**University of Puerto Rico Rio Piedras Campus**

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Assignment 3: Memory Management

This assignment consists of three programs for the purpose of simulating three different types of page replacement algorithms: optimal, second chance and working set clock. Each algorithm checks if a page is located in the frames in RAM. If the page is not in the frames, retrieve a page from physical memory and replace it with a suitable page from the frames. Each program receives an input file specified by the user.

**Description of Algorithms:**

The optimal page replacement algorithm checks if the pages that are currently located in the frames are going to be referenced again in the future. If a page is not referenced again, then that page will be replaced. If all the pages in the frames are going to be referenced again, then the last page that is going to be referenced will be replaced.

The second chance page replacement algorithm is a modified version of FIFO. This version of the algorithm will not check the reference bit of each page that is hit. Instead, each page hit will take the page from its current location in the frames and place it as the newest element in the array, which is the last element.

The working set clock page replacement algorithm consists of a data structure that contains: the page address, a reference bit, a modified bit, and the virtual time of the page. The program requires a parameter called tau, that serves as an interval of time and is used to compare the age of the page. If there is a page hit, then its reference bit is set to 1, the virtual time is set to the current virtual time, and if the operation is "w", then the modified bit is set to 1. If there is a page fault, then the current page that is being pointed by the clock hand is examined. If the reference bit is set to 1, then it is set 0 and the clock hand advances. If the reference bit is set to 0, then the page is examined to see if it is in the working set: If the age of the frame is less than tau, the clock hand advances. If the age of the frame is greater than tau and its mod bit is 0, then its reference bit is set to 1, the virtual time is set to the current virtual time, and if the operation is "w", then the modified bit is set to 1, and the clock hand advances. If the mod bit is set to 1, the clock hand advances.

**Significant Data Structures:**

frames: array with size fixed by user specification.

flist: array of all page access numbers(addresses).

distance: array that contains the distance of the next reference of each element in frames array.

Page: page class contains reference bit, modified bit, virtual time and page access number.

**Instructions:**

1. Run the optimal program by executing the following command on the terminal:

    python optimal.py <Number of physical memory pages> <access sequence file>

2. Run the second chance program by executing the following command on the terminal:

    python second.py <Number of physical memory pages> <access sequence file>

3. Run the wsclock program by executing the following command on the terminal:

    python wsclock.py <Number of physical memory pages> <tau> <access sequence file>

**Issues:**

   Had discussion with Omar Rosado about the implementation of second chance algorithm
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