COMP 222 Computer Organization
Assignment #4—Virtual Memory

Objective:
　　　　To translate a virtual address to a physical address, involving a custom-sized fully associative page table.

Inputs:
　　　　The total size of physical memory (in words)
　　　　The page size (words/page)
　　　　The replacement policy (LRU, FIFO)

Outputs:
　　　　The corresponding physical address for a virtual address
　　　　A message indicating a page fault (if any) in the page table

Specification:
　　　　The program translates a virtual address to a physical address based on choosing from a menu of choices, where each choice calls the appropriate procedure, where the choices are:

　　　　　　　　a) Set parameters
　　　　　　　　b) Map virtual address
　　　　　　　　c) Quit program

　　　　Upon entering the parameters, the page table is to be dynamically allocated based on the total number of page frames. The virtual pages will be mapped to the page frames on demand in the page frame order 0,1,2,3,…

　　　　{Hint: When dynamically allocating the page table, initialize each virtual page field to -1 to make it invalid; the page frames do not need to be initialized}

　　　　{Hint: In order to maintain the order of references, arrange the virtual page/physical page frame entries in the page table such that the least-recently-used (or first-in) entry is at index 0—upon revisiting a virtual page (page hit), rearrange the entries, such that the most recently visited page is moved to the last (or lowest-indexed used) entry of the page table.}

　　　　{**Hint:** Upon replacement (page fault), decrease the index of each of the valid entries by 1 and insert the new virtual page/page frame entry at the last (or lowest-indexed unused) entry of the page table}.

What to turn in:
- The source code as a single C file uploaded to Canvas (http://canvas.csun.edu) by the deadline (-20% per consecutive day for late submissions, up to the 4th day).

Sample test run

```
% ./a.out

Virtual memory to Main memory mapping:
--------------------------------------
a) Enter parameters
b) Map virtual address
c) Quit

Enter selection: a
Enter main memory size (words): 2048
Enter page size (words/page): 1024
Enter replacement policy (0=LRU, 1=FIFO): 0

Virtual memory to Main memory mapping:
--------------------------------------
a) Enter parameters
b) Map virtual address
c) Quit

Enter selection: b
Enter virtual memory address to access: 5000
Page fault!
-----------------
| VP    | PF    |
-----------------
| 4     | 0     |
-----------------

Virtual memory to Main memory mapping:
--------------------------------------
a) Enter parameters
b) Map virtual address
c) Quit

Enter selection: b
Enter virtual memory address to access: 2048
Page fault!
-----------------
| VP    | PF    |
-----------------
| 4     | 0     |
-----------------
| 2     | 1     |
-----------------

Virtual memory to Main memory mapping:
--------------------------------------
a) Enter parameters
b) Map virtual address
c) Quit

Enter selection: b
Enter virtual memory address to access: 4509
Virtual address 4509 maps to physical address 413
-----------------
| VP    | PF    |
-----------------
| 2     | 1     |
-----------------
| 4     | 0     |
-----------------

Virtual memory to Main memory mapping:
--------------------------------------
a) Enter parameters
b) Map virtual address
c) Quit

Enter selection: b
Enter virtual memory address to access: 7160
Page fault!
-----------------
| VP    | PF    |
-----------------
| 4     | 0     |
-----------------
| 6     | 1     |
-----------------

Virtual memory to Main memory mapping:
--------------------------------------
a) Enter parameters
b) Map virtual address
c) Quit

Enter selection: c
```