CUDA Project

Download and CUDA code, run the code and submit a report including presentation.

By Quswar (CS2003) & Sherjeel (CS1913)

Source Code

Sourced from Raghav Pandya’s GitHub Repo:

https://github.com/rpandya1990/Parallel-N-Body-Problem

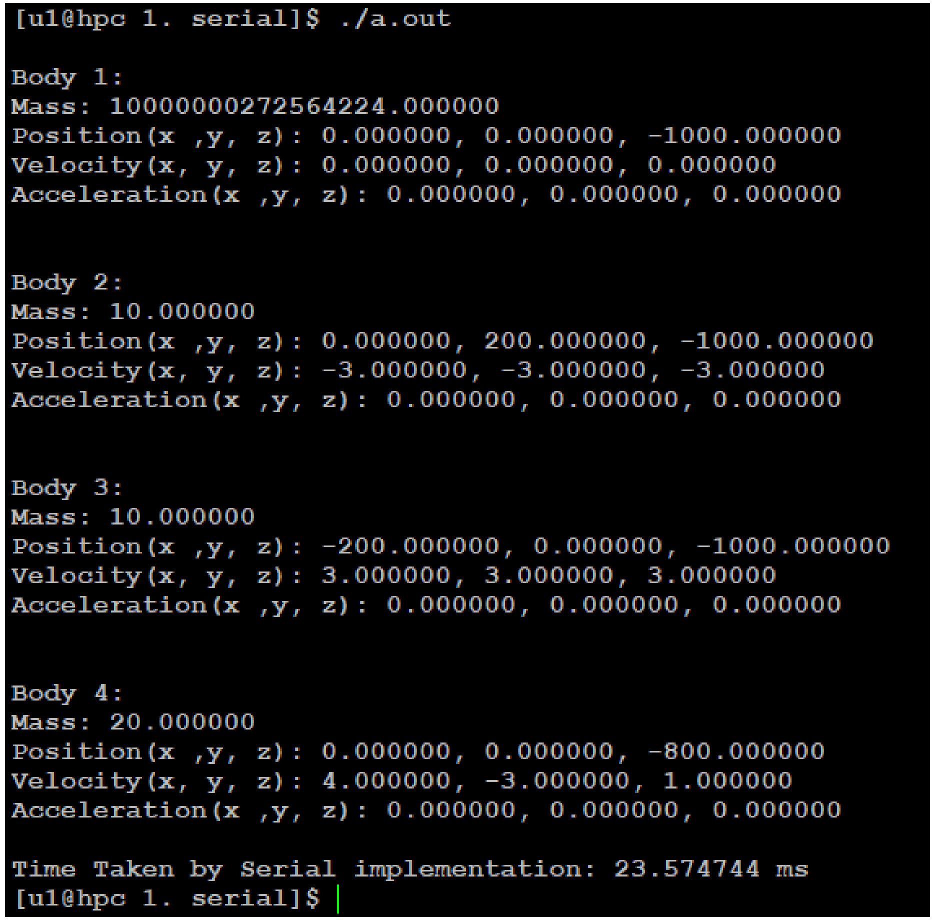
An edited fork available at:

https://github.com/quswarabid/raghavpandya

Project Overview

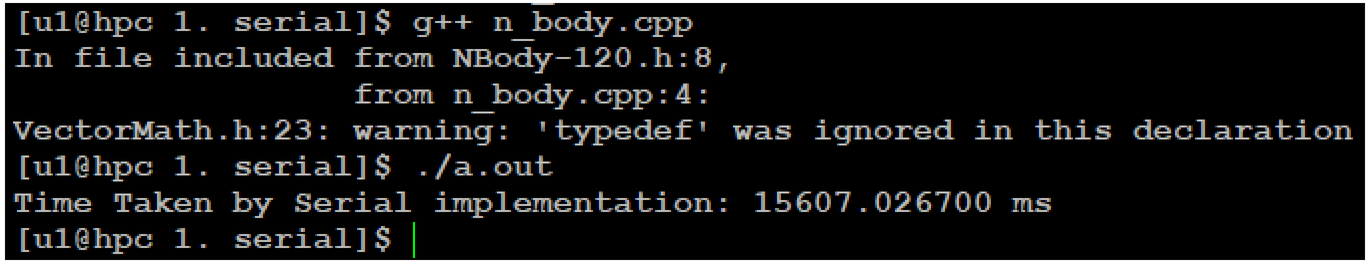
- N-body simulation
- Based on Barnes-Hut Algorithm
- Simulates for 10,000 rounds
- Simulates for 4, 120, 240, 480, 600, and 960 bodies
- Results of these are provided in following slides
  - Compiled & Run on GIKI’s HPC
  - Results may vary on different computers

