Ex 10 (i) - Least recently used algorithm:

```cpp
#include<bits/stdc++.h>
using namespace std;
using ll=long long;
void ynans(bool x){if(x) cout<<"YES";else cout<<"NO";}
#define vi vector<int>
#define rep(i,k,n) for(ll i=k;i<n;i++)
#define rof(i,k,n) for(ll i=k;i>n;i--)
#define pb(x) push_back(x)
#define sp(x,y) fixed<<setprecision(y)<<x
int sum() { return 0; }
template<typename T, typename... Args>
T sum(T a, Args... args) { return a + sum(args...); }
#define vi vector<int>
#define vc vector<char>
#define vs vector<string>
#define vll vector<ll>
#define vvi vector < vi >
#define pll pair<ll, ll>
#define ff first
#define ss second
#define casePrint(x,y) cout<<"Case #"<<x<<": "<<y;
#define all(c) c.begin(),c.end()
bool cmp(pair<char, int>& a,
         pair<char, int>& b)
{
    return a.second < b.second;
}
bool not_found(vector<pair<char, int> > &r,char c){
    bool flag=0;
    for(auto i:r){
        if(i.first==c){
            flag=1;
            break;
        }
    }
    return flag;

}
void replacement(vc &frame,string x,int p){
```

```cpp
        ll ind=p;
        p--;
        ll done=0;
        while(p>=0){
            rep(j,0,frame.size()){
                if(frame[j]==x[p])
                {
                    frame[j]=x[ind];
                    done=1;
                    break;
                }
            }
            if(done)
            break;
        }

}
int main(){
    string ref_string;
    cout<<"Enter the reference string(min length 20)\n";
    cin>>ref_string;
    ll n,pgfaults=0;
    cout<<"Enter frame size\n";
    cin>>n;
     vc frame(n,'-');
     ll p=0;
     rep(i,0,ref_string.length()){
        int flag=0;
        rep(j,0,n){
            if(ref_string[i]==frame[j])
            flag=1;
        }
        if(!flag){
            pgfaults++;
            ll ok=0;
            rep(j,0,n){
                if(frame[j]=='-'){
                    frame[j]=ref_string[i];
                    ok=1;
                    break;
                }
            }
            if(!ok){
```

```cpp
                replacement(frame,ref_string,i);
            }
        }
        rep(j,0,n){
            cout<<frame[j]<<" ";
        }
        cout<<"\n";


    }
        cout<<"No. of page fault: "<<pgfaults;



}
```

```
PS E:\VIT\4thsem\OS\lab\linuxpractice\20bce1161\lab10> cd
Enter the reference string(min length 20)
70120304230321201 70
Enter frame size
3
7 - -
7 0 -
7 0 1
7 0 2
7 0 2
7 3 2
7 0 2
7 4 2
7 4 2
7 4 3
7 4 0
7 4 3
7 4 2
7 4 1
7 4 2
7 4 0
7 4 1
7 4 1
0 4 1
No. of page fault: 16
```

```
PS E:\VIT\4thsem\OS\lab\linuxpractice\20bce1161\lab10> cd '
Enter the reference string(min length 20)
70120304230321201 70
Enter frame size
4
7 - - -
7 0 - -
7 0 1 -
7 0 1 2
7 0 1 2
7 3 1 2
7 0 1 2
7 4 1 2
7 4 1 2
7 4 1 3
7 4 1 0
7 4 1 3
7 4 1 2
7 4 1 2
7 4 1 2
7 4 1 0
7 4 1 0
7 4 1 0
7 4 1 0
No. of page fault: 12
```

Exercise 10b - Second chance algorithm

1. **Code:**

```cpp
#include<bits/stdc++.h>
using namespace std;
using ll=long long;
void ynans(bool x){if(x) cout<<"YES";else cout<<"NO";}
#define vi vector<int>
#define rep(i,k,n) for(ll i=k;i<n;i++)
#define rof(i,k,n) for(ll i=k;i>n;i--)
#define pb(x) push_back(x)
#define sp(x,y) fixed<<setprecision(y)<<x
int sum() { return 0; }
template<typename T, typename... Args>
```

```cpp
T sum(T a, Args... args) { return a + sum(args...); }
#define vi vector<int>
#define vc vector<char>
#define vs vector<string>
#define vll vector<ll>
#define vvi vector < vi >
#define pll pair<ll, ll>
#define ff first
#define ss second
#define casePrint(x,y) cout<<"Case #"<<x<<": "<<y;
#define all(c) c.begin(),c.end()

int main(){
//      ll a[50][1];
    string ref_string;
    cout<<"Enter the reference string(min length 20)\n";
    cin>>ref_string;
    ll n,pgfaults=0;
    cout<<"Enter frame size\n";
    cin>>n;
    char frame[n][2];
    rep(i,0,n){


        frame[i][1]='-';
    }
    ll pt=0;

    rep(i,0,ref_string.length()){
            ll j=pt;
            while(j!=pt+n){

            if(ref_string[i]==frame[j%n][0])
                {
                    if(frame[j%n][1]=='-'){
                        frame[j%n][0]=ref_string[i];
                        frame[j%n][1]='0';
                        pgfaults++;

                    }
                    else if (frame[j%n][1]=='0')
                    {
                        frame[j%n][1]='1';
```

```
                    }

                    break;
                }

                j++;
            }
            if(j==pt+n){
                frame[j%n][0]=ref_string[i];
                frame[j%n][1]=0;
                pgfaults++;



            }
            else
            pt=j%n;
            rep(j,0,n)
            cout<<frame[j]<<" ";


    }
    cout<<pgfaults;



}
```

Output:

```
($?) { .\secondchance }\linuxpractice\20bce1161\lab10>
Enter the reference string(min length 20)
502103024303213015
Enter frame size
3
5 - -
5 0 -
5 0 2
1 0 2
1 0 2
1 0 3
1 0 3
2 0 3
2 0 4
3 0 4
3 0 4
3 0 4
3 0 2
3 1 2
3 1 2
3 1 0
3 1 0
3 1 5
page faults: 12
```

```
($?) { .\secondchance }\linuxpractice\20bce1161\lab10>
Enter the reference string(min length 20)
502103024303213015
Enter frame size
3
5 - -
5 0 -
5 0 2
1 0 2
1 0 2
1 0 3
1 0 3
2 0 3
2 0 4
3 0 4
8 5 6 7
8 4 1 7
8 4 1 5
2 4 1 5
2 4 1 5
2 4 1 5
2 4 1 5
page fauts: 8
```