

Week → B

Date 5/10/23

Assignment

Q) Valid Anagram →

Word → anagram ← S



Use these word to make another

⇒→ naganam (check it)

i) Sorting

S → a a a g m n o
T → a a a g m n o

S = T
✓

TC → O(nlogn)

True
else false

ii) Optimal Counting

No of respective chars in S should be same to that of T

S = anagram

T = naganam

freq Table → a → 3

a → 3

g → 1

g → 1

m → 1

m → 1

n → 1

n → 1

r → 1

r → 1

APCO

Teacher's Sign.....

Date. 5/30/23

Forget Table of S = Forget Table of T

Return True else False

Freq Table creation → q7 @rogram

$$\begin{array}{r} \overline{1010101001} - \boxed{112} \\ \hline 0 \end{array}$$

Q.S Anagram → nag saran

\rightarrow ~~anagram~~

Ex- S. S. Carat

$$\begin{array}{l} c \rightarrow \phi \neq 0 \\ a \rightarrow \phi \neq 0 \\ s \rightarrow \phi \neq 0 \end{array} \quad \left. \begin{array}{l} c \rightarrow \phi \neq 0 \\ a \rightarrow \phi \neq 0 \\ s \rightarrow \phi \neq 0 \end{array} \right\} \rightarrow c = 1 \quad \text{Not}$$

or Analogous

$$T \hookrightarrow \mathcal{O}(n|m)$$

Date..... 6/10/23

Ques Reverse only letters \rightarrow

$s = \underline{ab} - \underline{cd}$

$l = 0$

$h = \text{size}(s) - 1$

$\Rightarrow \underline{.db} - \underline{c} .a$

$\Rightarrow dc \underline{\underline{ba}}$

$j \rightarrow \text{skip}$
 $j > i \rightarrow \text{stop}$

$\rightarrow \text{if } (s[l] \rightarrow \text{alphabet} \ \& \ s[h] \rightarrow \text{alphabet})$
 $\quad \text{swap}(s[l], s[h])$

$\text{else if } (s[l] \rightarrow \text{Non alphabet})$
 $\quad \text{st+}$

$\text{else if } (s[h] \rightarrow \text{Non alphabet}) \rightarrow h--$

How to know if alphabet or not

$A-Z \rightarrow [97-122]$

$A-Z \rightarrow [65-90]$

If $((ch > 97 \ \& \ ch \leq 122) \ || (ch \geq 65 \ \& \ ch \leq 90))$
d
1) alpha
2) else \rightarrow No

$\text{isalpha}() \rightarrow \text{inbuilt}$

\hookrightarrow returns T & F

APCO

Teacher's Sign.....

③ → Longest Common Prefix Date... 6/10/23.

Set of characters

④ → Coldshelp

⑤ → Cold no help → 4 common characters

⑥ → flower, flow, flight

O = O ≠ I

So → fl

⑦ → dog, soccer, car

d ≠ s → X

empty
String

0 flower

curr ch = f⁰ l

1 flow

Str [1] [0] == f → T/F

2 flight

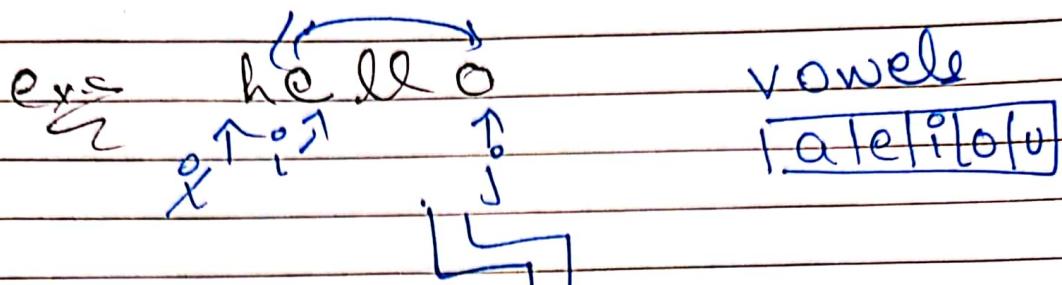
Str [1] [1] = f

Equal Toh Next char
check Else → break

Date... 6.10.23

(q)

