

Lab8 Questions

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Lab8.A: Funny Fluffy Tuzi

- ▶ Given a finite sequence s of length 2^N of equally-spaced samples of a function, find the result of its Discrete Fourier Transform.

Sample 1 Input

2
0 1 0 -1



$x_0 = 0$
 $x_1 = 1$
 $x_2 = 0$
 $x_3 = -1$



$$X_k = \sum_{n=0}^{N-1} x_n * e^{-\frac{2\pi i}{N}kn}$$



$$X_0 = x_0 * e^{-\frac{2\pi i}{4}*0*0} + x_1 * e^{-\frac{2\pi i}{4}*0*1} + x_2 * e^{-\frac{2\pi i}{4}*0*2} + x_3 * e^{-\frac{2\pi i}{4}*0*3}$$

$$X_1 = x_0 * e^{-\frac{2\pi i}{4}*1*0} + x_1 * e^{-\frac{2\pi i}{4}*1*1} + x_2 * e^{-\frac{2\pi i}{4}*1*2} + x_3 * e^{-\frac{2\pi i}{4}*1*3}$$

$$X_2 = x_0 * e^{-\frac{2\pi i}{4}*2*0} + x_1 * e^{-\frac{2\pi i}{4}*2*1} + x_2 * e^{-\frac{2\pi i}{4}*2*2} + x_3 * e^{-\frac{2\pi i}{4}*2*3}$$

$$X_3 = x_0 * e^{-\frac{2\pi i}{4}*3*0} + x_1 * e^{-\frac{2\pi i}{4}*3*1} + x_2 * e^{-\frac{2\pi i}{4}*3*2} + x_3 * e^{-\frac{2\pi i}{4}*3*3}$$



$$X_0 = 0 \quad X_1 = -2i \quad X_2 = 0 \quad X_3 = 2i$$



magnitude of complex number
 $X_i = a+bi, \quad z_i = \sqrt{a^2 + b^2}$

$$z_0 = 0 \quad z_1 = 2 \quad z_2 = 0 \quad z_3 = 2$$



Sample 1 Output

0 2 0 2

For more details, please refer to : FFT Supplementary Instruction.pdf

Lab8.B: Too easy

- ▶ Given an array a_1, a_2, \dots, a_N , find the median of them.
- ▶ The median of an array of length L is defined as the $\left\lfloor \frac{L+1}{2} \right\rfloor^{th}$ entry in its non-decreasing sorted version (the array is 1 – indexed).

"No." Satori thought, "This is too easy. No."

- ▶ She has Q queries (L_i, R_i) for you. For each query (L_i, R_i) , she wants to know the median of $a_{L_i}, a_{L_i+1}, \dots, a_{R_i}$.

Sample Input

10 10
10 18 4 9 12 18 6 8 6 16
4 5
3 10
5 5
6 10
7 10
1 10
1 2
2 4
4 6
2 9

Q1:

$$\left\lfloor \frac{2+1}{2} \right\rfloor = 1$$

non-decreasing:

9 12 \rightarrow 9

1	2	3	4	5	6	7	8	9	10
10	18	4	9	12	18	6	8	6	16

Q2:

$$\left\lfloor \frac{8+1}{2} \right\rfloor = 4$$

non-decreasing:

4 6 6 8 9 12 16 18 \rightarrow 8

1	2	3	4	5	6	7	8	9	10
10	18	4	9	12	18	6	8	6	16

Sample Input

10 10
10 18 4 9 12 18 6 8 6 16
4 5
3 10
5 5
6 10
7 10
1 10
1 2
2 4
4 6
2 9

...

Q6:

$$\left\lfloor \frac{10+1}{2} \right\rfloor = 5$$

non-decreasing: 4 6 6 8 **9** 10 12 16 18 18 → **9**

1	2	3	4	5	6	7	8	9	10
10	18	4	9	12	18	6	8	6	16

...

Q10:

$$\left\lfloor \frac{8+1}{2} \right\rfloor = 4$$

non-decreasing: 4 6 6 **8** 9 12 18 18 → **8**

1	2	3	4	5	6	7	8	9	10
10	18	4	9	12	18	6	8	6	16

Sample Input

10 10

10 18 4 9 12 18 6 8 6 16

4 5	→	9
3 10	→	8
5 5	→	12
6 10	→	8
7 10	→	6
1 10	→	9
1 2	→	10
2 4	→	9
4 6	→	12
2 9	→	8

Sample Output

