*Z-Transform Definition*

Z[x(n)] = -n = x(z) + ROC

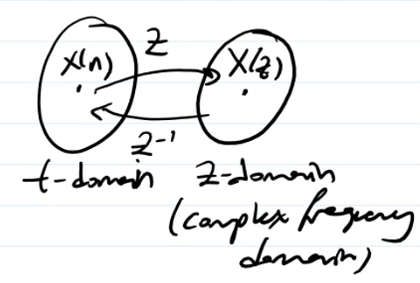
ROC: Region of Convergence (condition that summation converge into the last result). Integral part of Z-transform.

z: complex frequency

z = r . ejw 🡪 r: magnitude, w: angle, j: complex number

x(n): Discrete time signal in time domain

We try to convert x(n) to x(z) in z-domain which is complex frequency domain.



Text, letter

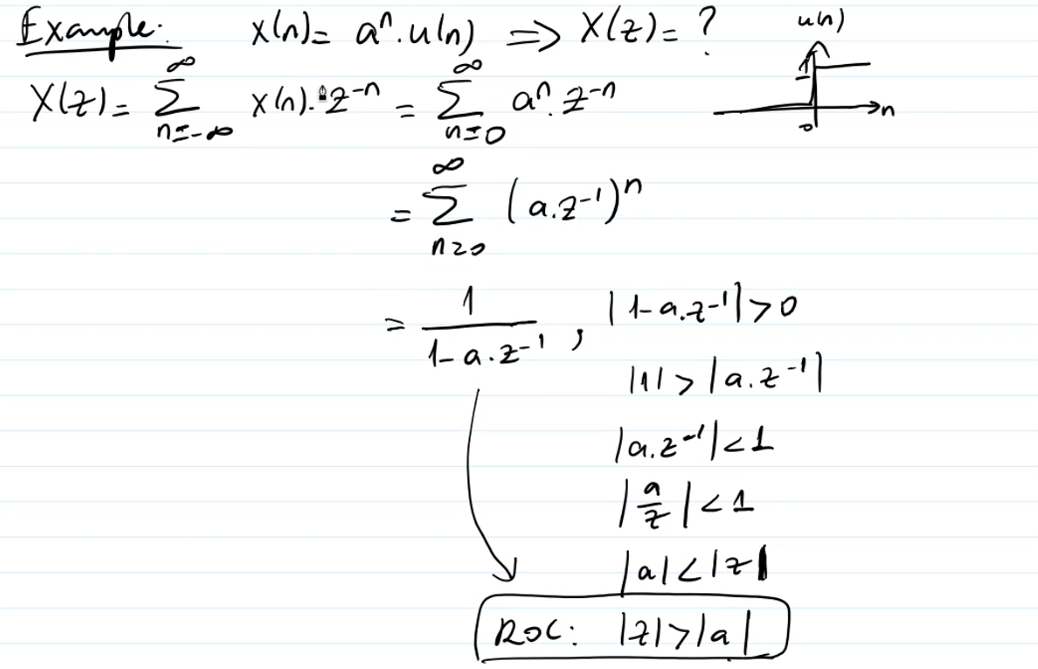
Description automatically generated

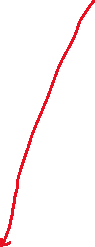
Inverse Z-Transform

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*Example*:





u(n) 🡪 unit step function

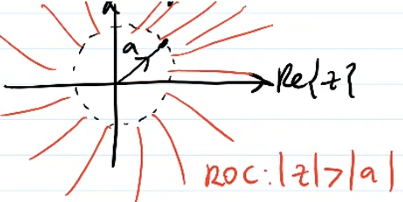
Question is “Can you find Z transform of given x(n) signal?”

Text

Description automatically generatedROC: |z| > |a| means result is valid under this condition.

Diagram

Description automatically generated

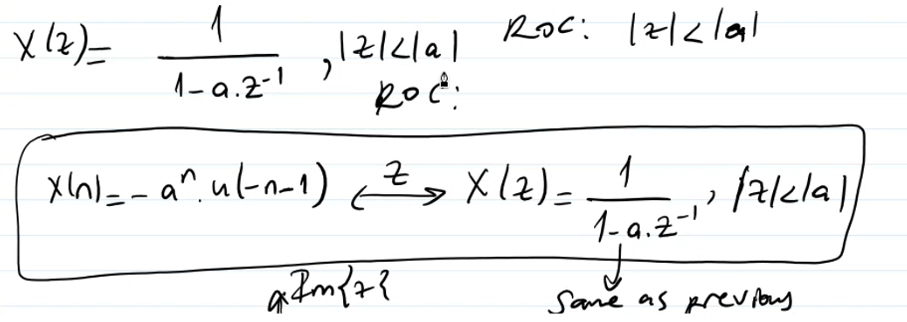


Result is valid within red region.