Reverse Vowels of a string →



if ($i \rightarrow$ vowel)
 $i++$

if ($j \rightarrow$ vowel)
 $j--$

else swap (i, j)
 $i++$
 $j--$

h o l l o

h o l l o
e j i $j > i \rightarrow$ stop
loop

How to check vowels

char ch = Input

ch → to lower

return ch == 'a' || ch == 'e' || ch == 'i'
ch == 'o' || ch == 'u';

→ Use Two pointers Approach

Date... 6/10/23

(3) \Rightarrow

Isomorphic Strings

\hookrightarrow If the char in s can replaced together

e.g.

abb Mapping dee
↓
 $a \rightarrow 1$
 $b \rightarrow 2$

$d \rightarrow 1$
 $e \rightarrow 2$

e.g.

abcd

bares \rightarrow Isomorphic

e.g.

abca Wrong bac
Isomorphic bab

Count equal hone pe hoga
Isomorphic

\Rightarrow Use Mapping

aba

$a \rightarrow a$

$b \rightarrow b$

$a \rightarrow$ already mapped

$\Rightarrow aba \neq abc$

pqr^x

$p \rightarrow q$

$q \rightarrow r$

$r \rightarrow e$

$\hookrightarrow aba$ equal

pqr

Aba

$p \rightarrow q$

$q \rightarrow r$

$r \rightarrow b$

Isomorphic

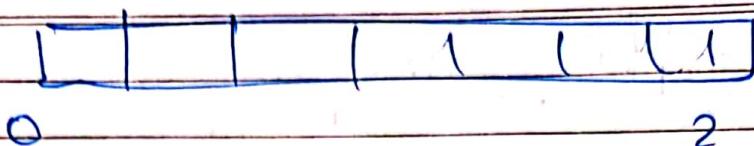
$b \rightarrow$ already Mapp

APCO

Teacher's Sign.....

math

Date... 6/10/23



256

$$s = '0'$$

string \rightarrow 100
↓
ch

map [ch] = S₊₊

firstly check map[ch] == 0

map [ch] != 0 \rightarrow we already change
in past

then \rightarrow for (auto ch : str)

change old
String acc to Map
~~ch = map [ch]~~

\Rightarrow check $s == t$? true : false.
both string after
mapping

APCO

Teacher's Sign.....

⑥ → Group Anagrams

Date.. 6/30/23

str = [{ "cat": "cat", "rat": "rat", "tan": "tan", "nat": "nat", "ate": "ate", "bat": "bat"}]

A [bat]

B [nat, tan]

C [ate, eat, tea]

Method
↓

Identify anagram
with each string

Q.1 →

A
↓

string

B
↓

string

of (Anagrams) of

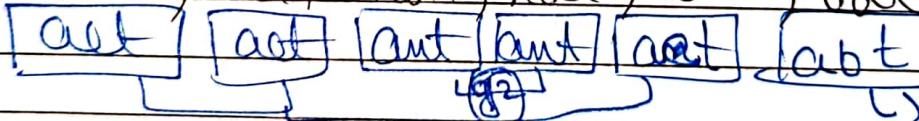
sort A, sort B

A = B

nat → ant

tan → ant

e.g. cat, tea, tan, nat, ate, bat



go

Map
(unique) key
act

Value
cat, tea, ate
tan, nat
bat

Entries will
be mapped

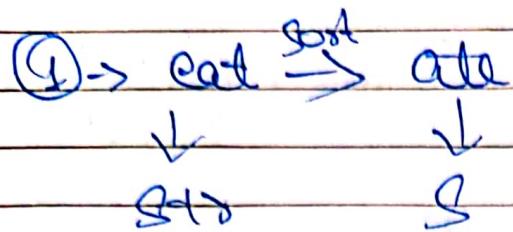
with help of
map

Teacher's Sign.....

