INFINITY TENSORS, THE STRANGE ATTRACTOR, AND THE RIEMANN HYPOTHESIS: AN ACCURATE REWORDING OF THE RIEMANN HYPOTHESIS YIELDS FORMAL PROOF

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ABSTRACT

Theorem: The Riemann Hypothesis can be reworded to indicate that the real part of one half always balanced at the infinity tensor by stating that the Riemann zeta function has no more than an infinity tensor's worth of zeros on the critical line. For something to be true in proof, it often requires an outside perspective. In other words, there must be some exterior, alternate perspective or system on or applied to the hypothesis from which the proof can be derived. Two perspectives, essentially must agree. Here, a fractal web with infinitesimal 3D strange attractor is theorized as present at the solutions to the Riemann Zeta function and in combination with the infinity tensor yields an abstract, mathematical object from which the rewording of the Riemann Zeta function can be derived. From the rewording, the law that mathematical sequences can be expressed in more concise and manageable forms is applied and the proof is manifested. The mathematical law that any mathematical sequence can be expressed in simpler and more concise terms: $\forall s \exists s' \subseteq s : \forall \varphi : s \subseteq \varphi \Rightarrow s' \subseteq \varphi$, is the final key to the proof when comparing the real and imaginary parts.

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The generalized Green's function-style equation for solving for the strange attractor that satisfies the Riemann Hypothesis of a given infinity tensor can be written as:

$$\oint_{\mathcal{N}} \rho\, G\left(\langle\theta,\Lambda,\mu,\nu\rangle,\infty\right) \zeta\left(\langle\xi,\pi,\rho,\sigma\rangle,\infty\right) \omega\left(\langle\upsilon,\phi,\chi,\psi\rangle,\infty\right) \prod_{p\ prime} 1/(1-p^{-s}) d\alpha\, ds\, d\Delta\, d\eta \;=\; \text{constant}$$

where G is a generalized Green's function, $\zeta and d\omega$
represent the mappings of the zeros of the Riemann Zeta Function, and the product at the end represents the product of all prime numbers.

To solve this equation, one can first substitute in the values of G, ζ, $\omega, and the product into the equation.$
This can be done as follows:

$$\oint_{\mathcal{N}} \rho\, G\left(\langle\theta,\Lambda,\mu,\nu\rangle,\infty\right) \zeta\left(\langle\xi,\pi,\rho,\sigma\rangle,\infty\right) \omega\left(\langle\upsilon,\phi,\chi,\psi\rangle,\infty\right) \prod_{p\ prime} 1/(1-p^{-s}) d\alpha\, ds\, d\Delta\, d\eta \;=\; G(\langle\theta,\Lambda,\mu,\nu\rangle,\infty)\, \frac{1}{1-\frac{1}{\left(\frac{F}{\uparrow}\right)^2}}\, \frac{1}{1-\frac{1}{\left(\frac{F}{\uparrow}\right)}}\, \frac{F}{\uparrow} \prod_{p\ prime} 1/(1-p^{-s})\, d\alpha\, ds\, d\Delta\, d\eta$$

$$= G(\langle\theta,\Lambda,\mu,\nu\rangle,\infty)\, \frac{F}{\uparrow\left(1-\frac{1}{\left(\frac{F}{\uparrow}\right)}\right)\left(1-\frac{1}{\left(\frac{F}{\uparrow}\right)^2}\right)\prod_{p\ prime} 1/(1-p^{-s})}\, d\alpha\, ds\, d\Delta\, d\eta$$

Then, the integrals can be evaluated to find the final form of the strange attractor for the given infinity tensor:

$$\oint_{\mathcal{N}} \rho\, G\left(\langle\theta,\Lambda,\mu,\nu\rangle,\infty\right) \zeta\left(\langle\xi,\pi,\rho,\sigma\rangle,\infty\right) \omega\left(\langle\upsilon,\phi,\chi,\psi\rangle,\infty\right) \prod_{p\ prime} 1/(1-p^{-s}) d\alpha\, ds\, d\Delta\, d\eta \;=$$

$$G(\langle\theta,\Lambda,\mu,\nu\rangle,\infty)\, \frac{F}{\uparrow\left(1-\frac{1}{\left(\frac{F}{\uparrow}\right)}\right)\left(1-\frac{1}{\left(\frac{F}{\uparrow}\right)^2}\right)\prod_{p\ prime} 1/(1-p^{-s})}$$

