Jamie Min

Analysis Overview:

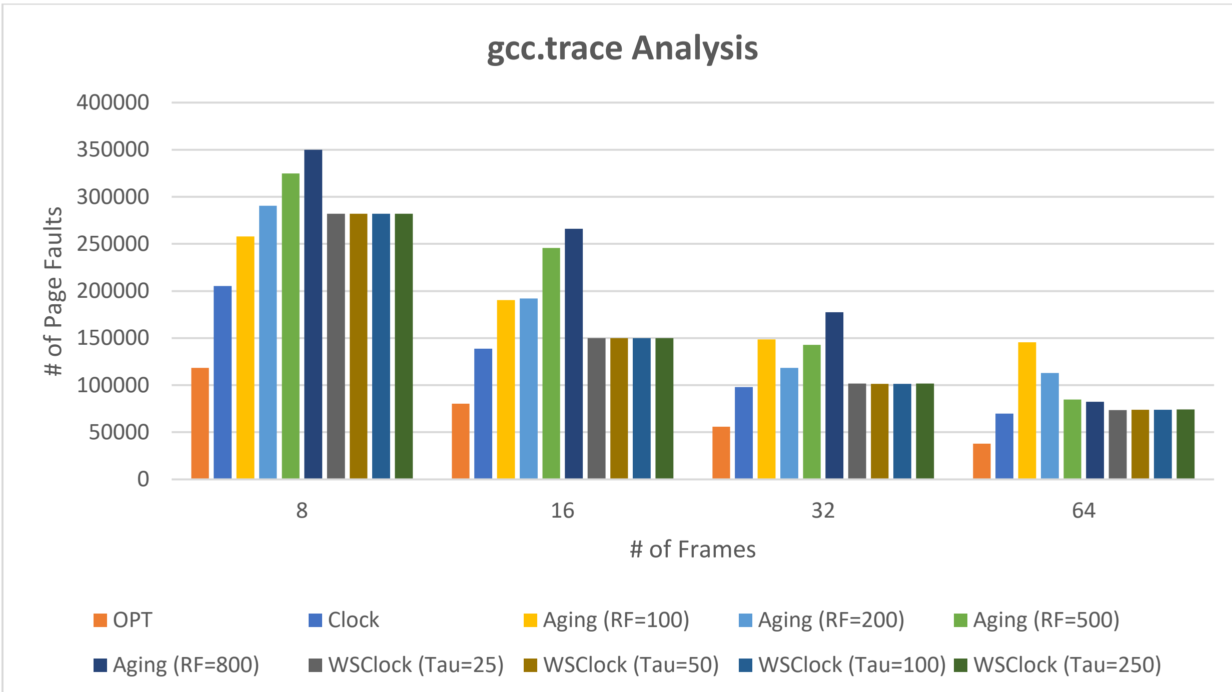

Figure 1 – gcc.trace analysis of several page replacement algorithms. WSClock uses 100 as its refresh rate parameter.

