

**NPTEL**

**NPTEL ONLINE COURSE**

**Discrete Mathematics**

**Let Us Count**

**Motivation for Catalan numbers**

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We are now going to see a not so easy example. It is more of a puzzle than a problem or example. Try solving this all by yourself by spending some time on it. We will soon give you the answer.

So this chapter is all about training you all on how to count. I'll give you a good illustration of how counting can get very complicated . Look at this figure in how many ways can you start from 0,0, and then reach 5,5? As you can see this is a grid, labeling the bottom left most point as 0,0 and the top rightmost point as 5,5. In how many ways can you reach 5,5 starting from 0,0 by using only rights and ups? You see this is one way. This is yet another way so on and so forth as you can see. What are the total number of ways?

Try Solving

Probably the problem that I just now stated is easy. Some of you could even figure out the answer. We will discuss the answer later but I want to give you a complicated version of the same question. What is the total number of ways in which you can reach 5,5 starting from 0,0; same question, there is a twist here provided you do not cross the diagonal joining 0,0, and 5,5. You can touch the diagonal but cannot cross the diagonal. So this is a valid possibility. This is another valid possibility and this one as you can see it's crossing the diagonal is an invalid possibility. Now count all those ways which do not cross the diagonal.

If you think the answer is whatever was the answer without diagonal by two you are wrong. This requires a brand new way of thinking. Right and observe. I'm asking you to count. I am asking you to count the total possible ways in which you can go from here to here without crossing the diagonal. This is one of the most important questions in computer science. We will see more of it at the end of the chapter but I am just trying to illustrate to you all that counting can get extremely complicated at times.

Pause the video and think for a while

So far I have just been motivating you all to think on the lines of counting and its importance. I even illustrated an example which is non-trivial, and I'm sure most of you did not get even close to the answer for the previous question. Don't worry, we'll describe that in detail very soon. Now let us go very slowly and try helping you all, I'm going to help you all to count from some of the basic, using some of the basic questions.

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