APCO

cat, tea, tan, ate, mat, bat

Date....6/20/23



② \rightarrow tea \rightarrow sort \rightarrow eat

③ \times str \rightarrow tan \rightarrow ant Q+

(4) \rightarrow

string	vector
cat	eat
tea	eat
ate	eat
tan	mat
mat	bat
bat	bat

i to second \rightarrow vector

i to second [0]
[1]

TC \rightarrow N \rightarrow str length
M \rightarrow length of largest string

O(nk log k)

Sorting one string
Sorting n strings

Space Complexity \rightarrow O(Nk)

N \rightarrow str length () \rightarrow 3

3 \rightarrow k \rightarrow length of longest string

Ex: APCO cat, ate, tea \Rightarrow 3 \times 3 \rightarrow 9 \rightarrow storing 9 char

- Class > 2 Question > 5 - Diff Question
But can use Approaches

Q1) Longest Palindrome Substring Date... 6/10/23

ex -> babad

Palindrome

i = 0 b → ✓ j = 0

b a → x j = 1

b a b → ✓ j = 2

b a b a d → x j = 3 can be one of
a b a → ✓ them answers

a c → ✓

a b → . x x

a b a d → x

①) Substrings of string

②) Extract Palindromic ones

↳ Max length string from
all palindromic strings

```
for(i=0 → s.size(),  
    for(j=i → s.size()) {  
        if(isPalindrome(s, i, j)) {  
            string = toSubstr(i, j - i + 1)  
            ans = ans.size() > t.size() ? ans : t;  
        }  
    }  
}
```

Substr (Start Index, Length)

i = 0 b j = 0

b a j = 1

b a b j = 2

b a b a j = 3

b a b a d j = 4

i = 0, j = 4

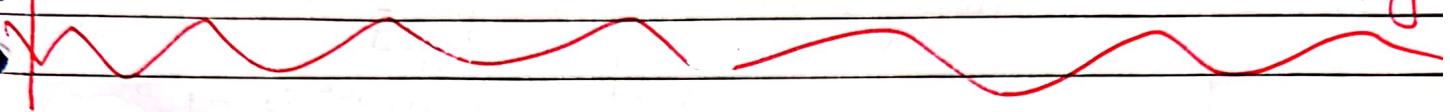
substr(0, 2 - 0) j = 3

Date... 6/30/23

$i = 1$ ja bad

a	j = 1
ab	j = 2
aba	j = 3
bad	j = 4

Note: \Rightarrow Best Method \Leftarrow P \Rightarrow Dynamic Programming



⑧ → String to Integer (atoi) Date... 6/10/23.

String $s = "66\text{ }1234"$ $\rightarrow s[0] = 6_1^9$
 $s[1] = 6_2^9$
↓
Integer $\rightarrow 1234 \Rightarrow 4$ byte

Note :- Inbuilt function atoi(s.c.st()) \rightarrow Take only char * input
↓
Converting string to char *
↓
Converting to integer

① $\rightarrow 66 - 42^9 \rightarrow 6642^9 \rightarrow 6642$

② $\rightarrow 66 - 42^9 \rightarrow -42 \rightarrow \text{int}$

③ $\rightarrow 6 - \dots - 123 \text{Hello}^9 \rightarrow -123$
 ↓↓↓↓

④ $\rightarrow 66 \xrightarrow{\text{Ignore}} \text{Lak } 41^9 \rightarrow 0$

Steps :- ① \rightarrow Ignore leading white spaces

 → ② \rightarrow determine sign

③ \rightarrow If digit found after finding \rightarrow integer prepare

④ \rightarrow Till Next Non-Digit character is found

⑤ \rightarrow num \rightarrow out of Range return INTMIN
APCO

Teacher's Sign or
INTMIN

(8-1) \rightarrow num = 0, i = 0, sign = 1; Date..... 6/6/23

while ($s[i] == '0'$) { i++ }

If ($i < s.size() \& \& (s[i] == '6-9' || s[i] == '6+9')$)
sign = $s[i] = \pm 1$; $i = i - 1$
i++

