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Lab 10:
Page Replacement in OS

Programme	:	**BTech. CSE Core**	Semester	:	**Win 2021-22**
Course	:	**Operating Systems**	Code	:	**CSE2005**
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Date: 22-04-2022	LAB 10	Page Replacement in OS	VIT Vellore Institute of Technology (Deemed to be University under section 3 of UGC Act, 1956)

LAB 10

Ques.1
Page Replacement Algorithm (FIFO, Optimal and LRU)

Write a C Program to Implement Page Replacement Algorithm (FIFO, Optimal, and LRU) and determine their number of page fault.

Your Program can be menu-driven program

1. Enter data(length of page reference sequence, page reference sequence and no of frames)

2. FIFO

3. Optimal

4. LRU

5. Exit

Example

Consider the following page reference string:

1, 2, 3, 4, 2, 1, 4,2,5, 6, 2, 1, 6,5, 2, 3, 7, 5, 4,2, 6, 3, 2, 1, 2, 3, 6,4,2,5.

How many page faults would occur for the following replacement algorithms, assuming three, four, five? Remember that all frames are initially empty, so your first unique pages will cost one fault each.

• LRU replacement

• FIFO replacement

• Optimal replacement

```c
#include <stdio.h>

void FIFO() {
    int referenceString[10], pageFaults = 0, m, n, s, pages, frames;
    printf("\nEnter the number of Pages: ");
    scanf("%d", & pages);
    printf("\nEnter reference string values: ");
    for (m = 0; m < pages; m++) {
        scanf("%d", & referenceString[m]);
    }
    printf("\nEnter total number of frames: "); {
        scanf("%d", & frames);
    }
    int temp[frames];
    for (m = 0; m < frames; m++) {
```

```
        temp[m] = -1;
    }
    for (m = 0; m < pages; m++) {
        s = 0;
        for (n = 0; n < frames; n++) {
            if (referenceString[m] == temp[n]) {
                s++;
                pageFaults--;
            }
        }
        pageFaults++;
        if ((pageFaults <= frames) && (s == 0)) {
            temp[m] = referenceString[m];
        } else if (s == 0) {
            temp[(pageFaults - 1) % frames] = referenceString[m];
        }
        printf("\n");
        for (n = 0; n < frames; n++) {
            printf("%d\t", temp[n]);
        }
    }
    printf("\nTotal Page Faults:\t%d\n", pageFaults);
}

void Optimal() {
    int no_of_frames, no_of_pages, frames[10], pages[30], temp[10], flag1, flag2, flag3, i,
j, k, pos, max, faults = 0;
    printf("Enter number of pages: ");
    scanf("%d", & no_of_pages);

    printf("Enter page 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("Enter number of frames: ");
    scanf("%d", & no_of_frames);

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

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

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

        if (flag2 == 0) {
            flag3 = 0;
```

```
            for (j = 0; j < no_of_frames; ++j) {
                temp[j] = -1;

                for (k = i + 1; k < no_of_pages; ++k) {
                    if (frames[j] == pages[k]) {
                        temp[j] = k;
                        break;
                    }
                }
            }

            for (j = 0; j < no_of_frames; ++j) {
                if (temp[j] == -1) {
                    pos = j;
                    flag3 = 1;
                    break;
                }
            }

            if (flag3 == 0) {
                max = temp[0];
                pos = 0;

                for (j = 1; j < no_of_frames; ++j) {
                    if (temp[j] > max) {
                        max = temp[j];
                        pos = j;
                    }
                }
            }
            frames[pos] = pages[i];
            faults++;
        }

        printf("\n");

        for (j = 0; j < no_of_frames; ++j) {
            printf("%d\t", frames[j]);
        }
    }

    printf("\n\nTotal Page Faults: %d", faults);
}

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

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

int LRU() {
    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 pages: ");
    scanf("%d", & no_of_pages);
    printf("Enter reference string: ");
    for (i = 0; i < no_of_pages; ++i) {
        scanf("%d", & pages[i]);
    }
    printf("Enter number of frames: ");
```

```
    scanf("%d", & no_of_frames);
    for (i = 0; i < no_of_frames; ++i) {
        frames[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 = findLRU(time, no_of_frames);
            counter++;
            faults++;
            frames[pos] = pages[i];
            time[pos] = counter;
        }

        printf("\n");

        for (j = 0; j < no_of_frames; ++j) {
            printf("%d\t", frames[j]);
        }
    }
    printf("\n\nTotal Page Faults = %d", faults);
}

int main() {

    int choice, tocontinue;
    do {
        printf("\nEnter the option to carry out Page referencing in:
\n1.FIFO\n2.Optimal\n3.LRU\n4.To exit\nYour choice: ");
        scanf("%d", & choice);
        tocontinue = choice;
        switch (choice) {
        case 1:
            FIFO();
            break;
        case 2:
            Optimal();
            break;
        case 3:
            LRU();
            break;
        }
```

```
    } while (tocontinue < 4);
    return 0;
}
```

