Hw3 Hairu Wen

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https://github.com/CS211-Fall2023/hw3-hwen020

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## Problem 1 (10 points):

Run the parallel Sieve of Eratosthenes program given in the slides (which is also sieve0).

Problem 2 (30 points):

Modify the parallel Sieve of Eratosthenes program in class (sieve0) so that the program does NOT set aside memory for even integers. Put your code in sieve1. Problem 3 (30 points):

Modify sieve1 so that each process of the program finds its own sieving primes via local computations instead of broadcasts. Put your code in sieve2. Problem 4 (30 points):

Modify sieve2 so that the program can have effective uses of caches. Put your code in sieve3.

For each version of sieve, record the time and number of primes when  $n=10^{10}$  and number of cores = 24, 48, 72, 96, 120 (which means number of nodes = 1, 2, 3, 4, 5). Check whether your execution time is inversely proportional to the number of cores. Compare the execution time of each version of your program to see how different designs affect the execution time.

## Answer:

```
[hwen020@cluster-001-login-node hw3-hwen020]$ python3 starter.py
make: 'main' is up to date.
mkdir: cannot create directory 'sh': File exists
Submitted batch job 34037
Submitted batch job 34038
Submitted batch job 34039
Submitted batch job 34040
Submitted batch job 34041
Submitted batch job 34042
Submitted batch job 34043
Submitted batch job 34044
Submitted batch job 34045
Submitted batch job 34046
Submitted batch job 34047
Submitted batch job 34048
Submitted batch job 34049
Submitted batch job 34050
Submitted batch job 34051
Submitted batch job 34052
Submitted batch job 34053
Submitted batch job 34054
Submitted batch job 34055
Submitted batch job 34056
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	n-node hw3-hwen020]\$ sacctformat=JobID,JobName,AllocCPUS,Start,Ei
JobID JobName A	AllocCPUS Start End
33839 sieve0_1 33839.batch batch	24 2023-11-22T00:44:02 2023-11-22T00:44:24 24 2023-11-22T00:44:02 2023-11-22T00:44:24
33839.extern extern	24 2023-11-22T00:44:02 2023-11-22T00:44:24
33839.0 hydra_pmi+	24 2023-11-22T00:44:02 2023-11-22T00:44:24
33915.0 hvdra_pmi+	120 2023-11-22T01:19:13 2023-11-22T01:19:15
34037 sieve0_1 34037.batch batch	24 2023-11-22T02:25:49 2023-11-22T02:26:12 24 2023-11-22T02:25:49 2023-11-22T02:26:12
34037.extern extern	24 2023-11-22T02:25:49 2023-11-22T02:26:12 Z3S
34037.0 hydra pmi+ 34038 sieve1_1	24 2023-11-22T02:25:49 2023-11-22T02:26:12 24 2023-11-22T02:25:49 2023-11-22T02:26:00
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34038.extern extern 34038.0 hydra_pmi+	24 2023-11-22102:25:49 2023-11-22102:26:00
34039 sieve2_1 34039.batch batch	24 2023-11-22T02:25:49 2023-11-22T02:26:02 24 2023-11-22T02:25:49 2023-11-22T02:26:02
34039.extern extern	24 2023-11-22T02:25:49 2023-11-22T02:26:02
34039_0 <u>hydra_pmi+</u> 34040 sieve3_1	24 2023-11-22T02:25:49 2023-11-22T02:25:57
34040.batch batch	24 2023-11-22T02:25:49 2023-11-22T02:25:57
34040.extern extern 34040.0 hvdra pmi+	24 2023-11-22T02:25:49 2023-11-22T02:25:57 24 2023-11-22T02:25:49 2023-11-22T02:25:57
34041 sieve0_2 34041.batch batch	48 2023-11-22T02:25:57 2023-11-22T02:26:09 24 2023-11-22T02:25:57 2023-11-22T02:26:09
34041.extern extern	48 2023-11-22T02:25:57 2023-11-22T02:26:09 12s
34041.0 hydra_pmi+ 34042 sieve1_2	48 2023-11-22T02:25:57 2023-11-22T02:26:09 48 2023-11-22T02:26:03 2023-11-22T02:26:08
34042.batch batch	24 2023-11-22T02:26:03 2023-11-22T02:26:08
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number of nodes	1	2	3	4	5
sieve0	23	12	8	6	5
sieve1	11	11	4	3	2
sieve2	13	6	4	3	2
sieve3	8	4	2	2	1

Table. Execution Time(seconds) of each version

From the above outcome we can see that execution time is inversely proportional to the number of cores.

Execution time gets lower and lower(which means efficiency getting higher and higher) from sieve0 to 3: the program that can have effective uses of caches (3)

>(is better than / has lower execution time / is more efficient than)the program that finds its own sieving primes via local computations instead of broadcasts (2)

>the program that does NOT set aside memory for even integers (1)

>the origin version (0)