NPTEL

NPTEL ONLINE CERTIFICATION COURSE

Discrete Mathematics
Principle of Inclusion and Exclusion

Placing rooks on the chessboard

By
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We have seen the power of polynomials and its representation in counting,
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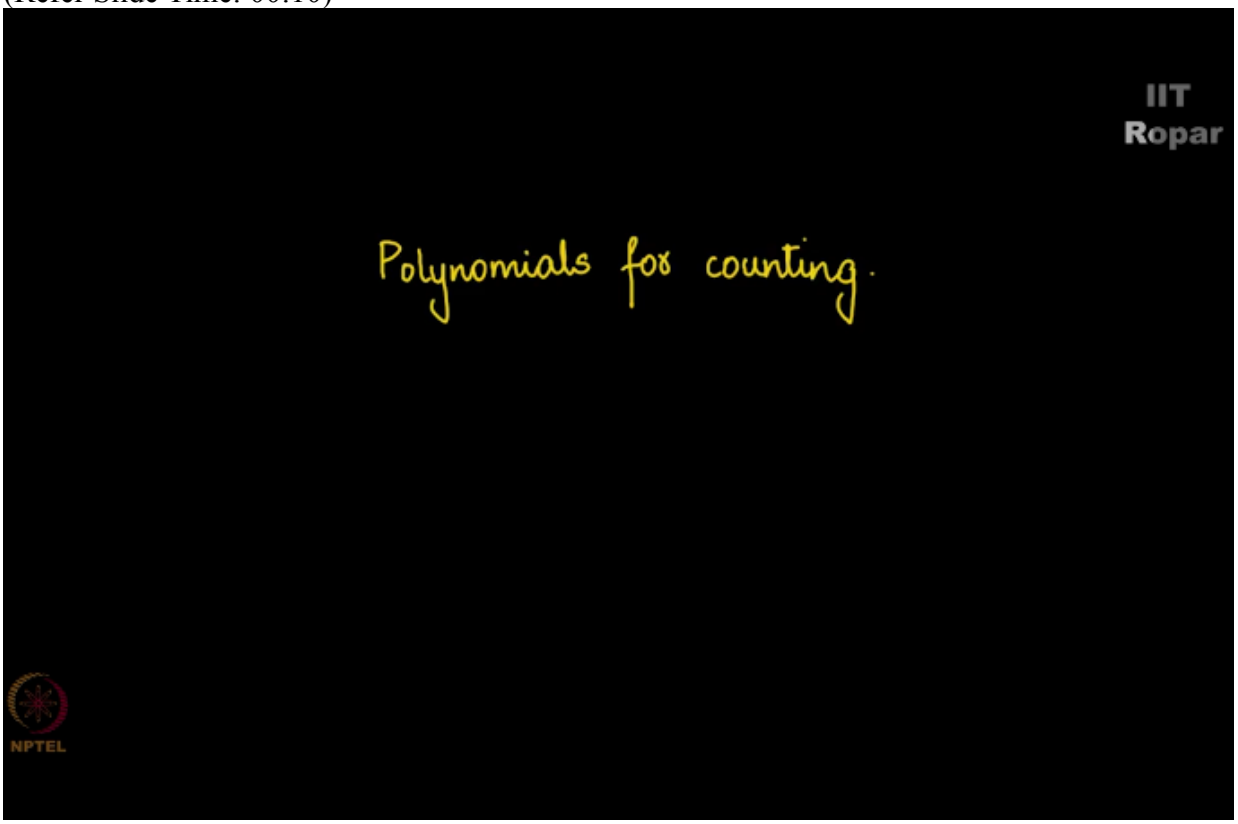

the way idea of using a polynomials coefficients and then multiplying two polynomials leads to a different form of counting as you saw in the chapter of generating functions, we will further look at the idea of polynomials that originate in chessboard by using this a pawn called the rook,
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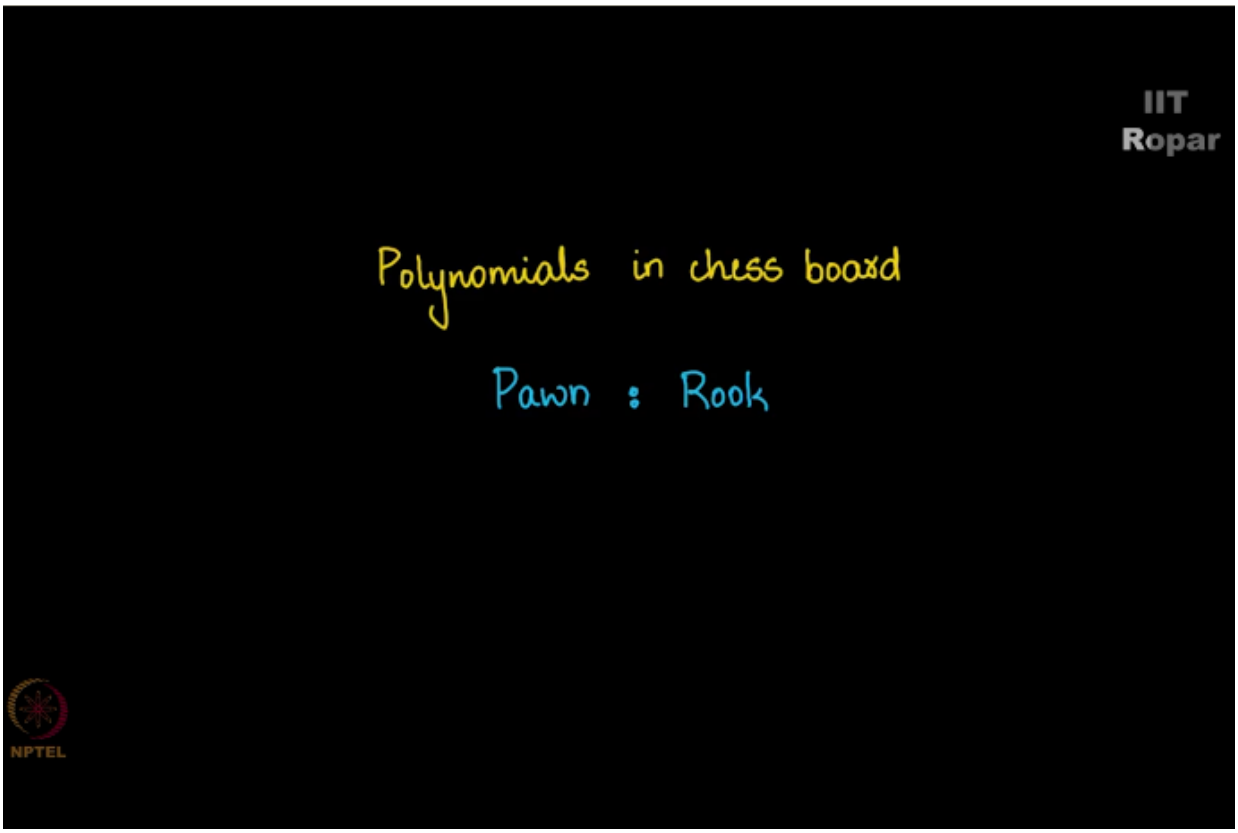

