Ex. No.: 9
Date: 4/4/25

DEADLOCK AVOIDANCE

Aim:

To find out a safe sequence using Banker's algorithm for deadlock avoidance.

Algorithm:

1. Initialize work=available and finish[i]=false for all values of i
2. Find an i such that both:
finish[i]=false and $Need_i$<= work
3. If no such i exists go to step 6
4. Compute work=work+allocationi
5. Assign finish[i] to true and go to step 2
6. If finish[i]==true for all i, then print safe sequence
7. Else print there is no safe sequence

Program Code:

```
#include <stdio.h>
# include <stdbool.h>
int main (){
    int n,m;
    printf ("Enter number of process:");
    scanf ("%d", &n);
    printf ("Enter number of resources: ");
    scanf("%d", &m);
    int max[n][m];
    printf ("Enter values for max array:");
    for (int i=0; i<n; i++){
        for (int j=0; j<m; j++){
            scanf("%d", &max[i][j]);
        }
    }
    int allocate[n][m];
    printf ("Enter values for allocate array:");
```

```
for (int i=0; i<n ; i++) {
    for (int j = 0 ; j<m; j++) {
        scanf("%d", &allocate [i][j]);
    }
}
int avail[m];
for (int i=0 ; i<m ; i++)
{
    printf ("Enter Avail [%d]" ,i);
    scanf ("%d", &avail[i]);
}
int Need[n][m];
for (int i=0; i<n ; i++) {
    for (int j=0 ; j<m ; j++)
    {
        Need[i][j] = max[i][j] - allocate [i][j];
    }
}
int work[m];
boolean finish[n];
for (int i=0; i<m ; i++)
{
    work[i] = avail [i];
}
for (int i=0 ; i<n ; i++)
    finish [i] = false;
int seq [n];
int flag, ind = 0;
while (ind != n) {
    for (int i=0 ; i<n ; i++) {
        flag = 1;
        if (finished [i] == false) {
            for (int j=0 ; j<m ; j++) {
                if (Need[i][j] > work[j])
                    flag = 0;
            }
```

```
            if (flag == 1) {
                for (int j=0; j<m; j++) {
                    finish[i] = true;
                    work[j] += allocate[i][j];
                }
                seq[ind++] = i;
            }
        }
    }
}
printf("The SAFE Sequence is \n");
for (int i=0; i<n-1; i++)
    printf("P%d -> ", seq[i]);
printf("P%d", seq[ind-1]);
}
```

Sample Output:

The SAFE Sequence is
P1 -> P3 -> P4 -> P0 -> P2

Result:

Program to find out a safe sequence using Banker's algorithm for deadlock avoidance was written & executed successfully.

Output:

Enter number of process: 5

Enter number of resources: 3

Enter values for max array:

7 5 3

3 2 2

9 0 2

2 2 2

4 3 3

Enter values for Allocate array:

0 1 0

2 0 0

3 0 2

2 1 1

0 0 2

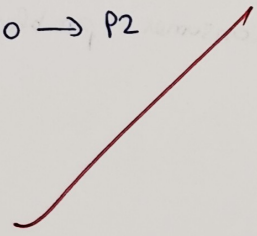
Enter Avail [0] : 3

Enter Avail [1] : 2

Enter Avail [2] : 2

The SAFE Sequence is:

P1 → P3 → P4 → P0 → P2



Max Array

$$\begin{bmatrix} 7 & 5 & 3 \\ 3 & 2 & 2 \\ 9 & 0 & 2 \\ 2 & 2 & 2 \\ 4 & 3 & 3 \end{bmatrix}$$

Allocation Array

$$\begin{bmatrix} 0 & 1 & 0 \\ 2 & 0 & 0 \\ 3 & 0 & 2 \\ 2 & 1 & 1 \\ 0 & 0 & 2 \end{bmatrix}$$

Available Array

$$\begin{bmatrix} 3 & 2 & 2 \end{bmatrix}$$

Need Array

$$\begin{bmatrix} 7 & 4 & 3 \\ 1 & 2 & 2 \\ 6 & 0 & 0 \\ 0 & 1 & 1 \\ 4 & 3 & 1 \end{bmatrix}$$

Safe Sequence:

P1 → P3 → P4 → P0 → P2