Serial simulation for 4 bodies



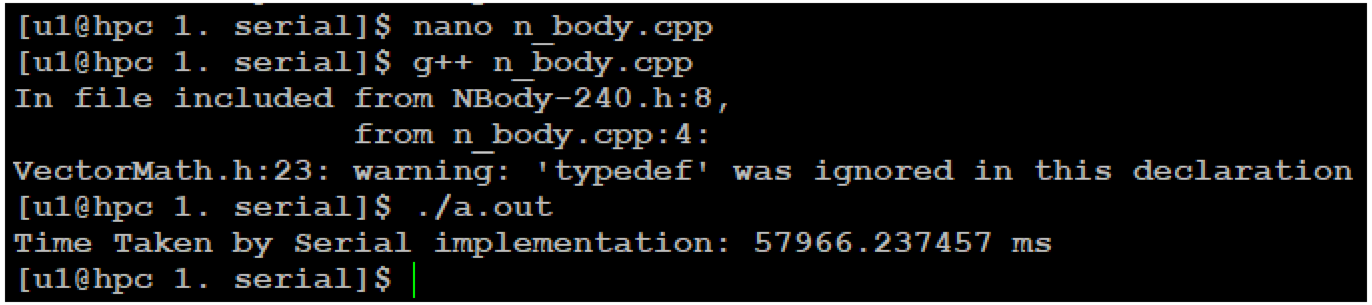
```
[u1@hpc 1. serial]$ ./a.out

Body 1:
Mass: 10000000272564224.000000
Position(x ,y, z): 0.000000, 0.000000, -1000.000000
Velocity(x, y, z): 0.000000, 0.000000, 0.000000
Acceleration(x ,y, z): 0.000000, 0.000000, 0.000000


Body 2:
Mass: 10.000000
Position(x ,y, z): 0.000000, 200.000000, -1000.000000
Velocity(x, y, z): -3.000000, -3.000000, -3.000000
Acceleration(x ,y, z): 0.000000, 0.000000, 0.000000


Body 3:
Mass: 10.000000
Position(x ,y, z): -200.000000, 0.000000, -1000.000000
Velocity(x, y, z): 3.000000, 3.000000, 3.000000
Acceleration(x ,y, z): 0.000000, 0.000000, 0.000000


Body 4:
Mass: 20.000000
Position(x ,y, z): 0.000000, 0.000000, -800.000000
Velocity(x, y, z): 4.000000, -3.000000, 1.000000
Acceleration(x ,y, z): 0.000000, 0.000000, 0.000000

Time Taken by Serial implementation: 23.574744 ms
[u1@hpc 1. serial]$ 
```

Serial simulation for 120 bodies



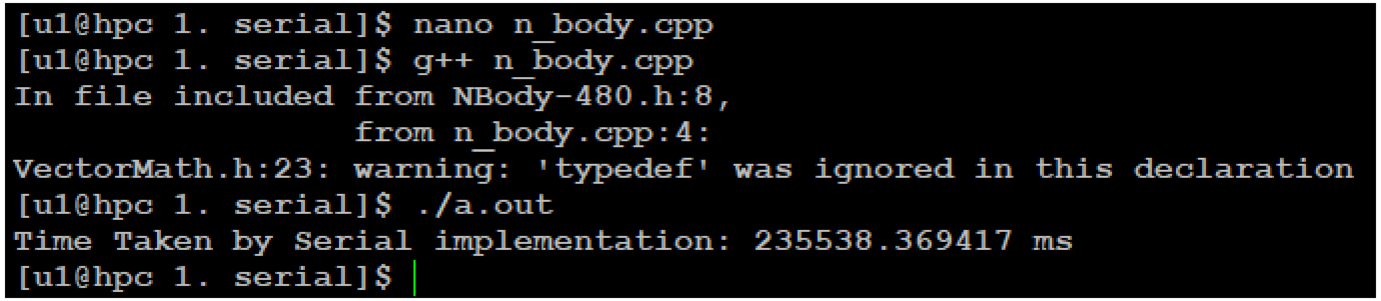
```
[u1@hpc 1. serial]$ g++ n_body.cpp
In file included from NBody-120.h:8,
                 from n_body.cpp:4:
VectorMath.h:23: warning: 'typedef' was ignored in this declaration
[u1@hpc 1. serial]$ ./a.out
Time Taken by Serial implementation: 15607.026700 ms
[u1@hpc 1. serial]$ 
```