while ($i < s.size()$ $\&$ $i.isdigit(s[i]))$ {

num = num * 10

+ ($s[i] - '0'$)
i++ \downarrow $\rightarrow 49$

$'9' \rightarrow \text{ASCII } 50$

$$50 - 49 = 1$$

$$'2' \rightarrow 51 - 49 = 2$$

Num Out of Bound ->

i) INT MAX $\rightarrow 214747483647$

[num > 214749364] \rightarrow out of Range
return Int Max

INTMIN $\leftarrow 2147483648$

← kuch bhi age

ii) 2147493647

$8/9 \rightarrow$ not allowed

0
1
2
3
4
5
6
7
8
9

Q) String Compression \Rightarrow

Date, 8/19/02

aabbcccd → ab₂b₂c₂d₂

-6-

Aa

13 Total

para 3 → Revision this Paragraph

ex- \rightarrow $\frac{a}{b} \frac{b}{c} b c d e$
 $b e s(p)$

if ($sfp] == \text{posn}$) {
 Count++;

~~o~~ ~~b~~ ~~a~~
J N V L
R A E H C D S S
a - b 2

Yell f [Windows] = bad
trash [Counters]

Q RY- $\xrightarrow{\text{Rxn}}$ a.b.baddes

g. $S^2 = \text{const}$

$$i) S(i) = -b(e) \Rightarrow ?$$

$$\text{count} = 1$$
$$\text{first} = S[0]$$

ii) $\{p\} \neq \{q\}$
 $a[1] = p$

$$8[\sigma] = 0$$

i) ($\epsilon > 1$)

• 5187

$\text{SL}(\mathbb{F}) = \Sigma$, ($\neq \emptyset$) ist ein finiter

$$(ii) \quad \left\{ \begin{array}{l} 3x + y = 1 \\ x + 2y = 0 \end{array} \right. \quad \text{Ans: } x = 1$$

b b

Date: 6/3/2023

(iv) $s[i] \neq \text{prev}$

$s[\text{index}] = b$, $\text{ind}++$

$\text{if } (c > 1) \{$

$s[\text{index}] = c$

$c = 1$

$i++$, $\text{ind}++$

v) $s[i] \neq \text{prev}$

$s[\text{index}] = c$, $\text{ind}++$

$\rightarrow \text{if } (c > 1) \rightarrow \text{NO}$

$c = 1$

aabbccdd

b² c² d²

Index 1 2 3 4

a₂ b₂ c₂ d₂

vi) $s[i] \neq \text{prev}$

$s[\text{index}] = d$, $\text{ind}++$

$\rightarrow \text{if } (c > 1) \rightarrow \text{NO}$

$c = 1$

vii) $s[i] = \text{prev}$ $c = 2$
 $c++ \rightarrow$

(viii) $i \rightarrow$ out of bound
after loop

$s[\text{index}] = \text{prev}$ $\text{ind}++$

$\text{if } (c > 1)$

$s[\text{index}+1] = c$

$y \rightarrow$ if kya agar index > kya
kaise toh

return index

Return $\text{ind}++$

Date..... 15/10/23

\Rightarrow How to store count if its greater than 1

$$\text{a a a a a a a a a a} = 10$$

$\downarrow \quad \downarrow \quad \downarrow$

$a = 0$

Count = 10

$s[\text{Pindex}++]$ = pvcv

S
I
T
d
a
a
a
a
o
i
e

$\text{int } s = \text{index} \Rightarrow 1$

while (count) { }

$S \text{ index}++ = (\text{count} \% 10) * 10 + 69$

Count \neq 10;

- $\boxed{a \perp 0}$ \rightarrow $i \rightarrow 2$ reverse (e. $\text{begin}(1 + \text{start})$,
e. $\text{begin}(1 + i)$)

