1 Advanced Mathematical Document

This document tests all markdown features including special characters, equations, tables, and more.

1.1 Mathematical Equations

1 Inline Mathematics

The quadratic formula is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ and Euler's identity is $e^{i\pi} + 1 = 0$.

The area of a circle: $A = \pi r^2$ where r is the radius.

2 Block Equations

Partial Differential Equation (Heat Equation):

$$\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2}$$

Navier-Stokes Equation:

$$\rho \left(\frac{\partial \mathbf{v}}{\partial t} + \mathbf{v} \cdot \nabla \mathbf{v} \right) = -\nabla p + \mu \nabla^2 \mathbf{v} + \mathbf{f}$$

Integral Example:

$$\int_0^\infty e^{-x^2} dx = \frac{\sqrt{\pi}}{2}$$

Double Integral:

$$\iint_D f(x, y)\, dA = \int_a^b \int_c^d f(x, y)\, dy\, dx$$

Matrix Example:

$$\mathbf{A} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}$$

Matrix Multiplication:

$$\mathbf{C} = \mathbf{A} \times \mathbf{B} = \begin{pmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{pmatrix}$$

Square Root and Fractions:

$$\sqrt{x^2 + y^2} = \sqrt{\frac{a}{b} + \frac{c}{d}}$$

Summation and Product:

$$\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6} \quad \text{and} \quad \prod_{i=1}^{n} i = n!$$

Limit Example:

$$\lim_{x \to \infty} \frac{1}{x} = 0$$

Taylor Series:

$$f(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \frac{f'''(a)}{3!}(x-a)^3 + \cdots$$

1.2 Special Characters & Symbols

1 Greek Letters

α (alpha), β (beta), γ (gamma), δ (delta), ε (epsilon), ζ (zeta), η (eta), θ (theta), λ (lambda), μ (mu), π (pi), σ (sigma), τ (tau), φ (phi), ω (omega)

Uppercase: Γ (Gamma), Δ (Delta), Θ (Theta), Λ (Lambda), Ξ (Xi), Π (Pi), Σ (Sigma), Φ (Phi), Ψ (Psi), Ω (Omega)

2 Mathematical Operators

$\pm \mp \times \div \cdot \surd \sqrt[3]{} \sqrt[4]{} \infty \propto \approx \neq \equiv \leq \geq \subset \supset \subseteq \supseteq \cap \cup \int \oint \partial \nabla \Delta \prod \sum$

3 Other Symbols

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1.3 Complex Tables

1 Table 1: Special Characters in Cells

Symbol	Name	LaTeX	Unicode
α	Alpha	`\alpha`	U+03B1
β	Beta	`\beta`	U+03B2
$\int$	Integral	`\int`	U+222B
$\sum$	Sum	`\sum`	U+2211
$\surd$	Square Root	`\sqrt{}`	U+221A
∞	Infinity	`\infty`	U+221E
$\approx$	Approximately	`\approx`	U+2248
$\neq$	Not Equal	`\neq`	U+2260

2 Table 2: Mathematical Constants

Constant	Symbol	Approximate Value	Formula
Pi	π	3.14159265359	$\pi = \frac{C}{d}$
Euler's Number	e	2.71828182846	$e = \lim_{n \to \infty}(1 + \frac{1}{n})^n$
Golden Ratio	φ	1.61803398875	$\phi = \frac{1+\sqrt{5}}{2}$
Planck's Constant	h	$6.62607015 \times 10^{-34}$ J·s	$E = h\nu$

3 Table 3: Programming Languages & Operators

Language	Addition	Multiplication	Division	Modulo	Power
Python	`a + b`	`a * b`	`a / b`	`a % b`	`a ** b`
C++	`a + b`	`a * b`	`a / b`	`a % b`	`pow(a, b)`
JavaScript	`a + b`	`a * b`	`a / b`	`a % b`	`a ** b`
Java	`a + b`	`a * b`	`a / b`	`a % b`	`Math.pow(a, b)`

1.4 Code Blocks

1 Python Code with Special Characters

```
import numpy as np
import matplotlib.pyplot as plt

# Calculate π using Monte Carlo method
def estimate_pi(n_samples=1000000):
    """Estimate π using random points in a square"""
    x = np.random.uniform(-1, 1, n_samples)
    y = np.random.uniform(-1, 1, n_samples)
    inside_circle = (x**2 + y**2) <= 1
    pi_estimate = 4 * np.sum(inside_circle) / n_samples
    return pi_estimate

# Test with special operators: +, -, *, /, %, **, //, &, |, ^, ~, <<, >>
result = (2 ** 3) * (10 // 3) + (15 % 4) - (100 / 7)
print(f"Result: {result:.4f}")

# Unicode in strings
symbols = "α β γ δ ε ζ η θ λ μ π σ τ φ ω"
operators = "± × ÷ √ ∞ ≈ ≠ ≤ ≥ ∫ ∑"
```

