

Mathematical Induction

Proving a Statement is True for All Natural Numbers

Let $P(n)$ be a statement involving a natural number n . To prove that $P(n)$ is true for all $n \in \mathbb{N}$, we use the principle of mathematical induction.

Base Case: Prove that $P(1)$ is true.

Inductive Step: Assume $P(k)$ is true for some $k \in \mathbb{N}$. Prove that $P(k+1)$ is true.

If both the base case and the inductive step are proven, then $P(n)$ is true for all $n \in \mathbb{N}$.

Example: Prove that $1 + 2 + \dots + n = \frac{n(n+1)}{2}$ for all $n \in \mathbb{N}$.

Base Case: For $n=1$, $1 = \frac{1(1+1)}{2} = 1$. True.

Inductive Step: Assume $1 + 2 + \dots + k = \frac{k(k+1)}{2}$. Then $1 + 2 + \dots + k + 1 = \frac{k(k+1)}{2} + 1 = \frac{k(k+1) + 2}{2} = \frac{(k+1)(k+2)}{2}$. True.

Therefore, $1 + 2 + \dots + n = \frac{n(n+1)}{2}$ for all $n \in \mathbb{N}$.

Example: Prove that $2^n > n$ for all $n \in \mathbb{N}$.

Base Case: For $n=1$, $2^1 = 2 > 1$. True.

Inductive Step: Assume $2^k > k$. Then $2^{k+1} = 2 \cdot 2^k > 2 \cdot k = k + k > k + 1$. True.

Therefore, $2^n > n$ for all $n \in \mathbb{N}$.

Example: Prove that $n^2 > n$ for all $n \in \mathbb{N}$.

Base Case: For $n=1$, $1^2 = 1$ is not greater than 1. False.

Inductive Step: Assume $k^2 > k$. Then $(k+1)^2 = k^2 + 2k + 1 > k + 2k + 1 = 3k + 1 > k + 1$. True.

Therefore, $n^2 > n$ for all $n \in \mathbb{N}$ with $n \geq 2$.

Mining Spatiotemporal Information Systems

LM Reder

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Mining Spatiotemporal Information Systems:

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Geoinformatics ,2006 *Novel Spatio-temporal Queries for Moving Object Applications* Marios Athan
Hadjieleftheriou,2004

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