LAB 12

QUESTION: Write a C program to simulate page replacement algorithms.

a) FIFO b) LRU c) Optimal d)MRU

ANSWER:

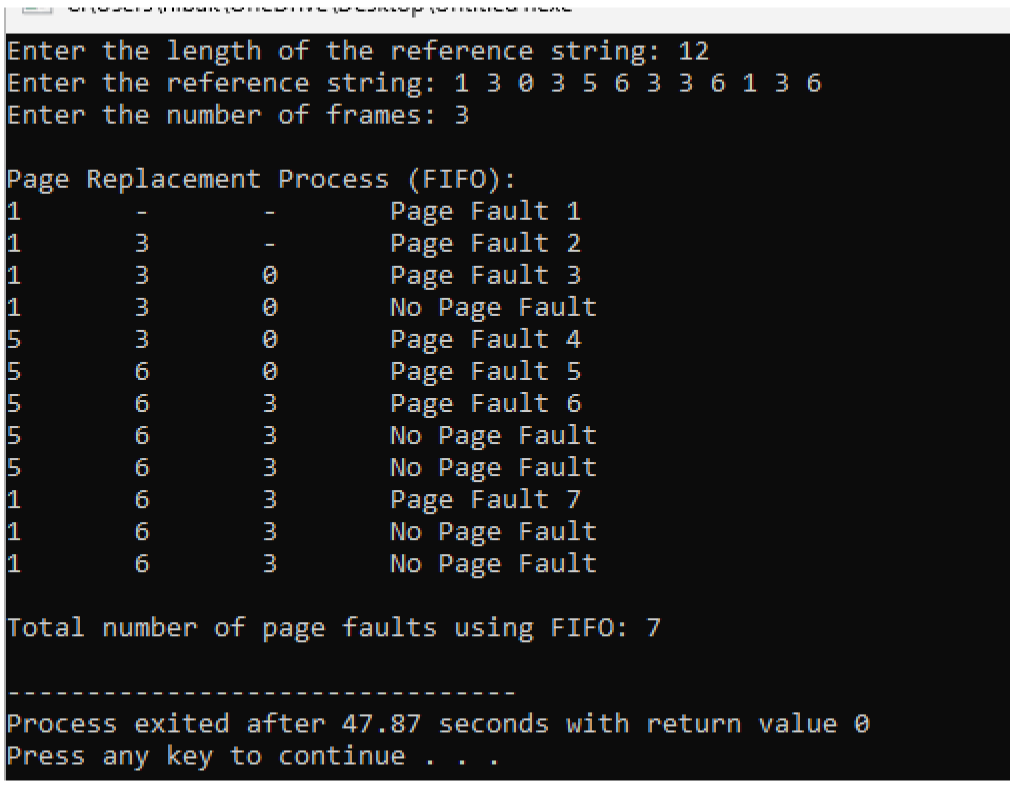
a) FIFO

CODE:

```
#include <stdio.h>


int main() {
   int i, j, k, frameIndex = 0, pageFaults = 0;
   int referenceString[25], frames[10], n, f;


   printf("Enter the length of the reference string: ");
   scanf("%d", &n);


   printf("Enter the reference string: ");
   for (i = 0; i < n; i++)
      scanf("%d", &referenceString[i]);


   printf("Enter the number of frames: ");
   scanf("%d", &f);


   for (i = 0; i < f; i++)
      frames[i] = -1; // initialize all frames to -1


   printf("\nPage Replacement Process (FIFO):\n");
```

```
for (i = 0; i < n; i++) {
    // Check if the page is already in a frame
    for (k = 0; k < f; k++) {
        if (frames[k] == referenceString[i])
            break;
    }

    // Page not found -> page fault
    if (k == f) {
        frames[frameIndex] = referenceString[i];
        frameIndex = (frameIndex + 1) % f;
        pageFaults++;

        // Display current frame state
        for (j = 0; j < f; j++) {
            if (frames[j] != -1)
                printf("%d\t", frames[j]);
            else
                printf("-\t");
        }
        printf("Page Fault %d", pageFaults);
    } else {
        // Page hit - no fault
        for (j = 0; j < f; j++) {
            if (frames[j] != -1)
                printf("%d\t", frames[j]);
            else
                printf("-\t");
        }
        printf("No Page Fault");
    }

    printf("\n");
}

printf("\nTotal number of page faults using FIFO: %d\n", pageFaults);
return 0;
}
```