also called the elephant and seen how many ways can we place a rook in chessboard and this problem has something to do with some deep counting questions, so let us start with the introduction to the problem, look at this chessboard this is 3 x 3 chessboard.
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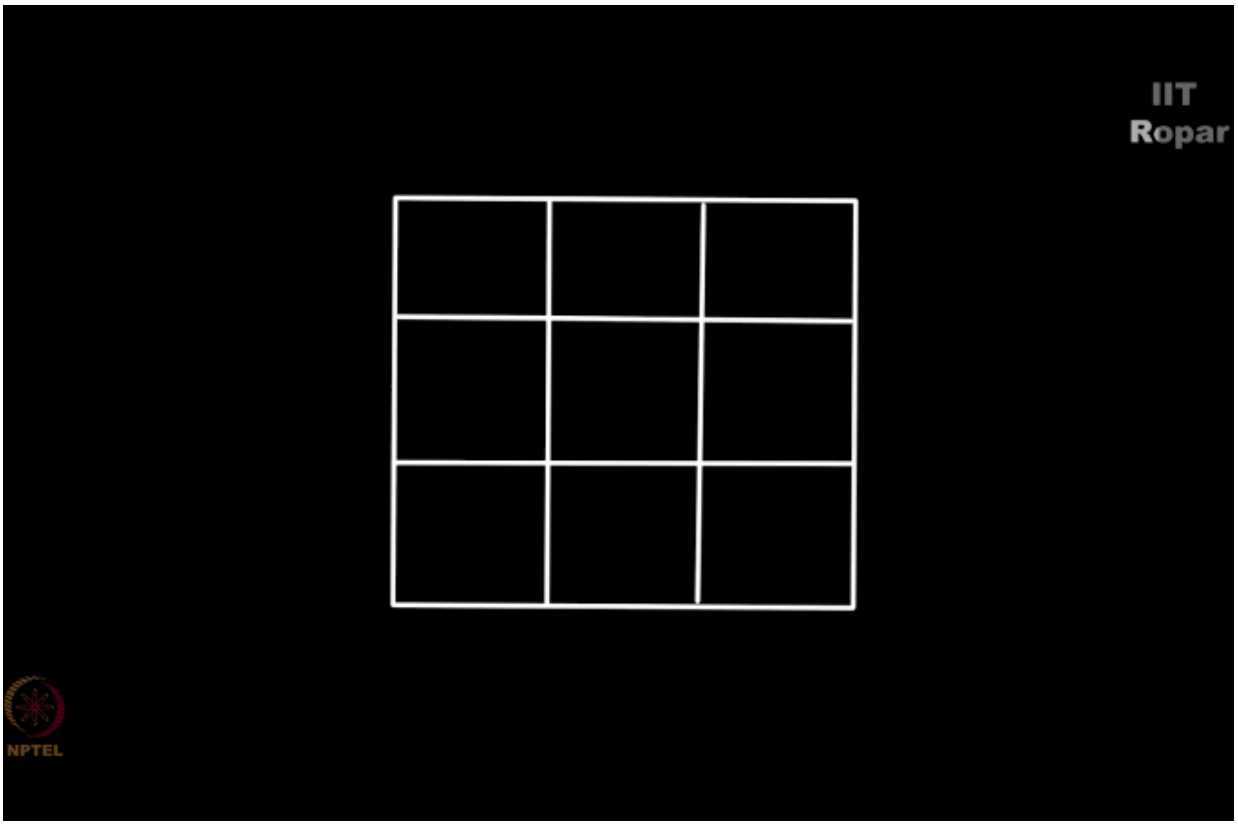

