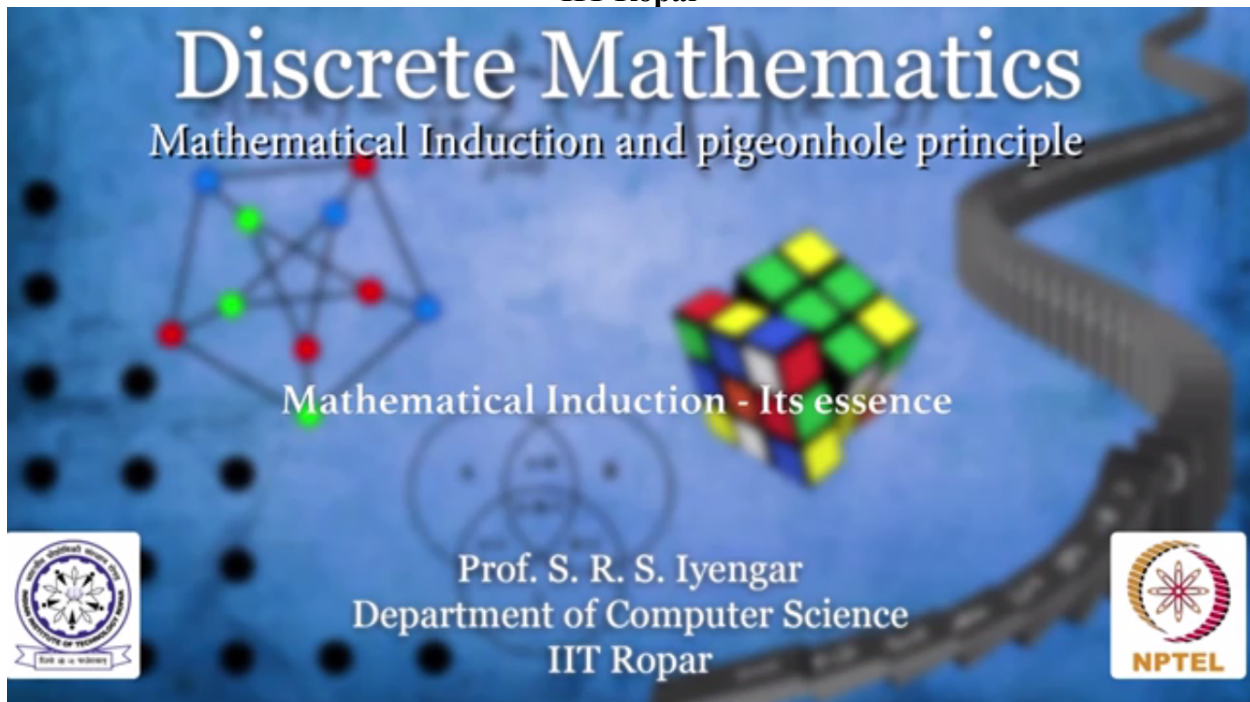**Discrete Mathematics**
Mathematical Induction and pigeonhole principle

Mathematical Induction - Its essence

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Let us have a keen eye for what happened. You see we need to first start off. That's called the Kickstart step. The step when you kickstart you see to get the engine forward, you should first start the engine, right? To get the domino effect to happen, you should first disturb the first domino. That is called the Kickstarting step.

Kickstart step — Disturb the first domino.

And then second thing you must ensure is the gap between two dominoes. What do you mean by gap between two dominoes? By gap I mean i falls on $(i+1)^{th}$ and $(i+1)$ should get disturbed. i should fall on $(i+1)$. The distance should be such that i falls on $(i+1)$. Okay. This is called the Ideal Gap. Kickstart, ideal gap. If you ensure these two, then every domino falls. Even the last domino falls. If you had infinitely many dominoes, the dominoes keep falling one on the other and the other on the next one. Right?

Kickstart step — Disturb the first domino.

Ideal Gap — i^{th} domino should fall on the $(i+1)^{th}$ domino.

Mathematically speaking, we have a little more complicated term than kickstart and gap. The kickstart step is called the base step and the gap step is called the induction step. All of you would have heard of an induction stove, but in mathematics induction doesn't mean an induction stove. Induction doesn't mean your electromagnetic induction. Induction here means going from i to i+1. The base step here means the first one should get disturbed.

So don't worry so much. When you see these complicated terms. Base step means kickstart. Induction step means the gap concept. So from now onwards what we will do is we will first note that the kickstart step is happening and the gap is there.

1. Kickstart step should happen.

2. Something that is true for the (first) case, and something that is true for (i+1)th case whenever (ith) case is true, then it is true for all elements.

By this I mean something that is true for the first case and something that is true for the $(i+1)^{th}$ case whenever ith case is true sounds complicated, but see more examples. It will be clear what I am saying. When something is true for one, something is true for i and hence it is true for i+1. It is true for all elements. Okay.

If you didn't understand, if you don't get what I am saying, all you need to know is we are still discussing the dominoes falling and nothing more than that.

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