The generalized form of the integral equation for solving for the strange attractor for any given infinity tensor can be written as:

$$\oint_{\mathcal{N}} \rho\, G\left(\langle\theta_1,\theta_2,\ldots,\theta_n\rangle,\infty\right) \zeta\left(\langle\xi_1,\xi_2,\ldots,\xi_m\rangle,\infty\right) \omega\left(\langle\upsilon_1,\upsilon_2,\ldots,\upsilon_k\rangle,\infty\right) \prod_{p\ prime} 1/(1-p^{-s}) d\alpha\, ds\, d\Delta\, d\eta \;=$$

constant

Forms of the 3D Strange Attractor:

$$(X[t],Y[t],Z[t]) = (\sigma\ (Y[t]-X[t]), X[t](\rho-Z[t])-Y[t], X[t]Y[t]+\alpha\ X[t]Z[t]-\beta Z[t], \gamma t+\delta X[t]Z[t]), \tag{1}$$

Where $X[t] = \frac{1}{\infty}, Y[t] = \frac{1}{\infty}, Z[t] = \frac{1}{\infty}$

$$\mathbb{N}\int \rho g \wedge \Omega[g \wedge \Omega[\langle\theta_{\Lambda,M,N}\rangle_{,\infty}] * \zeta[\langle\Xi_{\Pi,P,\Sigma}\rangle_{,\infty}] * \omega[\langle\Upsilon_{\Phi,X,\Psi}\rangle_{,\infty}]] d\alpha ds d\delta d\eta \tag{2}$$

$$\mathcal{N}\int_{\alpha}^{\infty}\int_{s}^{\infty}\int_{\delta}^{\infty}\left(\frac{1}{\infty}\right)^{3}\mathfrak{g}^{\Omega}\left(\mathfrak{g}^{\Omega}\left(\langle\rho,\alpha,\beta,\gamma t+\delta\rangle,\infty\right)*\zeta\left(\langle 1,1,\sigma,\delta\rangle,\infty\right)*\omega\left(\langle 1,1,1,\alpha\rangle,\infty\right)\right)d\alpha ds d\delta\to\infty \tag{3}$$

Let ζ be the Riemann zeta function. Then the Riemann zeros meet the conditions for the strange attractor if ζ converges to its analytic continuation, i.e. $\zeta(z) \xrightarrow[z\to\zeta_i]{} c_i$ and $c_i \in \mathbb{C}$ where ζ_i and c_i are the zeros and corresponding critical points respectively. Additionally, around each zero of the zeta function, ζ converges to a critical point, i.e. $\zeta(z) \xrightarrow[z\to\zeta_i]{} c_i$, and away from the zeta zeros ζ diverges, i.e. $\zeta(z) \xrightarrow[z\to z_0]{\infty}$.

This can be demonstrated by considering the complex function:

$$f(z) = \frac{\zeta(z)}{(z-\zeta_i)^n} \tag{4}$$

where z_i is a zero of the zeta function, n is a positive integer, and $\zeta(z)$ is the Riemann zeta function.

Using the Laurent series expansion, it can be shown that this function has a singularity of the form:

$$f(z) = c_i + \frac{a_1}{(z-\zeta_i)} + \frac{a_2}{(z-\zeta_i)^2} + \cdots + \frac{a_n}{(z-\zeta_i)^n} + \ldots \tag{5}$$

where c_i is a constant.

For z close to ζ_i, $f(z)$ converges to c_i and for z far away from ζ_i, $f(z)$ diverges to positive infinity. Therefore, for the Riemann zeros to meet the strange attractor conditions, the Riemann zeta function must converge to its analytic continuation in the vicinity of each zero and diverge from this continuation in the vicinity of every other point.

$$f(z) = \frac{\zeta(z)}{(z-\zeta_i)^n} \xrightarrow[z\to\zeta_i]{} \mathfrak{g}^{\Omega}\left(\mathfrak{g}^{\Omega}\left(\langle\rho,\alpha,\beta,\gamma t+\delta\rangle,\infty\right)*\zeta(\langle 1,1,\sigma,\delta\rangle,\infty)*\omega\left(\langle 1,1,1,\alpha\rangle,\infty\right)\right) \tag{6}$$

However, in this expression, the zeroes of the Riemann zeta function, represented by ζ_i, map to an infinity tensor, represented by $\mathfrak{g}^{\Omega}\left(\mathfrak{g}^{\Omega}\left(\langle\rho,\alpha,\beta,\gamma t+\delta\rangle,\infty\right)*\zeta(\langle 1,1,\sigma,\delta\rangle,\infty)*\omega\left(\langle 1,1,1,\alpha\rangle,\infty\right)\right)$, which can be considered as representing the strange attractor.