In how many ways can I place one elephant here,
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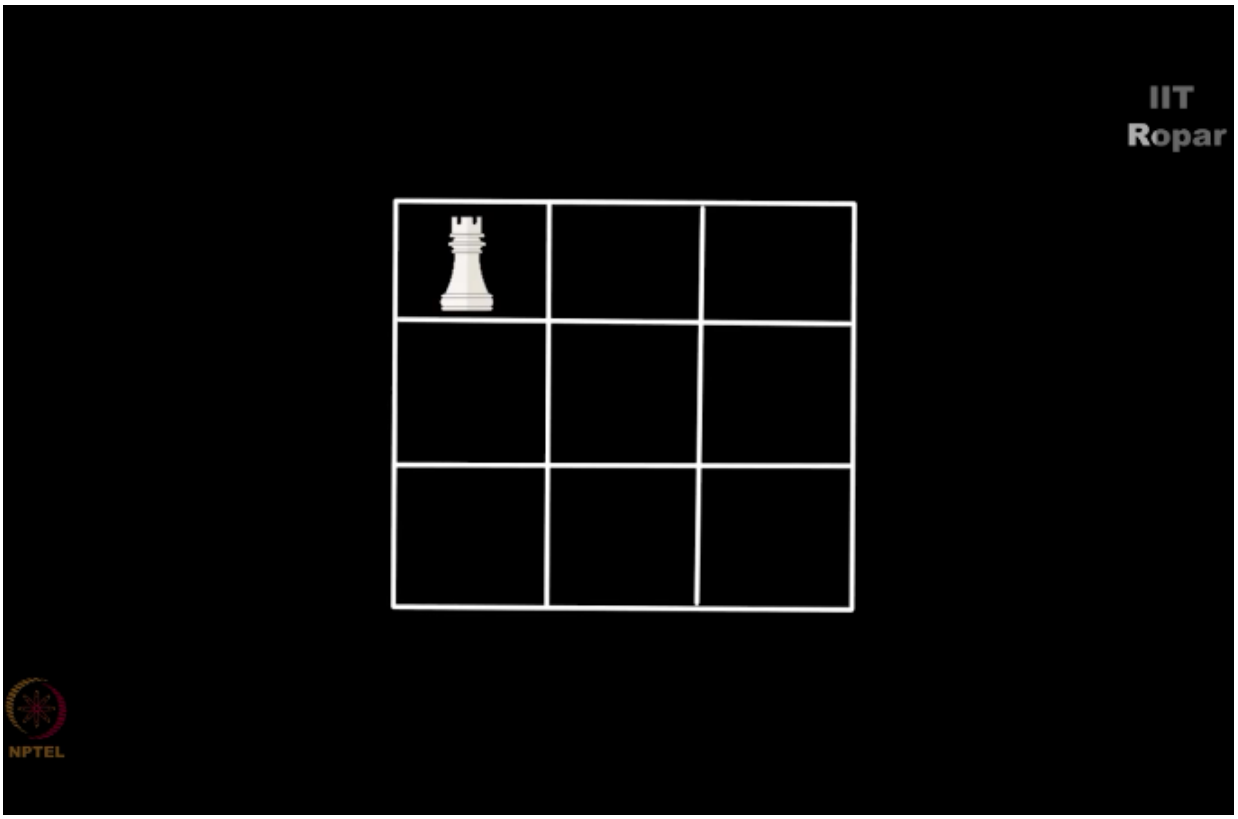

one rook here, I can place it here or here or here and so on,

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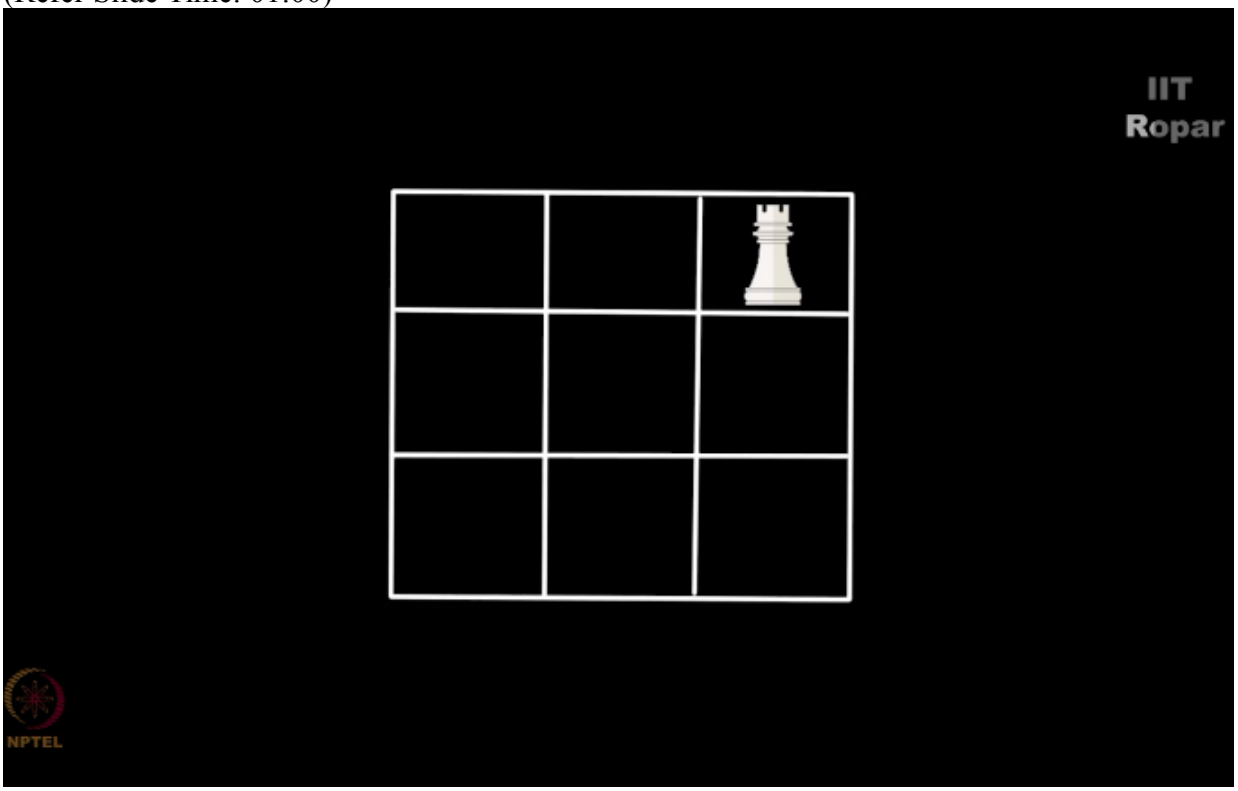

