

1) How to calculate Z value.

0 1 2 3 4 5 6 7 8 9 10
 a b c a a b c a a b c
 j i

2) Brute force

→ Take 2 pointers

↳ (i) i from the index
 (ii) j from 0

→ Compare char by char & increase count.

$$T.C. = O(N^2)$$

2) Optimized approach

$N = 19$

prefix index

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

S = x x y a x x y a z x x y a x x y a x z

Z 19 1 0 0 4 1 0 0

$$\text{count} = 0 \neq 2 \neq 4$$

if (index + 1 [Equal element in prefix
subarray] < i-1) d

copy the z value from
prefix box.

c-s = \emptyset 1

1-8

a → 0 char - 'a'

b → 1

c → 2 Mismatch

$S =$

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
x	x	y	a	x	x	y	a	x	x	x	y	a	x	x	y	a	x	x
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
19	1	0	0	4	1	0	0	0	8	1	0	0	4	?	?			

count = 0 1 2 3 4 5 6 7 8

2) for every index. We try to use the BF to find the substring which is also a prefix.

2) Mark the start & end of the subseq.

i \Rightarrow index for which you are updating the δ value.

if $(i + z[i-s] \leq \text{end} - 1) \&$

copy

}

else if

I need to calculate (compare for the index $i + z[i-8]$)

↓ ↓

$S =$	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	e
	x	x	y	a	x	x	y	a	z	x	x	y	a	x	x	y	a	x	z	
	↓	↓	↓	↓	↓									↓						
Z	19	1	0	0	4									5						

count = 4 5 e (4)

$i \Rightarrow$ Exactly once $(1 \times N)$
 $s \Rightarrow$ Atmax once $(1 \times N)$
 $e \Rightarrow$ Atmax twice $(2 \times N)$

 $(4 \times N)$
T.C. = $O(N)$

Code

(str)

z[N]

z[0] = N;

s = e = 1; , count = 0;

for (i = 1; i < N; i++) { \rightarrow Update the z value

if (i > e) {

e = s = i;
count = 0;

while (e < N && str[e] == str[e-s]) {

e++;
count++;

}
e--;
z[i] = count;

}

else {

if (i + z[i-s] <= e) {

z[i] = z[i-s];

}

else {

(if (i-s == 0) { count = 0

```
count = z[i-s];
```

```
s = i
```

```
e++;
```

```
while(e < N && str[e] == str[e-s])
```

```
    e++;
```

```
    count++;
```

```
    }
```

```
    e--;
```

```
    z[i] = count;
```

```
    }
```

```
}
```

	e	s	i																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
S =	x	x	y	a	x	x	y	a	z	x	x	y	a	x	x	y	a	x	z
	↓	↓	↓	↓	↓														
Z	19	1	0	0	4														

1 + z[0]

1 + 19 <= 1 ✗

count = 19



$s = a b d \quad a b t \quad y \quad a b c d$

$p = \begin{matrix} & 0 & 1 & 2 \\ a & b & c \end{matrix}$

⑦

1) Brute force

$$= O(N \times M)$$

↓ ↓
str pattern

2) Append pst as a prefix to string.

