Practical No 10

Aim : Develop, debug and Execute a C program to simulate LRU page replacement algorithms

Apparatus: Mingw compiler for C/C++, and a text editor for developing C code file (Dev C++).

Theory :

What is Page Replacement?

- In operating systems that use paging for memory management, page replacement algorithm are needed to decide which page needed to be replaced when new page comes in.
- Whenever a new page is referred and not present in memory, page fault occurs and Operating System replaces one of the existing pages with newly needed page.
- Different page replacement algorithms suggest different ways to decide which page to replace.
- The target for all algorithms is to reduce number of page faults.

What is LRU Page Replacement?

- LRU is short for Least Recently Used page replacement Algorithm.
- In LRU the least recently used page is removed and replaced with the new page.

Example:

Reference string: 7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1

No of frames: 4

F4				2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
F3			1	1	1	1	1	4	4	4	4	4	4	1	1	1	1	1	1	1
F2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F1	7	7	7	7	7	3	3	3	3	3	3	3	3	3	3	3	3	7	7	7
	*	*	*	*	HIT	*	HIT	*	HIT	HIT	HIT	HIT	HIT	*	HIT	HIT	HIT	*	HIT	HIT

Page fault (*): 8

Page hit (HIT): 12

Page fault ratio = No. of page fault / No. of reference string

= 8/20

= 40%

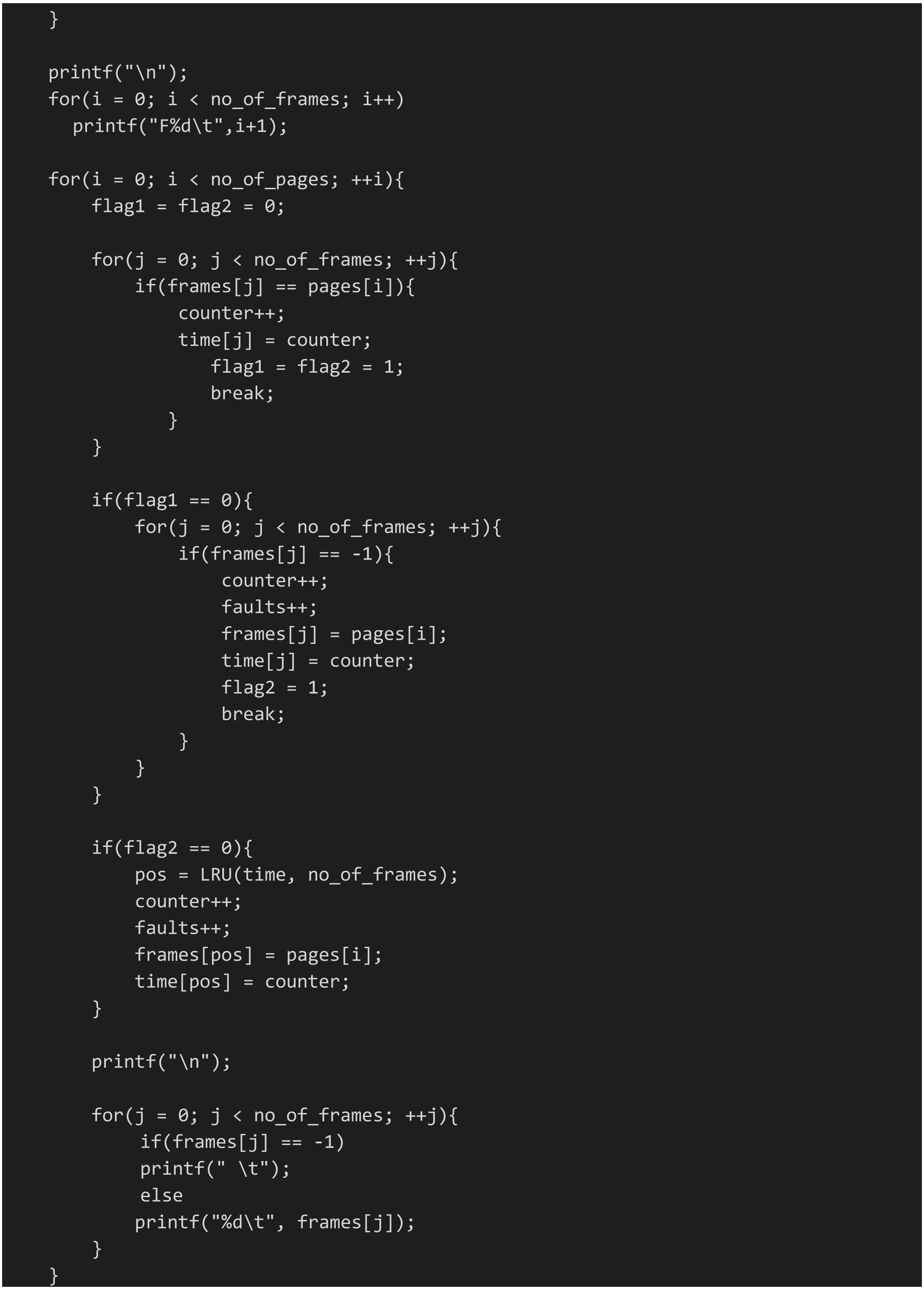
Page hit ratio = No. of page ratio / No. of reference string