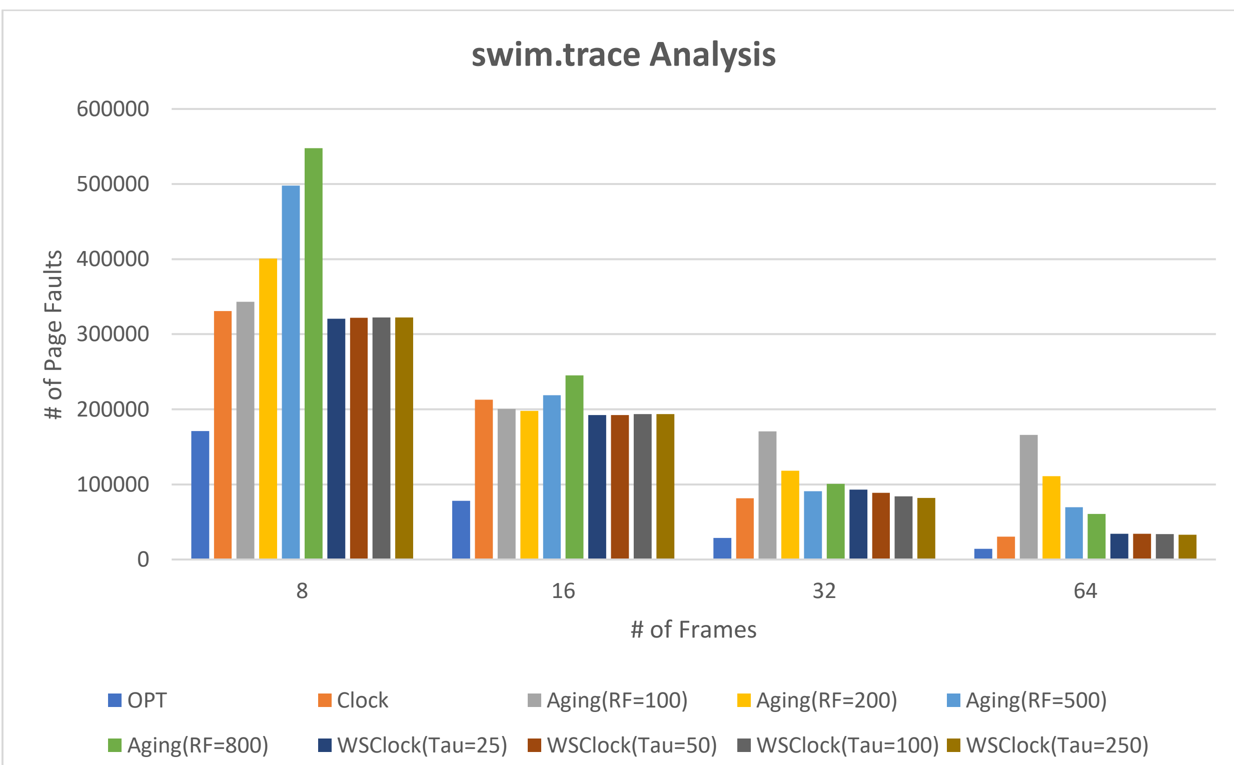

Figure 2 - swim.trace analysis of several page replacement algorithms. WSClock uses 100 as its refresh rate parameter

Aging Analysis:

