Multiplication of Two Matrices

(multiply each row of A with each col of B)

$$A = \begin{bmatrix} 1 & 2 & 1 \\ 3 & 1 & 2 \end{bmatrix}_{2\times 3} \quad (a \times b)$$

$$B = \begin{bmatrix} 0 & 1 \\ 2 & 0 \\ 1 & 3 \end{bmatrix}_{3\times 2} \quad (p \times q)$$

$$ans = \begin{bmatrix} 1\times0+2\times2+1\times1 & 1\times1+2\times0+1\times3 \\ 3\times0+1\times2+2\times1 & 3\times1+1\times0+2\times3 \end{bmatrix}$$

$$ans = \begin{bmatrix} 5 & 4 \\ 4 & 9 \end{bmatrix}$$

↳ **When to multiply**

↳ when $b == p$

($a \times b$, $p \times q$)

↳ our answer matrix will be of $a \times q$ size

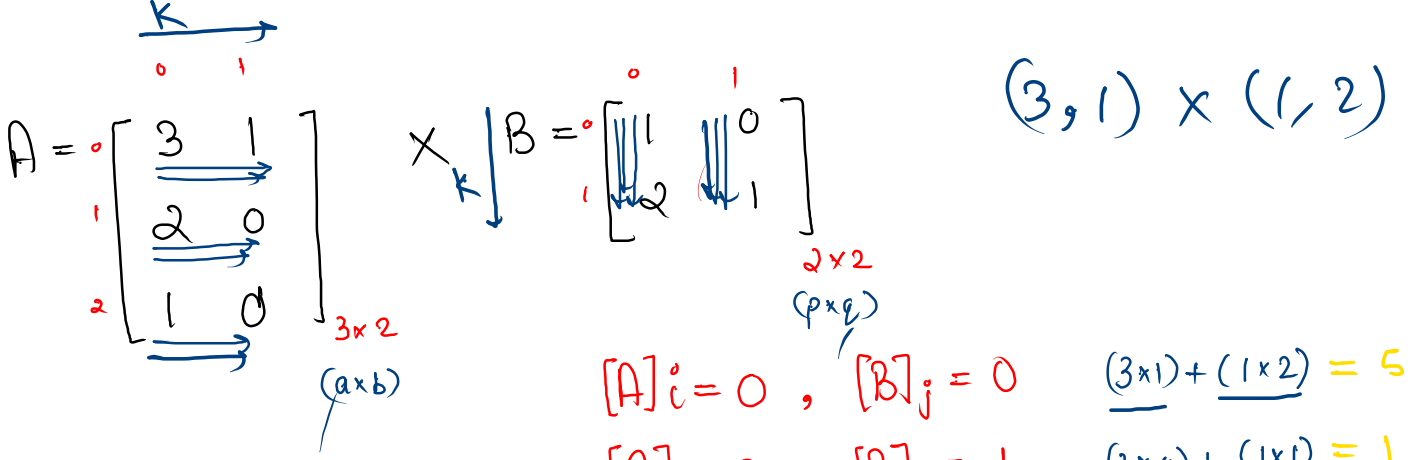
$$A = \begin{matrix} 0 \\ 1 \\ 2 \end{matrix}\begin{bmatrix} 3 & 1 \\ 2 & 0 \\ 1 & 0 \end{bmatrix}_{3\times 2}$$

$$B = \begin{matrix} 0 & 1 \end{matrix}\begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix}_{2\times 2}$$

$$\text{ans} = \begin{bmatrix} (3\times1)+(1\times2) & (3\times0)+(1\times1) \\ (2\times1)+(0\times2) & (2\times0)+(0\times1) \\ (1\times1)+(0\times2) & (1\times0)+(0\times1) \end{bmatrix}$$

Qu: Can we multiply B x A (Yes/No) ?