= 12/20

= 60%

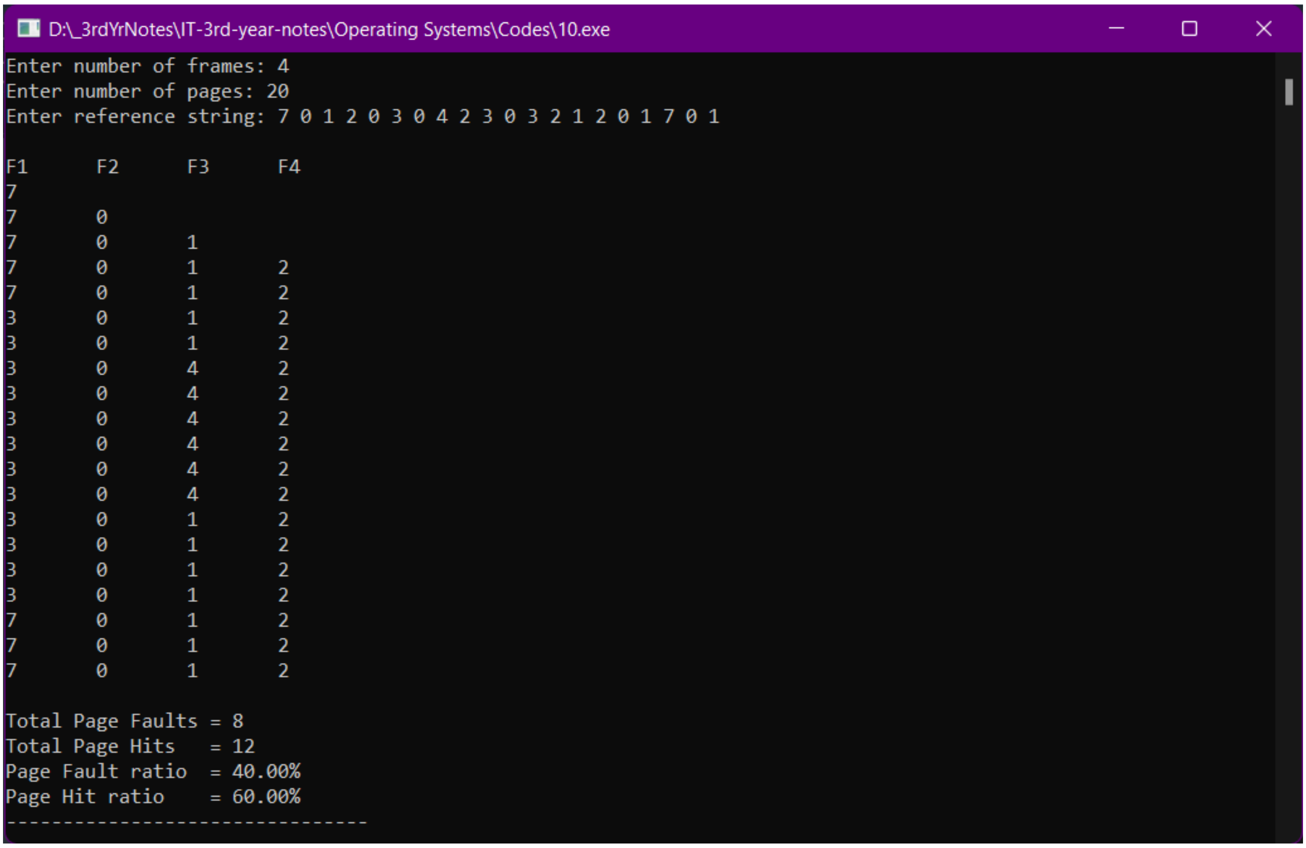
Code:

```
#include<stdio.h>

int LRU(int time[], int n){
    int minimum = time[0], pos = 0;

    for(int i = 1; i < n; ++i){
        if(time[i] < minimum){
            minimum = time[i];
            pos = i;
        }
    }

    return pos;
}

int main()
{
    int no_of_frames, no_of_pages, frames[10], pages[30], counter = 0, time[10], 
flag1, flag2, i, j, pos, faults = 0;
    printf("Enter number of frames: ");
    scanf("%d", &no_of_frames);

    printf("Enter number of pages: ");
    scanf("%d", &no_of_pages);

    printf("Enter reference string: ");

    for(i = 0; i < no_of_pages; ++i){
        scanf("%d", &pages[i]);
    }

    for(i = 0; i < no_of_frames; ++i){
        frames[i] = -1;
```



```
    }

    printf("\n");
    for(i = 0; i < no_of_frames; i++)
      printf("F%d\t",i+1);

    for(i = 0; i < no_of_pages; ++i){
        flag1 = flag2 = 0;

        for(j = 0; j < no_of_frames; ++j){
            if(frames[j] == pages[i]){
                counter++;
                time[j] = counter;
                   flag1 = flag2 = 1;
                   break;
               }
        }

        if(flag1 == 0){
            for(j = 0; j < no_of_frames; ++j){
                if(frames[j] == -1){
                    counter++;
                    faults++;
                    frames[j] = pages[i];
                    time[j] = counter;
                    flag2 = 1;
                    break;
                }
            }
        }

        if(flag2 == 0){
            pos = LRU(time, no_of_frames);
            counter++;
            faults++;
            frames[pos] = pages[i];
            time[pos] = counter;
        }

