

Artificial Intelligence: A Bridge that Connects Disjoint Sets, Approaches Infinity and Converges to Innovation

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Abstract

Mathematics is widely regarded as the foundation of all sciences and as a universal language that explains the structure of the world around us. From medieval mathematics to modern computational theory, concepts such as Boolean Algebra have evolved into essential components of Artificial Intelligence (AI). Today, AI not only assists in solving mathematical problems but also transforms the way mathematical ideas are visualized and understood. Memorizing sine values, for example, is very different from observing AI-generated sine wave visualizations that deepen conceptual understanding and curiosity. Modern AI platforms such as Wolfram Alpha, Symbolab, Photo math and AI4Math are reshaping mathematics education by providing intelligent solutions, visual interpretations and step-by-step reasoning. AI techniques also support the verification of human-generated proofs and contribute to advanced mathematical research. The ancient Chinese text I Ching, known for its symbolic hexagrams and decision-making guidance, has inspired AI-driven digital interpretations that combine symbolic reasoning with intelligent analysis. The emergence of AI4Math marks a new interdisciplinary field where machine learning intersects with mathematical reasoning. Beyond education, AI contributes to black hole theory, geometry, differential equations, and cosmological simulations through advanced data analysis and 3D visualization. The integration of Mathematics, Artificial Intelligence, and General Relativity continues to reshape our understanding of time, space, and the universe, highlighting the transformative potential of AI in mathematics, scientific discovery, and future innovation. Although time travel remains theoretical, these disciplines enable scientists to reconstruct, simulate, and interpret events with remarkable precision, opening possibilities for understanding cosmic phenomena and advancing modern physics through computational models.

Keywords: *AI4Math and Cosmic Phenomena, I Ching, General Relativity*

Introduction

Mathematics is humanity's first language. It transformed abstract thoughts into petroglyphs and petrographs (in forms of straight line), giving ideas their first written, permanent form. The evolution of mathematics began with ancient Egyptian mathematics, developed through Babylonian mathematics, and was further advanced by Chinese, Greek, Indian, and Medieval mathematics. It then grew through European mathematics into the 21st century (Boyer & Merzbach, 2011). Mathematics has grown vastly. From this evidence, it is evident that the advancement of our species is inextricably linked to our understanding of mathematics. For the fruits of improvement, we must water the garden of mathematics.

However, the learning process and the iteration is highly complex so to unite fractals we can use Artificial Intelligence.

Review of Related Literature

Ancient Egyptian mathematics gave rise to a sophisticated understanding of arithmetic, algebra, and geometry. These ideas made it possible to solve second- and third-order equations and to calculate the volume of objects like pyramids and cylinders. The Egyptians also developed the first accurate calendar with a 365-day cycle. The Babylonians advanced mathematics through astronomy. They tracked the sun, moon, and planets using a base-60 number system, which gave us 60 seconds in a minute and 60 minutes in an hour. They also solved polygonal areas, computed square and cube roots, estimated π , and used fractions.

Chinese mathematics made significant advances in geometry, algebra and trigonometry (Wilhelm, 1967). They calculated the value of π to five decimal places and invented the abacus, a counting frame used for calculation since ancient times. They developed I Ching, a system used for divination and astrological calculations, divination being the practice of seeking knowledge of the future or the unknown by supernatural means. The concept of negative numbers was first formalized by the Chinese mathematician Yang Hui in the 13th century (Euclid, 2008). The yin-yang symbol also reflects their early grasp of duality, a concept fundamental to mathematics and logic.

Greek mathematics introduced many fundamental concepts and theorems, including the Pythagorean Theorem, Euclid's Elements and the concept of formal proof. Euclid, known as the "father of geometry," authored Elements, a foundational work in mathematics. The Project Gutenberg archive (<https://www.gutenberg.org>) provides detailed access to his work. Apollonius of Perga (c. 262 BCE) is renowned for his work on conic sections, ellipses, parabolas and hyperbolas and for generalizing the Pythagorean Theorem.

