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Discrete Mathematics

Let Us Count

Proof of n! - Part 2

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So you would have observed something here. There are two ways in which you can write a and b but then keep it as it is. Similarly there are two ways in which you can write b and c you see and two ways in which you can write a and c. So the point is whenever you bring in a new entity, let's say c you can think of keeping c in the first place or the second place or the third place. When you keep seeing the first place you have options to put your other two letters a and b in the other two places and this you can do in two ways. Similarly a, b here this you can do in two ways and here this you can do in two ways. The point I'm trying to make is if for two objects a b it takes two ways for three objects it takes three times because you can write c in first or second or third placeholder three times the times it takes for you to arrange two objects. So the answer is the answer for three objects is going to be the answer for two objects times three. Now you note if we had four objects let's say a, b, c and d you take d in the first place, d in the second place, d in the third place and d in the fourth place and in the remaining three places a, b, c can appear in how many ways; whatever was the answer for three objects right and here again you have one placeholder, one here, one here, and a, b, c is the possibilities for this placeholders and this a, b, c can appear as you can see in six ways. Six ways here. Six ways here and six ways here. So basically it is four times six ways which in other words let me write that down answer for four objects is going to be answer for three objects times four which we know answer for three objects was 6, it is 6 into 4.

So in general you probably are seeing a pattern that's forming here. The answer for 5 objects is answer for 4 objects into five. Correct? So answer for n objects in general is going to be answered for n minus 1 objects times n. So for 3 it happened to be 2 into 1. For 4 it turns out to be 4 into answer for 3 which is 3 into 2 into 1. For 5 it's going to be 5 times 4 into 3 into 2 into 1.

In general for n this is going to be n into n minus 1 into n minus 2 up to 2 into 1. So this is also called n factorial. What did we just now observe? We observed that ways in which n people can take all possible photographs happens to be n factorial which stands for n into n minus 1 into n minus 2 up to 2 into 1. Now this is a very important finding that we have observed and we're going to use this in almost all of the lectures that are forthcoming from this onwards.

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