there are 9 ways, one rook can be placed in 9 place,

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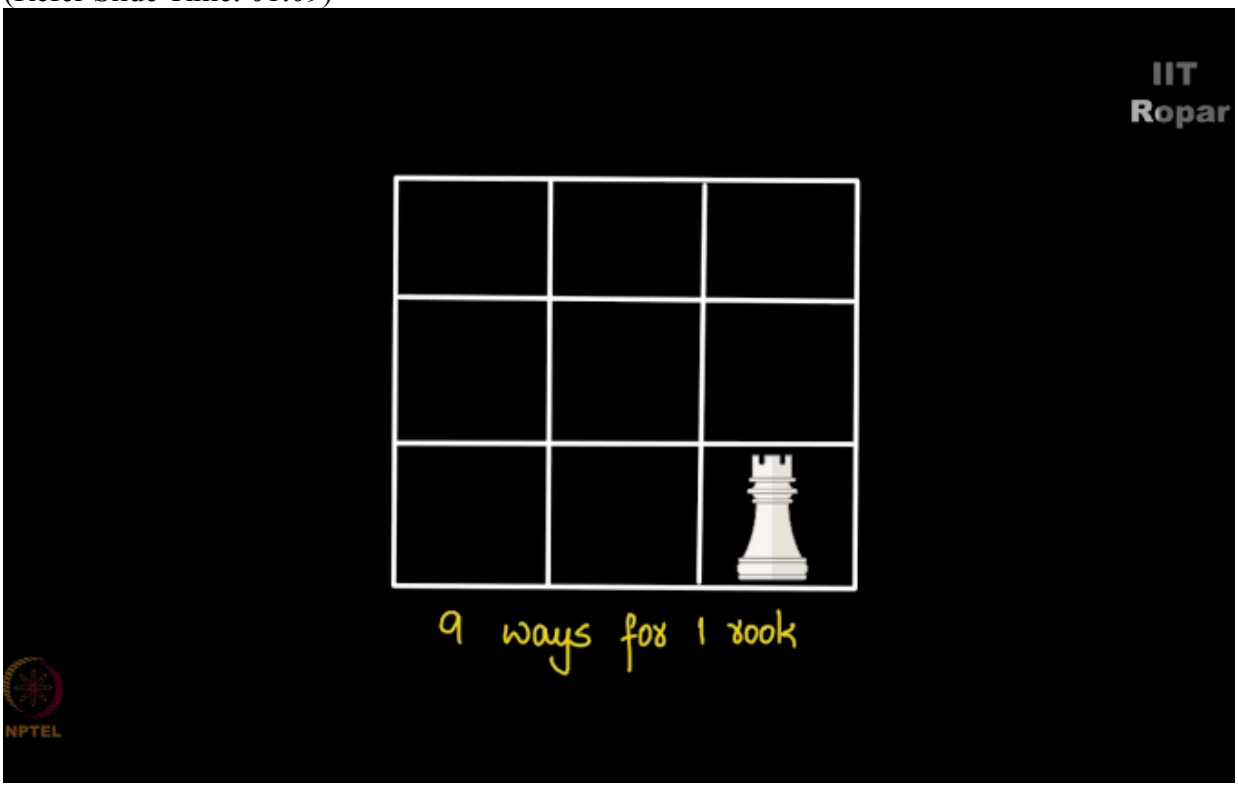

in how many ways can I place 2 rooks?

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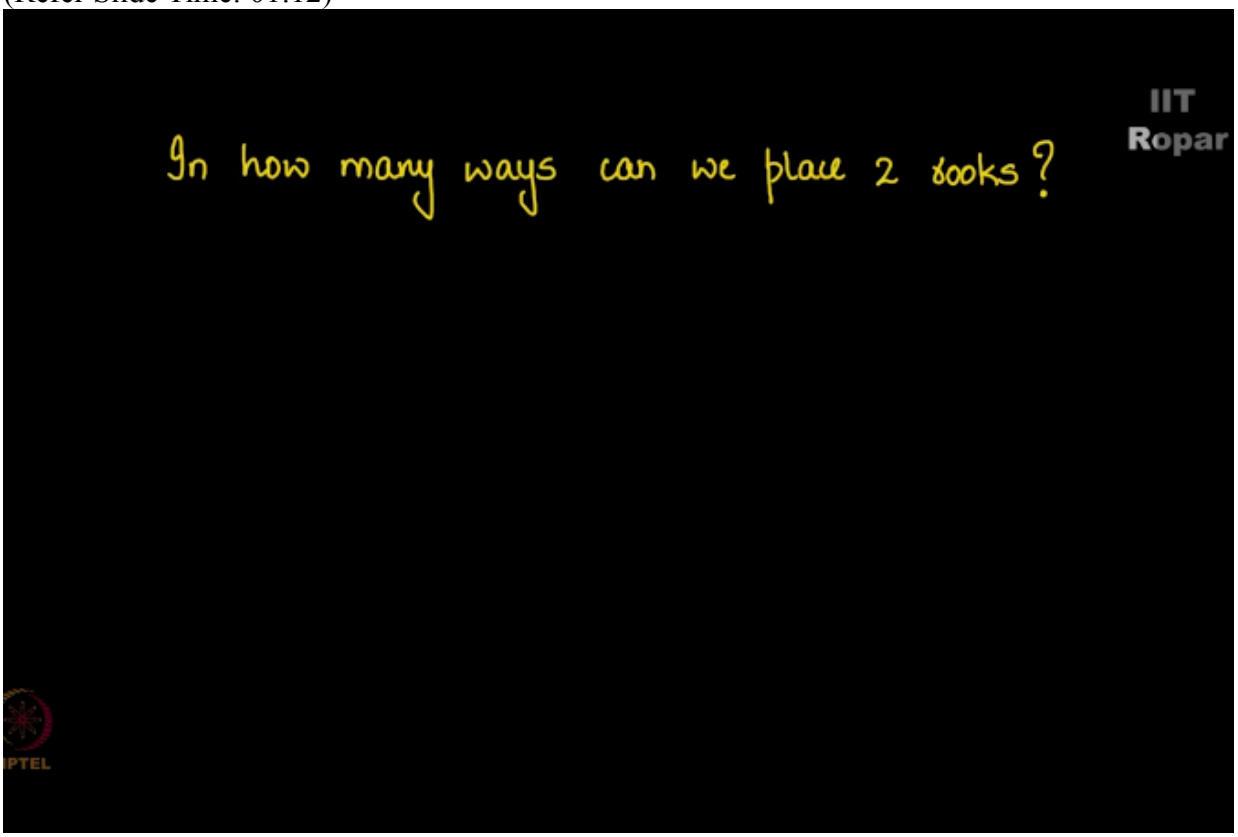

