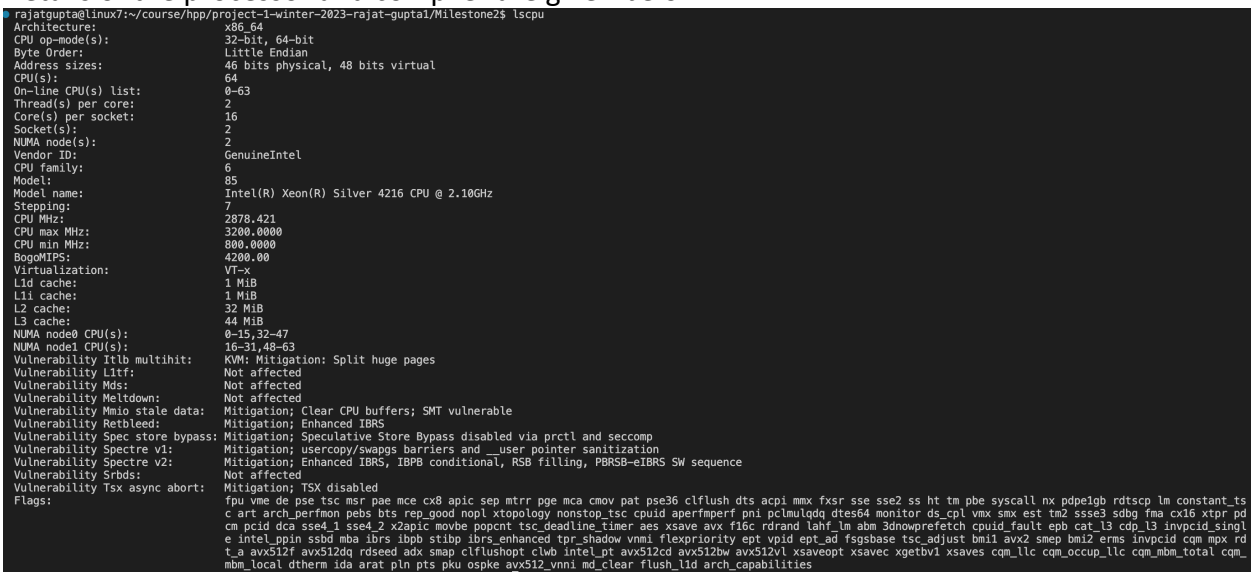
Project-1 Milestone-2

Details of the processor and compiler are given below:



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rajatgupta@linux7:~/course/hpp/project-1-winter-2023-rajat-gupta1/Milestone2$ lscpu
Architecture:                    x86_64
CPU op-mode(s):                  32-bit, 64-bit
Byte Order:                      Little Endian
Address sizes:                   46 bits physical, 48 bits virtual
CPU(s):                          64
On-line CPU(s) list:             0-63
Thread(s) per core:              2
Core(s) per socket:              16
Socket(s):                       2
NUMA node(s):                    2
Vendor ID:                       GenuineIntel
CPU family:                      6
Model:                           85
Model name:                      Intel(R) Xeon(R) Silver 4216 CPU @ 2.10GHz
Stepping:                        7
CPU MHz:                         2878.421
CPU max MHz:                     3200.0000
CPU min MHz:                     800.0000
BogoMIPS:                        4200.00
Virtualization:                  VT-x
L1d cache:                       1 MiB
L1i cache:                       1 MiB
L2 cache:                        32 MiB
L3 cache:                        44 MiB
NUMA node0 CPU(s):               0-15,32-47
NUMA node1 CPU(s):               16-31,48-63
Vulnerability Itlb multihit:     KVM: Mitigation: Split huge pages
Vulnerability L1tf:              Not affected
Vulnerability Mds:               Not affected
Vulnerability Meltdown:          Not affected
