

DESIGNING A VIRTUAL MEMORY MANAGER

**A
MINI PROJECT**

**OPERATING SYSTEMS
(CS1401)
IV SEMESTER**



**MANIPAL UNIVERSITY
JAIPUR**

Submitted

By

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Problem Statement

This project consists of writing a program that translates logical to physical addresses for a virtual address space of size $2^{16} = 65,536$ bytes. Your program will read from a file containing logical addresses and, using a TLB as well as a page table, will translate each logical address to its corresponding physical address and output the value of the byte stored at the translated physical address. The goal behind this project is to simulate the steps involved in translating logical to physical addresses.

Program Code

```
/*      OPERATING SYSTEMS  LAB PROJECT
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*      DESIGNING A VIRTUAL MEMORY MANAGER
*/

#include<stdio.h>
#include<stdlib.h>
#include<string.h>

const int VM_SIZE=256;
const int PAGE_SIZE=256;
const int TLB_SIZE=16;
const int MM_SIZE=256;

int main(int argc, char* argv[])
{
    FILE *fd;

    if(argc<2)
    {
        printf("NOT ENOUGH ARGUMENTS\n EXITING\n");
        return 0;
    }
    fd=fopen(argv[1],"r");
    if(fd==NULL)
    {
        printf("ERROR OPENING FILE\n FILE FAILED TO
OPEN\n");
        return 0;
    }
    char *value=NULL;
    size_t len=0;
    ssize_t read;
```

```

        long long
page_no,offset,page_table,totalhits=0,fault=0,pages=0;

        int qp=0;                                //to
maintain the queue position
        int physicalad=0,frame,logicalad;

        int tlb[TLB_SIZE][2];
        int pagetable[PAGE_SIZE];

        memset(tlb,-1,TLB_SIZE*2*sizeof(tlb[0][0]));
        memset(pagetable,-1,sizeof(pagetable));

        int mask=255,maskl=62580,i,hit;

        while((read=getline(&value,&len,fd))!=-1)
        {
                pages++;
                //get page number and offset from logical address
                page_no=atoi(value);
                page_no=page_no>>8;
                page_no=page_no & mask;

                offset=atoi(value);
                offset=offset & mask;

                logicalad=atoi(value);
                //printf("%lld %lld\n",page_no,offset);
                frame=0,physicalad=0;

                hit=0;                                //1 if found in TLB

                //CHECK IN TLB

                for(i=0;i<TLB_SIZE;i++)
                {
                        if(tlb[i][0]==page_no)
                        {
                                hit=1;
                                totalhits++;
                                frame=tlb[i][1];
                                break;
                        }
                }
                //if present in tlb
                if(hit==1)
                        printf("TLB HIT\n");

                //search in pagetable
                else
                {

                        int f=0;

```

```

        for(i=0;i<PAGE_SIZE;i++)
        {
            if(pagetable[i]==page_no)
            {
                frame=i;
                fault++;
                break;
            }
            if(pagetable[i]==-1)
            {
                f=1;

                break;
            }
        }
        if(f==1)
        {
            pagetable[i]=page_no;
            frame=i;
        }
        //replace in tlb using fifo
        tlb[qp][0]=page_no;
        tlb[qp][1]=i;
        qp++;
        qp=qp%15;
    }
    if(logicalad<10000)
    printf("VIRTUAL ADDRESS = %d \t\t\t",logicalad);
    else
    printf("VIRTUAL ADDRESS = %d \t\t",logicalad);

    physicalad=frame*PAGE_SIZE + offset;
    printf("PHYSICAL ADDRESS = %d\n",physicalad);
}
double hitrate=(double)totalhits/pages*100;
double faultrate=(double)fault/pages*100;
printf("\nTLB HIT RATE= %.2f %c", hitrate,'%');
printf("\nTLB MISS RATE= %.2f %c", (100-hitrate),'%');
printf("\nPAGE TABLE HIT RATE= %.2f %c", faultrate,'%');
printf("\nPAGE TABLE MISS RATE= %.2f %c\n", (100-
faultrate),'%');
}