Serial simulation for 240 bodies



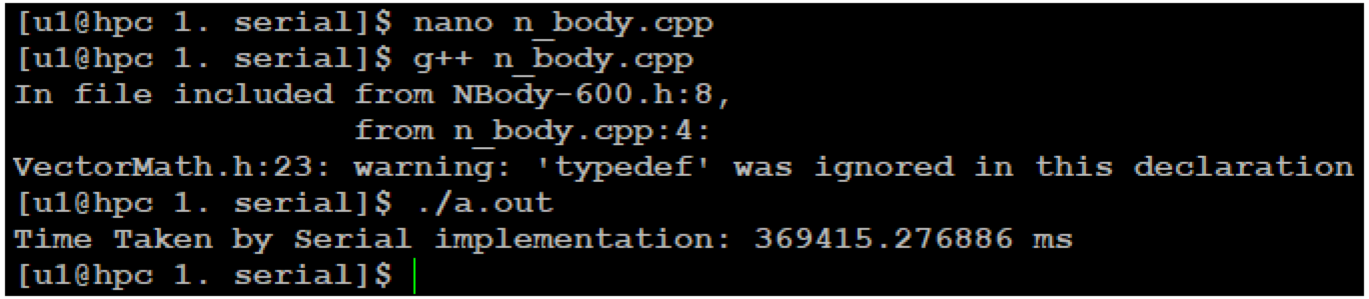
```
[u1@hpc 1. serial]$ nano n_body.cpp
[u1@hpc 1. serial]$ g++ n_body.cpp
In file included from NBody-240.h:8,
                 from n_body.cpp:4:
VectorMath.h:23: warning: 'typedef' was ignored in this declaration
[u1@hpc 1. serial]$ ./a.out
Time Taken by Serial implementation: 57966.237457 ms
[u1@hpc 1. serial]$
```

Serial Simulation for 480 bodies



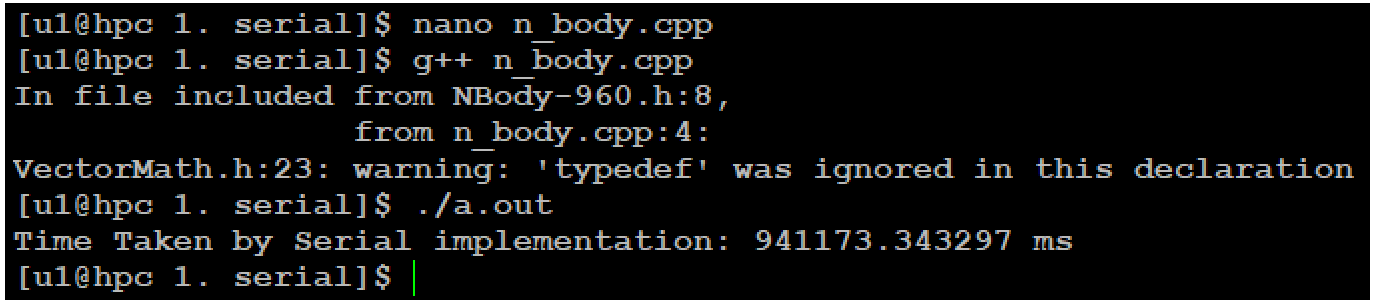
```
[u1@hpc 1. serial]$ nano n_body.cpp
[u1@hpc 1. serial]$ g++ n_body.cpp
In file included from NBody-480.h:8,
                 from n_body.cpp:4:
VectorMath.h:23: warning: 'typedef' was ignored in this declaration
[u1@hpc 1. serial]$ ./a.out
Time Taken by Serial implementation: 235538.369417 ms
[u1@hpc 1. serial]$
```

