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An Interesting Geometric Series

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PROOFS WITHOUT WORDS

An Interesting Geometric Series

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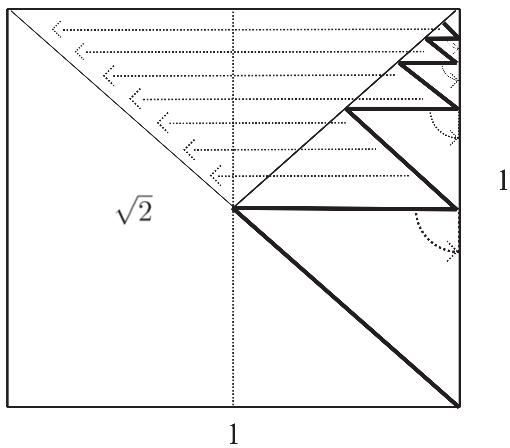
Theorem 1.

$$\sum_{n=1}^{\infty}\left(\frac{1}{\sqrt{2}}\right)^n = 1+\sqrt{2}.$$



Proof.

$$\sum_{n=1}^{\infty}\left(\frac{1}{\sqrt{2}}\right)^n = \frac{\sqrt{2}}{2}+\frac{1}{2}+\frac{\sqrt{2}}{4}+\cdots = 1+\sqrt{2}.$$

■

Note: The idea illustrated above may be generalized for an $a \times b$ rectangle, where the length of a zigzaging path is equal to the sum of the lengths of the diagonal and shorter side of the rectangle (a different path has length equal to the sum of the lengths of the diagonal and longer side of the rectangle). For example, in a $(1/2) \times 1$ rectangle, the length of the path is equal to the golden ratio $\frac{1+\sqrt{5}}{2}$.

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Summary. We present a visual proof that $\sum_{n=1}^{\infty}\left(\frac{1}{\sqrt{2}}\right)^n = 1+\sqrt{2}$.

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