OUTPUT:

FIFO: Pages = 30; Frame=3; Page Faults = 22

```
Enter the option to carry out Page referencing in:
1.FIFO
2.Optimal
3.LRU
4.To exit
Your choice: 1

Enter the number of Pages: 30

Enter reference string values: 1 2 3 4 2 1 4 2 5 6 2 1 6 5 2 3 7 5 4 2 6 3 2 1 2 3 6 4 2 5

Enter total number of frames: 3

1       -1      -1
1       2       -1
1       2       3
4       2       3
4       2       3
4       1       3
4       1       3
4       1       2
5       1       2
5       6       2
5       6       2
5       6       1
5       6       1
5       6       1
2       6       1
2       3       1
2       3       7
5       3       7
5       4       7
5       4       2
6       4       2
6       3       2
6       3       2
6       3       1
2       3       1
2       3       1
```

```
2       3       7
5       3       7
5       4       7
5       4       2
6       4       2
6       3       2
6       3       2
6       3       1
2       3       1
2       3       1
2       6       1
2       6       4
2       6       4
5       6       4
Total Page Faults:      22
*** stack smashing detected ***: terminated
```

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FIFO: Pages = 30; Frame=5; Page Faults = 17

```
Enter the option to carry out Page referencing in:
1.FIFO
2.Optimal
3.LRU
4.To exit
Your choice: 1

Enter the number of Pages: 30

Enter reference string values: 1 2 3 4 2 1 4 2 5 6 2 1 6 5 2 3 7 5 4 2 6 3 2 1 2 3 6 4 2 5

Enter total number of frames: 5

1       -1      -1      -1      -1
1       2       -1      -1      -1
1       2       3       -1      -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       -1
6       2       3       4       -1
6       2       3       4       -1
6       1       3       4       -1
6       1       3       4       -1
6       1       5       4       -1
6       1       5       2       -1
6       1       5       2       3
7       1       5       2       3
7       1       5       2       3
7       4       5       2       3
7       4       5       2       3
7       4       6       2       3
7       4       6       2       3
7       4       6       2       3
```

```
7       4       6       2       3
7       4       6       2       3
7       4       6       2       3
7       4       6       1       3
7       4       6       1       2
3       4       6       1       2
3       4       6       1       2
3       4       6       1       2
3       4       6       1       2
3       5       6       1       2
Total Page Faults:      17
*** stack smashing detected ***: terminated
```

LRU: Pages = 30; Frame=3; Page Faults = 22

```
Enter the option to carry out Page referencing in:
1.FIFO
2.Optimal
3.LRU
4.To exit
Your choice: 3
Enter number of pages: 30
Enter reference string: 1 2 3 4 2 1 4 2 5 6 2 1 6 5 2 3 7 5 4 2 6 3 2 1 2 3 6 4 2 5
Enter number of frames: 3

1       -1      -1
1       2       -1
1       2       3
4       2       3
4       2       3
4       2       1
4       2       1
4       2       1
4       2       5
6       2       5
6       2       5
6       2       1
6       2       1
6       5       1
6       5       2
3       5       2
3       7       2
3       7       5
4       7       5
4       2       5
4       2       6
3       2       6
3       2       6
3       2       1
3       2       1
```

```
3       2       1
3       2       1
3       2       1
3       2       6
3       4       6
2       4       6
2       4       5

Total Page Faults = 22
```

LRU: Pages = 30; Frame=5; Page Faults = 13

```
Enter the option to carry out Page referencing in:
1.FIFO
2.Optimal
3.LRU
4.To exit
Your choice: 3
Enter number of pages: 30
Enter reference string: 1 2 3 4 2 1 4 2 5 6 2 1 6 5 2 3 7 5 4 2 6 3 2 1 2 3 6 4 2 5
Enter number of frames: 5

1       -1      -1      -1      -1
1       2       -1      -1      -1
1       2       3       -1      -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       5
1       2       6       4       5
1       2       6       4       5
1       2       6       4       5
```

```
1       2       6       4       5
1       2       6       4       5
1       2       6       4       5
1       2       6       4       5
1       2       6       4       5
1       2       6       3       5
7       2       6       3       5
7       2       6       3       5
7       2       4       3       5
7       2       4       3       5
7       2       4       6       5
3       2       4       6       5
3       2       4       6       5
3       2       4       6       1
3       2       4       6       1
3       2       4       6       1
3       2       4       6       1
3       2       4       6       1
3       2       4       6       1
```

```
3       2       4       6       5
3       2       4       6       1
3       2       4       6       1
3       2       4       6       1
3       2       4       6       1
3       2       4       6       1
3       2       4       6       1
3       2       4       6       5

Total Page Faults = 13
```

