

Compute Intensive Application

Purpose:

For this case, I have used the two-dimensional array in which I am trying to access the array entry in column-major format. The size of my array is based on the system page size. My column dimension would be total number of integers that can be accommodated within a page size such as division of page size by size of int on the system specific machine. And row dimension could be the number within the range of the column dimension otherwise segmentation fault or core dumped would be generated.

What's Important

The loop occurs in column major format so it skips over an entire page. Page fault occurs on purpose as I am trying to access the entry in an array using column major format and finally printing the average could be anything might be wrong answer as well. Just caring about how page fault is being generated. However, if you arrange the same in row-major fault then there would be page fault at first and then it would reduce slowly.

My Key Observation

As I am doing simple average calculation, if matrix multiplication was there then page fault would occur rapidly and at the same time cache and TLB would get re-populated based on how much page faults process does and how much size of your array is. Initially this is known as **Cold Start Penalty** because no TLB entry is present and as page fault occurs the TLB gets filled up and there would be reduction in page faults.

Log

Some of the page faults I have shown here that I have used the same to plot the graph:

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[14272.671533] Time (nsec) = 735013482 Address = 0x7ffc3f7f0240
[14272.671544] Time (nsec) = 735013482 Address = 0x7ffc3f7f1240
[14272.671546] Time (nsec) = 735013482 Address = 0x7ffc3f7f2240
[14272.671547] Time (nsec) = 735013482 Address = 0x7ffc3f7f3240
[14272.671549] Time (nsec) = 735013482 Address = 0x7ffc3f7f4240
[14272.671551] Time (nsec) = 735013482 Address = 0x7ffc3f7f5240
[14272.671552] Time (nsec) = 735013482 Address = 0x7ffc3f7f6240
[14272.671554] Time (nsec) = 735013482 Address = 0x7ffc3f7f7240
[14272.671556] Time (nsec) = 735013482 Address = 0x7ffc3f7f8240
[14272.671557] Time (nsec) = 735013482 Address = 0x7ffc3f7f9240
[14272.671559] Time (nsec) = 735013482 Address = 0x7ffc3f7fa240
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[14272.671561] Time (nsec) = 735013482 Address = 0x7ffc3f7fb240
[14272.671562] Time (nsec) = 735013482 Address = 0x7ffc3f7fc240

[14272.672011] Time (nsec) = 735013482 Address = 0x7ffc3fb00240
[14272.672013] Time (nsec) = 735013482 Address = 0x7ffc3fb01240
[14272.672015] Time (nsec) = 735013482 Address = 0x7ffc3fb02240
[14272.672016] Time (nsec) = 735013482 Address = 0x7ffc3fb03240
[14272.672018] Time (nsec) = 735013482 Address = 0x7ffc3fb04240
[14272.672019] Time (nsec) = 735013482 Address = 0x7ffc3fb05240
[14272.672021] Time (nsec) = 735013482 Address = 0x7ffc3fb06240
[14272.672023] Time (nsec) = 735013482 Address = 0x7ffc3fb07240
[14272.672024] Time (nsec) = 735013482 Address = 0x7ffc3fb08240
[14272.672026] Time (nsec) = 735013482 Address = 0x7ffc3fb09240
[14272.672028] Time (nsec) = 735013482 Address = 0x7ffc3fb0a240
[14272.672029] Time (nsec) = 735013482 Address = 0x7ffc3fb0b240
[14272.672031] Time (nsec) = 735013482 Address = 0x7ffc3fb0c240
[14272.672032] Time (nsec) = 735013482 Address = 0x7ffc3fb0d240
[14272.672034] Time (nsec) = 735013482 Address = 0x7ffc3fb0e240
[14272.672036] Time (nsec) = 735013482 Address = 0x7ffc3fb0f240
[14272.672037] Time (nsec) = 735013482 Address = 0x7ffc3fb10240
[14272.672039] Time (nsec) = 735013482 Address = 0x7ffc3fb11240