Obviously you would say 9 choose 2 ways, but note that 2 rook should be placed in such a way that when you place a rook here in the first cell you cannot place another rook in the same row and same column, these are called the non-taking rooks when you place 2 rooks in such a way that no 2 rooks are in the,
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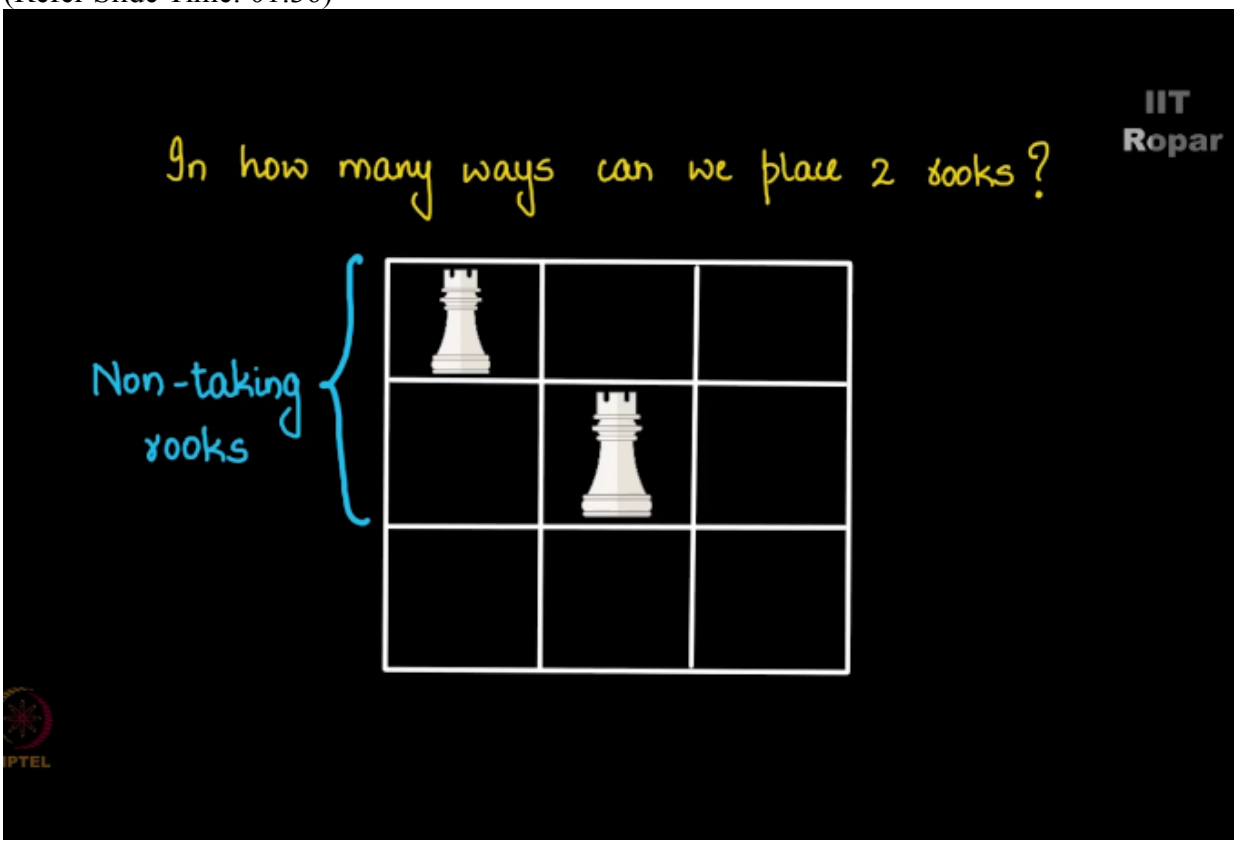

