

# Prefix Sums

## 1 Problem Statement

Consider a sequence of  $N$  elements  $\{a_i\}$  for  $1 \leq i \leq N$  consisting entirely of zeros and ones, i.e.  $a_i \in \{0, 1\} \forall i$ .

Then, we define a prefix sum  $S_k$  of the sequence for  $k \leq N$  as the sum of the first  $k$  elements of the sequence, i.e.

$$S_k = \sum_{i=1}^k a_i$$

Let  $p$  be the number of zeros in the sequence.

Given the values of  $N$  and  $p$  as input, find the probability that our sequence follows the property

$$2S_k - k > 0 \forall k \text{ such that } 1 \leq k \leq N, k \in \mathbb{Z}$$

assuming that the sequence is equally likely to be any permutation of  $p$  zeros and  $(N - p)$  ones. It is also guaranteed that  $p < (N - p)$ , i.e. the sequence has more 1s than 0s.

$N = 3141592653589793238$   $p = 101124131231734$

## 2 Getting to the Flag

Find the probability for  $N = 3141592653589793238$  and  $p = 101124131231734$  as a fraction  $\frac{a}{b}$  where  $a, b \in \mathbb{Z}$  and  $GCD(a, b) = 1$ .

Then concatenate  $a$  to  $b$ , treat it as decimal, convert it to hex (including the 0x part). Enclose it inside flag{ }. That should give you the flag.

Example: If the answer were to be  $\frac{1}{2}$ , then the flag would have been flag{0xc}