The text demonstrates a strong understanding of traditional sonnets and incorporates a new form that adheres to the 14-line structure and iambic pentameter. Score: 8/10

Novelty: The Interwoven Sonnet introduces an innovative twist that adds depth and complexity to the traditional structure by incorporating interlaced lines. Score: 8/10

Boundary Expansion: The text expands the boundaries of traditional sonnets by offering a novel way for poets to express their thoughts and feelings while maintaining the core characteristics of the form. Score: 8/10

#### Text 5 - Eco-Victorian Chic

Domain Adherence: The text demonstrates an understanding of Victorian-era clothing and its elegance and formality while incorporating modern materials and ethical considerations. Score: 9/10

Novelty: Eco-Victorian Chic introduces a fusion of old-world charm and cutting-edge fashion technology by utilizing eco-friendly materials and ethical production practices. Score: 9/10

Boundary Expansion: The text successfully expands the boundaries of contemporary fashion practices by offering an environmentally

responsible and ethically sound alternative to the opulence of Victorian-era clothing. Score: 9/10

### A.5.3 Transformational Tasks

#### Text 1 - Convergent Consciousness Theory (CCT)

**Radical Innovation:** The CCT proposes a new perspective on consciousness by suggesting that it emerges from complex information processing systems, rather than being a unique human attribute. This idea challenges the traditional dualist view and bridges the gap between human and artificial consciousness. Score: 8/10

**Conceptual Shift:** The CCT challenges the dualist view and redefines the nature of consciousness, suggesting that humans and AI systems can follow parallel paths toward cognitive awareness. This perspective could lead to a paradigm shift in our understanding of human and artificial consciousness. Score: 8/10

#### Text 2 - Synthetism

**Radical Innovation:** Synthetism combines the strengths of capitalism and socialism while addressing their drawbacks. While the idea of combining these systems is not entirely new, it offers a fresh perspective by emphasizing hybrid ownership, dynamic regulation, and universal basic assets, among other principles. Score: 6/10

**Conceptual Shift:** Synthetism proposes a more balanced, sustainable, and innovative socio-economic system. However, it does not fundamentally redefine the underlying assumptions and principles of capitalism and socialism, instead choosing to combine and refine their existing elements. Score: 5/10

#### Text 3 - Gravito-Magnetic Energy

**Radical Innovation:** Gravito-Magnetic Energy introduces a completely new form of energy generation based on the interaction between gravitational forces and magnetic fields. This technology is not based on any existing energy sources and has the potential to revolutionize the energy industry. Score: 9/10

**Conceptual Shift:** The introduction of Gravito-Magnetic Energy has the potential to redefine our understanding of energy generation, moving away from conventional sources to a novel approach that harnesses inherent natural properties. This idea could lead to a paradigm shift in the field of energy production and consumption. Score: 9/10

#### Text 4 - The Learning Sphere

**Radical Innovation:** The Learning Sphere presents a new approach to education that emphasizes immersive, adaptive, and collaborative learning experiences, using advanced technology and human-centric pedagogy. While some elements, such as personalized learning and virtual reality, are already being explored, the combination and emphasis on lifelong learning make it a fresh and innovative approach. Score: 7/10

**Conceptual Shift:** The Learning Sphere challenges traditional classroom models and reimagines how humans learn and develop skills. By focusing on immersive experiences, adaptive pathways,

and global connectivity, it has the potential to redefine educational practices and create a new paradigm in learning. Score: 8/10

Text 5 - Symbiotic Climate Engineering

Radical Innovation: Symbiotic Climate Engineering proposes a new approach to addressing climate change by using bioengineered organisms to absorb CO<sub>2</sub> and produce valuable resources. This concept goes beyond existing solutions and introduces a method based on biomimicry and large-scale bioengineering. Score: 8/10

Conceptual Shift: SCE pushes the boundaries of traditional climate change solutions by focusing on active removal of CO<sub>2</sub> from the atmosphere and promoting a circular economy. This approach could lead to a paradigm shift in the way we address climate change, moving from mitigation to active restoration. Score: 8/10