

Exercises

Algorithm theory

Winter term 2008/09

Exercise sheet 3

TASK 1 (1 point):

1. Specify all primitive n -th roots of unity. Show that they are indeed primitive. An n -th root of unity ω is primitive if $\omega^k \neq 1$ for $k = 1, \dots, n-1$. Thus, a primitive root of unity ω generates the group of n -th roots of unity:

$$\{\omega^k : 0 \leq k \leq n-1, k \in \mathbb{N}\} = \{\omega_n^0, \omega_n^1, \dots, \omega_n^{n-1}\}$$

2. Compute the product of the two polynomials

$$p(x) = 3x - 1 \quad \text{and} \quad q(x) = 2x + 5$$

using the Fast Fourier Transformation.

- (a) Compute the FFT of $p(x)$ and $q(x)$
- (b) Give the point-value representation of pq at the k -th roots of unity for an appropriate choice of k .
- (c) Compute the interpolation by using the FFT algorithm.
- (d) Check the correctness of your result.

Specify all (recursive) calls of FFT algorithm as well as the outputs used during the execution.