OUTPUT:



```
Enter the length of the reference string: 12
Enter the reference string: 1 3 0 3 5 6 3 3 6 1 3 6
Enter the number of frames: 3

Page Replacement Process (FIFO):
1       -       -       Page Fault 1
1       3       -       Page Fault 2
1       3       0       Page Fault 3
1       3       0       No Page Fault
5       3       0       Page Fault 4
5       6       0       Page Fault 5
5       6       3       Page Fault 6
5       6       3       No Page Fault
5       6       3       No Page Fault
1       6       3       Page Fault 7
1       6       3       No Page Fault
1       6       3       No Page Fault

Total number of page faults using FIFO: 7

--------------------------------
Process exited after 47.87 seconds with return value 0
Press any key to continue . . .
```

b) LRU

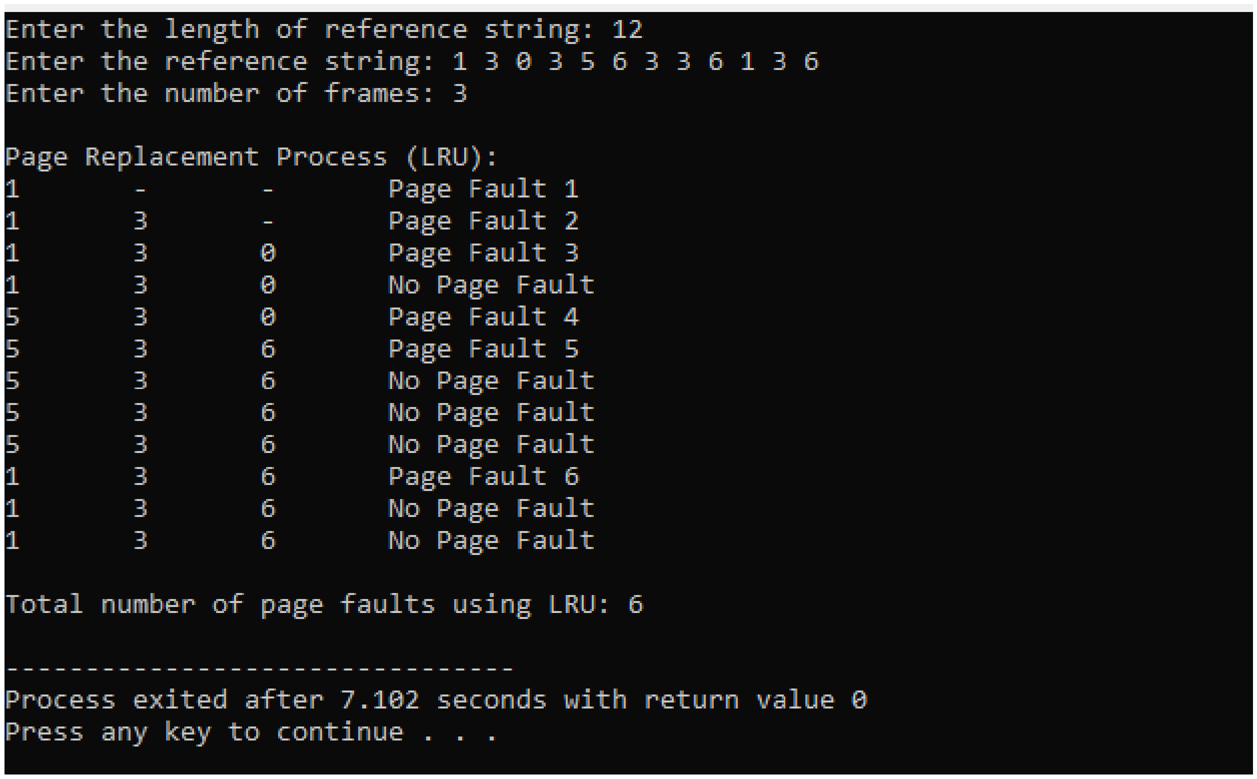
CODE:

```
#include <stdio.h>


int main() {

    int i, j, k, min, n, f;

    int referenceString[25], frames[10], lastUsed[10], pageFaults = 0, next = 1;

    int flag[25] = {0};


    printf("Enter the length of reference string: ");

    scanf("%d", &n);


    printf("Enter the reference string: ");

    for (i = 0; i < n; i++) {

        scanf("%d", &referenceString[i]);

        flag[i] = 0;

    }


    printf("Enter the number of frames: ");

    scanf("%d", &f);


    for (i = 0; i < f; i++) {

        frames[i] = -1;

        lastUsed[i] = 0;

    }
```

```
printf("\nPage Replacement Process (LRU):\n");

for (i = 0; i < n; i++) {
    int found = 0;

    for (j = 0; j < f; j++) {
        if (frames[j] == referenceString[i]) {
            flag[i] = 1;
            lastUsed[j] = next++;
            found = 1;
            break;
        }
    }

    if (!found) {
        if (i < f) {
            frames[i] = referenceString[i];
            lastUsed[i] = next++;
        } else {
            min = 0;
            for (j = 1; j < f; j++) {
                if (lastUsed[j] < lastUsed[min]) {
                    min = j;
                }
            }
            frames[min] = referenceString[i];
```

```
                lastUsed[min] = next++;
            }
            pageFaults++;
        }

        for (j = 0; j < f; j++) {
            if (frames[j] != -1)
                printf("%d\t", frames[j]);
            else
                printf("-\t");
        }

        if (!found)
            printf("Page Fault %d", pageFaults);
        else
            printf("No Page Fault");

        printf("\n");
    }

    printf("\nTotal number of page faults using LRU: %d\n", pageFaults);

    return 0;
}
```

