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Q1 Write a C/C++ program to take the number of frames and page sequence as input and select the best page replacement algorithm among (FIFO, LRU, Optimal) based on the number of page faults occurred. For the selected page replacement algorithm, output the frame content at each time step t and also the number of page faults. First line of input is number of frames and second line the page sequence. (ADD SCREENSHOT).

Ans: Creating three programs, one each for FIFO,LRU and optimal page replacement algorithm. Three files are namely:

1. Q1_fifo:
2. Q1_lru
3. Q1_optimal

Compilation:
g++ -o q1_fifo q1_fifo.cpp   ---- FIFO
g++ -o q1_lru q1_lru.cpp   ---- LRU
g++ -o q1_optimal q1_optimal.cpp   ---- Optimal

Syntax:
./q1
N   ---- Number of frames
A1 A2 A3 ……….. X   ---- Page sequence
                               ---- (Please enter ' X ' at the end of the sequence to stop taking the inputs)

Sample Input and Output : **FIFO**

Input: Output:
3
4 7 6 1 7 6 1 2 7 2 X

Page Defaults = 6

Sample Input and Output : **LRU**

Input: Output:

3

4 7 6 1 7 6 1 2 7 2 X

```
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$ ./q1_lru
3
4 7 6 1 7 6 1 2 7 2 X
LRU:
4 7 6 1 7 6 1 2 7 2
Frame content at each time step t
F1      F2      F3
X       X       X       at t = 0
4       X       X       at t = 1
4       7       X       at t = 2
4       7       6       at t = 3
1       7       6       at t = 4
1       7       6       at t = 5
1       7       6       at t = 6
1       7       6       at t = 7
1       2       6       at t = 8
1       2       7       at t = 9
1       2       7       at t = 10

Number of page defaults: 6
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$
```

Page Defaults = 6

Sample Input and Output : **Optimal**

Input: Output:

3

4 7 6 1 7 6 1 2 7 2 X

```
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$ ./q1_optimal
3
4 7 6 1 7 6 1 2 7 2 X
Optimal:
4 7 6 1 7 6 1 2 7 2
Frame content at each time step t
F1      F2      F3
X       X       X       at t = 0
4       X       X       at t = 1
4       7       X       at t = 2
4       7       6       at t = 3
1       7       6       at t = 4
1       7       6       at t = 5
1       7       6       at t = 6
1       7       6       at t = 7
2       7       6       at t = 8
2       7       6       at t = 9
2       7       6       at t = 10

Number of page defaults: 5
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$
```

Page Defaults = 5

Thus, Best page replacement algorithm is Optimal.

Q2 Either modify the existing page replacement algorithm (FIFO, LRU, Optimal) or design unique page replacement algorithm in such a way that modified technique has less page faults when compared with FIFO, LRU and Optimal. Write a C/C++ code for the modified page replacement algorithm.

Ans: We can design a new algorithm called Not frequently used/Least frequently used page replacement algorithm to reduce the page defaults when compared to FIFO and LRU.

The LFU page replacement algorithm stands for the **Least Frequently Used**. In the LFU page replacement algorithm, the page with the least visits in a given period of time is removed. It replaces the least frequently used pages. If the frequency of pages remains constant, the page that comes first is replaced first.

<u>Sample Input and Output :</u> **Least Frequently used**

Input: Output:

4

1 2 3 4 2 7 5 1 1 6 4 7 2 1 2 5 X

Page Defaults = 10

```
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$ ./q2_nfu
4
1 2 3 4 2 7 5 1 1 6 4 7 2 1 2 5 X
NFU:
1 2 3 4 2 7 5 1 1 6 4 7 2 1 2 5
Frame content at each time step t
F1      F2      F3      F4
1       X       X       X       at t = 1
1       2       X       X       at t = 2
1       2       3       X       at t = 3
1       2       3       4       at t = 4
1       2       3       4       at t = 5
1       2       3       7       at t = 6
1       2       3       5       at t = 7
1       2       3       5       at t = 8
1       2       3       5       at t = 9
1       2       3       6       at t = 10
1       2       3       4       at t = 11
1       2       3       7       at t = 12
1       2       3       7       at t = 13
1       2       3       7       at t = 14
1       2       3       7       at t = 15
1       2       3       5       at t = 16

Number of page defaults: 10
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$
```

LRU
Page Defaults = 13

```
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$ ./q1_lru
4
1 2 3 4 2 7 5 1 1 6 4 7 2 1 2 5 X
LRU:
1 2 3 4 2 7 5 1 1 6 4 7 2 1 2 5
Frame content at each time step t
F1      F2      F3      F4
X       X       X       X       at t = 0
1       X       X       X       at t = 1
1       2       X       X       at t = 2
1       2       3       X       at t = 3
1       2       3       4       at t = 4
1       2       3       4       at t = 5
7       2       3       4       at t = 6
7       2       5       4       at t = 7
7       2       5       1       at t = 8
7       2       5       1       at t = 9
7       6       5       1       at t = 10
4       6       5       1       at t = 11
4       6       7       1       at t = 12
4       6       7       2       at t = 13
4       1       7       2       at t = 14
4       1       7       2       at t = 15
5       1       7       2       at t = 16

Number of page defaults: 13
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$
```

Fifo
Page Defaults = 13

```
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$ ./q1_fifo
4
1 2 3 4 2 7 5 1 1 6 4 7 2 1 2 5 X
FIFO:
1 2 3 4 2 7 5 1 1 6 4 7 2 1 2 5
Frame content at each time step t
F1      F2      F3      F4
X       X       X       X       at t = 0
1       X       X       X       at t = 1
1       2       X       X       at t = 2
1       2       3       X       at t = 3
1       2       3       4       at t = 4
1       2       3       4       at t = 5
7       2       3       4       at t = 6
7       5       3       4       at t = 7
7       5       1       4       at t = 8
7       5       1       4       at t = 9
7       5       1       6       at t = 10
4       5       1       6       at t = 11
4       7       1       6       at t = 12
4       7       2       6       at t = 13
4       7       2       1       at t = 14
4       7       2       1       at t = 15
5       7       2       1       at t = 16

Number of page defaults: 13
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$
```

Optimal
Page Defaults = 9

```
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$ ./q1_optimal
4
1 2 3 4 2 7 5 1 1 6 4 7 2 1 2 5 X
Optimal:
1 2 3 4 2 7 5 1 1 6 4 7 2 1 2 5
Frame content at each time step t
F1      F2      F3      F4
X       X       X       X       at t = 0
1       X       X       X       at t = 1
1       2       X       X       at t = 2
1       2       3       X       at t = 3
1       2       3       4       at t = 4
1       2       3       4       at t = 5
1       2       7       4       at t = 6
1       5       7       4       at t = 7
1       5       7       4       at t = 8
1       5       7       4       at t = 9
1       6       7       4       at t = 10
1       6       7       4       at t = 11
1       6       7       4       at t = 12
1       2       7       4       at t = 13
1       2       7       4       at t = 14
1       2       7       4       at t = 15
5       2       7       4       at t = 16

Number of page defaults: 9
chiku@DESKTOP-5JCAMRU:/mnt/d/tanishq/3rd year/6th sem/os_lab/lab-9$
```

Thus our NFU algorithm is better than LRU and FIFO.

-- The End --