Vulnerability Mmio stale data:   Mitigation; Clear CPU buffers; SMT vulnerable
Vulnerability Retbleed:          Mitigation; Enhanced IBRS
Vulnerability Spec store bypass: Mitigation; Speculative Store Bypass disabled via prctl and seccomp
Vulnerability Spectre v1:        Mitigation; usercopy/swapgs barriers and __user pointer sanitization
Vulnerability Spectre v2:        Mitigation; Enhanced IBRS, IBPB conditional, RSB filling, PBRSB-eIBRS SW sequence
Vulnerability Srbds:             Not affected
Vulnerability Tsx async abort:   Mitigation; TSX disabled
Flags:                           fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant_ts
                                 c art arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid aperfmperf pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3 sdbg fma cx16 xtpr pd
                                 cm pcid dca sse4_1 sse4_2 x2apic movbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epb cat_l3 cdp_l3 invpcid_singl
                                 e intel_ppin ssbd mba ibrs ibpb stibp ibrs_enhanced tpr_shadow vnmi flexpriority ept vpid ept_ad fsgsbase tsc_adjust bmi1 avx2 smep bmi2 erms invpcid cqm mpx rd
                                 t_a avx512f avx512dq rdseed adx smap clflushopt clwb intel_pt avx512cd avx512bw avx512vl xsaveopt xsavec xgetbv1 xsaves cqm_llc cqm_occup_llc cqm_mbm_total cqm_
                                 mbm_local dtherm ida arat pln pts pku ospke avx512_vnni md_clear flush_l1d arch_capabilities
```

The basic command to run the code is given below:

./Project1 1600 400 1 1.0e3 5.0e-7 2.85e-7 4 1

