CS446 Lab 8 – Main Memory – Address Translation

Labs that are not scheduled for a Lab Test are not mandatory. These are practice labs, designed to help you on your assignments.

Solutions to practice labs will not be posted online.

Outline

Assume that a system has a 32-bits virtual address with a 4-KB ($=2^{12}$) page size. The physical memory address is 32 bits address as well. Consider a small program that needs only 8 pages of memory. Below is the page table for this program.

Page Table

Frame Number
6
4
3
7
0
1
2
5

In this lab, you are to write a C program that takes a text file named **labaddr.txt** on the command line **(you may download labaddr.txt file from Canvas).** This text file contains a sample of **20** logical addresses generated for this program. You are to read these addresses and output the page number and offset for each logical address in the file. In addition to this, your program needs to output the corresponding physical address for each logical address in labaddr.txt.

There are three parts to this practice lab:

1. Reading from a file.
2. Given a logical/virtual address output its page number and offset.
3. Given the page table and the logical address output its corresponding physical address.

It is recommended that you approach this problem in the above order that is, first read all the logical addresses from the file and simply output it to screen. Then compute the page number and offset and output these details for each logical address in the labaddr.txt file. Finally, compute the physical address and output it to screen.

In particular your program needs to do the following:

1. Define `PAGE_NUMBER_MASK`, `OFFSET_MARK`, etc., as macro definitions. Sample code is below, where you need to fill in the appropriate values in the blanks in your program.
```
#define PAGE_NUMBER_MASK _____
#define OFFSET_MASK ____
#define PAGES ____
#define OFFSET_BITS ____
#define PAGE_SIZE ____
```

2. For your program to run correctly (and to avoid segmentation faults) it's important that you use correct data types for page number, frame_number, virtual and physical address and offset.

3. Define page table as an integer array.
```
Eg: int page_table[PAGES] = {6,4,3,7,0,1,2,5};
```

4. Take the text file **labaddr.txt** as a command line argument. Use the C library function `openf()` to open the file. Since you will be simply reading from this file choose the 'r' (read) option.
```
Eg: FILE *fptr = fopen(argv[1], "r");
```

5. To read a logical address from the file use the fgets function. Since the addresses are no more than 10 characters long, you can store just 10 characters to the buffer. Sample code is:
```
#define BUFFER_SIZE 10;
char buff[BUFFER_SIZE];
while(fgets(buff, BUFFER_SIZE, fptr) != NULL){...}
```

6. For each logical address compute the page number and offset.

7. After computing the page number (p) and offset (d), extract the frame number for the page (p) and compute the corresponding physical address.

8. For each virtual address in the file, output this address, its page number and page offset, and its corresponding physical address.

9. Close the file. `Sample code: fclose(fptr);`

Note:

- **You are to use bitwise operators in C to compute page number, offset, and physical address.**

- **Refer to lecture notes of Main Memory (Chapter 9), particularly slides # (31, 32, 33, 34) and (52, 53) for this practice lab.**

Correct Program output: **./lab8 labaddr.txt**

Virtual addr is 19986: Page# = 4 & Offset = 3602. Physical addr = 3602.

Virtual addr is 16916: Page# = 4 & Offset = 532. Physical addr = 532.

Virtual addr is 24493: Page# = 5 & Offset = 4013. Physical addr = 8109.

Virtual addr is 8198: Page# = 2 & Offset = 6. Physical addr = 12294.

Virtual addr is 20683: Page# = 5 & Offset = 203. Physical addr = 4299.

Virtual addr is 18515: Page# = 4 & Offset = 2131. Physical addr = 2131.

Virtual addr is 28781: Page# = 7 & Offset = 109. Physical addr = 20589.

Virtual addr is 24462: Page# = 5 & Offset = 3982. Physical addr = 8078.

Virtual addr is 16399: Page# = 4 & Offset = 15. Physical addr = 15.

Virtual addr is 20815: Page# = 5 & Offset = 335. Physical addr = 4431.

Virtual addr is 18295: Page# = 4 & Offset = 1911. Physical addr = 1911.

Virtual addr is 12218: Page# = 2 & Offset = 4026. Physical addr = 16314.

Virtual addr is 13000: Page# = 3 & Offset = 712. Physical addr = 29384.

Virtual addr is 12229: Page# = 2 & Offset = 4037. Physical addr = 16325.

Virtual addr is 27966: Page# = 6 & Offset = 3390. Physical addr = 11582.

Virtual addr is 24894: Page# = 6 & Offset = 318. Physical addr = 8510.

Virtual addr is 28929: Page# = 7 & Offset = 257. Physical addr = 20737.

Virtual addr is 27865: Page# = 6 & Offset = 3289. Physical addr = 11481.

Virtual addr is 5000: Page# = 1 & Offset = 904. Physical addr = 17288.

Virtual addr is 2315: Page# = 0 & Offset = 2315. Physical addr = 26891.