

ANTONIUS' COMPENDIUM

Compendium of Knowledge
Volume II: Neural Nucleus
Version 0.003

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Written in: L^AT_EX



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Preface

This document is a compilation of scratch work, derivations, useful formulas, definitions, constants, and general information used for my own studies as a reference while furthering self education. These are my notes. It's purpose is to provide a complete 'compendium' per say of various mathematical and significant ideas used often. All the material in this document was either directly copied from one of the references listed at the end or derived from scratch. On occasion *typos may exist* due to human error but will be corrected when discovered.

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Topics Covered In This Book

- | | |
|-------------------------|-----------------------|
| • General Mathematics | • Astrophysics |
| • Calculus | • Electrodynamics |
| • Linear Algebra | • Relativity |
| • Geometry | • Classical Mechanics |
| • Statistical Mechanics | • Quantum Mechanics |

The information in this book is in no way limited to the topics listed above. They serve as a simple guideline to what you will find within this document. For more information about this book or details about how to obtain your own copy please visit:

<https://torodean.github.io/>

“Scientific theories deal with concepts, not with reality. All theoretical results are derived from certain axioms by deductive logic. In physical sciences the theories are so formulated as to correspond in some useful sense to the real world, whatever that may mean. However, this correspondence is approximate, and the physical justification of all theoretical conclusions is based on some form of inductive reasoning.” - Athanasios Papoulis (Probability, Random Variables, and Stochastic Processes book)

Disclaimer

This book contains formulas, definitions, and theorems that by nature are very precise. Due to this, some of the material in this book was taken directly from other sources such as but not limited to Wolfram Mathworld. This is only such in cases where a change in wording could cause ambiguities or loss of information quality. Following this, all sources used are listed in the references section and cited when used.

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Artificial Intelligence

1.1 Introduction

Artificial Intelligence (AI) is the field of study concerned with the design and development of systems capable of performing tasks that typically require human intelligence. These tasks include learning, reasoning, problem-solving, perception, and language understanding. In a sense, this is an attempt to artificially mimic human intelligence while simultaneously combining it with the advantages that modern technological computing powers bring. AI spans a wide range of sub-fields, from symbolic logic and knowledge representation to machine learning and neural networks. It intersects with disciplines such as computer science, mathematics, neuroscience, and philosophy.

Modern AI systems are broadly categorized into two classes: *narrow AI*, designed for specific tasks, and *general AI*, which aspires to emulate human-level cognition across diverse domains. Key concepts include algorithms, data structures, optimization, statistical inference, and computational models of learning. Recent advancements in Large Language Models (LLMs) have demonstrated the ability of transformer-based architectures to generate coherent text, perform reasoning tasks, and interface with complex domains using natural language, which gives an appearance for the foundations of creating a *general AI*. Artificial General Intelligence (AGI) refers to a type of AI that possesses the ability to understand, learn, and apply knowledge across a wide range of tasks at a level comparable to human intelligence, which is the goal of many.

Applications of AI are pervasive, influencing medicine, finance, robotics, language processing, and decision-making systems. Continued advancement in AI raises important technical, ethical, and societal questions, many of which remain open areas of research.

Psychology

2.1 Introduction

Psychology is the scientific study of mind and behavior, encompassing the processes underlying cognition, emotion, perception, and action. It explores how individuals think, feel, and behave across various contexts, integrating insights from biology, sociology, philosophy, and neuroscience. The field is broadly divided into sub-disciplines such as cognitive psychology, behavioral psychology, developmental psychology, clinical psychology, and social psychology. Each examines different aspects of mental processes and behavior, using both experimental and observational methods.

Psychological research informs fields like education, mental health, artificial intelligence, and human-computer interaction, providing foundational understanding of human cognition and behavior.

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