Archimedes of Syracuse (c. 287–212 BCE) made ground-breaking contributions to Mathematics, Physics and Engineering. He is best known for the Archimedes Principle, the law of the lever and his work on areas and volumes. Pythagoras (c. 570–495 BCE) is credited with the Pythagorean Theorem, which states: "In a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides." The sides are known as the perpendicular, base, and hypotenuse. Indian mathematics dates back to the Vedic period and made foundational contributions to algebra and trigonometry. Aryabhata formulated sine and cosine rules and made important contributions to number theory and algebra, including methods for solving cubic equations and calculating the area of a triangle (Aryabhata, 1973; Brahmagupta, 1880).

Indian mathematicians also developed the concept of zero and the decimal system. Bhaskara advanced logic through the concept of proof by contradiction. Brahmagupta made significant contributions to number theory and algebra through his writings, including rules for operating with zero and negative numbers. Centuries before Newton and Leibniz, mathematicians like Madhava of Sangamagrama and Nilakantha Somayaji initiated the development of calculus, including infinite series expansions for trigonometric functions. In computational geometry, Mahavira developed a theorem for cyclic quadrilaterals, stating that the area equals the sum of the areas of triangles formed on each side.

Islamic mathematics advanced algebra and number systems using Euclidean geometry (Al-Khwarizmi, 1831). Sharaf al-Din al-Tusi developed methods for solving cubic equations.

Al-Khwarizmi introduced reduction techniques for linear and quadratic equations, giving algebra its name. Islamic scholars also influenced logic systems that later shaped Boolean algebra, now essential to computer science and AI. Renaissance mathematicians revolutionized the field. Viète created symbolic algebra and methods for solving equations, paving the way for calculus (Euler, 1748). Descartes developed the Cartesian plane, linking algebra and geometry. De Beaune and Pascal established probability theory and Pascal also built one of the first mechanical calculators (Hilbert, 1902; Noether, 1971). The 17th and 18th centuries saw major advances in calculus, analysis and abstract algebra. Leonhard Euler, a Swiss mathematician, made profound contributions to calculus, number theory, graph theory and astronomy. He introduced much of modern mathematical notation and solved problems with remarkable rigor. Euler also wrote influential works on the calculus of variations and established foundational results in graph theory.

Joseph-Louis Lagrange, an Italian-French mathematician, advanced calculus and mechanics. He developed the method of Lagrange multipliers, contributed to the calculus of variations and made key advances in differential equations and number theory. The late 18th and early 19th centuries also saw the emergence of abstract algebra. Mathematicians such as Augustin-Louis Cauchy and Évariste Galois developed group theory and other algebraic structures to solve equations of an abstract nature. Abstract algebra would become one of mathematics' most influential fields, with applications across science.

The 19th century was a period of rigor and abstraction that reshaped mathematics. Georg Cantor, a German mathematician, founded set theory and formalized the concept of different sizes of infinity, now central to modern mathematics. Karl Weierstrass and Sofia Kovalevskaya advanced mathematical analysis. Weierstrass established rigorous foundations for calculus through his precise definition of limits and functions, while Kovalevskaya made pioneering contributions to partial differential equations and mechanics. The century transformed set theory, analysis and algebra, setting the stage for modern mathematics. The 20th century became an ever-expanding field, driven by advances in computer technology that enabled computers, the internet, and digital communication (Turing, 1934). Algebra progressed significantly through the work of David Hilbert and Emmy Noether, who developed the abstract theory of groups, rings, and fields. Real analysis and differential equations advanced through many contributors. While Carl Gauss and Isaac Newton worked in earlier centuries, 20th-century figures like Stephen Hawking applied these tools to cosmology and physics.

Objectives

Modern mathematics continues to expand, with fields like graph theory and network analysis gaining prominence. Mathematicians now apply algorithms and data mining techniques to develop practical solutions for real-world problems. To illustrate recent advances, consider the computation of π . The current record stands at over 31.4 trillion digits thousands of times greater than the number calculated by the Chudnovsky brothers on their home-built supercomputer. Emma Haruka Iwao, a Google employee, who performed the calculation over 121 days using the freely available program y-cruncher, set the record. The result was verified with an additional 48 hours of computation. The calculation required storage comparable to the entire digital collection of the Library of Congress.