[14272.672114] Time (nsec) = 735013482 Address = 0x7ffc3fb3b240
[14272.672116] Time (nsec) = 735013482 Address = 0x7ffc3fb3c240
[14272.672118] Time (nsec) = 735013482 Address = 0x7ffc3fb3d240
[14272.672120] Time (nsec) = 735013482 Address = 0x7ffc3fb3e240
[14272.672122] Time (nsec) = 735013482 Address = 0x7ffc3fb3f240
[14272.672125] Time (nsec) = 735013482 Address = 0x7ffc3fb40240
[14272.672127] Time (nsec) = 735013482 Address = 0x7ffc3fb41240
[14272.672129] Time (nsec) = 735013482 Address = 0x7ffc3fb42240
[14272.672132] Time (nsec) = 735013482 Address = 0x7ffc3fb43240
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[14272.672144] Time (nsec) = 735013482 Address = 0x7ffc3fb48240
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[14272.672148] Time (nsec) = 735013482 Address = 0x7ffc3fb4a240
[14272.672151] Time (nsec) = 735013482 Address = 0x7ffc3fb4b240
[14272.672153] Time (nsec) = 735013482 Address = 0x7ffc3fb4c240
[14272.672156] Time (nsec) = 735013482 Address = 0x7ffc3fb4d240
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[14272.672160] Time (nsec) = 735013482 Address = 0x7ffc3fb4f240
[14272.672162] Time (nsec) = 735013482 Address = 0x7ffc3fb50240
[14272.672165] Time (nsec) = 735013482 Address = 0x7ffc3fb51240
[14272.672167] Time (nsec) = 735013482 Address = 0x7ffc3fb52240

[14272.672169] Time (nsec) = 735013482 Address = 0x7ffc3fb53240
[14272.672171] Time (nsec) = 735013482 Address = 0x7ffc3fb54240
[14272.672173] Time (nsec) = 735013482 Address = 0x7ffc3fb55240

[14272.672190] Time (nsec) = 735013482 Address = 0x7ffc3fb5d240
[14272.672192] Time (nsec) = 735013482 Address = 0x7ffc3fb5e240
[14272.672194] Time (nsec) = 735013482 Address = 0x7ffc3fb5f240
[14272.672196] Time (nsec) = 735013482 Address = 0x7ffc3fb60240
[14272.672199] Time (nsec) = 735013482 Address = 0x7ffc3fb61240
[14272.672201] Time (nsec) = 735013482 Address = 0x7ffc3fb62240
[14272.672203] Time (nsec) = 735013482 Address = 0x7ffc3fb63240
[14272.672205] Time (nsec) = 735013482 Address = 0x7ffc3fb64240

Scatter Plot

Many page faults occur within the same time frame as and when array entry gets accessed as it skips over the entire page.

The graph uses the following set of pairs.

X- Time

Y- Virtual Address

Please see the red dots. It looks one however there are many of them.

(0,0)
(735013482, 140721373774400)
(735013482, 140721373778496)
(735013482, 140721373782592)
(735013482, 140721373786688)
(735013482, 140721373790784)
(735013482, 140721373794880)
(735013482, 140721373798976)
(735013482, 140721373803072)
(735013482, 140721373807168)
(735013482, 140721373811264)
(735013482, 140721373815360)
(735013482, 140721373819456)
(735013482, 140721373823552)
(735013482, 140721373827648)
(735013482, 140721373831744)
(735013482, 140721373835840)
(735013482, 140721373839936)
(735013482, 140721377276480)
(735013482, 140721377280576)
(735013482, 140721377284672)
(735013482, 140721377288768)
(735013482, 140721377292864)
(735013482, 140721377296960)
(735013482, 140721376936512)
(735013482, 140721376952896)
(735013482, 140721376977472)
(735013482, 140721376989760)

(735013482,140721376997952)
(735013482,140721377010240)
(735013482,140721377018432)
(735013482,140721377030720)
(735013482,140721377677888)
(735013482,140721377686080)
(735013482,140721377698368)
(735013482,140721377714752)
(735013482,140721377743424)
(743013477,140721373774392)
(743013477,140721373772972)

