

Practice Problem- 3.5

1.

```
int a=0, b=0;
int matrix[N][M];
for(i=0; i<N; i++){
    a=a+i;
    matrix[i][i]=a;
}
for(j=0; j<M; j++){
    b=b+2*j;
}
```

Here, in first loop matrix $[i][i] = a$, for matrix must have the capability to access matrix $[N-1][N-1]$.

$$\boxed{\text{So, } M \geq N}$$

a) Time complexity = $O(N) + O(M)$
 $= O(N+M)$

b) Space complexity = $O(1) + O(N*M)$
 $= O(N*M)$
(Ans)

3.

```
int a=0, i=N;
vector<int> vec;
while(i>0){
    a+=i;
    i/=2;
    vec.push_back(a);
}
```

if $N=10$,
 $i=10, i=5, i=2, i=1, i=0$
 $\checkmark \quad \checkmark \quad \checkmark \quad \checkmark \quad \times$
Suppose, loop will run k times,

$$\therefore 2^k = n$$

$$k = \log_2 n$$

Size of vector is also k

\therefore Time complexity = $O(\log_2 n)$

\therefore Space $n = O(\log_2 n)$

—x—

2.

```
int a=0;
for(i=0; i<N; i++){
    for(j=N; j>i; j--){
        a=a+i+j;
    }
}
```

1st loop will run N times.

2nd " " " $\frac{N}{i}$ times.

if $N=6$;

$$i=0 \rightarrow 6=N$$

$$i=1 \rightarrow 5=(N-1)$$

$$i=2 \rightarrow 4=(N-2)$$

$$i=3 \rightarrow 3=(N-3)$$

$$i=4 \rightarrow 2=(N-4)$$

$$i=5 \rightarrow 1=(N-5)$$

Sum

$$= 6N - 15$$

~~F.C. = $O(N*N)$~~

\therefore Total

$$= N \times N - \frac{N(N-1)}{2}$$

$$= N^2 - \frac{N^2}{2} - \frac{N}{2}$$

$$= \frac{N^2}{2} - \frac{N}{2}$$

$$\approx N^2 - N$$

$$\approx N^2$$

\therefore Time complexity = $O(N^2)$

\therefore Space complexity = $O(1)$

— x —