(10) → Integer to Roman Date... 6/10/23

$$8 \rightarrow 6 \underset{X}{\cancel{1}} \underset{I}{\cancel{2}} \xrightarrow{\text{Roman}} \underset{X}{\cancel{1}} \underset{I}{\cancel{1}}$$

$$\begin{array}{r} 10 + 2 \\ \times \quad \quad \quad \end{array}$$

Value But 4 → exceptional

$$M \rightarrow 1000$$

$$D \rightarrow 500$$

$$C \rightarrow 100$$

$$L \rightarrow 50$$

$$X \rightarrow 10$$

$$V \rightarrow 5$$

$$I \rightarrow 1$$

$$\text{eg} \rightarrow 58$$

$$50 + 8$$

$$L \rightarrow \text{num} = 58 - 50$$

$$num = 8$$

$$5 + 3 -$$

$$L \downarrow \quad \quad \quad \rightarrow num = 8 - 5 = 3$$

$$L \downarrow \quad \quad \quad \rightarrow num = 3 - 2 = 1$$

Search Through

Value till $num > value$

LVII

$\hookrightarrow num = 8 - 1$

= 1

LVII

Ex- $1994 = 1000 + 994$

$$num = 1994 - 1000 = 994$$

(ii) $994 = 500 + 494 \rightarrow X$

C M → 900

Symbo

Date... 6.10.23

Add some special values

M → 1000 → Value

CM → 900

D → 500

C → 100

X → 90

L → 50

XL → 40

X → 10

I → 9

V → 5

IV → 4

I → 1

Eg. → 1994 → I + 994

(i), 994 → 994 > 900

(ii) X → CM n = 994 - 900 = 94

(iii) 94 → 94 > 90

XCM → XC n = 94 - 90 = 4

(iv) 4 → 3+1 → 2+1 → 1+1

3 Steps

[XCMXCIII] → 1994

Algo Map → Roman Map

① → Map iterate (Longer to Smaller)
while (num > value[i]) {

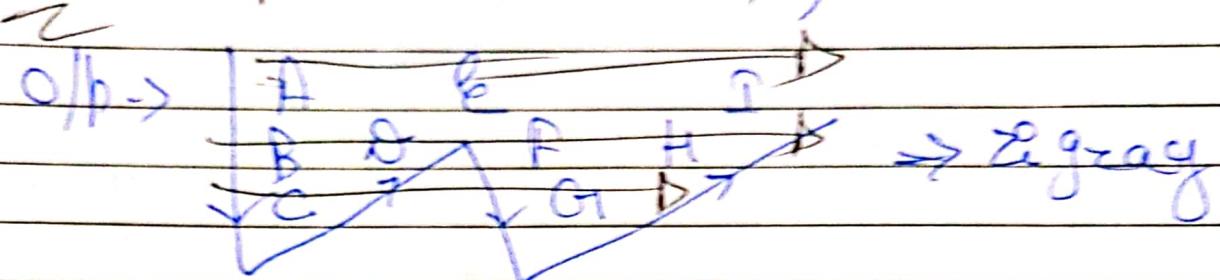
 romant = symbol[i]

 num = num - value[i]

