

(10 credits) Given is the integral

$$\int_0^1 \frac{4}{1+x^2} dx = \pi$$

It can be approximated by a sum of N rectangles

$$\sum_{i=0}^N f(x_i) \Delta x \approx \pi$$

where each rectangle has width Δx and height $f(x_i)$ in the middle of the interval i . Write a program that calculates π by making use of the approximation. Perform the following tasks with your code:

1. Use different Δx and compare the resulting values for π .
2. Parallelise your program using OpenMP and make sure that the result is still correct.
3. Choose a sufficiently small Δx and calculate π on 1, 2, 4 and 8 SGI Altix processors with fixed problem size (strong scaling). Now scale Δx according to the number of processors and measure the speed-up again (weak scaling). Create a plot of both cases showing the speed-up.

Submit your program to the `parallel` queue and start it with

```
dplace -x 6 ./your-program
```

The `dplace -x 6` is specific to the SGI Altix and influences the behaviour how threads are distributed among the processors.

4. Check what speedup you get when going from 1 two 2 processors on a single node of the IA32 cluster.
Use the `express` or `kurs` queue together with `#PBS -l nodes=1:ppn=2`
5. Try different schedules for the parallel loop and compare the run times.
6. Compare the speed of a `OMP critical` section for summing up the sums of the different processors with the `OMP reduction` statement.

Deadline for the exercises is Thursday June 24, in the tutorial.

Mail your answers to `hpc@rrze.uni-erlangen.de` with subject `PTfS2004: exercise6`.