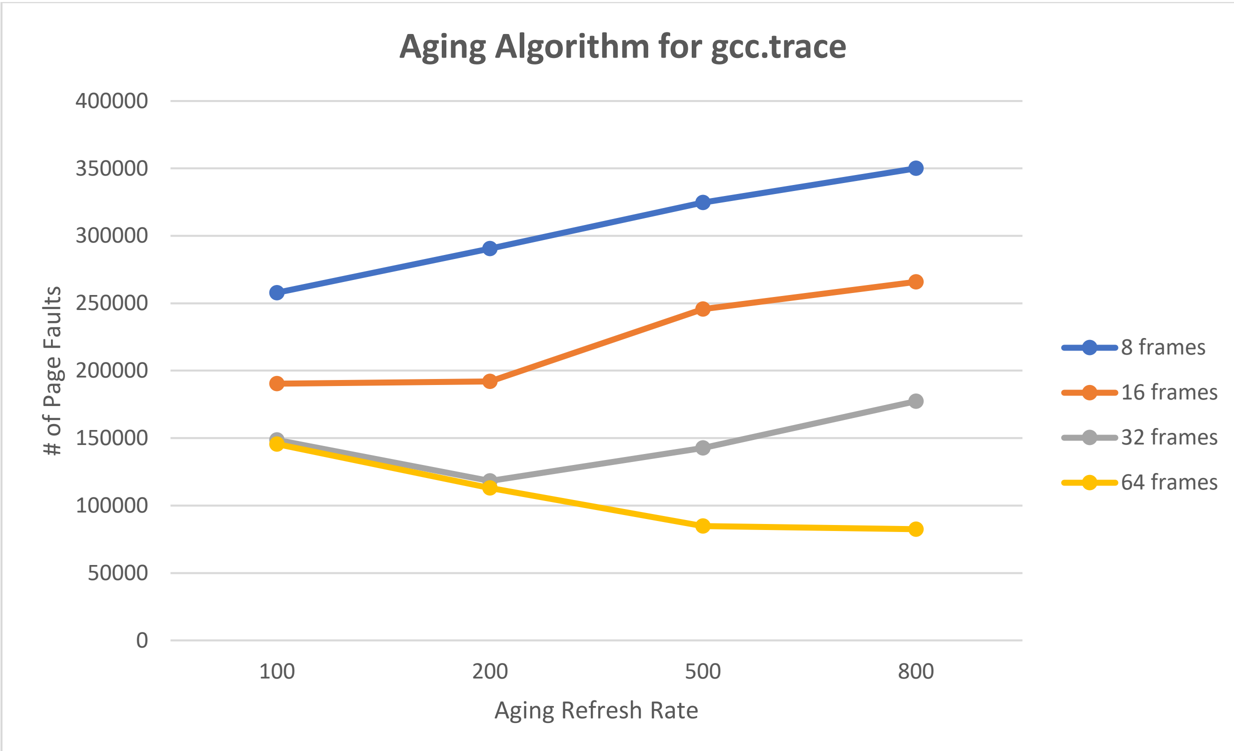

Figure 3 - Aging Algorithm analysis for gcc.trace using different refresh rates.

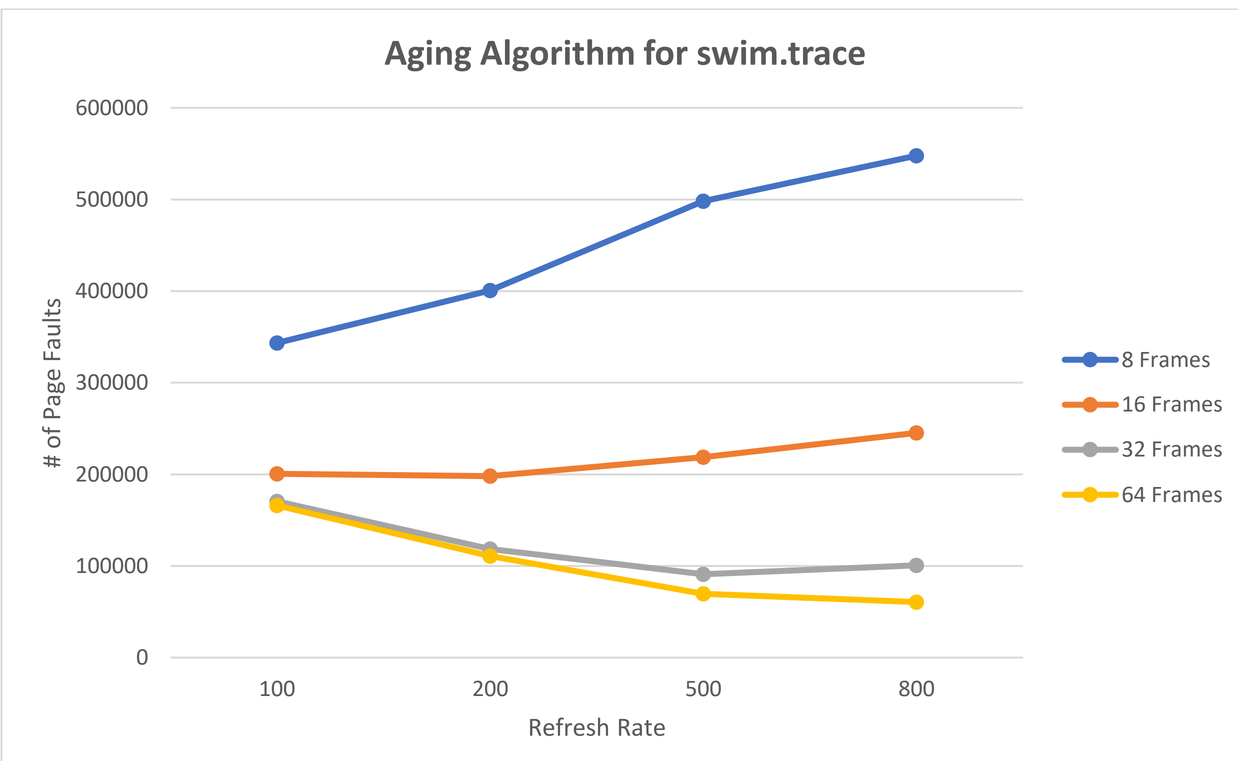

Figure 4 - Aging Algorithm analysis for swim.trace using different refresh rates.