y

Ques → Zigzag Conversion Date... 6/10/23

Ques → A B C D E F G H I, numRow = 3



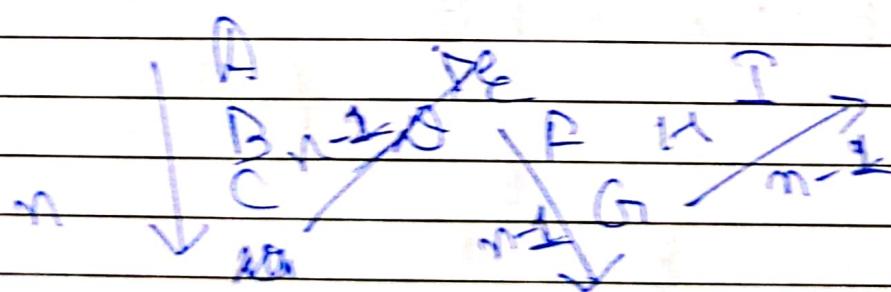
Ans → A E I B D F H C G

numRow = 1

→ A B C D E → original string
→ Return

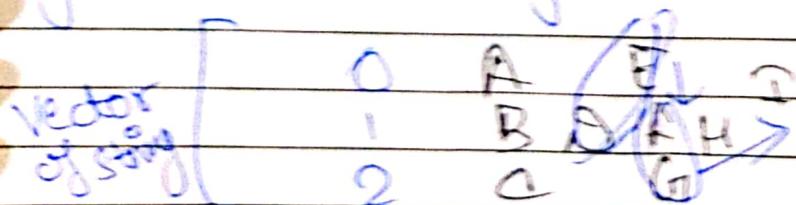
Ques → Change Direction after sometime

n = 3, A B C D E F G H I



m → look :

After m - 1 → change direction



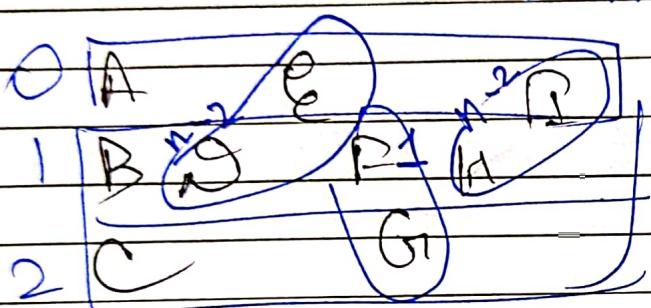
Date..... 6/10/23

① $\rightarrow \text{row} = 0 > \text{num rows}$
 $\text{row} = \text{num rows} - 2$

- 2 \rightarrow Isliye Index start from 0

② \rightarrow Dim change $\text{row} \geq 0$
take range

$\text{row} = 1$



$n - 3$

A B C D E F G

$[^6AE, ^6BD, ^6CG]$

$\Rightarrow s[0] \rightarrow A$
 $s[1] \rightarrow B$
 $s[2] \rightarrow C$

for $i \rightarrow$ zigzag(i)
ans \leftarrow zigzag(i)

return ans

APCO

Teacher's Sign.....

(12) \rightarrow Largest Number \rightarrow Date Slickz

e.g. $\{1, 2, 3, 5, 4\}$

$\xrightarrow{\text{all permutation}}$

$5 \underline{4} 3 2 1$

$\begin{array}{r} 12345 \\ 12354 \\ \hline \end{array}$

$N! \rightarrow$ Complexity

$\xrightarrow{54321} \rightarrow$ largest

e.g. $\{1, 2, 3, 5, 4\} \rightarrow$ Single Digit

$\xrightarrow{(54321)} \rightarrow$ Descending order

Largest \rightarrow smallest digit

\rightarrow But Didn't work on Double Digit or more

e.g. $3|30|34|5|9$ $\xrightarrow{\text{first letter then compare next letter}}$

String sort Lexigraphly \rightarrow Means also Alphabetic

a. Amazon

3|30|34|5|9

\downarrow

Int sorting descending

$34, 30, 9, 5, 3$

String sorting descending

$9|5|34|30|3$

Date 6/30/23

9 5 3 4 3 0 3 → largest X
↓ ↘

9 3 4 3 3 0 → case for Rakh

Use custom Comparer

3 1 3 0 1 3 4 1 3 1 9

9 5 3 3 3 3

9 5 3 4 3 0 3 → X

Touch A is a kro ki

9 5 3 4 3 3 0 ←

zero vala

baad me aye

→ function myComp (string a, string b)

f

$$a = 30$$

$$b = 3$$

return a > b → True
kro a
hai

[]

$$a = 30$$

$$b = 3$$

30 > 3
lexicographically

Opposite $t_1 + a = 303$

$$t_2 + b = 330$$

return $t_1 > t_2$,

True aye toh

a ko phale

Rakhlo b se

APCO

Use b ko phale Rakhlo a se

Teacher's Sign.....

