COMP3121 Homework Q4

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1 Answer a

Since all the values from $n = 1$ up to $n = k$ are 0, all the values are considered zero. The convolution, given in the question represents the poynomial

$$P(x) = A_0 + A_{k+1}x^{k+1}$$

Whats asked is square of the given polynomial, hence $(P(x))^2$ is:

$$(P(x))^2 = (A_0 + A_{k+1}x^{k+1})(A_0 + A_{k+1}x^{k+1})$$

$$(P(x))^2 = A_0^2 + 2A_0A_{k+1}x^{k+1} + A_{k+1}^2x^{2k+2}$$

In the question since the both given values of A_0 and A_{k+1} is equal to 1, hence the final $(P(x))^2$ will be:

$$(P(x))^2 = 1^2 + 2 * 1 * 1x^{k+1} + 1^2x^{2k+2}$$

$$(P(x))^2 = 1 + 2x^{k+1} + x^{2k+2}$$

Hence it can be written as $\langle 1, \underbrace{0, 0, \ldots, 0}_{k}, 2, \underbrace{0, 0, \ldots, 0}_{k}, 1\rangle$ where 0 occurs k times before and after the 2. Reference for the answer above is taken from Tutorial 2 question 15 b

2 Answer b

We need to compute the DFT of $A = \langle 1, \underbrace{0, 0, \ldots, 0}_{k}, 1\rangle$ where 0 occurs k times. As seen above, the polynomial associated with A will be,

$$P(x) = 1 + x^{k+1}$$

$$DFT(A) = \langle P(\omega_{k+2}^0), P(\omega_{k+2}^1), P(\omega_{k+2}^2), ..., P(\omega_{k+2}^{k+1})\rangle$$

$$DFT(A) = \langle 1 + (\omega_{k+2}^0)^{k+1}, 1 + (\omega_{k+2}^1)^{k+1}, 1 + (\omega_{k+2}^2)^{k+1}, ..., 1 + (\omega_{k+2}^{k+1})^{k+1}\rangle$$

$$DFT(A) = \langle 2, 1 + \omega_{k+2}^{k+1}, 1 + \omega_{k+2}^{2(k+1)}, ..., 1 + \omega_{k+2}^{(k+1)(k+1)}\rangle$$

Reference for the answer above is taken from Tutorial 2 Question 15 a