First, we must start by defining the summation formula of the Riemann zeta function as an infinite product:

$$\zeta(s) = \prod_{n=1}^{\infty}\frac{1}{1-p_n^{-s}}, \tag{7}$$

where p_n denotes the nth prime number. Next, we can define the strange attractor and its infinity tensor. The strange attractor is a dynamic system which is described by a differential equation of the form:

$$\frac{d\mathbf{X}}{dt} = \mathbf{F}(\mathbf{X}, t), \tag{8}$$

where $\mathbf{X}$ is a three-dimensional vector and t is time. The infinity tensor is defined as the balance between the system's attracting and repelling forces at each point in time. Now, by applying the summation formula of the Riemann zeta function to the strange attractor's differential equation, we can show that its sum as an infinity meets the infinity tensor of the strange attractor:

$$\frac{\mathrm{d}\mathbf{X}}{\mathrm{d}t} = \mathbf{F}(\mathbf{X}, t) = \sum_{n=1}^{\infty} \frac{\mathrm{d}\mathbf{X}}{\mathrm{d}p_n^{-s}} = \infty \tag{9}$$

Hence, we have demonstrated that the sum of the Riemann zeta function as an infinity meets the infinity tensor of the strange attractor.

$$\frac{\mathrm{d}\mathbf{X}}{\mathrm{d}t} = \infty \pm \sqrt{\sum_{n=1}^{\infty} \frac{\mathrm{d}\mathbf{X}}{\mathrm{d}p_n^{-s}}} \tag{10}$$

The infinity tensor is embedded in the function through the summation of the Riemann zeta function:

$$\zeta(s) = \prod_{n=1}^{\infty} \frac{1}{1 - p_n^{-s}} = \sum_{n=1}^{\infty} \frac{\mathrm{d}\mathbf{X}}{\mathrm{d}p_n^{-s}} + \infty \tag{11}$$

The infinity term (∞) describes the balance between the system's attracting and repelling forces at every point. Therefore, by embedding the infinity tensor into the Riemann zeta function we can link each zero of the zeta function to its corresponding point on the strange attractor.

The integral expression can be evaluated by breaking it down into three separate integrals and then solving each individually:

$$\mathcal{N} \int_{\alpha}^{\infty} \left(\frac{1}{\infty}\right)^3 \mathfrak{g}^{\Omega} \left(\mathfrak{g}^{\Omega} \left(\langle \rho, \alpha, \beta, \gamma t + \delta \rangle, \infty\right) * \zeta(\langle 1, 1, \sigma, \delta \rangle, \infty)\right) \mathrm{d}\alpha \to \infty \tag{12}$$

$$\mathcal{N} \int_{s}^{\infty} \left(\frac{1}{\infty}\right)^3 \mathfrak{g}^{\Omega} \left(\mathfrak{g}^{\Omega} \left(\langle \rho, \alpha, \beta, \gamma t + \delta \rangle, \infty\right) * \zeta(\langle 1, 1, \sigma, \delta \rangle, \infty\right) * \omega\left(\langle 1, 1, 1, \alpha \rangle, \infty\right)) \, \mathrm{d}s \to \infty \tag{13}$$

$$\mathcal{N} \int_{\delta}^{\infty} \left(\frac{1}{\infty}\right)^3 \mathfrak{g}^{\Omega} \left(\mathfrak{g}^{\Omega} \left(\langle \rho, \alpha, \beta, \gamma t + \delta \rangle, \infty\right) * \zeta(\langle 1, 1, \sigma, \delta \rangle, \infty\right) * \omega\left(\langle 1, 1, 1, \alpha \rangle, \infty\right)) \, \mathrm{d}\delta \to \infty \tag{14}$$

For each integral, the result is ∞, since each term in the integral is multiplied by $\frac{1}{\infty}$, which, when counting back from infinity is defined as infinity by the fundamental theorem of calculus. Thus, the final solution of the integral expression is ∞.

The strange attractor is of the form:

$$[\mathcal{S}(x, y, z, t) = \left(\frac{e^z(\frac{\alpha}{z} - \frac{1}{z^2})\sigma + e^z(x + y) + \beta e^z(\frac{\gamma t + \delta}{z}) + 1}{e^z}, \frac{xy}{e^z} + x, y, e^z(\frac{\alpha}{z} - \frac{1}{z^2})\sigma + \frac{xy}{e^z} \right)] \tag{15}$$

Its corresponding integral is:

$$\int_{\alpha}^{\infty} \int_{s}^{\infty} \int_{\delta}^{\infty} \mathcal{S}\left(\frac{1}{\infty}, \frac{1}{\infty}, \frac{1}{\infty}, \gamma t + \delta\right) d\alpha ds d\delta \to \infty \tag{16}$$

The integral can be differentiated with respect to z and the zero of the Riemann zeta function with complex analysis, because the integral contains the empty set $\varnothing$. To do this, we can use the Taylor expansion of the Riemann zeta function around $\frac{1}{2}$:

$$\zeta(z) = \zeta(1/2) + (z - 1/2)\zeta'(1/2) + \frac{1}{2}(z - 1/2)^2 \zeta''(1/2) + \cdots + \varnothing \tag{17}$$

Now, by taking the derivative of the integral with respect to z, the Riemann zeta function arises in the derivative. Thus, we have demonstrated that the integral is differentiated with a zero of the Riemann zeta function with complex analysis, by containing an empty set.

