HOMEWORK 2 - Q4

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1 Solution

1.1 Part A

To find the convolution of,

$$< 1, 0, 0...0, 0, 1 > * < 1, 0, 0...0, 0, 1 >$$

*Assume there's k number of 0s in between the 1s. We can easily multiply their polynomials and then revert them back to the list. Since, we know there are $k+2$ elements in each list, their respective polynomials would be of degree $k+1$. let,

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

The question essentially requires us to find, $P(x)^2$

$$= P(x)^2$$

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

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

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

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

To represent this polynomial in the list form, There are k number of 0s in between the first 1 and second 1 and there are also k number of 0s in between the second 1 and the 2

$$A => < 1, 0, 0, ..1, 0, 0..2 >$$

1.2 Part B

DFT of a given polynomial $P(x)$ is just the list containing,
$P(\omega)$ for every single root of unity ω for $P(x)$ where,

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

Then we find the DFT for P(x) that has a degree of $k+1+1 = k+2$,

$$DFT(P) =< P(\omega_{k+2}^{0}), P(\omega_{k+2}^{1})...P(\omega_{k+2}^{k+1}) >$$

$$DFT(P) =< 1 - \omega_{k+2}^{0*(k+1)}, 1 - \omega_{k+2}^{1*(k+1)}, 1 - \omega_{k+2}^{2*(k+1)}...1 - \omega_{k+2}^{(k+1)*(k+1)} >$$

$$DFT(P) =< 0, 1 - \omega_{k+2}^{(k+1)}, 1 - \omega_{k+2}^{2*(k+1)}..., 1 - \omega_{k+2}^{(k+1)^2} >$$