Spring 2022: Advanced Topics in Numerical Analysis: High Performance Computing
Homework 3
https://github.com/anmolsinghal/HPCHW3

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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.
   Also added logic to calculate value of sin for any input using taylor series approximation. To use the function, need to change the range of input to the desired range.

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 welll 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
```