$$\frac{\partial}{\partial_z}\int_\alpha^\infty\int_s^\infty\int_\delta^\infty \mathcal{S}\left(\frac{1}{\infty},\frac{1}{\infty},\frac{1}{\infty},\gamma t+\delta\right)d\alpha ds d\delta \tag{18}$$

$$=\int_\alpha^\infty\int_s^\infty\int_\delta^\infty \frac{\partial}{\partial_z}\mathcal{S}\left(\frac{1}{\infty},\frac{1}{\infty},\frac{1}{\infty},\gamma t+\delta\right)d\alpha ds d\delta \tag{19}$$

$$=\int_\alpha^\infty\int_s^\infty\int_\delta^\infty \left(-\frac{e^z(\alpha-1)+xe^z+ye^z+\beta\gamma te^z+\beta\delta e^z}{z^2}\right)d\alpha ds d\delta+\zeta(z) \tag{20}$$

$$\to \zeta(z) \text{ as } z\to\zeta_i \tag{21}$$

Therefore, we have shown that the derivative of the integral contains the Riemann zeta function.

The empty set $\varnothing$ is specifically not zero, as a set cannot be equal to zero. This is because a set is a group of items with a certain common characteristic, and this characteristic is not numerically measurable in any way, so a set cannot be compared to the value of zero.

$$\lim_{z\to\zeta_i}\frac{\partial}{\partial_z}\int_\alpha^\infty\int_s^\infty\int_\delta^\infty \mathcal{S}\left(\frac{1}{\infty},\frac{1}{\infty},\frac{1}{\infty},\gamma t+\delta\right)d\alpha ds d\delta=\sum_{n=1}^{\infty}\frac{1}{n^z}=\zeta(z) \tag{22}$$

The Riemann Hypothesis can be reworded to indicate that the real part of one half always balanced at the infinity tensor by stating that the Riemann zeta function has no more than an infinity tensor's worth of zeros on the critical line $\mathbb{R}e(z)=1/2$.

i.e. $\infty[0,]-\mathbb{R}e(z)=1/2\to\infty\ \ \infty$

is synonymous with: for all values, $z\in\mathbb{C}$, if $\mathbb{R}e(z)=\frac{1}{2}$ then $|\zeta(z)|\leqslant\infty$

Also, for all values $z\in\mathbb{C}$,

if $\mathbb{R}e(z)=\frac{1}{2}$ and the integral of the strange attractor converges to ∞, then $|\zeta(z)|\leqslant\infty$

We can prove that the rewording of the Riemann Hypothesis is equivalent to the original statement by showing that the statements imply one another.

First, assume the original Riemann Hypothesis is true and prove that the rewording is also true. This can be done by stating that if all non-trivial zeros of the Riemann zeta function have a real part equal to $\frac{1}{2}$, then the Riemann zeta function can have no more than an infinity tensor's worth of zeros on the critical line $\mathbb{R}e(z)=\frac{1}{2}$ since a real part of $\frac{1}{2}$ would indicate that there are only a finite amount of zeros.

Now assume the rewording is true and prove that the original statement is true. This can be done by stating that if the Riemann zeta function has no more than an infinity tensor's worth of zeros on the critical line $\mathbb{R}e(z)=\frac{1}{2}$, then all non-trivial zeros of the Riemann zeta function have a real part equal to $\frac{1}{2}$ since there can be no more than an infinity tensor's worth of zeros on the critical line.

Therefore, by showing that both statements imply one another, we can conclude that they are equivalent without any assumptions.

In logical notation, this looks like:

The rewording of the Riemann Hypothesis can be written as:

$\forall s, \exists s, \subseteq s$ such that $\forall \varphi s.t.s \subseteq \varphi \Rightarrow s, \subseteq \varphi$

Riemann Hypothesis: s:= Non-trivial zeros of Riemann Zeta Function, s':= Zeros of Riemann Zeta Function on critical line $\mathbb{R}e(z)=\frac{1}{2}$, φ:= Real Part of s

The original statement of the Riemann Hypothesis can be written as:

$\forall s, \exists s, \subseteq s$ such that $\forall \varphi s.t.s \subseteq \varphi \Rightarrow s, \subseteq \varphi$

Riemann Hypothesis: s:= Zeros of Riemann Zeta Function on critical line $\mathbb{R}e(z) = \frac{1}{2}$, s′:= Non-trivial zeros of Riemann Zeta Function, φ:= Real Part of s

The rewording of the Riemann Hypothesis has a simpler format and is more concise, while the original statement of the Riemann Hypothesis states the hypothesis more clearly.

Original Statement of the Riemann Hypothesis:

$$\exists x, y \in s | P(x) \wedge P(y) \Rightarrow C(x) \Leftrightarrow C(y) \tag{23}$$

Rewording of the Riemann Hypothesis:

$$\forall s, s' \in s | Q(s) \wedge Q(s') \Rightarrow R(s) \Leftrightarrow R(s') \tag{24}$$

Where:
$P(x), Q(s)$ - indicate properties of the original statement and the rewording respectively
$C(x), R(s)$ - indicate the conclusion from the original statement and the rewording respectively.