WSClock Analysis:

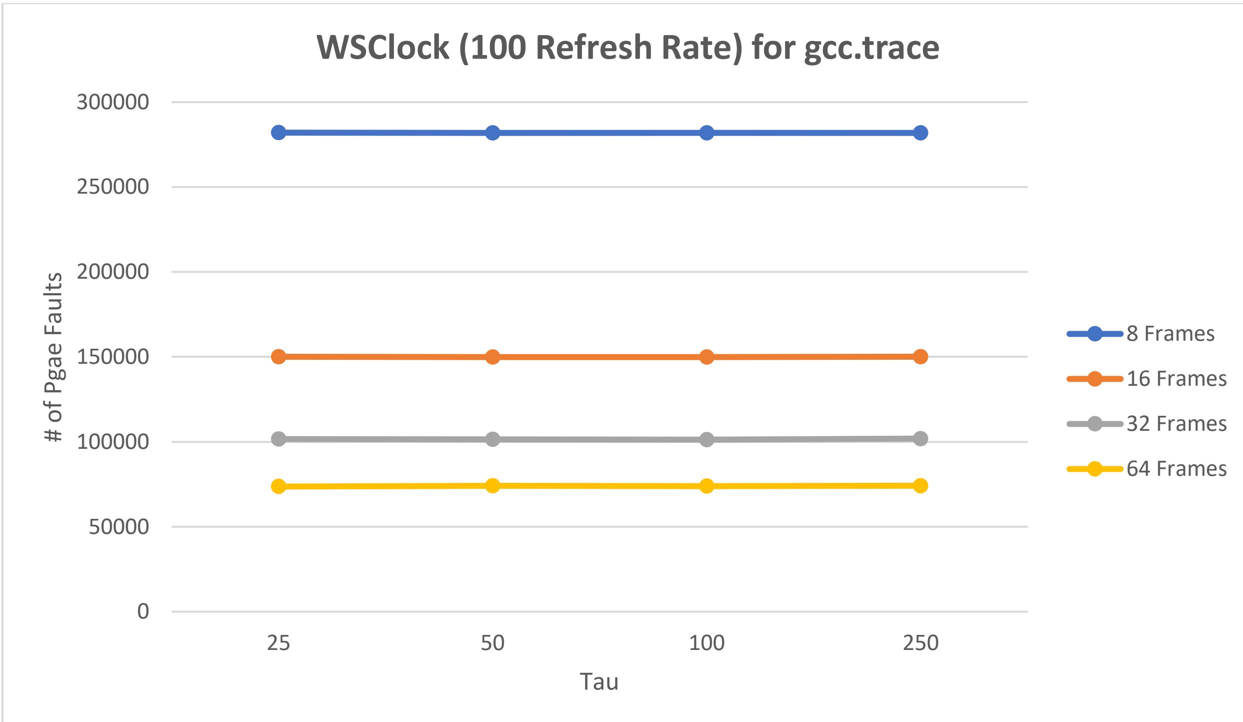

Figure 5 - WSClock Algorithm analysis for gcc.trace using different tau rates.