$$M = 3$$

0 1 2 3 4 5 6 7 8 9 10 11 12 13

a b c a b d a b t y a s c d

↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓

14 0 0 2 0 0 2 0 0 0 3 0 0 0

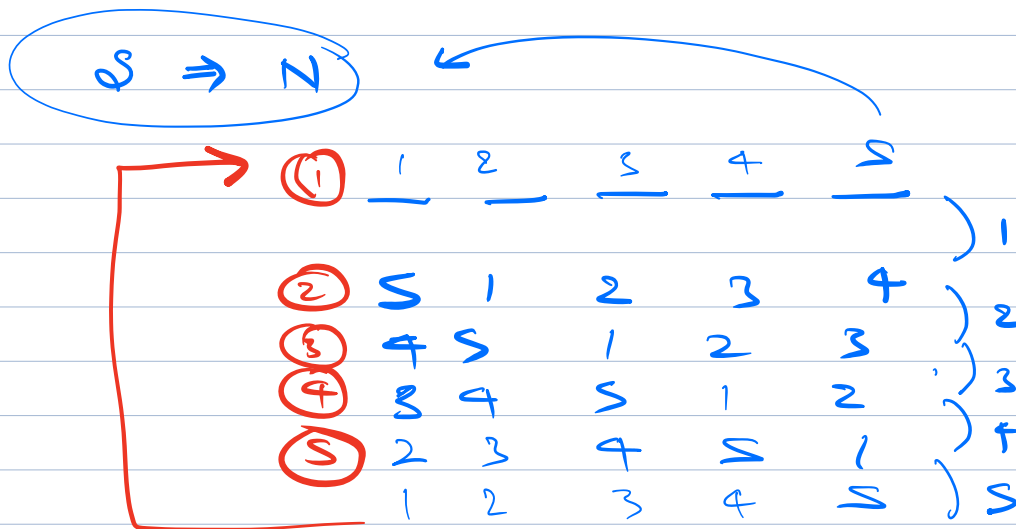
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
a b c ~~##~~ a b d a b t y a b c a
 ↓
 special
 char

$$T.C. = O(N+M)$$

Q // Given 2 Binary strings of same length.

A = 1010

B = 0101



Find the count of cyclic permutations of B s.t

$$f(B) \wedge A = \underline{\underline{0}}$$

↓
cyclic permutation

$1 \neq B$

$$A = 1010$$

$$B = 0101$$

$$\begin{aligned} 1 &= 0 \leftarrow \begin{pmatrix} 0 & 1 & 0 & 1 \end{pmatrix}^T (1010) = 1111 \\ &\leftarrow \begin{pmatrix} 1 & 0 & 1 & 0 \end{pmatrix}^T (1010) = 0000 \\ &\begin{pmatrix} 0 & 1 & 0 & 1 \end{pmatrix}^T (1010) = 1111 \\ &\begin{pmatrix} 1 & 0 & 1 & 0 \end{pmatrix}^T (1010) = 0000 \end{aligned}$$

②

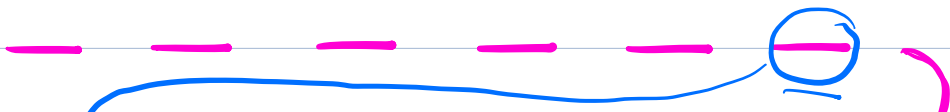
$$A^T \underline{\underline{A}} = 0$$

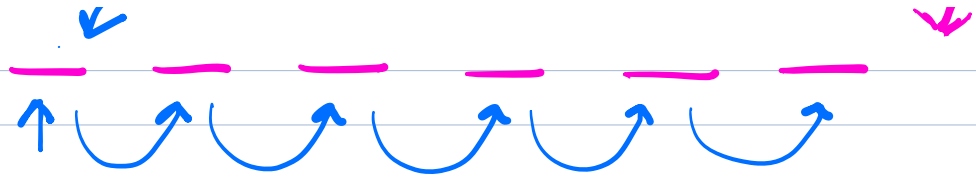
!

find the cyclic permutations of B which are equal to A

① Brute force

⇒ Generate all cyclic permutations
 check





$$O((N+N) \times N)$$

$$= O(N^2)$$

$$B' = \underline{0 \ 1 \ 0 \ 1 \ 0 \ 1 \ 0}$$

$$A = \underline{1010}$$

$$\begin{array}{cc} B + B[0, N-2] \\ N \quad \quad N-1 \end{array}$$

Count the occurrences of A in B'

$$\begin{array}{ccc} \textcircled{A \# B} & \approx & 3N \approx O(N) \\ \downarrow & & \downarrow \\ N & & 2N-1 \end{array}$$

$$\text{T.E.} = \underline{\underline{O(N)}}$$