*Example:*

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Text, letter

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Knowledge of x(z) + ROC uniquely determines x(n).

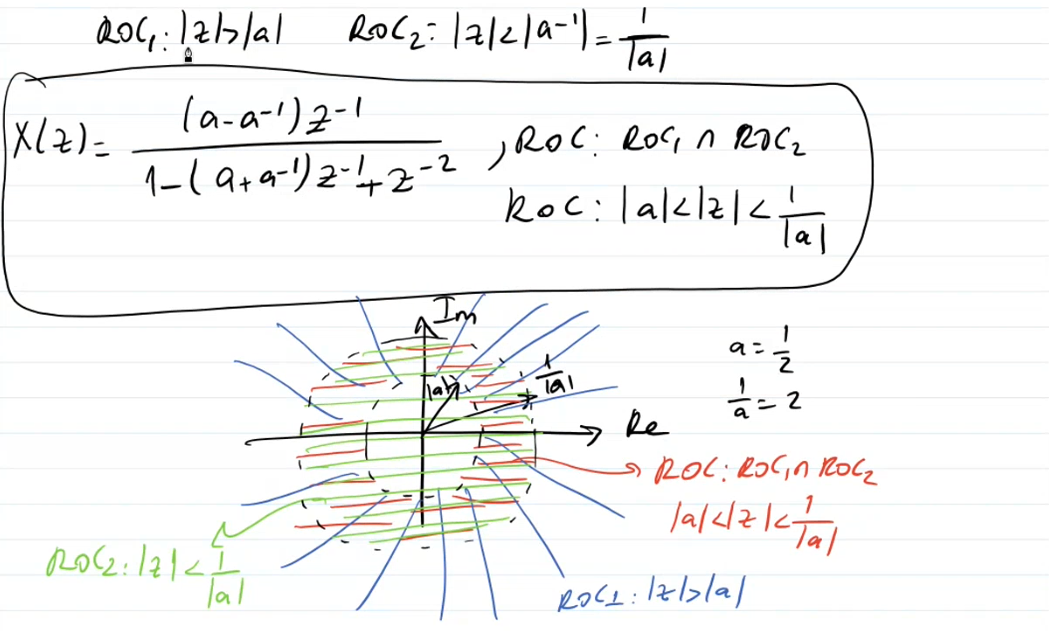
Important Property: Linearity

Text, letter

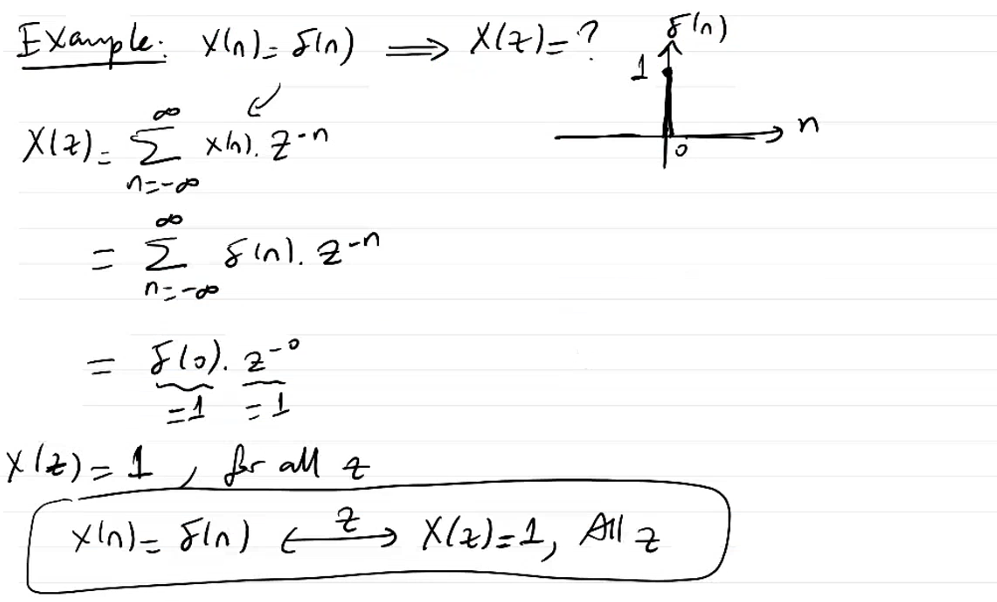
Description automatically generatedThe Z-transform is linear, that is (apply linearity condition):