Eg: for 0, 0, 0, 0, 0

↳ sort \rightarrow In Descending Order

String TO GO —
↓

first char O Tek Baki sare
the zero hoga kiguki

We are having all five no
& Arranging them in descending order

(B) \rightarrow Reorganize String

$s \rightarrow aab \rightarrow a_b\ a$

(C) \rightarrow aagbc

abace \rightarrow ✓

(D) \rightarrow aaabll \rightarrow ababer

(P-1) \rightarrow Priority Queue \rightarrow TC (O(n log n))

↳ Solve after Learning it

(M-2) \rightarrow Greedy \rightarrow

(D) \rightarrow Most Occurant character & fit it
non-adjacently

Date... 6/30/23...

② -> fill the Rest

e.g. aaabc. \rightarrow unique
 \rightarrow abcdefg

$a \rightarrow 0$
 $b \rightarrow 1$
 $c \rightarrow 2$

$a \frac{0}{1}$ $b \frac{1}{2}$ $a \frac{2}{3}$ $c \frac{3}{4}$

Fails \rightarrow a aab

a $\frac{0}{1}$ a $\frac{1}{2}$ $a \rightarrow$ out of bound

when I am placing most occurrent character
then the remaining is not possible.

Steps - (1) Count hash

(2) Try to place most occurrent in
one go

if (not possible) \rightarrow return 66 99

③ -> place other characters with index gaps

hash 0 \rightarrow 255
hash [26]
[S[i] - 65] \rightarrow 97
97 (a) 102 (z)

Date...6..10.23

Eg :- a a a b c

a b a c a o
0 1 2 3 4 5 6
 $\frac{a}{\text{freq}}$ $\frac{b}{\text{freq}}$ $\frac{a}{\text{freq}}$ $\frac{c}{\text{freq}}$ $\frac{a}{\text{freq}}$ $\frac{o}{\text{freq}}$
 $i = 6$

a \rightarrow 3
b \rightarrow 1
c \rightarrow 1

Index = Index of size. (1 \leq 1 \leq Index)

TC \rightarrow $O(n) + O(1) + O(n)$ + $O(\log n)$
hash creation (merging) most frequent placing Most frequent placing other characters

Space $\rightarrow O(1)$

Q4 \rightarrow Find the index of first occurrence in o n g of s a d in h a y s t a c k

haystack = G G g a y s t a c k k
needle = G G s a d k

\rightarrow Is sad present in haystack or Not

k a l d e e p [s a d]
0 1 2 3 4 5 6
return 4

WAP for finding substring

Date: 4/10/2023

[Let] Sadu
[sad]

s+1

[let sadu]
[sad]

s+1

[let sadu]
[sad]

s+1

[let/sadu]
[0, 1, 2, 3, 4, 5, 6]
[sad]

$\rightarrow s=1$ return 3

Outer loop $\rightarrow i=0 \rightarrow$ haystack

Inner loop $\rightarrow j=0 \rightarrow$ needle

(1) $\rightarrow i=0, j=0$

[let sadu]
[sad]

$i+j$
 $i=0, j=0 \rightarrow 0+0=0$

needle[0] = haystack[i, j]