Serial simulation for 600 bodies



```
[u1@hpc 1. serial]$ nano n_body.cpp
[u1@hpc 1. serial]$ g++ n_body.cpp
In file included from NBody-600.h:8,
                 from n_body.cpp:4:
VectorMath.h:23: warning: 'typedef' was ignored in this declaration
[u1@hpc 1. serial]$ ./a.out
Time Taken by Serial implementation: 369415.276886 ms
[u1@hpc 1. serial]$
```

Serial simulation for 960 bodies

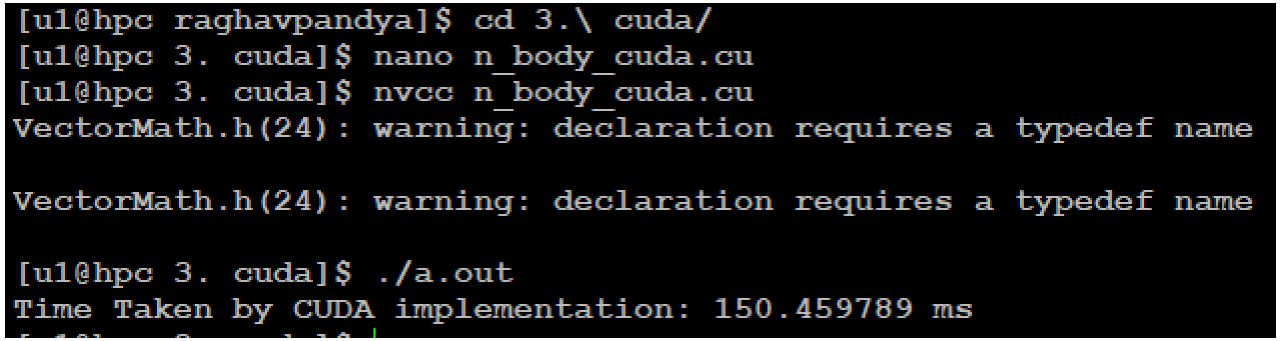


```
[u1@hpc 1. serial]$ nano n_body.cpp
[u1@hpc 1. serial]$ g++ n_body.cpp
In file included from NBody-960.h:8,
                 from n_body.cpp:4:
VectorMath.h:23: warning: 'typedef' was ignored in this declaration
[u1@hpc 1. serial]$ ./a.out
Time Taken by Serial implementation: 941173.343297 ms
[u1@hpc 1. serial]$
```

Time taken by Serial Simulation

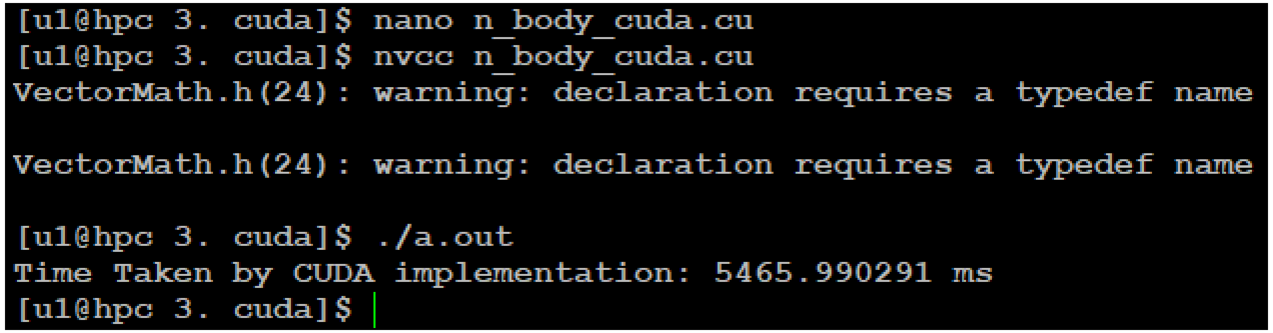
Number of bodies	Time to simulate for 10,000 rounds (in ms)
4	23.574744
120	15,607.0267
240	57,966.237457
480	235,538.369417
600	369,415.276886
960	941,173.343297

