CS 5/7343 Fall 2021

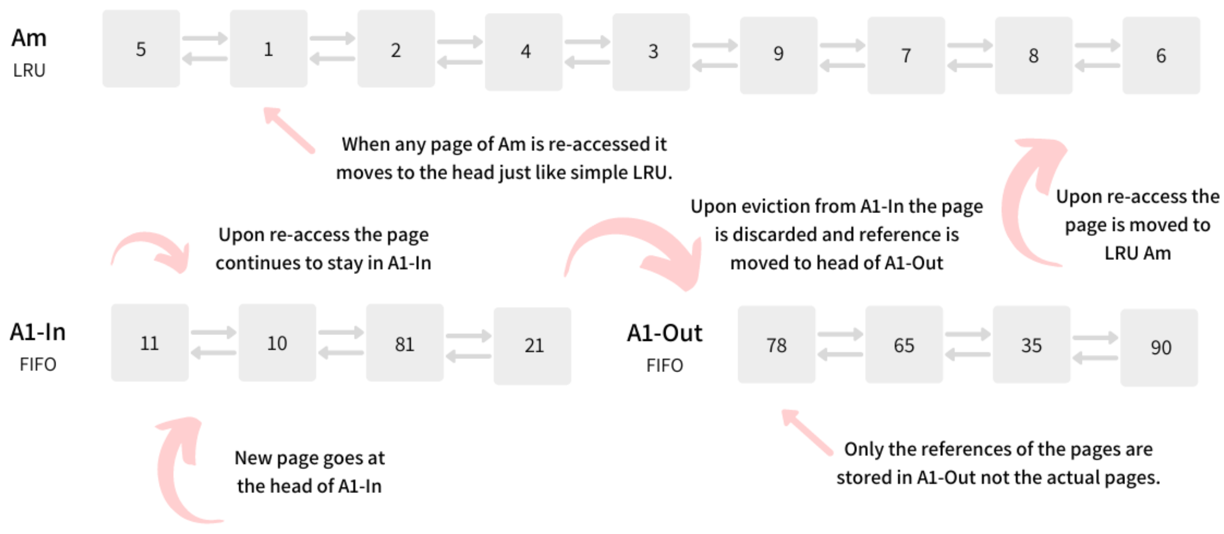
Programming Homework 4

2Q Page Replacement Algorithm

The replacement algorithm I have implemented is the full version of the 2Q replacement algorithm. The 2Q algorithm was proposed by Theodore Johnson and Dennis Shasha. The algorithm incorporates both recently used and frequently used pages. It was designed to address the failings of the LRU algorithm during database scans.

Pages are split between two buffers. The main buffer functions as a traditional LRU queue labeled Am and the secondary buffer is labeled A1. The secondary buffer is further split into two FIFO queues labeled A1in and A1out. When a page fault occurs the reference to the page to A1in. If the A1in queue grows past a certain threshold, its last page will be swapped out of memory and the reference will be pushed into A1out. When the A1out queue grows beyond a threshold, a reference is popped from the end of it and discarded. If a page fault occurs for a page referenced in the A1out queue, then that reference is removed and pushed into the main Am queue. If necessary, a page in the Am queue will be swapped out and its reference discarded.

The algorithm only admits frequently used pages to the main buffer and tests every page for a second reference. Just because a page is accessed once does not entitle it to stay in memory. Instead, only after it is accessed again will the algorithm decide whether or not to move it to the main buffer. The below graphic (courtesy of Arpit Bhayani at https://arpitbhayani.me/blogs/2q-cache) does a better job of describing the algorithm than my description.



Am
LRU
5
1
2
4
3
9
7
8
6
When any page of Am is re-accessed it moves to the head just like simple LRU.
Upon re-access the page continues to stay in A1-In
Upon eviction from A1-In the page is discarded and reference is moved to head of A1-Out
Upon re-access the page is moved to LRU Am
A1-In
FIFO
11
10
81
21
A1-Out
FIFO
78
65
35
90
New page goes at the head of A1-In
Only the references of the pages are stored in A1-Out not the actual pages.

2Q - Full Version