they both are not on the same vertical line or horizontal line, so in how many ways can I place a rook here? Once I place it in the first cell I have 4 options to place the second, so 4 ways,
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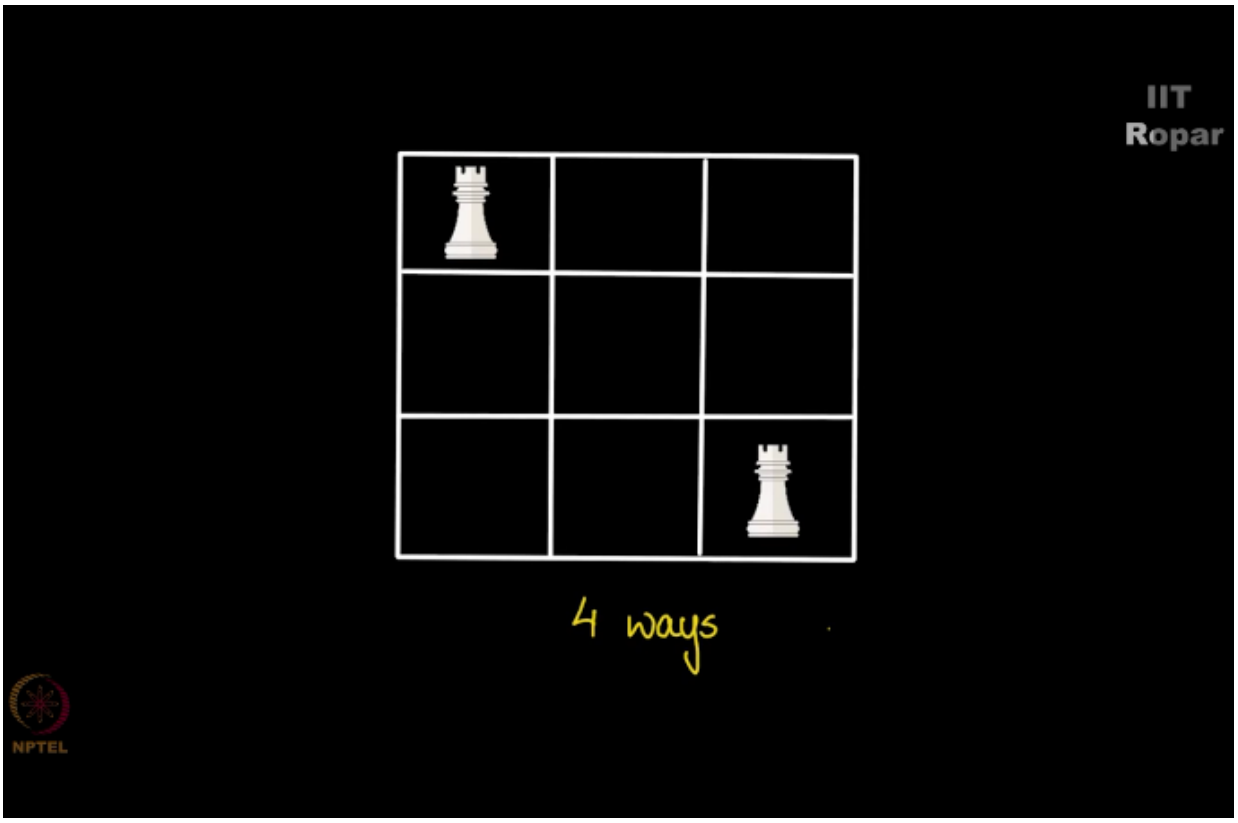

when I place the rook here

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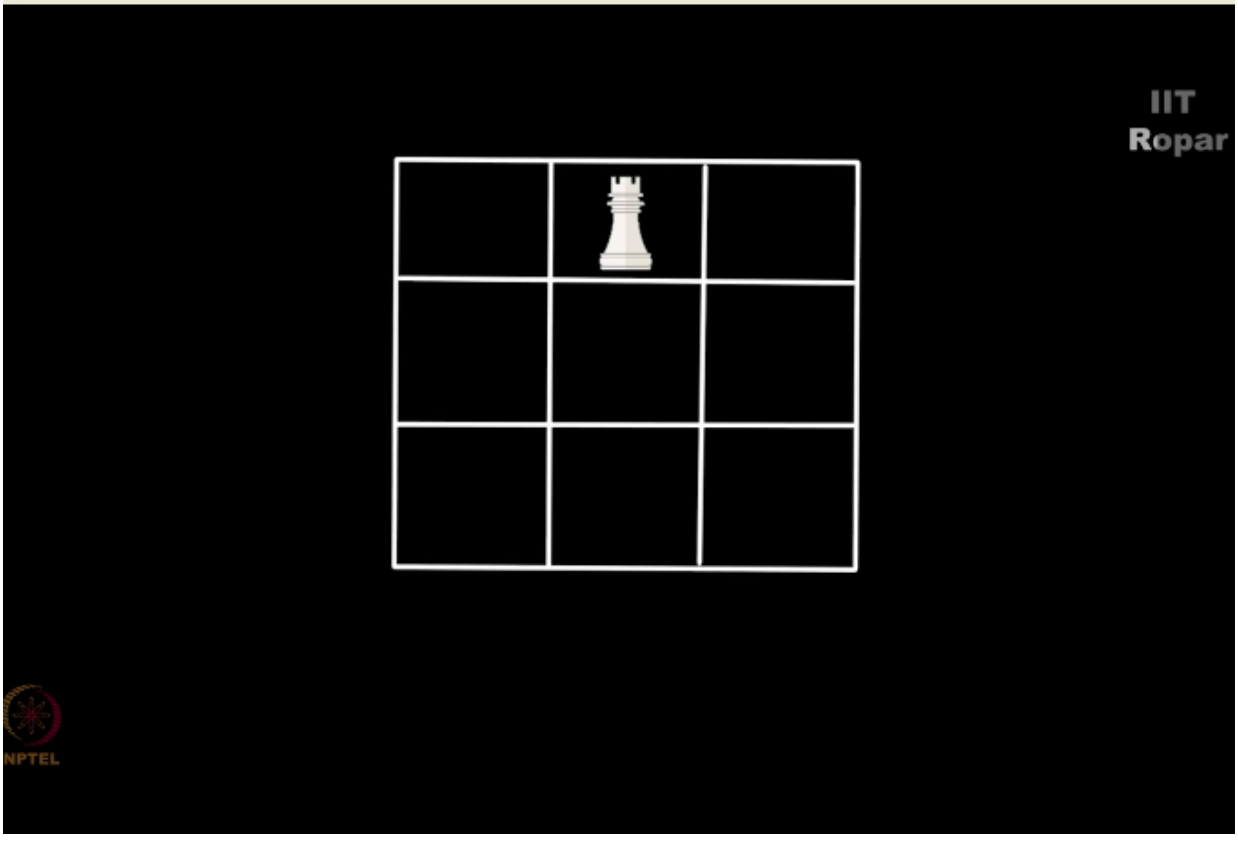

