

**Spring 2022: Advanced Topics in Numerical Analysis:  
High Performance Computing  
Assignment 3 (due Apr. 4, 2022)**

**Handing in your homework:** Hand in your homework as for the previous homework assignment (git repo with Makefile), answering the questions by adding a text or a  $\text{\LaTeX}$  file into your repo. The git repository <https://github.com/pehersto/HPCSpring2022> contains the code you can build on for this homework.

1. **Pitch your final project.**

Submitted previously

2. **Approximating Special Functions Using Taylor Series & Vectorization.**

fast-sin.cpp has the `sin4_vec()` function improved to provide higher accuracy of upto 12 decimal places.

3. **Parallel Scan in OpenMP.** Results in image provided. Tests are run on CIMS server and the speedup is observed till upto 8 threads after which performance tapers off.

**Figure 1:** Results of speed up of fast-sin as well as omp-scan

```
[as15151@access2 HW3]$ ./fast-sin
Reference time: 17.2199
Taylor time:    12.2404      Error: 6.928125e-12
Intrin time:    0.5076      Error: 2.454130e-03
Vector time:    0.6680      Error: 6.928014e-12
[as15151@access2 HW3]$ ./omp-scan
sequential-scan = 0.701978s
Num of threads 4
parallel-scan   = 0.206100s
error = 0
[as15151@access2 HW3]$ make && ./omp-scan
g++ -std=c++11 -O3 -march=native -fopenmp -fno-tree-vectorize omp-scan.cpp -o omp-scan
sequential-scan = 0.634786s
Num of threads 2
parallel-scan   = 0.208771s
error = 0
[as15151@access2 HW3]$ make && ./omp-scan
g++ -std=c++11 -O3 -march=native -fopenmp -fno-tree-vectorize omp-scan.cpp -o omp-scan
sequential-scan = 0.715279s
Num of threads 8
parallel-scan   = 0.169806s
error = 0
[as15151@access2 HW3]$ make && ./omp-scan
g++ -std=c++11 -O3 -march=native -fopenmp -fno-tree-vectorize omp-scan.cpp -o omp-scan
sequential-scan = 0.655634s
Num of threads 1
parallel-scan   = 0.310206s
error = 0
[as15151@access2 HW3]$ make && ./omp-scan
g++ -std=c++11 -O3 -march=native -fopenmp -fno-tree-vectorize omp-scan.cpp -o omp-scan
sequential-scan = 0.678448s
Num of threads 32
parallel-scan   = 0.166021s
error = 0
[as15151@access2 HW3]$ cat /proc/cpuinfo
processor       : 0
vendor_id      : AuthenticAMD
cpu family     : 23
model          : 1
model name     : AMD EPYC Processor (with IBPB)
stepping       : 2
microcode      : 0x1000065
cpu MHz        : 2894.562
cache size     : 512 KB
physical id    : 0
```