Optimal: Pages = 30; Frame=5; Page Faults = 10

```
Enter the option to carry out Page referencing in:
1.FIFO
2.Optimal
3.LRU
4.To exit
Your choice: 2
Enter number of frames: 5
Enter number of pages: 30
Enter page reference string: 1 2 3 4 2 1 4 2 5 6 2 1 6 5 2 3 7 5 4 2 6 3 2 1 2 3 6 4 2 5

1       -1      -1      -1      -1
1       2       -1      -1      -1
1       2       3       -1      -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       -1
1       2       3       4       5
1       2       3       6       5
1       2       3       6       5
1       2       3       6       5
1       2       3       6       5
```

```
1       2       3       4       -1
1       2       3       4       5
1       2       3       6       5
1       2       3       6       5
1       2       3       6       5
1       2       3       6       5
1       2       3       6       5
1       2       3       6       5
1       2       3       6       5
7       2       3       6       5
7       2       3       6       5
4       2       3       6       5
4       2       3       6       5
4       2       3       6       5
4       2       3       6       5
4       2       3       6       5
4       2       3       6       1
4       2       3       6       1
4       2       3       6       1
4       2       3       6       1
4       2       3       6       1
4       2       3       6       1
5       2       3       6       1
```

```
1       2       3       6       5
7       2       3       6       5
7       2       3       6       5
4       2       3       6       5
4       2       3       6       5
4       2       3       6       5
4       2       3       6       5
4       2       3       6       5
4       2       3       6       1
4       2       3       6       1
4       2       3       6       1
4       2       3       6       1
4       2       3       6       1
4       2       3       6       1
5       2       3       6       1

Total Page Faults = 10
```

Optimal: Pages = 30; Frame=3; Page Faults = 16

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Optimal: Pages = 30; Frame=3; Page Faults = 16

```
Enter the option to carry out Page referencing in:
1.FIFO
2.Optimal
3.LRU
4.To exit
Your choice: 2
Enter number of frames: 3
Enter number of pages: 30
Enter page reference string: 1 2 3 4 2 1 4 2 5 6 2 1 6 5 2 3 7 5 4 2 6 3 2 1 2 3 6 4 2 5

1       -1      -1
1       2       -1
1       2       3
1       2       4
1       2       4
1       2       4
1       2       4
1       2       4
1       2       5
1       2       6
1       2       6
1       2       6
1       2       6
5       2       6
5       2       6
5       2       3
5       2       7
5       2       7
5       2       4
5       2       4
6       2       4
6       2       3
6       2       3
1       2       3
1       2       3
1       2       3
6       2       3
```

```
5       2       6
5       2       6
5       2       3
5       2       7
5       2       7
5       2       4
5       2       4
6       2       4
6       2       3
6       2       3
1       2       3
1       2       3
1       2       3
6       2       3
4       2       3
4       2       3
5       2       3

Total Page Faults = 16
```

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FIFO: Pages = 30; Frame=4; Page Faults = 19