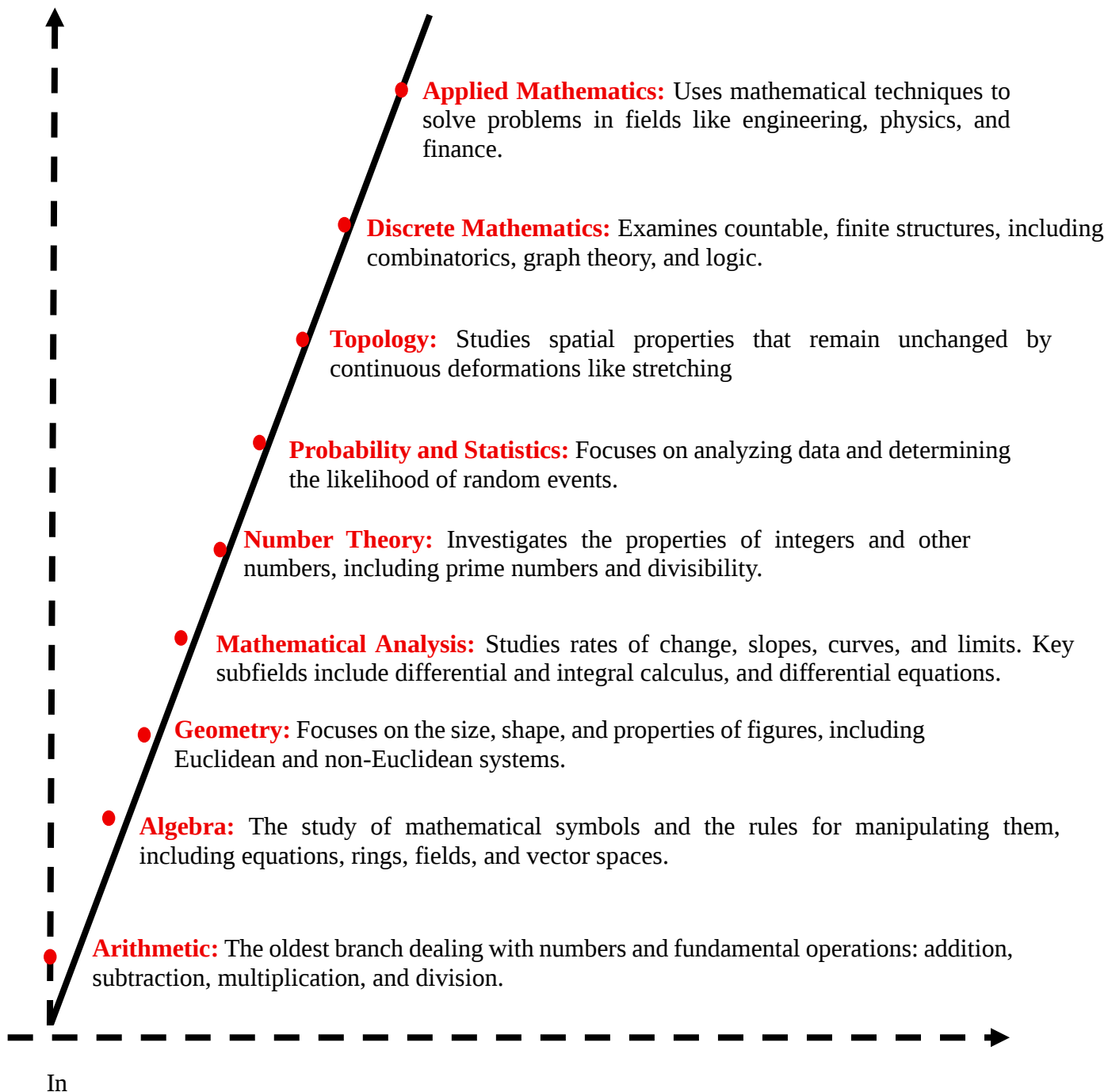
Iwao has been computing π since childhood. Her achievement increased humanity's known digits of π by roughly 40%. The previous record, over 22 trillion digits, was computed in

105 days on a Dell server, also using y-cruncher. This program employs both the Ramanujan and Chudnovsky formulas and has been used to calculate record-length expansions of other irrational numbers, including e , $\log 2$, and the golden ratio.