2 LaTeX Equation

```
\begin{equation}
\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}
\end{equation}

\begin{align}
\nabla \cdot \mathbf{E} &= \frac{\rho}{\epsilon_0} \\
\nabla \cdot \mathbf{B} &= 0 \\
\nabla \times \mathbf{E} &= -\frac{\partial \mathbf{B}}{\partial t} \\
\nabla \times \mathbf{B} &= \mu_0 \mathbf{J} + \mu_0 \epsilon_0 \frac{\part
ial \mathbf{E}}{\partial t}
\end{align}
```

1.5 Lists with Special Characters

1 Unordered List

- Item with α (alpha) and β (beta)
- Mathematical operators: $\int \sum \prod \sqrt{}$
- Comparison: $\approx \neq \leq \geq \infty$
- Arrows: $\rightarrow \leftarrow \uparrow \downarrow \leftrightarrow$
- Symbols: © ® ™ € £ ¥

2 Ordered List

1. First: Calculate $\int_0^1 x^2 dx = \frac{1}{3}$
2. Second: Evaluate $\sum_{i=1}^{10} i = 55$
3. Third: Solve $\frac{dy}{dx} = 2x$ to get $y = x^2 + C$
4. Fourth: Matrix multiplication $\mathbf{A} \times \mathbf{B}$
5. Fifth: Compute $\lim_{x \to 0} \frac{\sin x}{x} = 1$

3 Nested Lists

- Top level with $\pi \approx 3.14159$
  - Nested with $e^{i\pi} + 1 = 0$
  - Another nested: $\sqrt{-1} = i$
- Another top: ∞ (infinity)
  - Sub-item: $\lim_{n \to \infty}$

1.6 Text Formatting Tests

Bold text with _italic text_ and `inline code` with special chars: `α_β^γ`

Regular text with **bold**, *italic*, and ***bold italic*** combined.

Text with special characters: @ # $ % ^ & * ( ) _ + = { } [ ] | \ : ; " ' < > , . ? /

Escaped characters test: _underscore_ *asterisk* \#hash\# \$dollar\$ \%percent\%

1.7 Links and References

Visit Python Official for documentation.

Check out NumPy for numerical computing.

Mathematical reference: Wolfram MathWorld

1.8 Advanced Equations Section

1 Schrödinger Equation

$$i\hbar\frac{\partial}{\partial t}\Psi(\mathbf{r},t) = \left[-\frac{\hbar^2}{2m}\nabla^2 + V(\mathbf{r},t)\right]\Psi(\mathbf{r},t)$$

2 Maxwell's Equations

$$\begin{aligned}
\nabla \cdot \mathbf{E} &= \frac{\rho}{\epsilon_0} \\
\nabla \cdot \mathbf{B} &= 0 \\
\nabla \times \mathbf{E} &= -\frac{\partial \mathbf{B}}{\partial t} \\
\nabla \times \mathbf{B} &= \mu_0\mathbf{J} + \mu_0\epsilon_0\frac{\partial \mathbf{E}}{\partial t}
\end{aligned}$$

3 Einstein Field Equations

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu}$$

4 Fourier Transform

$$\hat{f}(\xi) = \int_{-\infty}^{\infty} f(x) e^{-2\pi i x \xi}\,dx$$

1.9 Conclusion

This document contains:

- Multiple heading levels (# ## ### ####)
- Tables with special characters (α β γ π $\sum$ $\int$)
- Mathematical equations (*inline* and $$block$$)
- Code blocks with various languages
- Lists (ordered, unordered, nested)
- Special symbols (©®™€£¥)
- Links and references
- Text formatting (**bold**, *italic*, `code`)
- Greek letters (α β γ δ ε ζ η θ λ μ π σ τ φ ω Γ Δ Θ Λ Ξ Π Σ Φ Ψ Ω)
- Mathematical operators ($\pm$ $\times$ $\div$ $\surd$ ∞ $\approx$ $\neq$ $\leq$ $\geq$ $\int$ $\sum$ $\prod$ ∂ ∇)
- Complex LaTeX equations with matrices, integrals, partial derivatives