z5242692
Chenqu Zhao
COMP9101 (T2-2020)
Homework 2 – Q3

Compute the sequence $L = A * N$ using FFT. Write L in polynomial format, therefore, each coefficient of x^k $(0 \leq k \leq 100n - 1)$ represents the numbers of fishes caught in one attempt. We can easily go through all coefficients to find the largest value, and then figure out the corresponding net placement. To prove this, we have the following derivation:

Let N' be the net sequence N in the reverse order, think about the slide window thing. Now slide N' along A. Mark the overlapped areas between A and N' in N' as B, where A denotes the sequence of the whole seashore. Then, compute the convolution $C = A * B$ in each sliding window circumstance, which represents the fishes caught in one attempt net whose right end is the rightmost area of the overlapped areas.

Give subscripts to each result of C as C_0, C_1, C_2 ... If we write the result of $A * N'$ in polynomial, since that only the first area of A and the first area of N could produce constant term in L, the value C_0 is equal to the coefficient of x^0 in L. Again, only the first area of A times the second area of N along with the first area of N times the second area of A could produce the coefficient of x^1 in L, thus, the value C_1 is equal to the coefficient of x^1 in L. Similarly, C_2, C_3, C_4 ... corresponds to the coefficients of x_2, x_3, x_4 ... in L.

As a whole, the FFT algorithms cost $100n \cdot \log(100n) = 100n \cdot \log 100 + 100n \log n = O(n) + O(n \log n) = O(n \log n)$. Traversing all coefficients costs $O(100n) = O(n)$. So, the total cost is $O(n \log n) + O(n) = O(n \log n)$.