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CSCI 4210 — Operating Systems ↘
Spring 2020 Quiz 9 (April 27, 2020)

- This is an open book, open notes quiz. Please do not use any other people as resources including your classmates.
- This quiz is designed to take 25 minutes; therefore, for 50% extra time accommodations, the expected time is 38 minutes and 100% extra time accommodations is 50 minutes (i.e., the end of class).
- Questions will not be answered except when there is a glaring mistake or ambiguity in a question. Please do your best to interpret and answer each question.
- Below is an honor code pledge for this course. By submitting this quiz for grading, you are asserting that you agree with and will abide by this pledge.

Honor Pledge: On my honor, I have neither given nor received any unauthorized aid on this quiz.

For the 4 questions on this quiz, consider a virtual memory that uses static and equal allocation schemes in which all processes have three frames of physical memory. For given process `H`, assume that the three frames of physical memory are allocated to logical pages 4, 2, and 5, as shown below:

```
                  4  2  2  5  4  1  5  4  2  4  2  2  4  1
                  ----------------------------------------
                  4  4  4  4
                  .  2  2  2
                  .  .  .  5
                  ----------------------------------------
page faults ===>  p  p     p
```

1. **(5 POINTS)** Given the remaining 10 page references shown above, how many page faults occur if the least-frequently used (LFU) page replacement algorithm is applied? If a "tie" occurs, use the lowest-numbered page as the page to be replaced. Be sure to count the initial three page faults already shown.

   (a) 6 page faults
   (b) 7 page faults
   (c) 5 page faults
   (d) 4 page faults
   (e) 8 page faults
   (f) 9 page faults

2. **(5 POINTS)** After the LFU algorithm is applied in Question 1 above, what pages are in physical memory? Circle the best answer.

   (a) Pages 2, 4, and 5
   (b) Pages 1, 2, and 5
   (c) Pages 1, 2, and 4
   (d) Pages 1, 2, 4, and 5
   (e) I can't remember
   (f) None of the above

3. **(5 POINTS)** Now consider the `First-In-First-Out` algorithm applied to the same sequence of memory accesses. (The diagram is repeated below for your convenience)

```
                    4  2  2  5  4  1  5  4  2  4  2  2  4  1
                   ----------------------------------------
                    4  4  4  4
                    .  2  2  2
                    .  .  .  5
                   ----------------------------------------
page faults ===>   p  p     p
```

   Given the remaining 10 page references shown above, how many page faults occur if the (FIFO) page replacement algorithm is applied? If a "tie" occurs, use the lowest-numbered page as the "victim" page. Be sure to count the initial three page faults already shown.

   (a) 6 page faults
   (b) 7 page faults
   (c) 5 page faults
   (d) 4 page faults
   (e) 8 page faults
   (f) 9 page faults

4. **(5 POINTS)** After the FIFO algorithm is applied in Question 3 above, what pages are in physical memory? Circle the best answer.

   (a) Pages 2, 4, and 5
   (b) Pages 1, 2, and 5
   (c) Pages 1, 2, and 4
   (d) Pages 1, 2, 4, and 5
   (e) I can't remember
   (f) None of the above