Text, application, letter

Description automatically generated



*Example:*



Delta (impulse) function has only non-zero value at n=0

*Example:*

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Text, letter

Description automatically generated

*Example:*

Text, letter

Description automatically generated

PROPERTIES OF Z-TRANSFORM

Time-shift

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*Example*:

Text, letter

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Text, letter

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Scaling in the Z-domain

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Description automatically generated

*Example*:

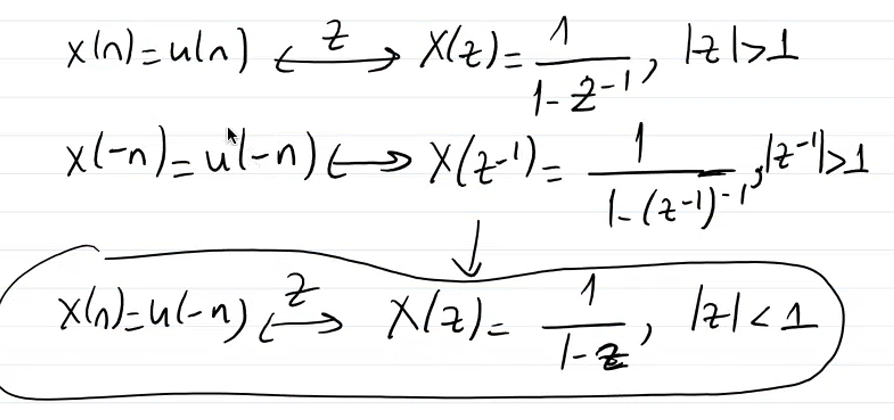
Text, letter

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Time-reversal

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Description automatically generated

*Example:*

Convolution

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Description automatically generated

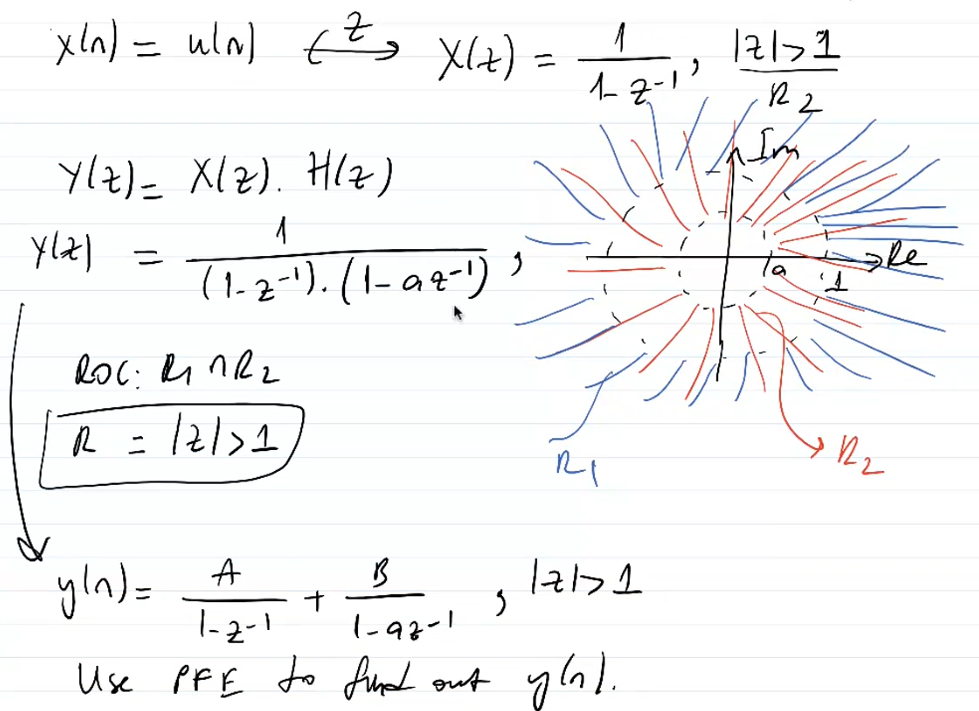
*Example*:

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h(n) is impulse response.

x(n) is unit step function.





R1 ve R2’nin yerleri değiş tokuş olmalı. Yanlış yazılmış.

Inverse Z-transform.