The twenty-first century marks the first era in which earlier mathematical ideologies have been consolidated and applied to artificial intelligence to drive the future of mathematics.

Methodology

The Spectrum of Mathematics:



Arithmetic: AI-based tools can explain calculations step by step, correct mistakes instantly, and use interactive methods such as quizzes, games, and virtual tutors to make mathematical concepts easier, faster, and more engaging for students to learn.

Algebra: AI-powered virtual reality classrooms can visually demonstrate algebraic concepts such as graphs, functions, and equations in a real-time interactive environment. Advanced AI assistants can predict areas where students may struggle in algebra and provide preventive guidance, personalized study plans, and real-world problem-solving applications.

Geometry: Artificial Intelligence enhances the learning of Geometry by helping students visualize shapes, angles, and spatial relationships through interactive 3D models and simulations. AI-based tools can provide step-by-step explanations for geometric constructions and theorems, identify errors in diagrams and calculations, and create personalized exercises to improve understanding of Euclidean and non-Euclidean geometry concepts.

Mathematical Analysis: Artificial Intelligence enhances the learning of Mathematical Analysis by helping students understand concepts such as limits, slopes, curves, and rates of change through interactive graphs and visual simulations. AI-powered tools can solve differential and integral calculus problems step by step, explain complex equations clearly, and provide personalized practice and instant feedback to improve understanding of calculus and differential equations.

Number Theory: Artificial Intelligence enhances the learning of Number Theory by helping students understand the properties of integers, prime numbers, divisibility, and mathematical equations through step-by-step explanations and logical analysis. AI-based tools can identify number patterns, solve complex numerical problems, generate personalized practice exercises, and use interactive methods to improve understanding of concepts related to factors, multiples, and number relationships.

Probability and Statistics: Artificial Intelligence enhances the learning of Probability and Statistics by helping students analyze data, identify patterns, and understand the chances of random events through interactive graphs and simulations. AI-powered tools can solve statistical and probability problems step by step, provide instant feedback, generate personalized practice questions, and use real-world data analysis to improve understanding of concepts such as distributions, averages, and probability calculations.

Topology: Artificial Intelligence enhances the learning of Topology by helping students visualize spatial properties and continuous transformations such as stretching, bending, and twisting through interactive 3D simulations. AI-based tools can explain topological concepts step by step, analyze shapes and structures, and provide personalized exercises and visual models to make abstract topology concepts easier to understand and apply.

Discrete Mathematics: Artificial Intelligence enhances the learning of Discrete Mathematics by helping students understand finite and countable structures through interactive problem-solving and logical analysis. AI-powered tools can explain concepts such as combinatorics, graph theory, and logic step by step, generate personalized practice

questions, and use visual models and simulations to make complex discrete mathematical concepts easier and more engaging to learn.

Applied Mathematics: Artificial Intelligence enhances the learning of Applied Mathematics by helping students apply mathematical methods to real-world problems in engineering, physics, finance, and technology. AI-based tools can analyze complex data, simulate practical situations, solve mathematical models step by step, and provide interactive visualizations to improve understanding of formulas, calculations, and problem-solving techniques used in applied fields.

Analysis

Some of the tools to learn the above are:

Arithmetic

1. Photomath – Solves arithmetic problems with step-by-step explanations.
2. Prodigy Math – Uses AI-based games to improve basic calculations and problem-solving skills.
3. Khan Academy – Provides personalized arithmetic practice and instant feedback.

Algebra

1. Microsoft Math Solver – Explains algebraic equations step by step.
2. Wolfram Alpha – Solves algebra problems and simplifies expressions.
3. Symbolab – Provides detailed algebra solutions and graph visualizations.

