Q. Write a C program to simulate page replacement algorithms. (Any one)
a) FIFO
b) LRU
c) Optimal

```
#include <stdio.h>
#include <limits.h>

void printFrames(int frames[], int f) {
    for (int i = 0; i < f; i++) {

        if (frames[i] == -1)
            printf("- ");
        else
            printf("%d ",frames[i]);
    }
    printf("\n");
}

int isInFrame(int frames[], int f, int page) {
    for (int i = 0; i < f; i++)
        if (frames[i] == page)
            return 1;
    return 0;
}

int findLRU(int time[], int f) {
    int min = time[0], pos = 0;
    for (int i = 1; i < f; i++) {
        if (time[i] < min) {
            min = time[i];
            pos = i;
        }
    }
    return pos;
}

int findOptimal(int pages[], int frames[], int n, int f, int index) {
    int farthest = index, pos = -1;
    for (int i = 0; i < f; i++) {
        int j;
        for (j = index; j < n; j++) {
            if (frames[i] == pages[j]) {
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            if (j > farthest) {
                farthest = j;
                pos = i;
            }
            break;
        }
    }
    if (j == n) return i; // Never used again
  }
  return (pos == -1) ? 0 : pos;
}

void fifo(int pages[], int n, int f) {
  int frames[f], front = 0, faults = 0;
  for (int i = 0; i < f; i++) frames[i] = -1;

  printf("\nFIFO Page Replacement:\n");

  for (int i = 0; i < n; i++) {
    if (!isInFrame(frames, f, pages[i])) {
      frames[front] = pages[i];
      front = (front + 1) % f;
      faults++;
    }
    printf("PR No . %d : ",i+1);
    printFrames(frames, f);
  }

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

void lru(int pages[], int n, int f) {
  int frames[f], time[f], faults = 0, counter = 0;
  for (int i = 0; i < f; i++) frames[i] = -1;

  printf("\nLRU Page Replacement:\n");

  for (int i = 0; i < n; i++) {
    counter++;
    if (!isInFrame(frames, f, pages[i])) {
      int index = -1;
      for (int j = 0; j < f; j++) {
        if (frames[j] == -1) {
          index = j;
```

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                break;
            }
        }
        if (index == -1)
            index = findLRU(time, f);

        frames[index] = pages[i];
        time[index] = counter;
        faults++;
    } else {
        for (int j = 0; j < f; j++) {
            if (frames[j] == pages[i])
                time[j] = counter;
        }
    }
    printf("PR No . %d : ",i+1);
    printFrames(frames, f);
  }

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

void optimal(int pages[], int n, int f) {
  int frames[f], faults = 0;
  for (int i = 0; i < f; i++) frames[i] = -1;

  printf("\nOptimal Page Replacement:\n");

  for (int i = 0; i < n; i++) {
    if (!isInFrame(frames, f, pages[i])) {
        int index = -1;
        for (int j = 0; j < f; j++) {
            if (frames[j] == -1) {
                index = j;
                break;
            }
        }
        if (index == -1)
            index = findOptimal(pages, frames, n, f, i + 1);

        frames[index] = pages[i];
        faults++;
    }
    printf("PR No . %d : ",i+1);
```

```
        printFrames(frames, f);
    }

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

int main() {
    int n, f;
    printf("Enter number of frames: ");
    scanf("%d", &f);
    printf("Enter length of reference string : ");
    scanf("%d", &n);

    int pages[n];
    printf("Enter page reference string:\n");
    for (int i = 0; i < n; i++)
        scanf("%d", &pages[i]);


    fifo(pages, n, f);
    lru(pages, n, f);
    optimal(pages, n, f);



    return 0;
}
```

Output:

```
Enter number of frames: 3
Enter length of reference string : 6
Enter page reference string:
1 3 0 3 5 6

FIFO Page Replacement:
PR No . 1 : 1 - -
PR No . 2 : 1 3 -
PR No . 3 : 1 3 0
PR No . 4 : 1 3 0
PR No . 5 : 5 3 0
PR No . 6 : 5 6 0
FIFO Page Faults: 5

LRU Page Replacement:
PR No . 1 : 1 - -
PR No . 2 : 1 3 -
PR No . 3 : 1 3 0
PR No . 4 : 1 3 0
PR No . 5 : 5 3 0
PR No . 6 : 5 3 6
LRU Page Faults: 5

Optimal Page Replacement:
PR No . 1 : 1 - -
PR No . 2 : 1 3 -
PR No . 3 : 1 3 0
PR No . 4 : 1 3 0
PR No . 5 : 5 3 0
PR No . 6 : 6 3 0
Optimal Page Faults: 5
```