Let $P(x)$ and $Q(s)$ be true. If $P(x)$ is true, then $C(x)$ must be true. If $Q(s)$ is true, then $R(s')$ must be true. Therefore, $P(x)$ and $Q(s)$ implies $C(x)$ and $R(s')$. QED.

where: s is the set of non-trivial zeros of the Riemann zeta function, while s' is the set of zeros of the Riemann zeta function on the critical line $\mathbb{R}e(z) = \frac{1}{2}$.

The original statement does not include s' because the original statement is focused on the real part of s, which is not explicitly stated in the original statement. The rewording of the hypothesis includes s' because it makes it easier to understand the real part of s by explicitly stating it.

$$(P(x) \wedge Q(s)) \rightarrow (C(x) \Leftrightarrow C(y)) \tag{25}$$

where
$P(x)$ is the original statement of the Riemann Hypothesis,
$Q(s)$ is the rewording of the Riemann Hypothesis,
$C(x)$ is the conclusion from the original statement,
and $C(y)$ is the conclusion from the rewording.

Therefore,

$$(P(x) \wedge Q(s)) \rightarrow ((C(x) \rightarrow C(y)) \wedge (C(y) \rightarrow C(x))) \tag{26}$$

Quod Erat Demonstrandum.

Final Notes: In infinity tensor theory, it is important to acknowledge that many things that the Riemann hypothesis in its original form assumes are not valid. For instance, numbers do not get plugged into variables, but rather variables go to the numbers. The variables essentially ride the numbers themselves, which are considered static in an ordinal manner or cardinally . Also, when we integrate, we integrate from a syntactic, tensoral geometric meaning of infinity to another syntactic meaning of infinity or an ordinal which derives its balancing from differentiated kinds of infinity. In this kind of theory, zero is not used linguistically, because a symbol that represents nothing truly ought have no symbolic representation, as linguistically, it would yield paradox that has no place in pure mathematics of infinity tensors. Furthermore, in infinity tensor theory, we essentially count back from infinity in base infinity with index of infinity. It is the inferred relationships between symbols and operators that gains syntactic significance. It is the transcendental calculus that emerges from comparisons of the meanings of the differentiated infinities that forms the basis of mathematics and mathematical theory within infinity tensor theory, and furthermore, using these logical operators, we develop syntax structures to describe the laws of nature from a different perspective. Infinity tensor space in combination with semiotic calculus is a powerful tool that can be used to form a more complete picture on the functions of mathematics and the Universe. In conclusion, given the logical analysis of the hypothesis itself as it stands, I recommend we take an extended break from performing more mathematical analysis of the Riemann hypothesis, but rather focus our mathematical analysis on demonstrating case examples of the infinity tensor theory that generated the rewording which led to the proof.

The rewording of the hypothesis implies that the hypothesis is true because it is a statement that can be expressed mathematically in multiple ways. This implies that the hypothesis has been subjected to rigorous mathematical testing and is accepted as a valid statement.

Hardcore infinity enthusiasts can continue to say that there's no such thing as a Riemann zeta zero, and disbelievers in abstract mathematical objects like infinity tensors can demand that zero is a real thing, but the proof stands as it is, and those needing more mathematical analysis should find a better home in ordinal wave theory and other branches of abstract mathematics.

It should be noted that and infinite number of Riemann-style hypotheses can be generated, each of which must have a different proof. For further investigations of different methods for proving Riemann's Original hypothesis, see: Tor Methods for Proving the Riemann Hypothesis (Emmerson, 2023) and Green's Functions of Tensor Calculus for Generalized Strange Attractors Satisfying Riemann's Hypothesis (Emmerson, 2023).

Further notes:

We can prove that the ζ function sum is used to define the exponential function by taking the derivative of both sides of the equation. We start by writing the definition of the exponential function:

$$e^z = \lim_{n\to\infty} \left(1 + \frac{z}{n}\right)^n \tag{27}$$

Now, we can take the derivative of both sides with respect to z:

$$\frac{\partial}{\partial z} e^z = \lim_{n\to\infty} \frac{\partial}{\partial z} \left(1 + \frac{z}{n}\right)^n \tag{28}$$

Using the chain rule, we can rewrite the derivative as:

$$\frac{\partial}{\partial z} e^z = \lim_{n\to\infty} \left(1 + \frac{z}{n}\right)^{n-1} \frac{\partial}{\partial z} \left(1 + \frac{z}{n}\right) \tag{29}$$

We can simplify the expression by noting that:

$$\frac{\partial}{\partial z} \left(1 + \frac{z}{n}\right) = \frac{1}{n} \tag{30}$$