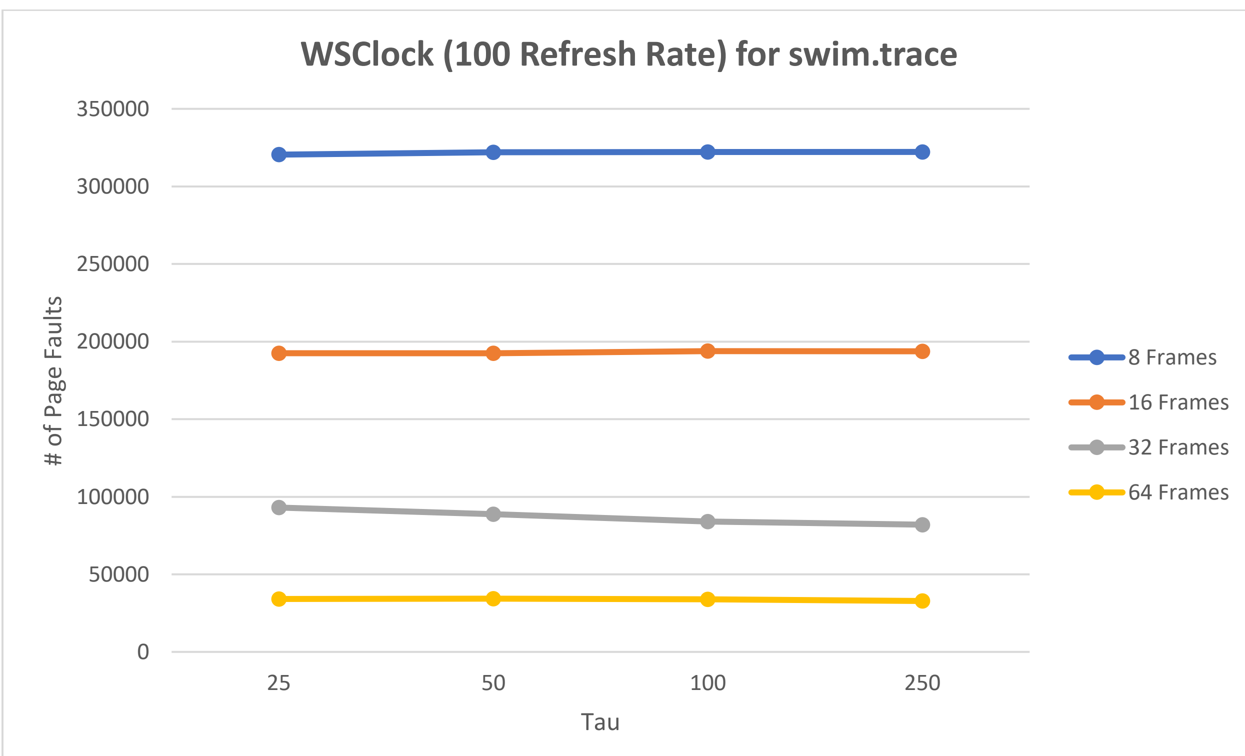

Figure 6 - WSClock Algorithm analysis for swim.trace using different tau rates.

According to the data for both trace files, the clock algorithm generates the least page faults on average for any number of frames given as the parameter. However, as noted in Figure 2 for both the 8 frames and 16 frames run, the clock simulation is not the preferred algorithm. In this case, the WSClock is preferred. Furthermore, according to the data having higher frames always generates less page faults. Across both Figure 1 and Figure 2, having 64 frames significantly decreases the number of page faults compared to 8 frames. Practically, this would not be a good choice as the memory overhead increases proportionately to the number of frames. The developer should make an informed and consistent approach should the developer have the choice on the number of frames to use in virtual memory implementation. Interestingly, the WSClock implementation for both trace files did not dramatically decrease or increase the number of page faults. Additionally, relative to the other algorithms, aging does not seem like a good choice for virtual memory management.

Looking at the aging analysis for Figure 3 and Figure 4, it seems that having a low refresh rate negatively impacts the performance of the aging algorithm. The data shows that using a refresh rate somewhere between 50 and 250 gives the least number of page faults. However, when using a low number of frames, having even a lower refresh rate is preferred. Anything more than 500 as a refresh rate shows an increase number of page faults for 8, 16, and 32 frames. Logically this makes sense as having a longer refresh rate increases the chances of encountering an invalid page, or a page fault. For 8 frames, anything lower than 100 is preferred.

Looking at the WSClock analysis for Figure 5 and Figure 6, surprisingly there was no dramatic change of page faults regardless of the tau parameter set at a refresh rate of 100. This leads me to two conclusions. Either there is an implementation error or the refresh rate to tau ratio is not optimal. The data shows a faulty logic in the way that page faults are generated when tau surpasses the set refresh rate. This leads me to believe that there is an implementation error as the page faults should largely be the same for any tau set at equal to or greater than the refresh rate as no page will ever be older than tau. However, I also believe that choosing the right refresh rate to tau ratio is important in determining a good choice for tau. According to the data, any tau set between 50 and 100 seems to be a good choice for this implementation. Having a low tau would accrue unnecessary work and having a tau greater than the refresh rate would be pointless.

