



Calculating number of page faults for 2-d array

Asked 9 years ago Viewed 20.95 k times

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I am trying to study for an exam..and I found this example but can't understand how they got the answer. Can anyone explain it please?

Question:

Consider the two-dimensional array A: `int A[][] = new int[100][100];` where `A[0][0]` is at location 200 in a paged memory system with pages of size 200. A small process that manipulates the matrix resides in the page 0 (location 0 to 199). Thus every instruction fetch will be from page 0. For two page frames, how many page faults are generated by the following array-initialization loops, using LRU replacement and assuming that the first page frame contains the process and the other is initially empty?

A:

```
for (int j=0; j<100; j++)  
    for (int i=0; i<100; i++)  
        A[i][j] = 0;
```

B:

```
for(int i=0; i<100; i++)  
    for (int j=0; j<100; j++)  
        A[i][j] = 0;
```

The correct answer given is : a: $100 \times 50 = 5000$ b: 50

I somewhat understand the first part. There are total of 50 pages. ($10000/200=50$) and every time j changes, a page fault occurs..so a total of 100 page faults..but why is that multiplied by 50? and why is the second one 50?

Thanks!!

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[nya82](#)

asked
9 years ago

Correct Answer



Suppose your systems allocated Two Frames for your process such that **200 * sizeof(int)** of matrix can be keep in memory at a time. And allocation for matrix happens in [Row Major Order](#).

Overview

3.45 M **3.45 M**

Questions Answers

51.42 k **13.5 k**

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In first loop **A**:

```
for (int j=0;j<100;j++)
    for (int i=0; i<100; i++)
        A[i][j] = 0;
```

loop access memory cells for matrix column-wise like:

```
A[0][0], A[2][0], A[3][0], ...A[0][2], A[0][3], A[0][4], .....
    ^      ^      ^
    row changes
```

At each iteration **Row changes** and allocation is in row major and each row takes one page. so code **A** will causes page fault for each alternative **A[i][j]** access so total number of page faults are = $100 * 100 / 2 = 5000$.

Where as second code **B**:

```
for(int i=0; i<100; i++)
    for (int j=0; j<100; j++)
        A[i][j] = 0;
```

loop access memory cells for matrix row-wise on each iteration, like:

```
A[0][0], A[0][5], A[0][6], ..., A[1][0], A[1][7], A[1][8], ..., A[2][0], A[2]
[9],
    ^      ^      ^
    column changes, row are same
```

Access row wise (columns changes at read read **row changes only after 100 read**), One row loaded at time so page fault happens when row changes (for outer loop) and for each alternative row access a page fault happens so number of page faults = $100/2 = 50$.

we can understand it another ways like:

In row major, Number of times row index changes we need new page to access because number of pages are small it page fault on each alternative index change in first A loop row index changes $100*100$ times where as in B loop row index changes 100 times so page fault ration in both $A/B = 100*100/100 = 100$, and if number of page faults happens in A = 50,00 then in B number of page faults = $50,00/100 = 50$.

Similarly you can calculate number of page-faults for [Column-major order](#) and because matrix has equal numbers of rows and cols result will be same.

The similar example is given in my book:

Download a pdf: [operating system book Galvin](#) Read chapter 9: Virtual Memory Section: 9.9.5 Program Structure.

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answered
9 years ago

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