Geometry

1. GeoGebra – Visualizes geometric shapes, angles, and constructions interactively.
2. Geometry Pad – Helps students draw and explore geometric figures.
3. Cabri Geometry – Uses dynamic models to explain geometric concepts.

Mathematical Analysis

1. MATLAB – Helps analyze functions, curves, and calculus problems.
2. Maple – Solves differential and integral equations step by step.
3. Desmos – Visualizes limits, slopes, and graphs interactively.

Number Theory

1. SageMath – Explores prime numbers and divisibility concepts.
2. PARI/GP – Performs advanced number theory calculations.
3. Mathematica – analyses numerical patterns and equations.

Probability and Statistics

1. IBM SPSS Statistics – Analyses data and probability distributions.
2. RStudio – Performs statistical modelling and data visualization.
3. Tableau – Uses AI-driven charts and graphs for statistical analysis.

Topology

1. Mathematica – Visualizes topological transformations and structures.
2. MATLAB – Simulates continuous deformations and spatial models.
3. Blender – Helps visualize complex topological surfaces in 3D.

Discrete Mathematics

1. Graphviz – Visualizes graph theory concepts and networks.
2. SageMath – Solves combinatorics and logic problems.
3. Prolog – Helps understand logical reasoning and discrete structures.

Applied Mathematics

1. MATLAB – Solves engineering and scientific mathematical problems.
2. Simulink – Simulates real-world systems and mathematical models.
3. COMSOL Multiphysics – Applies mathematics to physics and engineering

Findings and Discussion

Avenues for Future Investigation

I Ching – Theory:

The I Ching or Book of Changes is a text in Chinese philosophy. It says that change is always happening. Life is not static and being wise means understanding and going with that flow. At its core are 64 hexagrams. These are symbols made of unbroken lines. Each one represents a situation, energy or phase of change. Traditionally people use them to think about decisions, relationships, personal growth and what next. The I Ching is based on Yin and Yang. These are two forces, like light and dark action and stillness, strength and receptivity. Over time the I Ching has influenced thought, ethics and culture.

Here are some ways people use the I Ching:

1. Decision Making – It helps when making personal, professional or relationship choices.
2. Self-Understanding – It gives a way to look at your motives, emotions and behavior to grow.
3. Spirituality – It teaches balance, patience and accepting that things change.
4. Business and Leadership – Leaders use its ideas for strategy, risk and uncertainty.
5. Psychology – The symbols help with self-analysis and therapy.
6. Art and Creativity – Its images and themes inspire writers, artists and musicians.
7. Technology and Computing – The hexagram structure is like binary code, which computers use.

Benefits of the I Ching Theory:

1. It helps see change, as normal making it easier to handle transitions and encourages decision-making.
2. It supports harmony by emphasizing balance and increases self-awareness and emotional intelligence.
3. It can be used in areas, like philosophy, psychology, business and art.
4. It sparks creativity. Helps solve problems and gives a direction when things are uncertain.

Cosmic phenomena:

Cosmic phenomena are events and processes that happen outside Earth. They include things like stars being born and dying and how galaxies, black holes and dark matter behave. These things are controlled by physics rules like General Relativity and quantum mechanics. They help shape the universe, as we know it. By studying phenomena, we can learn where we come from what rules the universe follows and what might happen next.

Applications of Studying Cosmic Phenomena

1. Astrophysics & Cosmology – We can test ideas about gravity, space and time. How the universe began.
2. Technology Development – Looking at pulsars, gravitational waves and black holes helps us make sensors, computers and measuring tools.
3. Navigation & Timekeeping – GPS and global timing systems need corrections that we found out by studying the universe.
4. Planetary Defence – We track asteroids, solar flares and gamma ray bursts to see if they are risks to Earth.
5. Space Exploration – Understanding things like radiation cosmic rays and gravitational fields helps us have trips to space.
6. Fundamental Science – We often start looking for particles and dark matter by studying the universe.
7. Inspiration – Finding out things about the universe makes people interested in science and helps us understand our place in it.

