We are going to see a few other generating functions they're closed forms and the sequence which they give, we know that 1/1-X is $1 + X + X$ square $+ X$ cube and so on,
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right, now in place of X I am going to substitute 2Y, so what does it become? 1/1-2Y = $1 + 2Y$ + 2 square Y square + 2 cube Y cube + 2 to the 4 Y to the 4 and so on,
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$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \ldots\ldots$$

$$x = 2y$$

$$\frac{1}{1-2y} = 1 + 2y + 2^2 y^2 + 2^3 y^3 + 2^4 y^4 + \ldots\ldots$$

now it's very easy for your people to observe here that 1 -2Y is the generating function for the sequence or rather it gives the sequence 1, 2, 2 square, 2 cube, 2 to the 4 and so on, 1 here if you observe was 2 to the 0 actually, so it is 2 to the 0, 2 to the 1, 2 square 2 cube, 2 to the 4 and so on.
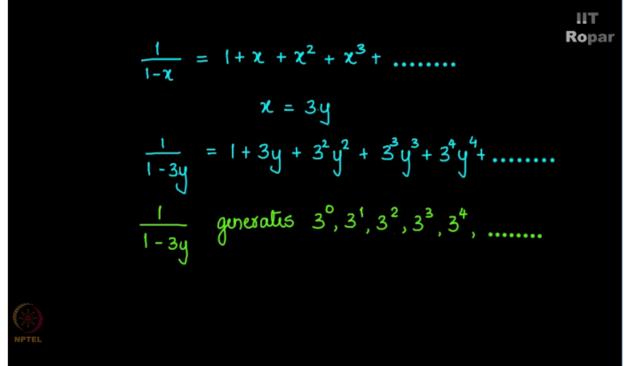
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$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \ldots\ldots$$

$$x = 2y$$

$$\frac{1}{1-2y} = 1 + 2y + 2^2 y^2 + 2^3 y^3 + 2^4 y^4 + \ldots\ldots$$

$$\frac{1}{1-2y} \quad \text{generates} \quad 1, 2, 2^2, 2^3, 2^4, \ldots\ldots$$

Now in place of 2Y what if I substitute 3Y, I will get it as 1/1-3Y is 1 + 3Y + 3 square Y square + 3 cube Y cube + 3 to the 4, Y to the 4 + so on,

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$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \ldots\ldots$$

$$x = 2y$$

$$\frac{1}{1-2y} = 1 + 2y + 2^2 y^2 + 2^3 y^3 + 2^4 y^4 + \ldots\ldots$$

$$\frac{1}{1-2y} \quad \text{generates} \quad 1, 2, 2^2, 2^3, 2^4, \ldots\ldots$$

now do you observe that 1/1-3Y has given us the sequence 3 to the 0, 3 to the 1, 3 square, 3 cube and so on,

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$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \ldots\ldots$$

$$x = 3y$$

$$\frac{1}{1-3y} = 1 + 3y + 3^2 y^2 + 3^3 y^3 + 3^4 y^4 + \ldots\ldots$$

$$\frac{1}{1-3y} \quad generates \quad 3^0, 3^1, 3^2, 3^3, 3^4, \ldots\ldots$$

you must be guessing my obvious next question, can we substitute in place of X any KY, or any constant into Y, so in general I can write 1/1-AX in place of Y I am just writing X here, 1/1-AX, A is any constant, I will get it as 1 + AX + A square X square + A cube X cube + A to the 4 X to the 4 + so on, so 1/1-AX is the closed form of the generating function for the sequence A to the 0, A, A square, A cube, A to the 4 and so on,

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$$\frac{1}{1-ax} = 1 + ax + a^2x + a^3x^3 + a^4x^4 + \ldots\ldots$$

$$\frac{1}{1-ax} \text{ generates } a^0, a^1, a^2, a^3, a^4, \ldots\ldots$$

take some time and go through all of these.

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