Parallel simulation for 4 bodies



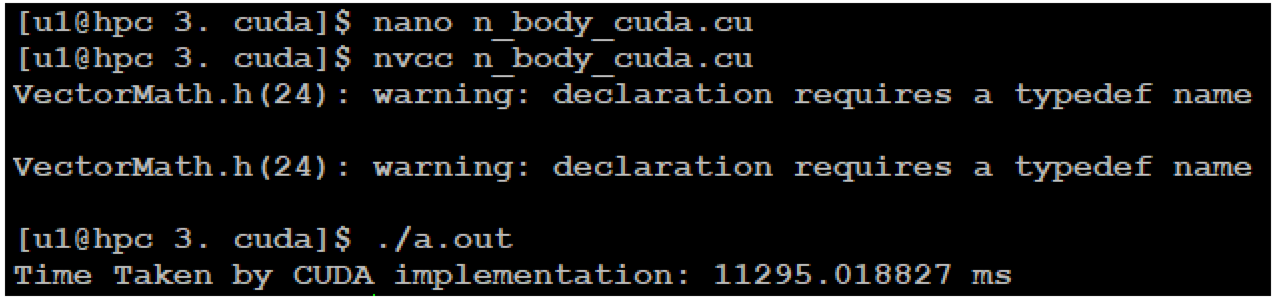
```
[u1@hpc raghavpandya]$ cd 3.\ cuda/
[u1@hpc 3. cuda]$ nano n_body_cuda.cu
[u1@hpc 3. cuda]$ nvcc n_body_cuda.cu
VectorMath.h(24): warning: declaration requires a typedef name

VectorMath.h(24): warning: declaration requires a typedef name

[u1@hpc 3. cuda]$ ./a.out
Time Taken by CUDA implementation: 150.459789 ms
[u1@hpc 3. cuda]$
```

Parallel simulation for 120 bodies



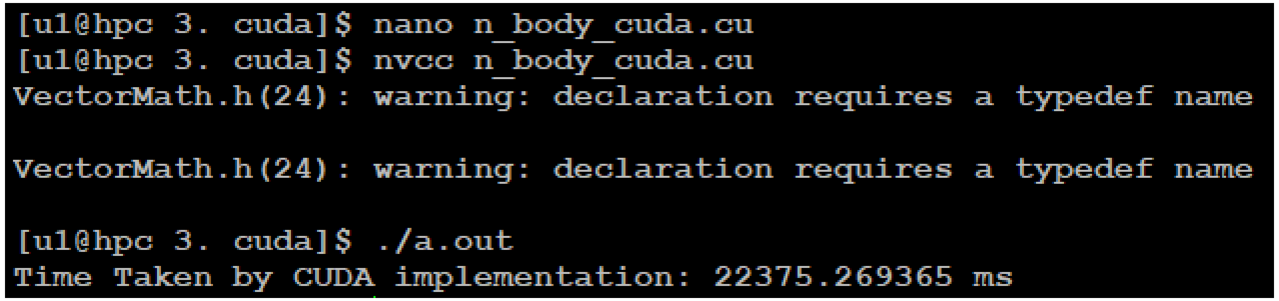
```
[u1@hpc 3. cuda]$ nano n_body_cuda.cu
[u1@hpc 3. cuda]$ nvcc n_body_cuda.cu
VectorMath.h(24): warning: declaration requires a typedef name

VectorMath.h(24): warning: declaration requires a typedef name

[u1@hpc 3. cuda]$ ./a.out
Time Taken by CUDA implementation: 5465.990291 ms
[u1@hpc 3. cuda]$
```