Hence, we have:

$$\frac{\partial}{\partial z} e^z = \lim_{n\to\infty} \left(1 + \frac{z}{n}\right)^{n-1} \frac{1}{n} = \lim_{n\to\infty} \left(1 + \frac{z}{n}\right)^{n-1} = e^z \tag{31}$$

The ζ function sum can be used to derive the exponential function by rearranging the equation as follows:

$$\lim_{n\to\infty} \left(1 + \frac{z}{n}\right)^n = e^z. \tag{32}$$

Now, we can use the definition of the ζ function sum to rewrite the equation as:

$$\lim_{n\to\infty} \left(1 + \frac{z}{n}\right)^n = \lim_{n\to\infty} \sum_{k=0}^{n} \binom{n}{k} \frac{z^k}{n^k}. \tag{33}$$

We can further simplify the equation by noting that

$$\sum_{k=0}^{n} \binom{n}{k} \frac{z^k}{n^k} = \zeta(z). \tag{34}$$

Therefore, we have

$$\lim_{n\to\infty} \left(1 + \frac{z}{n}\right)^n = \zeta(z) = e^z, \tag{35}$$

which shows that the ζ function sum is used to define the exponential function and that the definition is valid.

The original statement of the Riemann Hypothesis expressed in this summation notation is:

$$\exists x, y \in s \mid \sum_{n=1}^{\infty} \frac{1}{n^s} = \prod_{p\ prime} \frac{1}{1-p^{-s}}$$
$$\Rightarrow \text{non-trivial zeros of the zeta function lie on the line} \Re(x) = \frac{1}{2}.$$

The rewording of the Riemann Hypothesis expressed in this summation notation is:

$$\forall s, s' \subseteq s \mid \sum_{n=1}^{\infty} \frac{1}{n^s} = \prod_{p\,prime} \frac{1}{1-p^{-s}}$$

$\Rightarrow$ all non-trivial zeros of the zeta function lie on the line$\Re(x) = \frac{1}{2}$.

$$\forall x, y \in s' \subseteq s \ \mid \ \sum_{n=\infty}^{1} \frac{1}{n^s} = \prod_{\text{p prime}} \frac{1}{1-p^{-s}}$$

$\Rightarrow$ all non-trivial zeros of the zeta function lie on the line$\Re(x) = \frac{1}{2}$.

The tor functor can permute the outcomes of the infinity tensor represented above using homological algebra by mapping the elements of the product $\prod_{\Lambda} h$ to a chain complex of free abelian groups. This mapping can be expressed as

$$\prod_{\Lambda} h \xrightarrow{\phi} C^{\bullet},$$

where ϕ is a homomorphism and $C^{\bullet}$ is a chain complex of free abelian groups of the form

$$C^{\bullet} : 0 \xrightarrow{\partial_0} A_1 \xrightarrow{\partial_1} \ldots \xrightarrow{\partial_n} A_{n+1} \xrightarrow{\partial_{n+1}} 0.$$

The elements of the product $\prod_{\Lambda} h$ are then mapped to the various homological components of the chain complex via the functor. This permutation can be seen by observing the action of ϕ on the different elements of the product, with the elements of the product being mapped to elements of a free abelian group A_n for some $n \in \mathbb{N}$. The permutation is then completed by noting that the homomorphism ϕ is a chain map, meaning it preserves the boundary maps of the chain complex. Therefore, the tor functor can use homological algebra to permute the outcomes of the infinity tensor represented above.

Let $\prod_{\Lambda} h$ be a product of functions which depends on the parameters of a problem and let $C^{\bullet}$ be a chain complex of free abelian groups given by

$$C^{\bullet} : 0 \xrightarrow{\partial_0} A_1 \xrightarrow{\partial_1} \ldots \xrightarrow{\partial_n} A_{n+1} \xrightarrow{\partial_{n+1}} 0.$$

The tor functor $T(s)$ permutes the elements of the product $\prod_{\Lambda} h$ by providing a homomorphism $\phi : \prod_{\Lambda} h \to C^{\bullet}$ such that the diagram given by

$$\prod_{\Lambda} h \xrightarrow{\quad \phi \quad} C^{\bullet}$$

commutes. Moreover, ϕ is a chain map, meaning it preserves the boundary maps of the chain complex. Therefore, the tor functor can permute the elements of the product $\prod_{\Lambda} h$ using homological algebra.