$B_{2\times2} \times A_{3\times2}$ = Can't



$(3,1) \times (1,2)$

$[A]_i = 0 , [B]_j = 0 \quad (3\times1)+(1\times2) = 5$

$[A]_i = 0 , [B]_j = 1 \quad (3\times0)+(1\times1) = 1$

$[A]_i = 1 , [B]_j = 0 \quad (2\times1)+(0\times2) = 2$

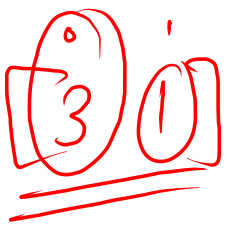
$[A]_i = 1 , [B]_j = 1 \quad (2\times0)+(0\times1) = 0$

$[A]_i = 2 , [B]_j = 0 \quad (1\times1)+(0\times2) = 1$

$[A]_i = 2 , [B]_j = 1 \quad (1\times0)+(0\times1) = 0$

Condition :- $b == p$

ans = $a \times q$



ans[i][j] = (3×1) + (1×2)

row ↓ col ↓

$[A]_i = 0, [B]_j = 0$ $\quad (3\times1)+(1\times2) = 5$

$[A]_i = 0, [B]_j = 1$ $\quad (3\times0)+(1\times1) = 1$

$[A]_i = 1, [B]_j = 0$ $\quad (2\times1)+(0\times2) = 2$

$[A]_i = 1, [B]_j = 1$ $\quad (2\times0)+(0\times1) = 0$

$[A]_i = 2, [B]_j = 0$ $\quad (1\times1)+(0\times2) = 1$

$[A]_i = 2, [B]_j = 1$ $\quad (1\times0)+(0\times1) = 0$

$(A \times B)$ ans

$$ans = \begin{array}{c} \\ 0 \\ 1 \\ 2 \end{array} \begin{array}{c} \begin{array}{cc} 0 & 1 \end{array} \\ \begin{bmatrix} 5 & 1 \\ 2 & 0 \\ 1 & 0 \end{bmatrix}_{3\times2} \end{array}$$

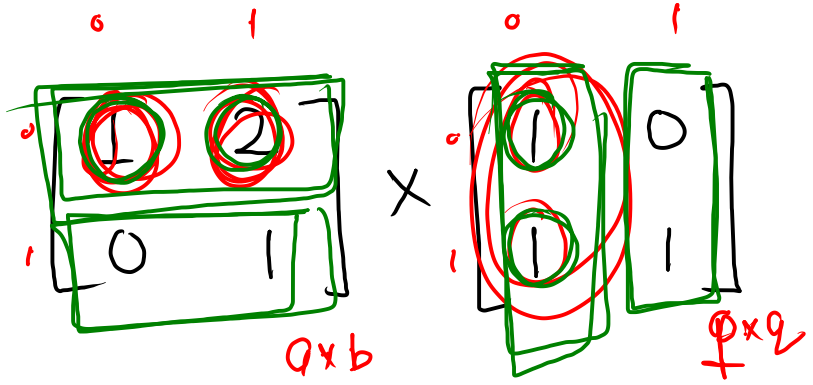
```java
public static void multiplyMatrix(int[][] arr1, int a, int b, int[][] arr2, int p, int q) {
    if ( b == p ) {
        int[][] ans = new int[a][q];
        for (int i = 0; i < a; i++) {
            for (int j = 0; j < q; j++) {
                for (int k = 0; k < b; k++) {
                    ans[i][j] += arr1[i][k] * arr2[k][j];
                }
            }
        }

        for (int i = 0; i < a; i++) {
            for (int j = 0; j < q; j++) {
                System.out.print(ans[i][j] + " ");
            }
            System.out.println();
        }

    } else {
        System.out.println("-1");
    }
}
```

i j
0,0
0 1 ←
1 0 ←
1 1 ←

b=2 , k=0,1



i=0, j=0

i=0, j=1

i=1, j=0

i=1, j=1

ans[0][0] = arr1[0][0] * arr2[0][0]] k=0
+
arr1[0][1] * arr2[1][0]] k=1

ans[0][1] = arr1[0][0] * arr2[0][1]] k=0
+
arr1[0][1] * arr2[1][1]] k=1

T.C = O(a*q*b)
=
O(a*q*p)

Traversing & Printing in String

Print Characters

```
public static void main(String[] args) {
    Scanner scn = new Scanner(System.in);
    String str = scn.nextLine();

    for (int i = 0; i < str.length(); i++) {
        System.out.println( str.charAt(i) );
    }
}
```