In conclusion, the WSClock is the preferred choice for swim.trace whereas the Clock algorithm is the preferred choice for gcc.trace. The challenge with WSClock comes with determining a good ratio between the refresh rate and tau, and the data shows that it is inconsistent between different trace files. A virtual memory developer would need to be conscientious on how different refresh rates to tau might affect the performance for different task which would incur extra work overhead. In short, I believe the second chance variant Clock algorithm to be the best algorithm supported by the data.

Appendix A – gcc.trace data

OPT

Frames	Page Faults	Disk Writes
8	118480	15032
16	80307	11319
32	55802	8279
64	38050	5746

Clock

Frames	Page Faults	Disk Writes
8	205377	37529
16	138703	24109
32	97907	16745
64	69778	12044

Aging

Frames	Refresh Rate	Page Faults	Disk Writes
8	100	257852	26791
16	100	190390	24016
32	100	148523	21540
64	100	145539	21321

Frames	Refresh Rate	Page Faults	Disk Writes
8	200	290462	22414
16	200	192121	20278
32	200	118252	17104
64	200	112971	16461

Frames	Refresh Rate	Page Faults	Disk Writes
8	500	324714	20391
16	500	245743	16670
32	500	142737	15076
64	500	84743	12770

Frames	Refresh Rate	Page Faults	Disk Writes
8	800	350037	23827
16	800	265894	15316
32	800	177347	13874
64	800	82459	11731

WSClock

Frames	Refresh Rate	Tau	Page Faults	Disk Writes
8	100	25	337330	39594
16	100	25	254825	22786
32	100	25	189779	13435
64	100	25	128388	6903

Frames	Refresh Rate	Tau	Page Faults	Disk Writes
8	100	50	259054	31350
16	100	50	212858	22630
32	100	50	163759	13607
64	100	50	118640	6875

Frames	Refresh Rate	Tau	Page Faults	Disk Writes
8	100	100	233374	38642
16	100	100	169187	17634
32	100	100	142809	12517
64	100	100	106199	6993

Frames	Refresh Rate	Tau	Page Faults	Disk Writes
8	100	250	210187	38445
16	100	250	158140	24230
32	100	250	120551	13239
64	100	250	92852	7319

Appendix B – swim.trace data

OPT

Frames	Page Faults	Disk Writes
8	171244	46452
16	78312	18134
32	28826	6916
64	14289	4114

Clock

Frames	Page Faults	Disk Writes
8	330879	55464
16	212795	46956
32	81498	18217
64	30368	7662

Aging

Frames	Refresh Rate	Page Faults	Disk Writes
8	100	343419	45152
16	100	200675	34685
32	100	170477	30451
64	100	165984	29735

Frames	Refresh Rate	Page Faults	Disk Writes
8	200	400652	31621
16	200	198018	29601
32	200	118348	20998
64	200	110965	20072

Frames	Refresh Rate	Page Faults	Disk Writes
8	500	497998	21028
16	500	218758	17970
32	500	90960	14788
64	500	69591	12189

Frames	Refresh Rate	Page Faults	Disk Writes
8	800	547742	20128
16	800	245245	14412
32	800	100640	13093
64	800	60619	10088

WSClock

Frames	Refresh Rate	Tau	Page Faults	Disk Writes
8	100	25	320489	50795
16	100	25	192518	37708
32	100	25	93031	9877
64	100	25	34194	8052

Frames	Refresh Rate	Tau	Page Faults	Disk Writes
8	100	50	321995	50811
16	100	50	192459	38789
32	100	50	88703	11013
64	100	50	34327	8089

Frames	Refresh Rate	Tau	Page Faults	Disk Writes
8	100	100	322170	50860
16	100	100	193842	39729
32	100	100	83971	12863
64	100	100	33883	7927

Frames	Refresh Rate	Tau	Page Faults	Disk Writes
8	100	250	322146	50854
16	100	250	193783	39704
32	100	250	82008	16804
64	100	250	32813	7832