        printf("\n");

        for(j = 0; j < no_of_frames; ++j){
             if(frames[j] == -1)
             printf(" \t");
             else
            printf("%d\t", frames[j]);
        }
    }
    printf("\n\nTotal Page Faults = %d", faults);
      printf("\nTotal Page Hits    = %d", no_of_pages - faults);
      printf("\nPage Fault ratio   = %.2f%%",faults/(float)no_of_pages * 100);
      printf("\nPage Hit ratio     = %.2f%%",(no_of_pages -
faults)/(float)no_of_pages * 100);
    return 0;
}

/*

4
20
7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1
Sample Test case
*/
```

Output:


D:_3rdYrNotes\IT-3rd-year-notes\Operating Systems\Codes\10.exe

```
Enter number of frames: 4
Enter number of pages: 20
Enter reference string: 7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1

F1      F2      F3      F4
7
7       0
7       0       1
7       0       1       2
7       0       1       2
3       0       1       2
3       0       1       2
3       0       4       2
3       0       4       2
3       0       4       2
3       0       4       2
3       0       4       2
3       0       4       2
3       0       1       2
3       0       1       2
3       0       1       2
3       0       1       2
7       0       1       2
7       0       1       2
7       0       1       2

Total Page Faults = 8
Total Page Hits   = 12
Page Fault ratio  = 40.00%
Page Hit ratio    = 60.00%
--------------------------------
```

Output 10.1

Conclusion:

Hence, by performing this practical I got to know about the LRU page replacement algorithm i.e. Least Recently Used Page Replacement Algorithm. I also developed, debugged and executed a C program to simulate LRU page replacement algorithm.