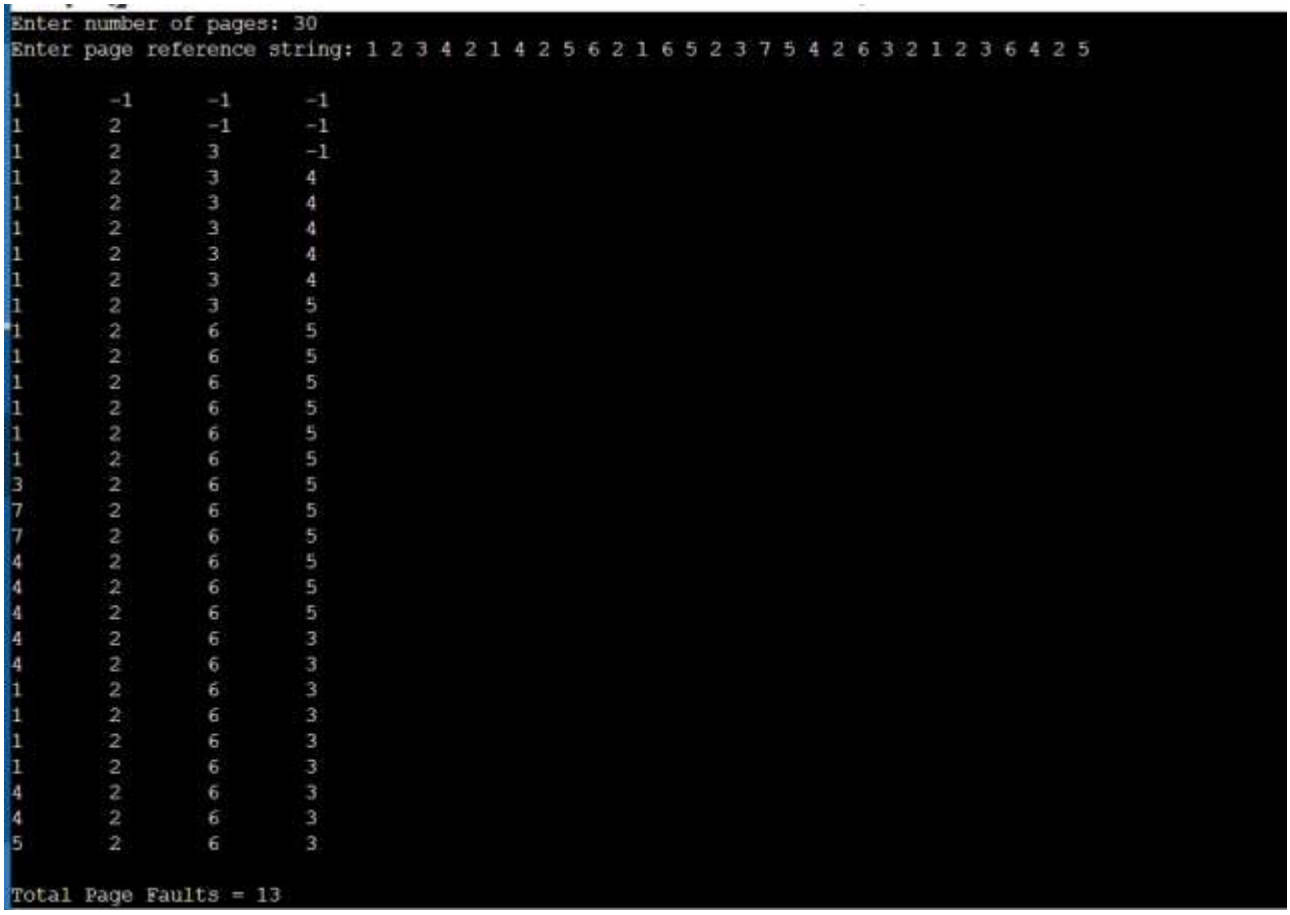
```
Enter the number of Pages: 30

Enter reference string values: 1 2 3 4 2 1 4 2 5 6 2 1 6 5 2 3 7 5 4 2 6 3 2 1 2 3 6 4 2 5

Enter total number of frames: 4

1       -1      -1      -1
1       2       -1      -1
1       2       3       -1
1       2       3       4
1       2       3       4
1       2       3       4
1       2       3       4
1       2       3       4
5       2       3       4
5       6       3       4
5       6       2       4
5       6       2       1
5       6       2       1
5       6       2       1
5       6       2       1
3       6       2       1
3       7       2       1
3       7       5       1
3       7       5       4
2       7       5       4
2       6       5       4
2       6       3       4
2       6       3       4
2       6       3       1
2       6       3       1
2       6       3       1
2       6       3       1
4       6       3       1
4       2       3       1
4       2       5       1
Total Page Faults:      19
```

Optimal: Pages = 30; Frame=4; Page Faults = 13



LRU: Pages = 30; Frame=4; Page Faults = 16

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```
Enter reference string: 1 2 3 4 2 1 4 2 5 6 2 1 6 5 2 3 7 5 4 2 6 3 2 1 2 3 6 4 2 5
Enter number of frames: 4

1       -1      -1      -1
1       2       -1      -1
1       2       3       -1
1       2       3       4
1       2       3       4
1       2       3       4
1       2       3       4
1       2       3       4
1       2       5       4
6       2       5       4
6       2       5       4
6       2       5       1
6       2       5       1
6       2       5       1
6       2       5       1
6       2       5       3
7       2       5       3
7       2       5       3
7       4       5       3
7       4       5       2
6       4       5       2
6       4       3       2
6       4       3       2
6       1       3       2
6       1       3       2
6       1       3       2
6       1       3       2
6       4       3       2
6       4       3       2
6       4       5       2

Total Page Faults = 16
```