Parallel simulation for 240 bodies



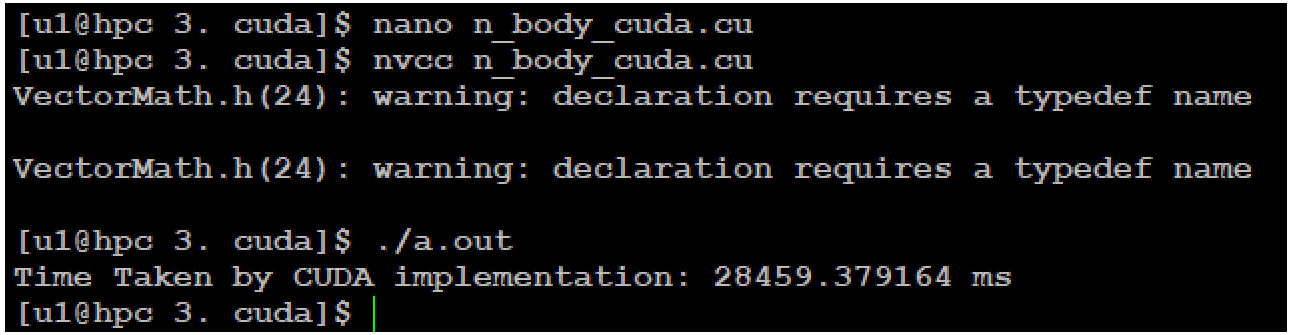
```
[u1@hpc 3. cuda]$ nano n_body_cuda.cu
[u1@hpc 3. cuda]$ nvcc n_body_cuda.cu
VectorMath.h(24): warning: declaration requires a typedef name

VectorMath.h(24): warning: declaration requires a typedef name

[u1@hpc 3. cuda]$ ./a.out
Time Taken by CUDA implementation: 11295.018827 ms
```

Parallel simulation for 480 bodies



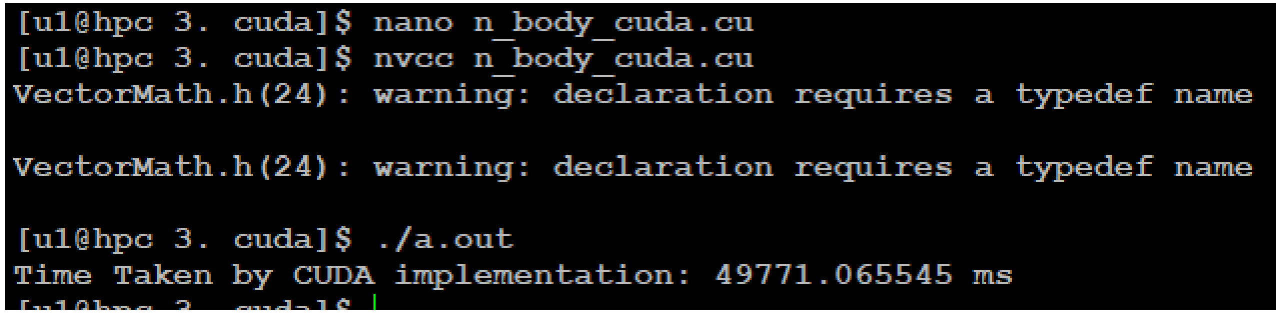
```
[u1@hpc 3. cuda]$ nano n_body_cuda.cu
[u1@hpc 3. cuda]$ nvcc n_body_cuda.cu
VectorMath.h(24): warning: declaration requires a typedef name

VectorMath.h(24): warning: declaration requires a typedef name

[u1@hpc 3. cuda]$ ./a.out
Time Taken by CUDA implementation: 22375.269365 ms
```

Parallel simulation for 600 bodies



```
[u1@hpc 3. cuda]$ nano n_body_cuda.cu
[u1@hpc 3. cuda]$ nvcc n_body_cuda.cu
VectorMath.h(24): warning: declaration requires a typedef name

VectorMath.h(24): warning: declaration requires a typedef name

[u1@hpc 3. cuda]$ ./a.out
Time Taken by CUDA implementation: 28459.379164 ms
[u1@hpc 3. cuda]$
```