Here the arguments are as follows:
N
NT
L
T
u
v
nt (Number of threads)
method (1 for Lax, 2 for first order method, 3 for second order method)

Here we are getting the same answer with parallel and series (When number of cores are 1 in series)
For parallel – 15.38
For parallel 4 cores – 4.31
For series – 15.9
Yes, bitwise reproducibility is expected, because in both series and parallel (when core is 1), the operations will take place one after the other

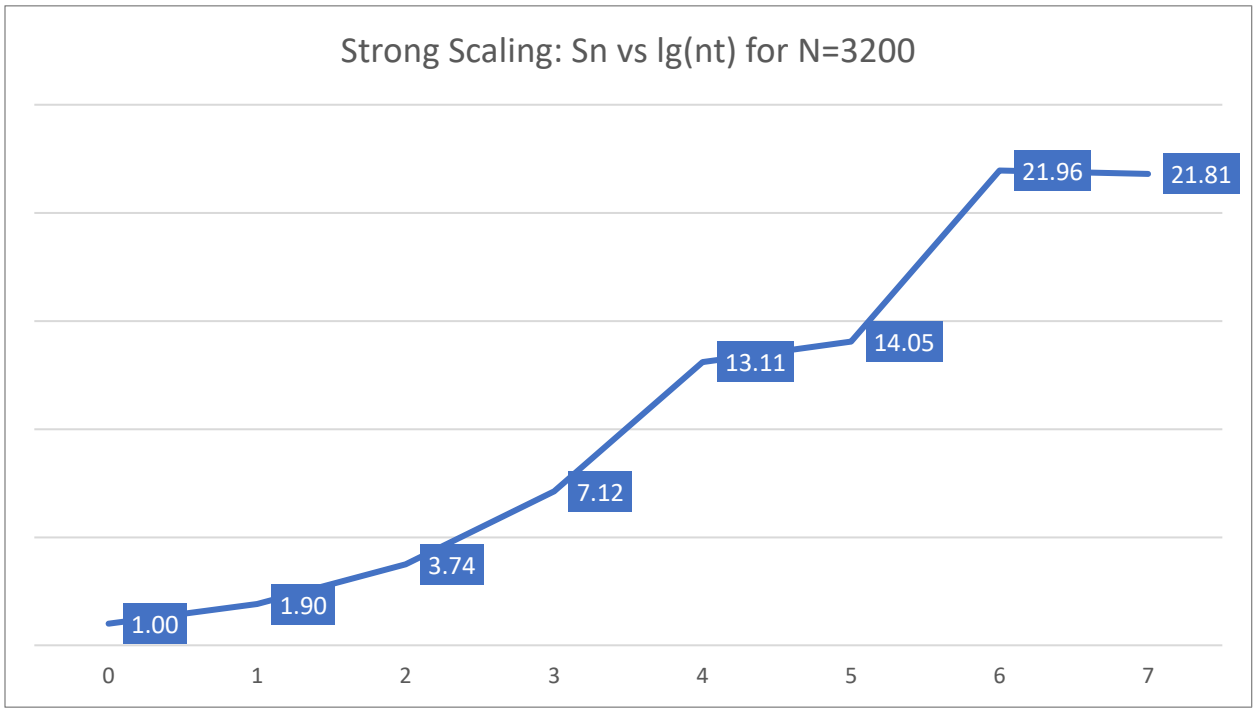
Time taken for N=10000 for first assignment: 2000s

```
The value of Matrix Dimension, N is:                    10000
The value of Number of timestamps, NT is:               20000
The value of Physical Cartesian Domain Length, L is:    1.000000
The value of Total Physical Timespan, T is:             1000000.000000
The value of X velocity scalar, u is:                   0.0000005000
The value of Y velocity scalar, v is:                   0.0000002850
Memory to be used will be 200000000 time size of double
time(s): 2000.893945
```

The value of grind rate = 10000 ^ 2 * 20000 / 2000.89 = 0.99B

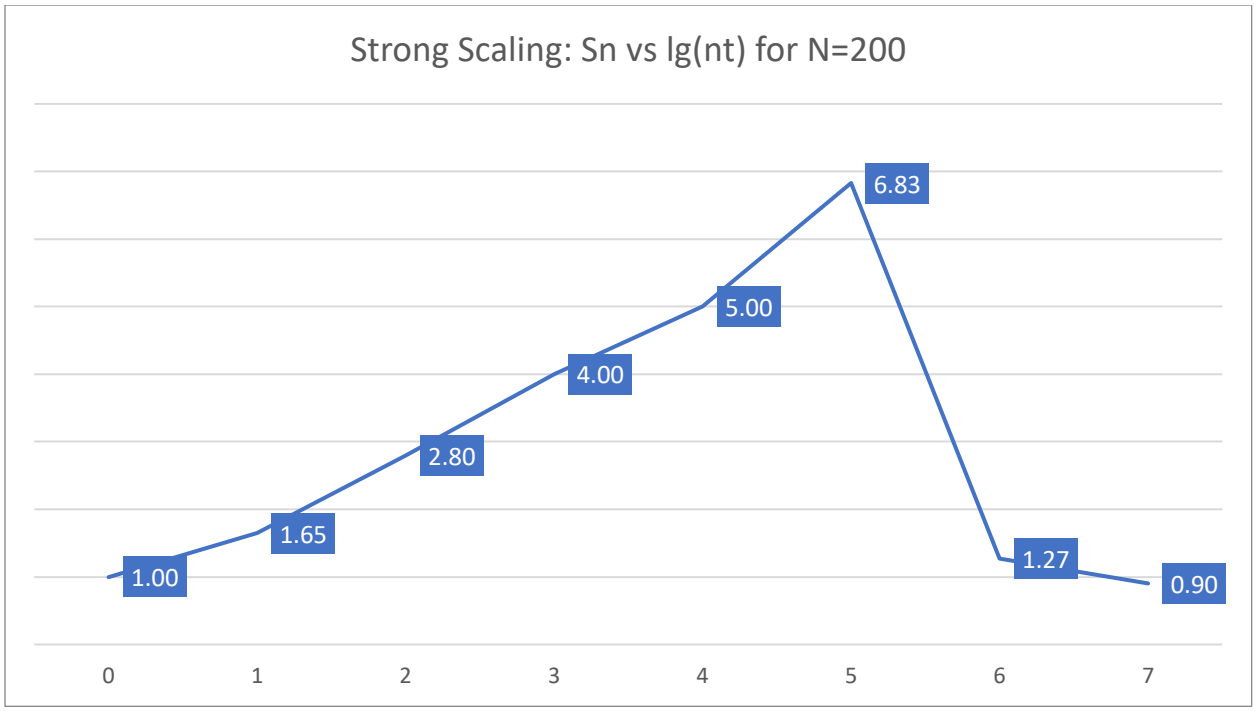
The plot for strong scaling when N = 3200 is given below:

Threads	1	2	4	8	16	32	64	128
Time (s)	62.8	33.02	16.8	8.82	4.79	4.47	2.86	2.88
Speed up	1.00	1.90	3.74	7.12	13.11	14.05	21.96	21.81



The plot for strong scaling when N=200 is given below:

Threads	1	2	4	8	16	32	64	128
Time (s)	0.28	0.17	0.1	0.07	0.056	0.041	0.22	0.31
Speed up	1.00	1.65	2.80	4.00	5.00	6.83	1.27	0.90



The plot for weak scaling is given below: