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Exercises „Operating Systems and Distributed Systems 2"
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Technology
Arts Sciences
TH Köln

Management of the Storage Hierarchy

Exercise 1: Replacement Strategies

- Given:

  - A "reference string" of a process: 1 2 3 4 1 2 5 1 2 3 4 5

    = sequence of virtual page numbers
      in the order by which they are accessed by the process

  - Replacement strategies:

    i.) FIFO   ii.) LRU

  - Main memory sizes:

    a.) 3 page frames   b.) 4 page frames

    Main memory is empty when the process starts.

- Determine, for all four combinations of replacement strategy and main memory size separately (i.e. FIFO with 3 and with 4 page frames, LRU with 3 and with 4 page frames):

  - The contents of main memory immediately before each page access

  - The instants of the page faults
    (i.e. accesses to pages that are currently not present in main memory)

  - The total number of page faults

- Proceed as shown in:

  - http://www.nt.th-koeln.de/vogt/bs/animationen/FIFOvsLRU_engl.pdf

  - http://www.nt.th-koeln.de/vogt/bs/videos/BVS2_7334.mp4 (from minute 6:55)

- What do you observe regarding the page fault numbers for the different memory sizes?

Exercise 2: Allocation of Fixed Amounts of Main Memory Space

- Assumptions:

  - Static allocation of main memory
    (i.e. a process gets a fixed number of page frames in main memory when it starts)

  - Main memory is initially empty

  - LRU page replacement

- Given: A reference string of a process

  1 2 1 2 1 2 1 2 1 2 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4

  - I.e. there are two phases:

    - 1st phase: Only pages 1 and 2 are accessed

    - 2nd phase: All pages 1-4 are accessed

- Determine:

  a.) For a static allocation of 4 main memory page frames

  b.) For a static allocation of 2 main memory page frames

  - The pages stored in main memory during phase 1 and during phase 2

  - The utilization of main memory (in percent) during phase 1 and during phase 2

  - The instants of the page faults

- What drawbacks do you see for a.) and for b.)?

Exercise 3: Working Set Strategy

- Given:

  - A reference string of a process:

    1212121212...121234123412341234...12343434343434...34
          ↑   ↑   ↑
         t_1 t_2 t_3

  - Window sizes:

    a.) $\delta = 2$ b.) $\delta = 4$

- Determine for both window sizes and each of the instants t_1, t_2, t_3:

  - The Working Set $WS(t_i, \delta)$

  - The amount of main memory space allocated to the process

- What drawback do you see for the smaller window size $\delta = 2$?