```

OUTPUT 1:

```
akash@akash-VirtualBox: ~/Desktop/179303013
File Edit View Search Terminal Help
akash@akash-VirtualBox:~/Desktop/179303013$ gcc -o manager manager.c
akash@akash-VirtualBox:~/Desktop/179303013$ ./manager address1.txt
VIRTUAL ADDRESS = 1234          PHYSICAL ADDRESS = 210
TLB HIT
VIRTUAL ADDRESS = 1256          PHYSICAL ADDRESS = 232
VIRTUAL ADDRESS = 6720          PHYSICAL ADDRESS = 320
TLB HIT
VIRTUAL ADDRESS = 1267          PHYSICAL ADDRESS = 243
TLB HIT
VIRTUAL ADDRESS = 6789          PHYSICAL ADDRESS = 389

TLB HIT RATE= 60.00 %
TLB MISS RATE= 40.00 %
PAGE TABLE HIT RATE= 0.00 %
PAGE TABLE MISS RATE= 100.00 %
akash@akash-VirtualBox:~/Desktop/179303013$ █
```

OUTPUT 2:

```
akash@akash-VirtualBox: ~/Desktop/179303013
File Edit View Search Terminal Help
akash@akash-VirtualBox:~/Desktop/179303013$ ./manager address1.txt
VIRTUAL ADDRESS = 123456789     PHYSICAL ADDRESS = 21
TLB HIT
VIRTUAL ADDRESS = 123456790     PHYSICAL ADDRESS = 22
TLB HIT
VIRTUAL ADDRESS = 123456791     PHYSICAL ADDRESS = 23
TLB HIT
VIRTUAL ADDRESS = 123456792     PHYSICAL ADDRESS = 24
TLB HIT
VIRTUAL ADDRESS = 123456793     PHYSICAL ADDRESS = 25

TLB HIT RATE= 80.00 %
TLB MISS RATE= 20.00 %
PAGE TABLE HIT RATE= 0.00 %
PAGE TABLE MISS RATE= 100.00 %
akash@akash-VirtualBox:~/Desktop/179303013$ █
```

OUTPUT 3:

```
akash@akash-VirtualBox: ~/Desktop/179303013
File Edit View Search Terminal Help
akash@akash-VirtualBox:~/Desktop/179303013$ ./manager address1.txt
VIRTUAL ADDRESS = 45678910          PHYSICAL ADDRESS = 62
VIRTUAL ADDRESS = 45628910          PHYSICAL ADDRESS = 494
VIRTUAL ADDRESS = 45638910          PHYSICAL ADDRESS = 766
VIRTUAL ADDRESS = 45658910          PHYSICAL ADDRESS = 798

TLB HIT RATE= 0.00 %
TLB MISS RATE= 100.00 %
PAGE TABLE HIT RATE= 0.00 %
PAGE TABLE MISS RATE= 100.00 %
akash@akash-VirtualBox:~/Desktop/179303013$
```

OUTPUT 4:

```
akash@akash-VirtualBox: ~/Desktop/179303013
File Edit View Search Terminal Help
VIRTUAL ADDRESS = 676              PHYSICAL ADDRESS = 43172
VIRTUAL ADDRESS = 60177            PHYSICAL ADDRESS = 39185
VIRTUAL ADDRESS = 60877            PHYSICAL ADDRESS = 32717
VIRTUAL ADDRESS = 58777            PHYSICAL ADDRESS = 52121
VIRTUAL ADDRESS = 65077            PHYSICAL ADDRESS = 42293
VIRTUAL ADDRESS = 46176            PHYSICAL ADDRESS = 63840
VIRTUAL ADDRESS = 54746            PHYSICAL ADDRESS = 41178
VIRTUAL ADDRESS = 63847            PHYSICAL ADDRESS = 25191
VIRTUAL ADDRESS = 19141            PHYSICAL ADDRESS = 39877
VIRTUAL ADDRESS = 52911            PHYSICAL ADDRESS = 13487
VIRTUAL ADDRESS = 51946            PHYSICAL ADDRESS = 49386
VIRTUAL ADDRESS = 6711             PHYSICAL ADDRESS = 54327
VIRTUAL ADDRESS = 59477            PHYSICAL ADDRESS = 37205
VIRTUAL ADDRESS = 62977            PHYSICAL ADDRESS = 45057
VIRTUAL ADDRESS = 52477            PHYSICAL ADDRESS = 56829
VIRTUAL ADDRESS = 18441            PHYSICAL ADDRESS = 29449
VIRTUAL ADDRESS = 55012            PHYSICAL ADDRESS = 16868
VIRTUAL ADDRESS = 28241            PHYSICAL ADDRESS = 28241

TLB HIT RATE= 1.30 %
TLB MISS RATE= 98.70 %
PAGE TABLE HIT RATE= 73.60 %
PAGE TABLE MISS RATE= 26.40 %
akash@akash-VirtualBox:~/Desktop/179303013$
```