OUTPUT:



```
Enter the length of reference string: 12
Enter the reference string: 1 3 0 3 5 6 3 3 6 1 3 6
Enter the number of frames: 3

Page Replacement Process (LRU):
1       -       -       Page Fault 1
1       3       -       Page Fault 2
1       3       0       Page Fault 3
1       3       0       No Page Fault
5       3       0       Page Fault 4
5       3       6       Page Fault 5
5       3       6       No Page Fault
5       3       6       No Page Fault
5       3       6       No Page Fault
1       3       6       Page Fault 6
1       3       6       No Page Fault
1       3       6       No Page Fault

Total number of page faults using LRU: 6

--------------------------------
Process exited after 7.102 seconds with return value 0
Press any key to continue . . .
```

c) Optimal

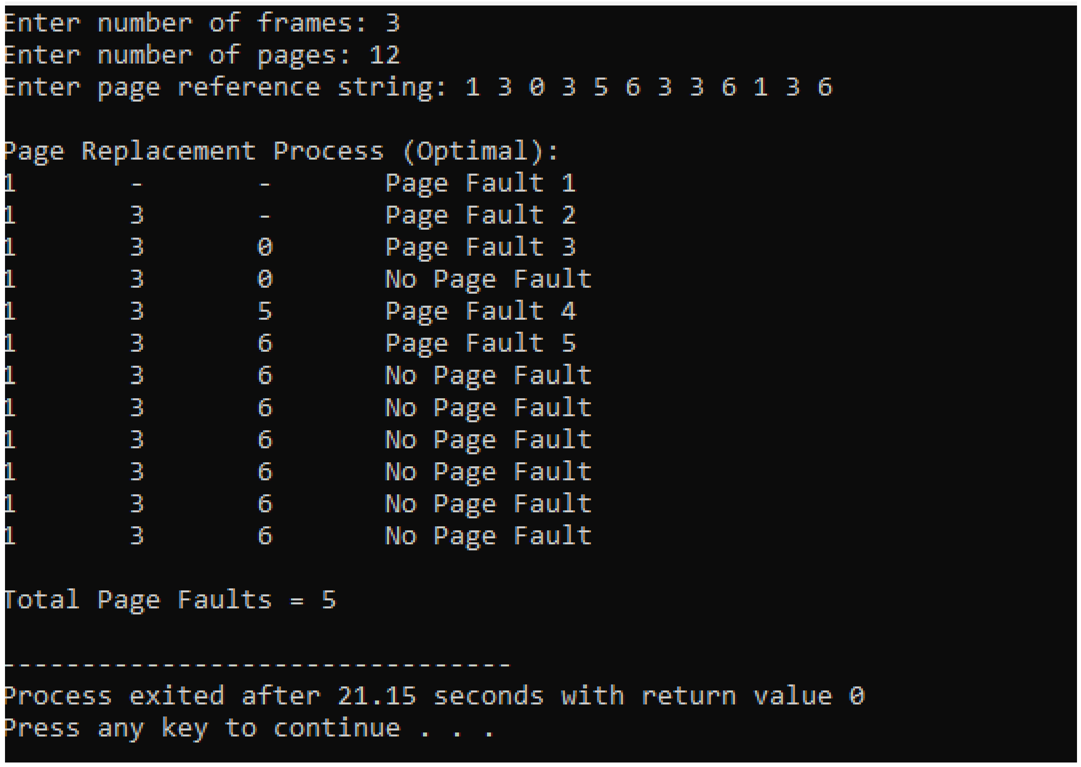
CODE:

```
#include <stdio.h>


int main() {

   int no_of_frames, no_of_pages;

   int frames[10], pages[30], temp[10];

   int flag1, flag2, flag3;

   int i, j, k, pos, max, faults = 0;


   printf("Enter number of frames: ");

   scanf("%d", &no_of_frames);


   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("\nPage Replacement Process (Optimal):\n");
```