Advantages of Studying Cosmic Phenomena

1. We learn more about how the universe works in situations.
2. We get technologies that can help us in everyday life like better medical imaging and GPS.
3. We can. Prepare for space weather that might affect Earth.
4. We make our navigation and communication systems better.
5. We challenge what we think we know which helps us make discoveries.
6. We get an idea of Earth's future and our place in the universe.
7. We inspire ideas, teamwork and working together across different areas of study.
8. Cosmic phenomena help us understand the universe and its mysteries.
9. Studying phenomena is important, for our understanding of the universe.
10. The universe and its phenomena are still not fully understood.

General Relativity:

General Relativity is Einstein's 1915 theory of gravity. This theory is very important. It changed the way we think about gravity. Before people thought, gravity was a force. Einstein said that mass and energy actually change the shape of space-time. That shape tells objects how to move. For example, planets go around stars because of this. Light bends when it goes near stars. Time goes slower when gravity is strong. This is because space-time is always changing. When gravity is weak, General Relativity is similar to Newton's idea of gravity. When gravity is strong, it makes different predictions. General Relativity has uses. Here are a few:

1. GPS and Navigation: Satellites have clocks that run faster when gravity is weak. They run slower when they are moving. GPS takes both of these effects into account so it can stay accurate.
2. Astrophysics: General Relativity helps us understand holes, neutron stars and how stars move around each other.
3. Cosmology: It helps us understand how the universe began and how it is still growing.
4. Gravitational Wave Astronomy: Scientists use General Relativity to detect waves in space-time that are made when black holes or neutron stars crash into each other.

5. Space Missions: General Relativity is used to plan the paths of spacecraft and to do experiments in space.
6. Fundamental Tests: Scientists are always testing General Relativity with clocks and spacecraft to see how well it works.
7. Imaging: General Relativity helps us see away galaxies by bending light around them.

General Relativity has advantages. It describes gravity precisely. It combines space and time into one framework. It helps us make technologies. It predicts things that we later discover. It gives us a model of the universe. It helps us test ideas. It connects abstract ideas to real effects. General Relativity is an important theory. It is used in areas of science. It has led to many new discoveries.

Conclusion

From times to today, it has changed alongside human thought, science and technology. The Egyptians and Babylonians used math for measurement, astronomy, trade and building. Chinese, Greek, Indian, Islamic and European mathematicians added to math knowledge in areas like geometry, algebra and calculus. Each group had ideas that helped shape modern math. The history of math shows that human progress is linked to math understanding. Every big step in science, engineering, navigation, communication and computing relied on math. Math helps us understand patterns order and the structure of reality.

The I Ching showed ideas of balance and change through symbols. Concepts like Yin and Yang represented opposing forces that are connected. This idea is similar to systems and computer thinking. The rise of Artificial Intelligence in the century is a new stage in math evolution. AI changes how we learn, use and research math. In education AI, systems give learning, explanations and feedback. These technologies help students understand math concepts better. AI tools like Wolfram Alpha and MATLAB make complex math tasks easier. AI also helps with discovery and research. Modern math relies on algorithms, simulations and data analysis. The calculation of trillions of digits of π shows how math and computing work together. AI-assisted systems speed up calculations. Identify patterns in large datasets. Math and AI are crucial in understanding the universe.

Concepts like holes and gravitational waves are explained using advanced math models. General Relativity, introduced by Albert Einstein in 1915 changed our understanding of gravity. This theory explained motion and the expansion of the universe. It showed how abstract math could describe reality. The applications of General Relativity still influence technology and research. GPS systems need corrections to stay accurate. Astrophysicists use the theory to study stars, galaxies and gravitational waves. AI helps by analyzing telescope data and simulating events. Studying the universe provides benefits to humanity. It drives innovation improves navigation and communication and inspires curiosity. Research encourages collaboration across disciplines and nations.

Many aspects of the universe remain unknown like matter and quantum gravity. These questions motivate math and scientific exploration. In conclusion, mathematics is a language that helps humanity understand the world and the universe. The evolution of mathematics laid the foundation for science and technology. Artificial Intelligence enhances this foundation by improving math learning and enabling discoveries. Together mathematics and AI are a combination, in modern civilization. Their continued

development will shape advancements in education, science, and technology and space exploration.

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