# OS 2016

Homework4:

## Memory Manager

**(Due date: 2016/12/22 23:59:59)**

# Requirements

- Implement a paging based memory manager
  - Allocate/manage physical frames
  - Use an one-level page table for mapping virtual pages to physical frames
  - Implement three place replacement policies
    - FIFO, LRU, Random
    - Any other policy for bonus credits(e.g., LRU Approximation)
- Show the page fault rate and other information under different policies
- Write a document to show the pros and cons of each policy
  - Show your own opinion

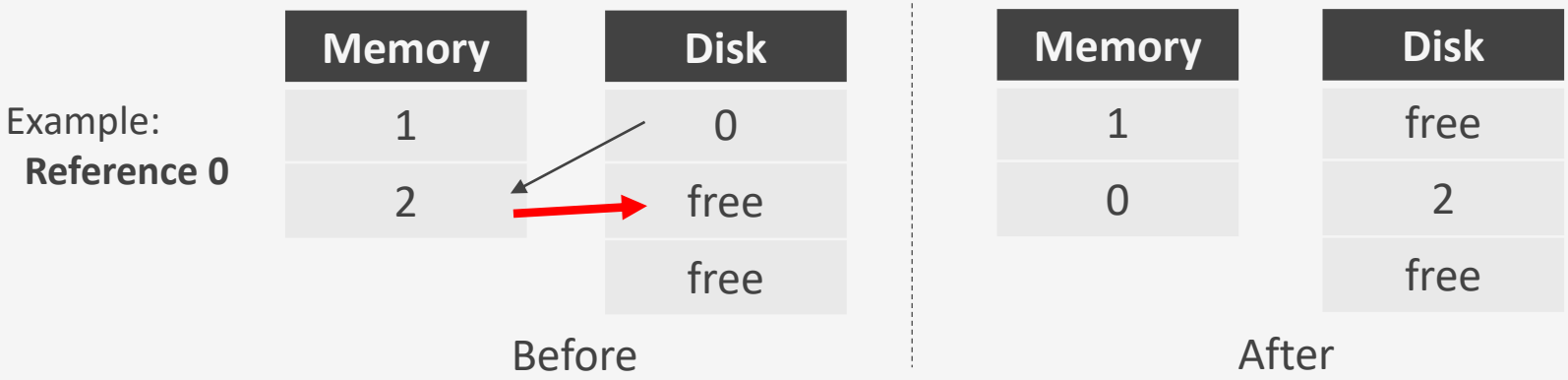
* Input: a sequence of virtual page accesses (trace file)

# Assumptions

- No TLB support
  - Each page access needs to consult the page table
- Only a single process
- Disk always has enough space for evicted pages
- There will be N virtual pages and M physical frames
  - N and M will be given in the trace file
  - N is greater than M

# Memory Manager

- First time reference to a page
  - Mark the corresponding page table entry as in-use
- If a page fault occurs, and physical memory
  - **is not full**: page-in the fault page from the disk to the frame with smallest frame number
  - **is full**: page-in the fault page from the disk to the frame selected by page replacement policy
- To page-out a page, select an free disk block with the smallest disk block number



# Page Table

- In-Use Bit – the page table entry is in-use or not
- Present Bit
  - **1**: the page is in physical memory
  - **0**: the page is not in physical memory
- When a page is page-out to disk block ***K***, the **PFN** field will be set as ***K***

| VPN | PFN | In-Use | Present |
|---|---|---|---|
| **0** | 4 | 1 | 0 |
| **1** | 0 | 1 | 0 |
| **2** | 0 | 0 | 0 |
| | … | | |
| **Z** | 2 | 1 | 1 |

# Input Trace File Format

- Line 1~3 are configs
  - Which Policy?
  - Number of Virtual Page N
    - N ≧ 2
  - Number of Physical Frame M
    - M ≧ 1

```
1 Policy: FIFO | LRU | Random
2 Number of Virtual Page: N
3 Number of Physical Frame: M
4 -----Trace-----
5 Reference 0
6 Reference 1
…
Z Reference 2
```

- Line 5~Z will be traces
  - ***Reference X***: to reference virtual page ***X***

# Output File Format

- Show **Miss/Hit** and related information for each reference
  - Format for a hit: **Hit, VPN=>PFN**
  - Format for a miss: **Miss, PFN, Evicted VPN>>Destination, VPN<<Source**
    - **Source:** the block number of the page which is **page-in** from disk
    - **Destination:** the block number where the evicted page **page-out**
    - If there is no source/destination (e.g., first reference, no page is page-out) or no evicted VPN, set the value as -1
- At the end, show the **page fault rate**

```
Policy: FIFO
Number of Virtual Page: 3
Number of Physical Frame: 2
-----Trace-----
Reference 2
Reference 0
Reference 1
Reference 2
Reference 2
```

```
Miss, 0, -1>>-1, 2<<-1
Miss, 1, -1>>-1, 0<<-1
Miss, 0, 2>>0, 1<<-1
Miss, 1, 0>>1, 2<<0
Hit, 2=>1
Page Fault Rate: 0.800
```

three decimal place accuracy