COMP.SGN.100 Introduction to Signal Processing
Exercise 6 - Task 1, 2

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September 24, 2021

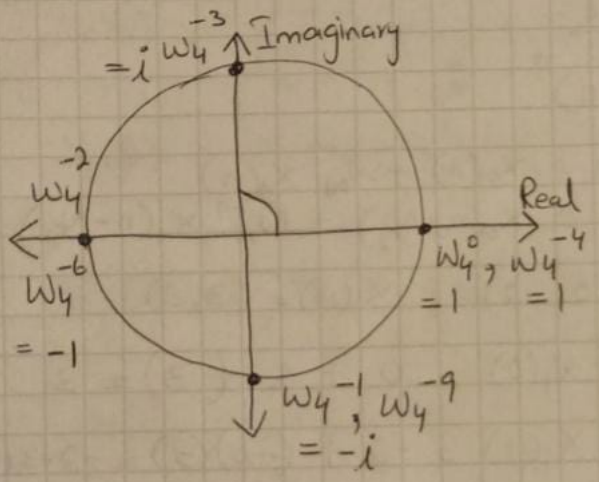
Task 1

EXERCISE 6

TASK 1

First Create DFT Matrix For $N = 4$

$$\begin{pmatrix} W_4^0 & W_4^0 & W_4^0 & W_4^0 \\ W_4^0 & W_4^{-1} & W_4^{-2} & W_4^{-3} \\ W_4^0 & W_4^{-2} & W_4^{-4} & W_4^{-6} \\ W_4^0 & W_4^{-3} & W_4^{-6} & W_4^{-9} \end{pmatrix}$$



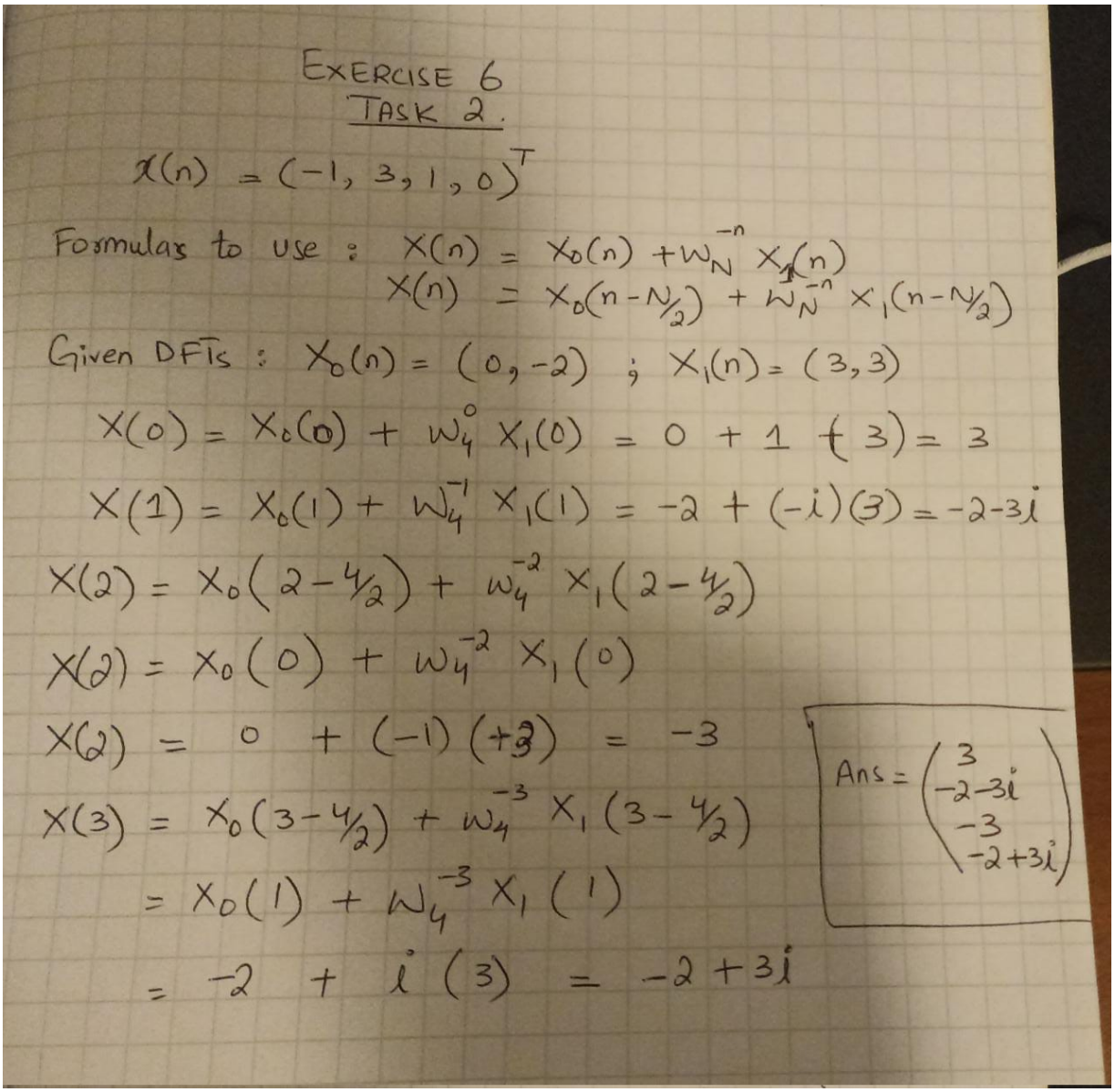
$$\Rightarrow \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & -i & -1 & i \\ 1 & -1 & 1 & -1 \\ 1 & i & -1 & -i \end{pmatrix}$$

Now, $x(n) = (5, 1, -1, 0)^T$

$$\begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & -i & -1 & i \\ 1 & -1 & 1 & -1 \\ 1 & i & -1 & -i \end{pmatrix} \cdot \begin{pmatrix} 5 \\ 1 \\ -1 \\ 0 \end{pmatrix} = \begin{pmatrix} 5 \\ 6-i \\ 3 \\ 6+i \end{pmatrix}$$

Ans.

Task 2


EXERCISE 6
TASK 2.
$x(n) = (-1, 3, 1, 0)^T$
Formulas to use : $X(n) = X_0(n) + W_N^{-n} X_1(n)$
$X(n) = X_0(n-N/2) + W_N^{-n} X_1(n-N/2)$
Given DFTs : $X_0(n) = (0, -2)$; $X_1(n) = (3, 3)$
$X(0) = X_0(0) + W_4^0 X_1(0) = 0 + 1(3) = 3$
$X(1) = X_0(1) + W_4^{-1} X_1(1) = -2 + (-i)(3) = -2-3i$
$X(2) = X_0(2-4/2) + W_4^{-2} X_1(2-4/2)$
$X(2) = X_0(0) + W_4^{-2} X_1(0)$
$X(2) = 0 + (-1)(+3) = -3$
$X(3) = X_0(3-4/2) + W_4^{-3} X_1(3-4/2)$
$= X_0(1) + W_4^{-3} X_1(1)$
$= -2 + i(3) = -2+3i$
Ans = $\begin{pmatrix} 3 \\ -2-3i \\ -3 \\ -2+3i \end{pmatrix}$