

Assignment 3, CS330a

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Group 21
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1 Part I

1.1 Page Faults

As the Number of Pages in the physical memory increases, we can accommodate more pages corresponding to code and data segment of a process. The first time when a page is accessed it leads to a fault. However, when a page is requested for the second time, the probability that it can be found in the physical memory increases. So the number of calls for allocating a new physical page for a virtual address decreases, Hence number of Page Faults decreases.

1.2 Total Ticks

When translate function raises page fault exception, the system is dedicated to handle the corresponding the exception via exception handler. Handling an exception increases the number of system ticks by 10 units in NACHOS(approximation to real systems). Also after handling the exception the current threads goes to sleep for 1000 time units thus if no thread is present to run in parallel it increases the idle time. Userticks also increases as after handling the exception the program executes from the same instruction which has caused the fault. As a result TotalTicks being the sum of SystemTicks, UserTicks, IdleTicks also increases.

1.3 Page replacement algo

A program has 2 parts code segment and data segment. In case of the program vmtest1, vmtest2 the code section consists instructions such as for loop and increment in the value of variable sum. While the data segment holds the value

of loop variable *i* and variable *sum* and array entries. The data page holding the *sum* and loop variable *i* are one of the first pages to be accessed . Thus this page is inserted at the start of the FIFO queue. Also the page containing the user code instructions are loaded quite early and also occupy position at the start of the queue. However both this code and data are used very frequently, In case of Page Fault exception these pages are replaced as it enters first in the queue . But this page leads to page fault exception shortly as it is required at every iteration of the loop, while in case of LRU the page holding the code and the loop variables are most recently used and are never replaced by page replacement algo. LRU algorithm replaces the page containing the array entries, which is not used for a long time in the future. Thus LRU in this case is a better approximation than FIFO. Owing to large number of replacement of frequently used pages in case of FIFO, the number of page Faults in LRU is less than FIFO . The pages corresponding to the array entries are accessed more or less sequentially.

In case of LRU CLOCK the pages holding the loop variable and instructions are very less likely to be replaced as they are very frequently accessed and their reference bit corresponding to their page is mostly set to one. thus it is very less probable that these pages are swapped out. LRU CLOCK replaces the pages corresponding to the array entries similar to LRU Thus it gives almost similar results in *vmtest1* and *vmtest2* as compared to LRU

1.4 Other Observations

After a certain limit of NumPhysPages of Physical memory (512 in case of *vmtest1*, *vmtest2* , 256 in case of *queue*) number of page Faults in all the algorithm reaches its lower bound (118 in case of *queue* and 376 for *vmtest1* and *vmtest2*) and becomes constant. This is because the number of pages available becomes larger than the number of pages loaded by the program. Page Replacement algo is never invoked and all the Page Faults are made only at the time of loading a page first time in the memory.

2 Statistics

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
queue	16	RANDOM	1443228	1877
queue	16	FIFO	1291019	1519
queue	16	LRU	1191716	1264
queue	16	LRUCLOCK	1192966	1288

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
queue	32	RANDOM	973945	1018
queue	32	FIFO	948381	933
queue	32	LRU	808800	804
queue	32	LRUCLOCK	782313	809

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
queue	64	RANDOM	508781	262
queue	64	FIFO	490167	177
queue	64	LRU	467136	166
queue	64	LRUCLOCK	468665	150

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
queue	128	RANDOM	451364	118
queue	128	FIFO	451364	118
queue	128	LRU	451364	118
queue	128	LRUCLOCK	451364	118

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
queue	256	RANDOM	451364	118
queue	256	FIFO	451364	118
queue	256	LRU	451364	118
queue	256	LRUCLOCK	451364	118

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
queue	512	RANDOM	451364	118
queue	512	FIFO	451364	118
queue	512	LRU	451364	118
queue	512	LRUCLOCK	451364	118

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest1	16	RANDOM	3921836	2373
vmtest1	16	FIFO	3931543	2381
vmtest1	16	LRU	3541602	2021
vmtest1	16	LRUCLOCK	3541602	2021

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest1	32	RANDOM	3475033	1962
vmtest1	32	FIFO	3580966	2055
vmtest1	32	LRU	3411829	1896
vmtest1	32	LRUCLOCK	3413606	1898

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest1	64	RANDOM	3041378	1552
vmtest1	64	FIFO	3233953	1732
vmtest1	64	LRU	3161181	1663
vmtest1	64	LRUCLOCK	3161193	1666

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest1	128	RANDOM	2412367	964
vmtest1	128	FIFO	2716564	1247
vmtest1	128	LRU	2691553	1225
vmtest1	128	LRUCLOCK	2691553	1225

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest1	256	RANDOM	1965679	549
vmtest1	256	FIFO	1785503	381
vmtest1	256	LRU	1783546	379
vmtest1	256	LRUCLOCK	1783546	379

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest1	512	RANDOM	1780259	376
vmtest1	512	FIFO	1780259	376
vmtest1	512	LRU	1780259	376
vmtest1	512	LRUCLOCK	1780259	376

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest2	16	RANDOM	1231111	744
vmtest2	16	FIFO	1217073	732
vmtest2	16	LRU	1109828	632
vmtest2	16	LRUCLOCK	1109828	632

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest2	32	RANDOM	1114141	637
vmtest2	32	FIFO	1136051	657
vmtest2	32	LRU	1088781	613
vmtest2	32	LRUCLOCK	1088845	614

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest2	64	RANDOM	1061213	587
vmtest2	64	FIFO	1070584	596
vmtest2	64	LRU	1049819	578
vmtest2	64	LRUCLOCK	1048030	577

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest2	128	RANDOM	946851	482
vmtest2	128	FIFO	983427	515
vmtest2	128	LRU	976216	509
vmtest2	128	LRUCLOCK	976216	509

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest2	256	RANDOM	873999	414
vmtest2	256	FIFO	839247	381
vmtest2	256	LRU	838713	380
vmtest2	256	LRUCLOCK	838713	380

Program Executed	Total Pages	TypeOfAlgo	TotalTicks	PageFaults
vmtest2	512	RANDOM	835389	377
vmtest2	512	FIFO	835389	377
vmtest2	512	LRU	835389	377
vmtest2	512	LRUCLOCK	835389	377