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

    // Check if page is already in a frame
    for (j = 0; j < no_of_frames; ++j) {
        if (frames[j] == pages[i]) {
            flag1 = flag2 = 1;
            break;
        }
    }

    // If page is not already in frame
    if (flag1 == 0) {
        // Check for empty frame
        for (j = 0; j < no_of_frames; ++j) {
            if (frames[j] == -1) {
                frames[j] = pages[i];
                faults++;
                flag2 = 1;
                break;
            }
        }
    }

    // If no empty frame, use optimal replacement
```

```
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++;
    }

    // Print current state of frames
    for (j = 0; j < no_of_frames; ++j) {
        if (frames[j] != -1)
            printf("%d\t", frames[j]);
        else
            printf("-\t");
    }
    if (!flag1) printf("Page Fault %d", faults);
    else printf("No Page Fault");
    printf("\n");
}

printf("\nTotal Page Faults = %d\n", faults);
return 0;
}
```

OUTPUT:



```
Enter number of frames: 3
Enter number of pages: 12
Enter page reference string: 1 3 0 3 5 6 3 3 6 1 3 6

Page Replacement Process (Optimal):
1       -       -       Page Fault 1
1       3       -       Page Fault 2
1       3       0       Page Fault 3
1       3       0       No Page Fault
1       3       5       Page Fault 4
1       3       6       Page Fault 5
1       3       6       No Page Fault
1       3       6       No Page Fault
1       3       6       No Page Fault
1       3       6       No Page Fault
1       3       6       No Page Fault
1       3       6       No Page Fault

Total Page Faults = 5

--------------------------------
Process exited after 21.15 seconds with return value 0
Press any key to continue . . .
```

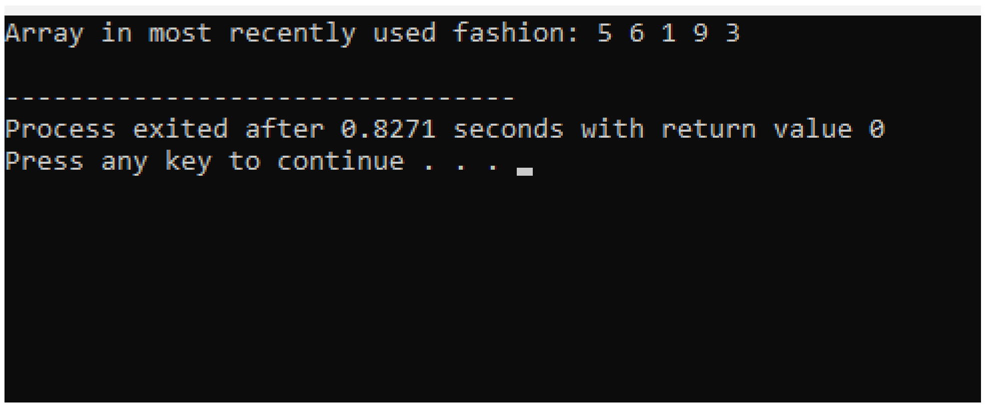
d) MRU

CODE:

```
#include <iostream>

using namespace std;


// Function to update the array in most recently used (MRU) fashion

void recently(int* arr, int size, int elem) {

    int index = elem % size;  // Find index using modulo

    int id = arr[index];      // Get the value at the index


    // Shift elements from index to front

    while (index > 0) {

        arr[index] = arr[index - 1];

        index--;

    }


    // Place the accessed element at the front

    arr[0] = id;

}


// Function to print array elements

void print(int* arr, int size) {

    for (int i = 0; i < size; i++)

        cout << arr[i] << " ";

    cout << endl;

}
```

```
int main() {
    int elem = 3;
    int arr[] = {6, 1, 9, 5, 3};
    int size = sizeof(arr) / sizeof(arr[0]);

    recently(arr, size, elem);

    cout << "Array in most recently used fashion: ";
    print(arr, size);

    return 0;
}
```

OUTPUT:



```
Array in most recently used fashion: 5 6 1 9 3

--------------------------------
Process exited after 0.8271 seconds with return value 0
Press any key to continue . . .
```