Differentiation in the Z-domain

Diagram

Description automatically generated

*Example:*

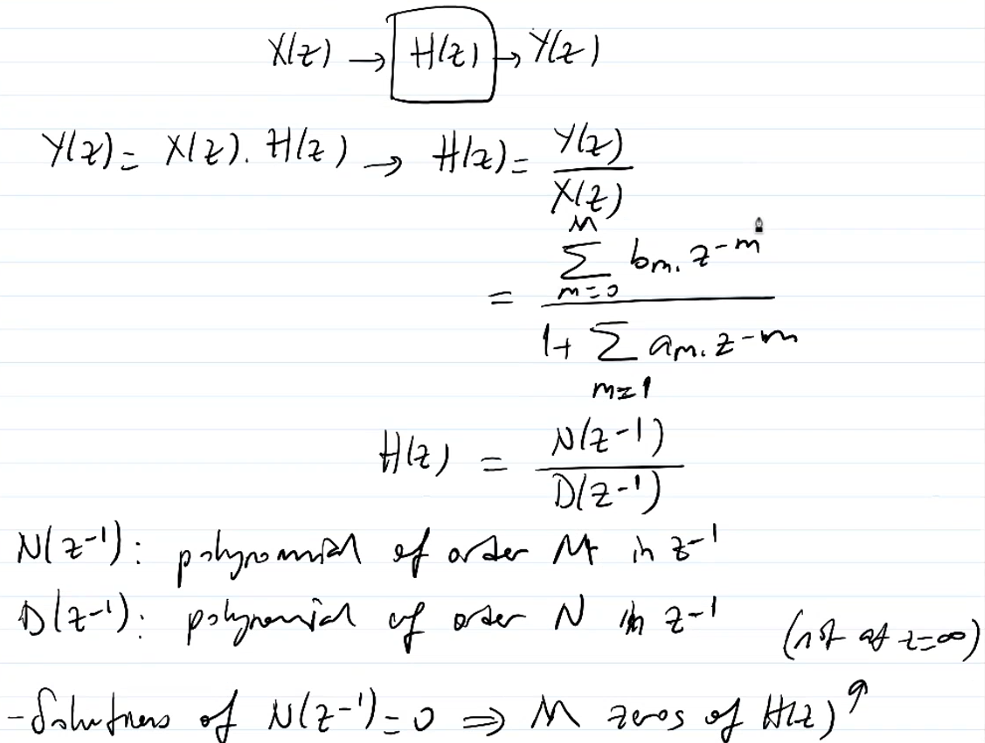
Text, letter

Description automatically generated

Text, letter

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Poles and Zeros



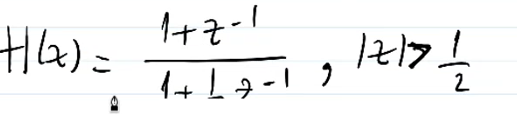
H(z) : Transfer function

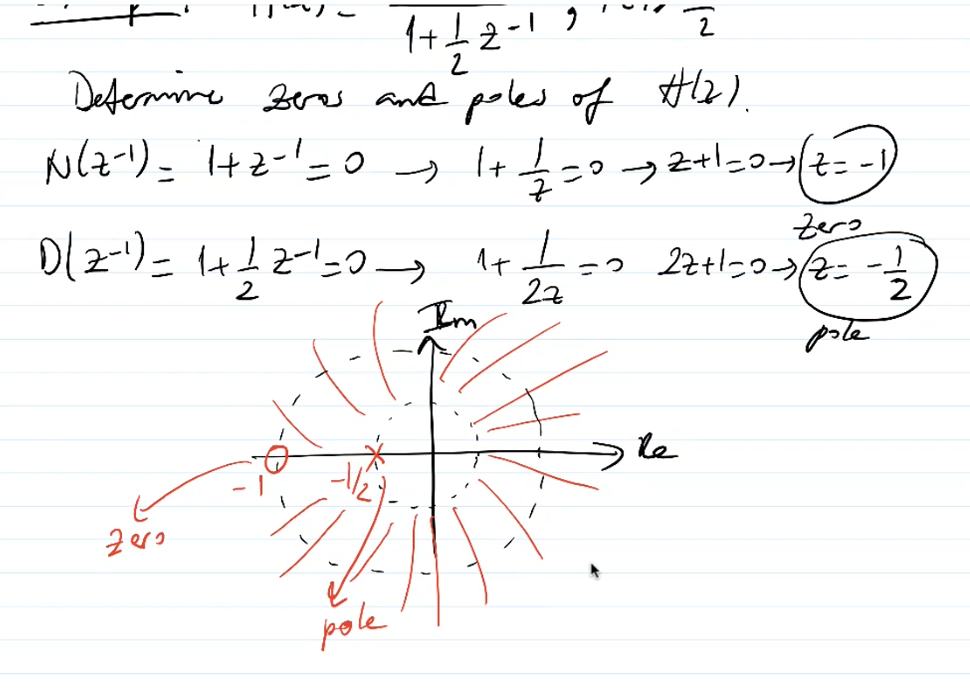
N: nominator D: denominator

Text, letter

Description automatically generated

*Example:*





In Z-plane; Zeros is notated with circle, Poles is notated with x.