& kuch nahi
yeh nahi
break

(2) $\rightarrow i=1, j=0$

[let sadu]
[sad]

needle[0] \neq needle[i+j] \rightarrow break

(3) $\rightarrow i=2, j=0$

[let sadu]
[sad]

needle[0] \neq needle[i+j] \rightarrow break

break

(4) $\rightarrow i=3, j=0$

[let sadu]
[sad]

needle[0] \neq needle[i+j] \rightarrow break

break

$j(j=m-1)$

$i \rightarrow n-m$

Date: 4/13/23

lets say its bad

\downarrow
bad \rightarrow Not available
Not equal

$n \rightarrow$ size of haystack
 $m \rightarrow$ size of needle

$T_C \rightarrow O((n-m+1) \times m)$

$O(nm)$

why not $(O(m^2))$

because

$n > m$

so $n \times m > m \times m$

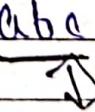
(ii) kmp

(iii) Rabin Karp

(ii) Knuth - Morris - Pratt (kmp) Algorithm

pattern : $a b c d a b c$
 0 1 2 3 4 5 6 7

prefix : $a, ab, abc, abcd, \dots$



suffix : $c, bc, abc, abc d, \dots$



Common

Index \rightarrow 123 \rightarrow Job Tak
No repeat ek pattern

Date... 8/10/23

P1: $\underline{\text{abc}} \text{dab} \text{eabf}$

P2: $\underline{\text{abcde}} \text{cibfabc}$

P3: $\text{aabca} \text{d} \text{aa} \text{be}$

P4: $\text{aaa} \text{a} \text{ba} \text{acd}$

\rightarrow Tracing

$i = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15$

(S) String: ~~a x b c x i b c~~ a b c a b a b a b d

pattern: $\begin{array}{|c|c|c|c|c|} \hline a & b & a & b & d \\ \hline 0 & 0 & 1 & 2 & 0 \\ \hline \end{array}$

$j = 1, 2, 3, 4, 5$

Table

j

\uparrow Table

$s[i] = p[j+1]$
 $i++$, $j++$

If $s[i] \neq p[j+1]$
 \downarrow
 j = trace

TC = $O(m+n)$

\uparrow Search

(iii) Rabin Karp Algo

Text: $a a a b a b$

$a \rightarrow 1$
 $b \rightarrow 2$

pattern: $\begin{array}{|c|c|c|} \hline a & b & \\ \hline 0 & 1 & 2 \\ \hline \end{array}$

$c \rightarrow 3$
 $d \rightarrow 4$
 $e \rightarrow 5$

$j+3=4 \rightarrow$ hex function
hexcode

$f \rightarrow 6$
 $g \rightarrow 7$
 $h \rightarrow 8$

using it we
will find hexcode

Teacher's Sign: \rightarrow 9
 \downarrow 10

APCO

Date Dec 12 1923

$\alpha \rightarrow \alpha M \rightarrow$ but to understand we take
 $\alpha M \rightarrow 1$

Text: babbaab $k_{ox} = 4$

aaa(bab) → found pattern
 $a = 4$

$$P_C = O(n \cdot m t)$$

Drawbacks → Spurious hits / waste hits

↳ In this $Tc = O(mn)$

~~Case 2~~ \Rightarrow ~~cca~~ \rightarrow $\{3, 3, 1\} = 7$

batteries \rightarrow $\{1, 6, 0\}$ $\tau = \tau$ but $cca \neq dba$
 \downarrow
 $\{1, 2, 1\} = 4$ waste hit;

1-1 all function \Rightarrow

by Robin Kasp

3 2 3
d b c
4 2 1

$$4 \times 10^2 + 2 \times 10^1 + 1 \times 10^0$$

$$P[\downarrow] \times 10^{m-1} + P[\uparrow] \times 10^{m-2} \rightarrow 421$$

~~def~~ => You can also define your hash function

Date: 2/10/23

Text: ccaa, ccaa@dba

$$3 \times 10^4 + 3 \times 10^3 + 1 \times 10^2 = 331$$

Pattern: dba $\rightarrow 421$

ccaa ccaa
331

$$331 - c + d = cod$$

$$[331 - 3 \times 10^2] \times 10^4 + 4 \times 10^6$$

$$\boxed{TC = O(n-m+1)}$$

* \Rightarrow But there is always possibility of hash function matching 2 different whole bits so, in that case

$$\boxed{TC = O(nm)}$$

* \Rightarrow But with this Rolling Rabin-karp hash function we are reducing changing of waste bits