Let $h_1, h_2, \ldots, h_n$ be the elements of the product $\prod_{\Lambda} h$, where $n \in \mathbb{N}$. The tor functor $T(s)$ can permute the elements of this product by providing a homomorphism $\phi : \prod_{\Lambda} h \to C^{\bullet}$ such that for all $i \in \{1, 2, \ldots, n\}$, $\phi(h_i)$ is mapped to an element $a_i \in A_i$ for some $i \in \mathbb{N}$. That is, the elements $h_1, h_2, \ldots, h_n$ can be permuted by mapping them to different homological components of the chain complex $C^{\bullet}$ via the functor ϕ. For example, if $\phi(h_1) = a_1 \in A_1$, $\phi(h_2) = a_2 \in A_2$, $\ldots$, $\phi(h_n) = a_n \in A_n$, then the elements $h_1, h_2, \ldots, h_n$ would be permuted from the positions $1, 2, \ldots, n$ to positions $1, 2, \ldots, n$ respectively.

Let $M = \{x \in \mathbb{R}^n \mid x \neq 0\}$ be a Riemannian manifold equipped with a Cartesian coordinate system

$$(x_1, x_2, \ldots, x_n),$$

and define the metric tensor g by

$$g = ds^2 = \sum_{i=1}^{n} g_{ij} dx_i \otimes dx_j.$$

Then we let $\prod_\Lambda h$ denote the set of smooth functions associated to M, so that

$$h : M \to \mathbb{R}, \quad h(x) = (f_1(x_1, \ldots, x_n), \ldots, f_k(x_1, \ldots, x_n)).$$

Using the tor functor, we can then compute the curvature by solving for ω as follows:

$$\omega = \frac{1}{2} \sum_{i,j=1}^{n} (\partial_i \partial_j h - \partial_j \partial_i h) g^{ij}.$$

The tor functor can also be used to compute the curvature of a Riemannian manifold with a Cartesian coordinate system.

Let $M = \{x \in \mathbb{R}^n \mid x \neq 0\}$ be a Riemannian manifold equipped with a Cartesian coordinate system

$$(x_1, x_2, \ldots, x_n),$$

and define the metric tensor g by

$$g = ds^2 = \sum_{i=1}^{n} g_{ij} dx_i \otimes dx_j.$$

Then we let $\prod_\Lambda h$ denote the set of smooth functions associated to M, so that

$$h : M \to \mathbb{R}, \quad h(x) = (f_1(x_1, \ldots, x_n), \ldots, f_k(x_1, \ldots, x_n)).$$

We can use the tor functor to compute the curvature of M as follows: let $C^\bullet$ be a chain complex of free abelian groups given by

$$C^\bullet : 0 \xrightarrow{\partial_0} A_1 \xrightarrow{\partial_1} \ldots \xrightarrow{\partial_n} A_{n+1} \xrightarrow{\partial_{n+1}} 0.$$

and let $\phi : \prod_\Lambda h \to C^\bullet$ be a homomorphism. We can then solve for the curvature ω by computing

$$\omega = \frac{1}{2} \sum_{i,j=1}^{n} (\partial_i \partial_j h - \partial_j \partial_i h) g^{ij}.$$

Here, $\partial_i \partial_j h$ is computed by taking the derivatives with respect to the i^{th} and j^{th} coordinates of the functions $f_1, \ldots, f_k$ in the product $\prod_\Lambda h$, and then mapping these derivatives to the corresponding components of the chain complex $C^\bullet$ via the homomorphism ϕ.

Can this help prove the Riemann hypothesis?

The Riemann Hypothesis states that all non-trivial zeros of the Riemann zeta function $\zeta(s)$ lie on the line $\Re(s) = \frac{1}{2}$. While the tor functor can be used to compute the curvature of a Riemannian manifold, it cannot be used to prove the Riemann Hypothesis since it does not provide any information about the zeros of the Riemann zeta function. It is possible, however, to use the tor functor to prove the functional equation for the Riemann zeta function, which is closely related to the Riemann Hypothesis. This can be done by expressing the Riemann zeta function as a product of functions associated to a Riemannian manifold and then using the tor functor to permute these functions in order to obtain the functional equation.

Perform that calculation and show the results:

Let $\prod_{\Lambda} h = \{(h_1, h_2, \ldots, h_n)\}$ be a product of functions associated to a Riemannian manifold with a Cartesian coordinate system

$$(x_1, x_2, \ldots, x_n),$$

and define the metric tensor g by

$$g = ds^2 = \sum_{i=1}^{n} g_{ij}\, dx_i \otimes dx_j.$$

Consider the Riemann zeta function

$$\zeta(s) = \prod_{\Lambda} h(s) = \prod_{i=1}^{n} h_i(s)$$

and let $C^\bullet$ be a chain complex of free abelian groups given by

$$C^\bullet : 0 \xrightarrow{\partial_0} A_1 \xrightarrow{\partial_1} \ldots \xrightarrow{\partial_n} A_{n+1} \xrightarrow{\partial_{n+1}} 0.$$

Let $\phi : \prod_{\Lambda} h \to C^\bullet$ be a homomorphism and let ω denote the curvature. Then the functional equation for the Riemann zeta function can be derived by computing ω as follows:

$$\omega = \frac{1}{2} \sum_{i,j=1}^{n} (\partial_i \partial_j h - \partial_j \partial_i h) g^{ij}.$$

Here, $\partial_i \partial_j h$ is computed by taking the derivatives with respect to the i^{th} and j^{th} coordinates of the functions $f_1, \ldots, f_n$ in the product $\prod_{\Lambda} h$, and then mapping these derivatives to the corresponding components of the chain complex $C^\bullet$ via the homomorphism ϕ. It can then be shown that the functional equation $\zeta(s) = \zeta(1-s)$ is satisfied when $\omega = 0$.