Str = "Abhijeet"
0 1 2 3 4 5 6 7

console

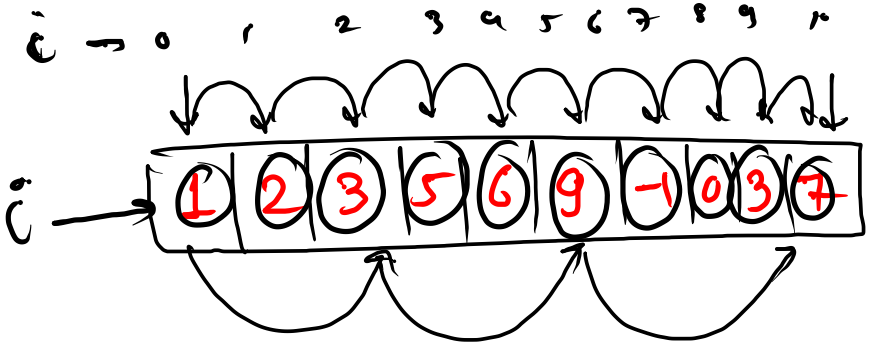
A
b
h
i
j
e
e
t

how we pick each character from a string?

str.charAt(i)
↳ index

arr[i]

```java
public static void main(String[] args) {
    int[] arr = {3, 7, 1, 0, -2, 7, 0, 1};
    for (int a: arr) {
        System.out.println(a);
    }
}
```



for each loop

syntex

```
for ( int i : arr) {
    Syso( i) ;
}
```

conditions :-

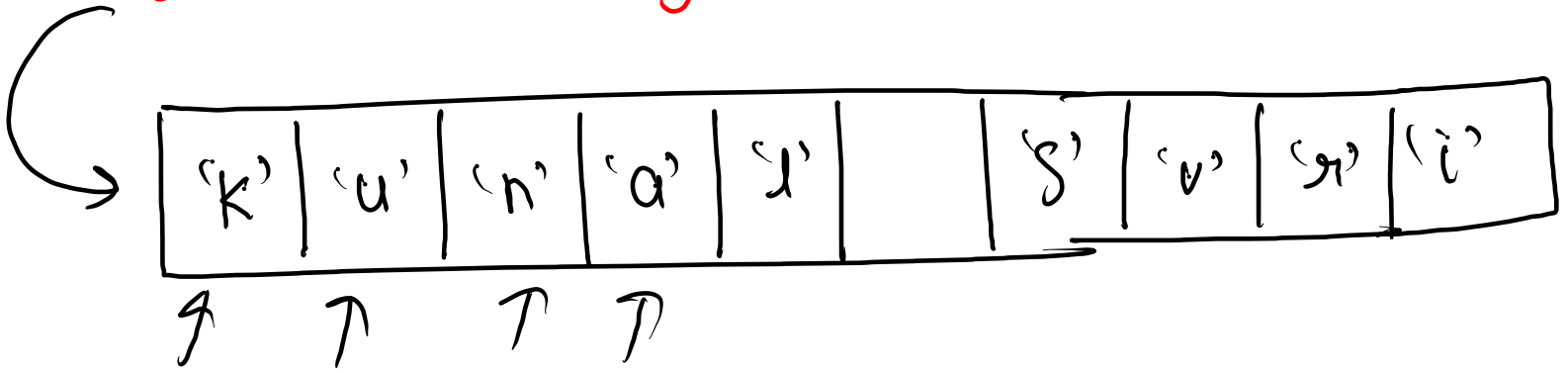
↳ it will always start from 0th idx and go till last

↳ it will always increment by 1 only

↳ here i will be value and not index

str = " Kunal Suri "

str.toCharArray();



Code

```java
public static void main(String[] args) {
    Scanner scn = new Scanner(System.in);
    String str = scn.nextLine();

    for (char c : str.toCharArray()) {
        System.out.println(c);
    }
}
```

Is Equal?

↳ condition

↳ when 2 strings are of same size

↳ each character at same indices will be equal

```
public static void main(String[] args) {
    Scanner scn = new Scanner(System.in);
    String str1 = scn.nextLine();
    String str2 = scn.nextLine();

    for (int i = 0; i < str1.length(); i++) {
        if ( str1.charAt(i) != str2.charAt(i) ) {
            System.out.println(false);
            return;
        }
    }
    System.out.println(true);

    // System.out.println(str1.equals(str2));
}
```

Print Indices of Vowels

str = "aquasboc";

0 1 2 3 4 5 6 7

ans =

0
2
3
6

```
public static void main(String[] args) {
    Scanner scn = new Scanner(System.in);
    String str = scn.nextLine();

    for (int i = 0; i < str.length(); i++) {
        if ( isVowel( str.charAt(i) ) ) {
            System.out.print(i + " ");
        }
    }
}

public static boolean isVowel(char c) {
    return c == 'a' || c == 'e'|| c == 'i'|| c == 'o'|| c == 'u';
}
```