Project 2

# Cache device

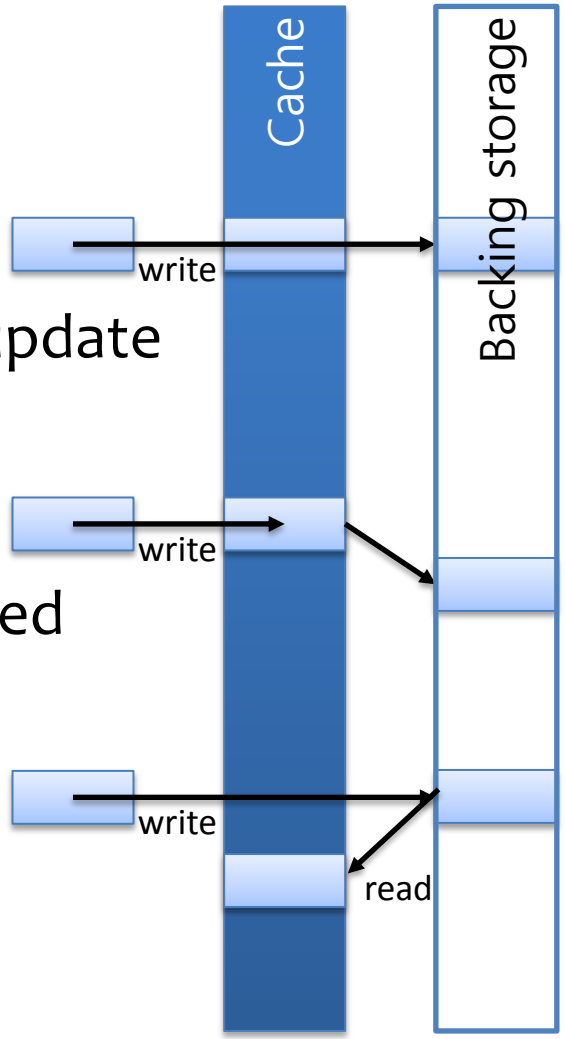
# Project overview

- Implement a cached storage system
  - A smaller device caches frequently used blocks in a larger device
  - Use device-mapper

- Due: 22th May 23:59

# Caching policy

- **Write through**
  - Write req. returns when BS finishes update
- **Write back**
  - Write req. returns when cache updated
- **Write around**
  - Cache is filled when data are read



# Replacement policy

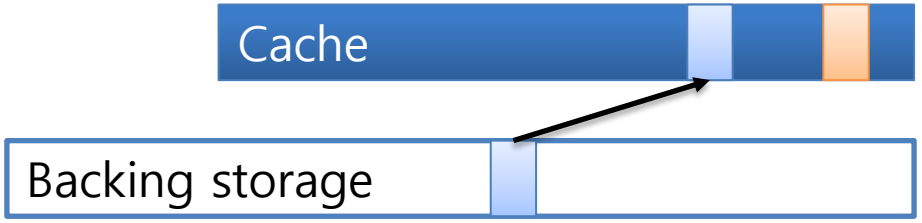
- **Fundamental rule**
  - Before replacing a data block in cache,
    it must have been updated to the backing device

- **FIFO:** simplest approach → sequential replacement

- **LRU:** in a unit of cache chunk (for efficiency)

# Cache meta-data management

- **Objective:** address translation
  - Acquiring the block number of cached block




- **Data structure**
  - Hash table
  - Search tree (B-Tree)
  - Journal (logging)

- ***Synchronization*** of **in-memory** and **on-disk** meta-data
  - Write-through caching simplifies meta-data management

# Other factors to consider

- **Caching unit**: sector, page, block, …
- **Sequential I/O**
  - HDDs show good sequential I/O performance
  - Caching small I/O requests only

# Example

- Existing caching solution in Linux kernel

| | Flashcache | Bcache | DM-cache |
|---|---|---|---|
| **Developer** | Facebook (Mohan Srinivasan) | Google (Kent Overstreet) | RedHat (Joe Thornber) |
| **Allocation** | Set-relative | Global | Global |
| **Metadata** | Set associative array | B-tree | B-tree |
| **Replacement** | FIFO, LRU | FIFO, LRU, RANDOM | Multi-Queue, Clean |
| **Cache modes** | WB / WT / WA<br>WB : writeback, | WB / WT / WA<br>WT : writethrough, | WB / WT<br>WA: writearound |
| **Sequential I/O size** | Configurable (512 blocks) | Dynamic (Sequential_io_avg) | Configurable (512KB) |

# Project goal

- **Base-line**
  - Write through caching
  - FIFO replacement
  - No on-disk meta-data management
- **Extension** (bonus)
  - Write back, write around caching
  - LRU replacement (or other policy)
  - On-disk meta-data management
  - Or other ideas of your own!