there are 4 ways, again the second cell, I'm going to place the rook here, there again 4 ways,
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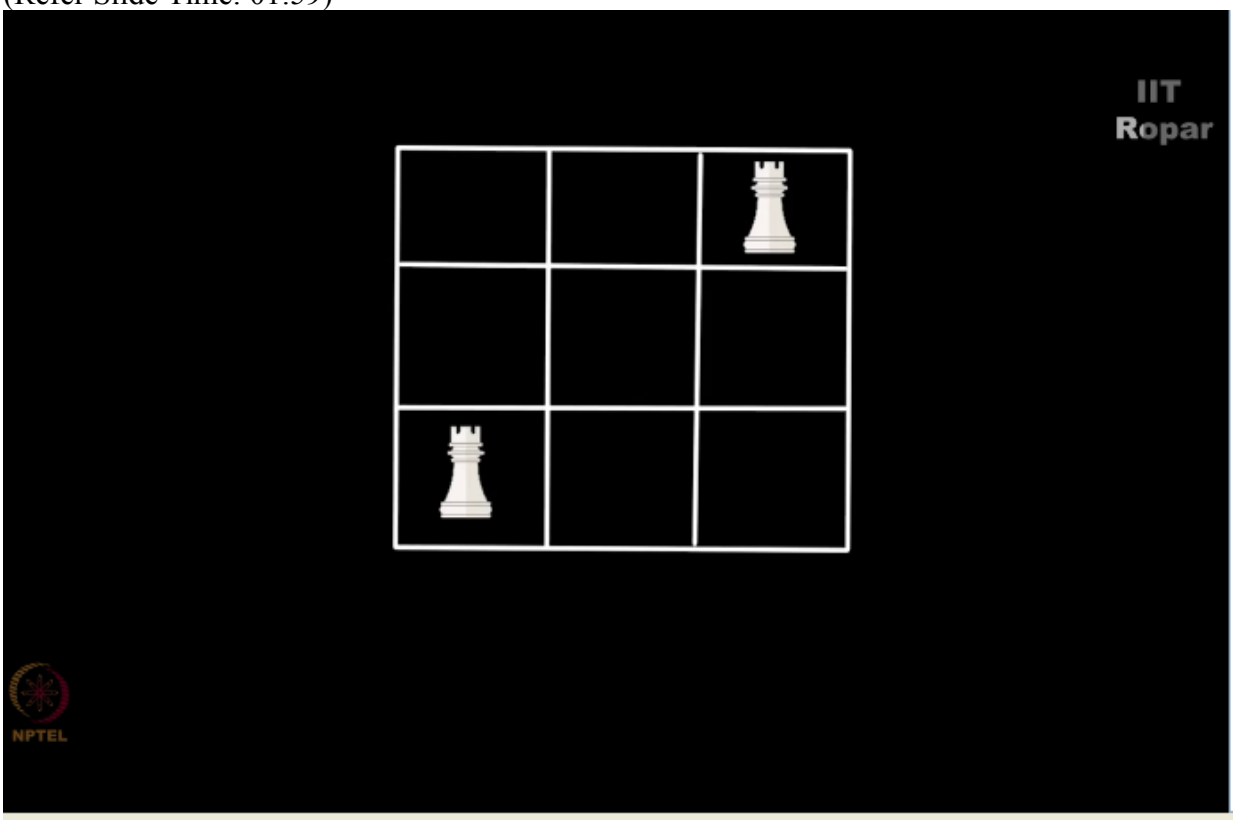

as you can see the only possible ways in which you can place 2 rooks is simply 12.

