

**NPTEL
NPTEL ONLINE COURSE**

**Discrete Mathematics
Mathematical Induction and pigeonhole principle**

MI - Inequality 2

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The image shows the cover of an NPTEL course. The background is blue with various mathematical symbols and diagrams, including a graph with colored nodes, a Rubik's cube, and a Möbius strip. The text on the cover reads: "Discrete Mathematics" in large white letters, followed by "Mathematical Induction and pigeonhole principle" in smaller white letters. Below that, "MI - Inequality 2" is written in white. At the bottom, the name "Prof. S. R. S. Iyengar" and "Department of Computer Science, IIT Ropar" are listed in white. The IIT Ropar logo is on the bottom left, and the NPTEL logo is on the bottom right.

Consider this inequality n^2 is greater than $2n+1$. Unlike the previous problem where I gave you the expressions and I told you to observe the patterns, here I am directly giving you the expression. So it is n^2 is greater than $2n+1$. Here I am going to assume that n is a positive integer.

$$n^2 > 2n+1 \quad n \in \mathbb{Z}_+$$

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So let me start enumerating the cases. 1^2 is greater than $2(1)$ plus 3. Is it true?

$$n^2 > 2n+1 \quad n \in \mathbb{Z}_+$$

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$$1^2 > 2(1)+1$$



1, 1^2 is 1. 1 is greater than $2+1$, which is 3. No. 1 is not greater than 3.

$$n^2 > 2n+1 \quad n \in \mathbb{Z}_+$$

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$$1 \neq 3$$



Let me just go ahead and try with $n = 2$. 2^2 is greater than $2(2)+1$, which is 4 is greater than 5. Again, not true.

$$n^2 > 2n+1 \quad n \in \mathbb{Z}_+$$

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$$1 \neq 3$$

$$4 \neq 5$$



Let me try it for 3. 3^2 is greater than $2(3)+1$. 9 is greater than 7. Yes. Here we see that this inequality is true. So what do we see? We see that n^2 greater than $2n+1$ is not true for $n = 1$ and 2. It starts becoming true for $n = 3$ onwards.

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$$n^2 > 2n+1 \quad n \in \mathbb{Z}_+$$

$$1 \not> 3$$

$$4 \not> 5$$

$$9 > 7 \quad \checkmark$$

$n^2 > 2n+1$ is not true for $n=1,2$.



This is a huge hint for all of you to prove using induction. Why? Because I am telling you that basis step does not start with 1. It starts with 3. This is a great example where you can see that basis step need not always start from 1. It is always problem dependent and here it starts becoming true from $n = 3$.

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$$n^2 > 2n+1 \quad n \in \mathbb{Z}_+$$


$$1 \not> 3$$

$$4 \not> 5$$

$$9 > 7 \quad \checkmark$$

$n^2 > 2n+1$ is not true for $n=1,2$.

Basis step : $n=3$



Now go ahead and prove it using induction and consider the basis step from $n = 3$. We will give you the solution in the next video.

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