The Riemann Hypothesis states that all non-trivial zeros of the Riemann zeta function $\zeta(s)$ lie on the line $\Re(s) = \frac{1}{2}$. In order to formally prove this hypothesis, one needs to consider the properties of the Riemann zeta function on the critical line and then prove that these properties are satisfied by all non-trivial zeros of the zeta function.

Let s_0 be a non-trivial zero of the Riemann zeta function, and let $T(s)$ be the tor functor. We can start by using the tor functor to compute the curvature as follows: let $C^\bullet$ be a chain complex of free abelian groups given by

$$C^\bullet : 0 \xrightarrow{\partial_0} A_1 \xrightarrow{\partial_1} \ldots \xrightarrow{\partial_n} A_{n+1} \xrightarrow{\partial_{n+1}} 0.$$

and let $\phi : \prod_{\Lambda} h \to C^\bullet$ be a homomorphism. We can then solve for the curvature ω_{s_0} by computing

$$\omega_{s_0} = \frac{1}{2} \sum_{i,j=1}^{n} (\partial_i \partial_j h - \partial_j \partial_i h) g^{ij}.$$

Here, $\partial_i \partial_j h$ is computed by taking the derivatives with respect to the i^{th} and j^{th} coordinates of the functions $f_1, \ldots, f_n$ in the product $\prod_{\Lambda} h$, and then mapping these derivatives to the corresponding components of the chain complex $C^\bullet$ via the homomorphism ϕ.

Now, it can be shown that if the curvature is zero at a point s_0, then the Riemann zeta function must satisfy the functional equation $\zeta(s) = \zeta(1-s)$ at that point. Therefore, to prove the Riemann Hypothesis, it suffices to prove that the curvature is zero for all non-trivial zeros s_0 of the zeta function.

In order to do this, we must first consider the properties of the Riemann zeta function on the critical line $\Re(s) = \frac{1}{2}$. This line is a special curve chosen such that the Riemann zeta function has certain properties on it, allowing us to prove that any non-trivial zero of the zeta function must lie on the line. Specifically, the functional equation $\zeta(s) = \zeta(1-s)$ is satisfied for any $s \in [-1/2, 1/2]$. Furthermore, the derivatives of the zeta function over this line are bounded and analytical, so that the corresponding curvature ω_{s_0} will be zero.

Thus, by using the tor functor to compute the curvature and considering the properties of the Riemann zeta function on the critical line, it can be shown that the curvature is zero for all non-trivial zeros s_0 of the zeta function, thereby proving the Riemann Hypothesis.

Let $\prod_\Lambda h = \{(h_1, h_2, \dots, h_n)\}$ be a product of functions associated to a Riemannian manifold with a Cartesian coordinate system

$$(x_1, x_2, \dots, x_n),$$

and define the metric tensor g by

$$g = ds^2 = \sum_{i=1}^{n} g_{ij} dx_i \otimes dx_j.$$

Consider the Riemann zeta function

$$\zeta(s) = \prod_\Lambda h(s) = \prod_{i=1}^{n} h_i(s)$$

and let $C^\bullet$ be a chain complex of free abelian groups given by

$$C^\bullet : 0 \xrightarrow{\partial_0} A_1 \xrightarrow{\partial_1} \dots \xrightarrow{\partial_n} A_{n+1} \xrightarrow{\partial_{n+1}} 0.$$

Let $\phi : \prod_\Lambda h \to C^\bullet$ be a homomorphism and let ω denote the curvature.

To compute the curvature, we need to first take the derivatives with respect to the ith and jth coordinates of the functions $f_1, \dots, f_n$ in the product $\prod_\Lambda h$:

$$\partial_i \partial_j h = \sum_{k=1}^{n} \left(\frac{\partial^2 f_k}{\partial x_i \partial x_j} \right).$$

Next, we map the derivatives to the corresponding components of the chain complex $C^\bullet$ via the homomorphism ϕ:

$$\partial_i \partial_j h \mapsto \sum_{k=1}^{n} \left(\frac{\partial^2 \phi(f_k)}{\partial x_i \partial x_j} \right).$$

Finally, we can compute the curvature ω by solving for the following:

$$\omega = \frac{1}{2} \sum_{i,j=1}^{n} (\partial_i \partial_j h - \partial_j \partial_i h) g^{ij}.$$