In how many ways can we place 3 rooks?
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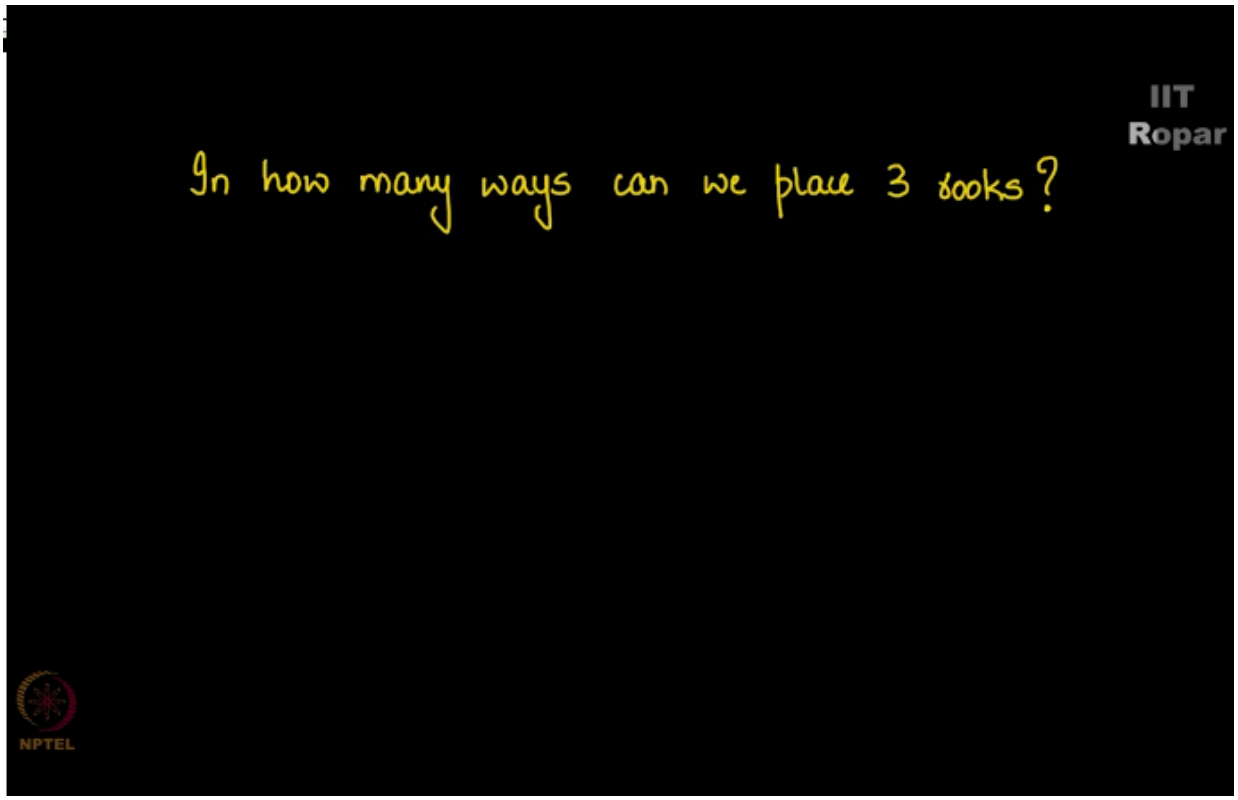

As you can see on this chessboard this is one way and this is another way and there are only 2 ways, right, obliquely you can place them 3 rooks,

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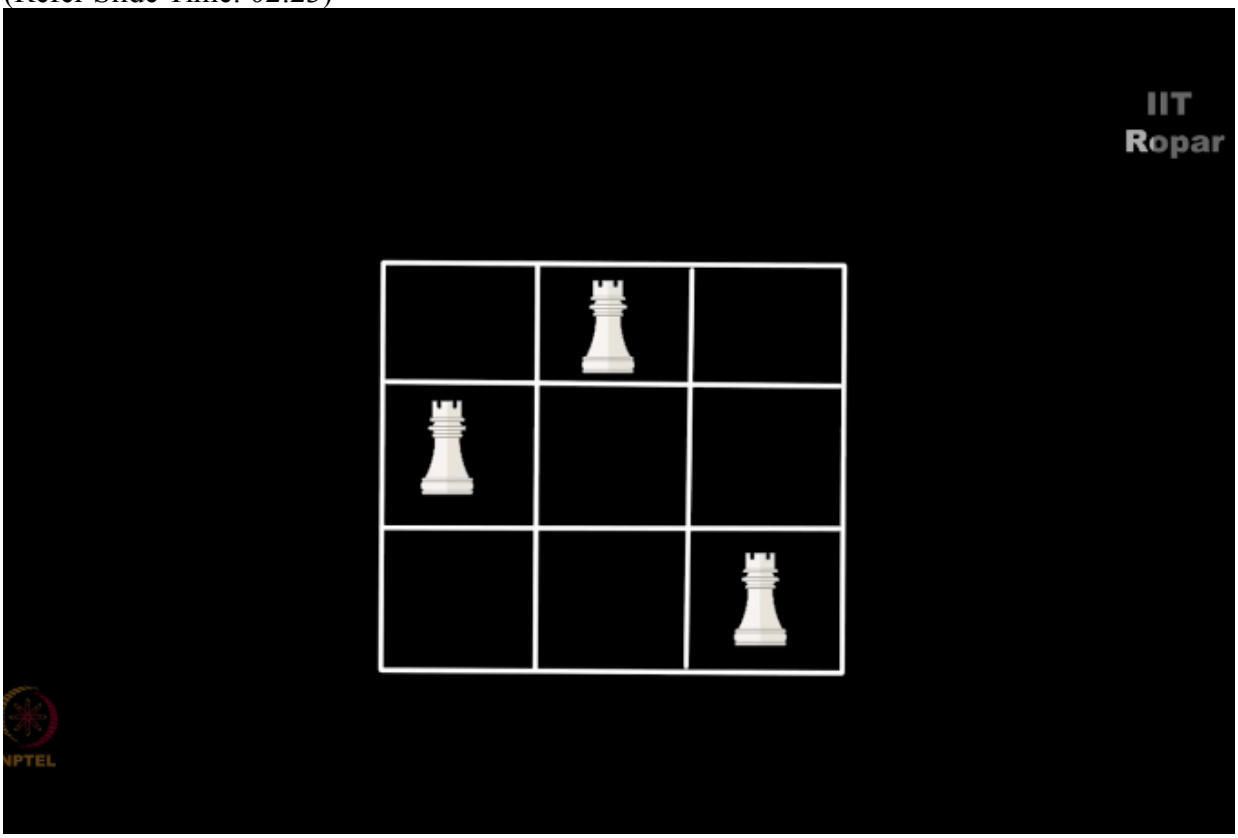

otherwise there is no other way, so you can place them in 3 ways.

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