

Experience Gauge Experiment

As a test of your experience with Linux distributions and ability to read documentation, we need you to perform these three tasks.

Task 0 (NSCC login)

Login to NSCC and explore the modules available.

NSCC uses the Environment Modules system for providing access to software. Explore NSCC's module system (`module av`) and figure out:

- How environment modules work
- Module loading
- Which modules provide a basic C compiler (`gcc` / `icc`).
- Which modules provide OpenMP-compatible C compilers (`gcc` / `icc`).
- Which modules provide MPI functionality (`mpicc`).

Task 1

$\pi/4 = \int_0^1 \sqrt{1-x^2} dx$

Write a serial program that uses this property to calculate the value of π .

Benchmark the execution time of this program against increasing numerical integration step count.

Must be done in C.

Task 2 (OpenMP)

Parallelize Task 1 using OpenMP. Benchmark with an additional variable in addition to the one already mentioned - thread count.

You'll need to use the module providing an OpenMP-compatible compiler that you should have found in Task 0.

Must be done in C.

Hint: (`omp parallel for reduce`)

Task 3 (MPI)

Parallelize the algorithm in Task 1 using MPI. Benchmark with an additional variable in addition to the one already mentioned - process count.

You'll need to use the module providing a MPI toolchain that you should have found in Task 1.

Must be done in C.

Hints: (`MPI_Init`, `MPI_Reduce`, `MPI_Finalize`, `MPI_Comm_rank`,
`MPI_Comm_size`, `mpicc` & `mpirun`).

Benchmarking requirements

- Integration step counts from $1e2$ to $1e9$, increasing by a factor of 10 each time.
- Thread / Process counts from 1 to 3.

Bonus tasks.

- Write GNU-Make compatible Makefiles for Task 2 and 3.
- Explore compiler options for general and architecture-specific optimizations.