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Exercises in SSDS

Extra Exercises - Virtual Memory

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Submission until and discussion: --

In this exercise, the focus is on the following page replacement algorithms:

- First-In First-Out (FIFO): remove pages that were first loaded into the frames. Please note that when a page is referenced but it is already at the frame, **do not move it to the end of the queue** (same procedure as described in the Virtual Memory slides).
- Least Recently Used (LRU): keep track of pages least recently used pages and remove whenever is necessary. When a page is referenced, it is placed at the end of the queue.
- **Most Recently Used (MRU)**: in contrast to LRU, it considers the most recently used pages. Therefore, when pages are referenced, they are placed at the beginning of the queue.

Algorithm	**Action**
FIFO	Page loaded first is removed
OPT (Optimal)	Remove page that will not be used for the longest period of time
LRU	Remove page that is not used for the longest period of time
MRU	Remove the most recently used page
LFU (Least Frequently Used)	Remove the least frequently used page

1. [Based on slides] A process references the pages below in the following order:

7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 0, 3, 2, 1, 2, 0, 1, 7, 0, 1

Consider that the operating system has **3 frames** in main memory. What is the number of page transfers in the following algorithms:

a) **FIFO**
b) **LRU**

2. [Based on previous exercises] A process references 5 pages identified as 1, 2, 3, 4 and 5 in the following order:

1, 2, 3, 1, 4, 2, 5, 1, 2, 5, 2, 1

Considering that the main memory is initially empty and a system with **3 frames** in main memory. What is the number of page transfers in the following algorithms:

a) **FIFO**
b) **LRU**
c) **MRU**

3. [Based on previous exercises] A process references 5 pages identified as 1, 2, 3, 4 and 5 in the following order:

1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5

Considering that the main memory is initially empty and a system with **3 frames** in main memory. What is the number of page transfers in the following algorithms:

a) **FIFO**
b) **LRU**
c) **MRU**

4. Consider the following pages accessed by a process in an operating system using **FIFO**.

1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5

a) What is the number of page transfers considering **3 frames**? Answer: 9
b) What is the number of page transfers considering **4 frames**? Answer: 10

5. Consider the following pages accessed by a process in an operating system using **OPT**.

1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5

a) What is the number of page transfers considering **4 frames**? Answer: 6
b) Why OPT is unfeasible for a real deployment?