Consider two polynomials

\[ 4x^3 - 3x^2 - x - 1, \]
\[ 3x^3 + 5x^2 - 2x - 1, \]
their sum
\[ 7x^3 + 2x^2 - 3x - 2, \]
and their product
\[ 12x^6 + 11x^5 - 26x^4 - 6x^3 + 0x^2 + 3x + 1 \]
\[ = 12x^6 + 11x^5 - 26x^4 - 6x^3 + 3x + 1. \]

Using traditional, by-hand calculation methods we can add polynomials of degree \( n \) in time \( \sim n \) (by adding the coefficients of the corresponding \( n + 1 \) terms. We can multiply them in time \( \sim n^2 \) by multiplying one polynomial by each term of the other and adding the intermediate results.

Sketch a polynomial multiplication algorithm that uses divide and conquer to obtain a faster algorithm. For simplicity assume that the degree of each input polynomial is \( n - 1 \) (and hence has \( n \) terms counting the constant term) where \( n = 2^k, k \geq 0 \).

Then use the master theorem to determine the computing time of your algorithm.