Parallel simulation for 960 bodies

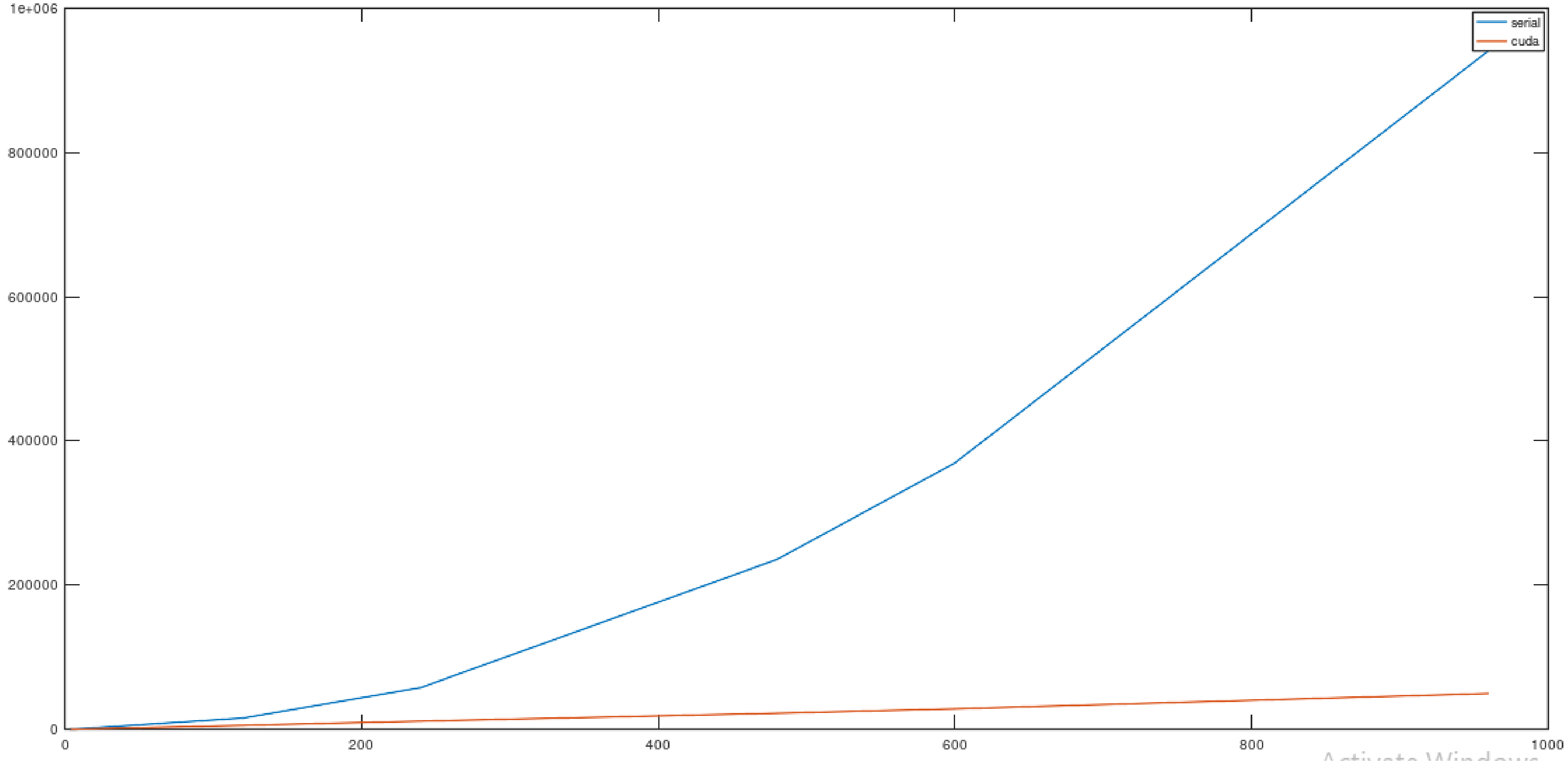


```
[u1@hpc 3. cuda]$ nano n_body_cuda.cu
[u1@hpc 3. cuda]$ nvcc n_body_cuda.cu
VectorMath.h(24): warning: declaration requires a typedef name

VectorMath.h(24): warning: declaration requires a typedef name

[u1@hpc 3. cuda]$ ./a.out
Time Taken by CUDA implementation: 49771.065545 ms
[u1@hpc 3. cuda]$
```

Time taken by Parallel Simulation

Number of bodies	Time to simulate for 10,000 rounds (in ms)
4	150.459789
120	5,465.990291
240	11,295.018827
480	22,375.269365
600	28,459.379164
960	49,771.065545

Comparison chart of performance time against number of bodies


1e+006
serial
cuda