Report

pi.c

Algorithm analysis

The algorithm runs in two main phases, one is serial and the other one is parallel.
The serial part is initialisation. It consists of setting the number of threads wanted, creating one random number generator per thread and put them in an array, and declaring and initializing an array of variables for counting the points that will land inside the circle (one per thread). This part is executed once, and run therefore in O(1).

The parallel phase is the calculus phase and look like this :

```
    #pragma omp parallel for
    for (size_t i = 0; i < samples; ++i) {
        double x = next_rand(rand);
        double y = next_rand(rand);
        if (x*x + y*y < 1){
            result[omp_get_thread_num()] += 1;
        }
    }
```

For each samples needed, we generate two random numbers, representing the X and Y coordinates of a points. If the distance between the point and the origin is less than 1, it is in the circle, and need to be added to result[omp_get_thread_num()]. Because each thread has its own variable in the array, there is no need to add an atomic condition.
As every iteration of the loop is independent, it is possible to run it in a parallel manner. The dominant operation is the distance computation, and it runs overall in O(samples).

integral.c

Algorithm analysis

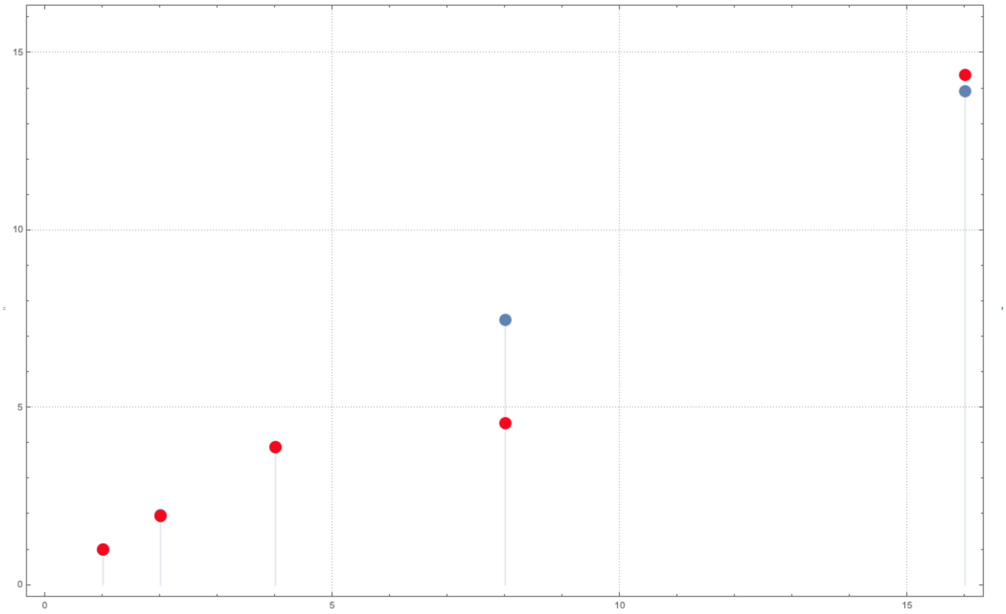
The algorithm is very similar to *pi.c*, so it will not be detailed.
The initialisation part run in constant time (O(1)), and the calculus part runs in O(samples).

Parallelism

Roughly, 99% of each programm can be parallel, so a significant speedup is expected. Blue points on the graph represents the expected speedup for 1, 2, 4, 8, 16, 32 and 64 cores.

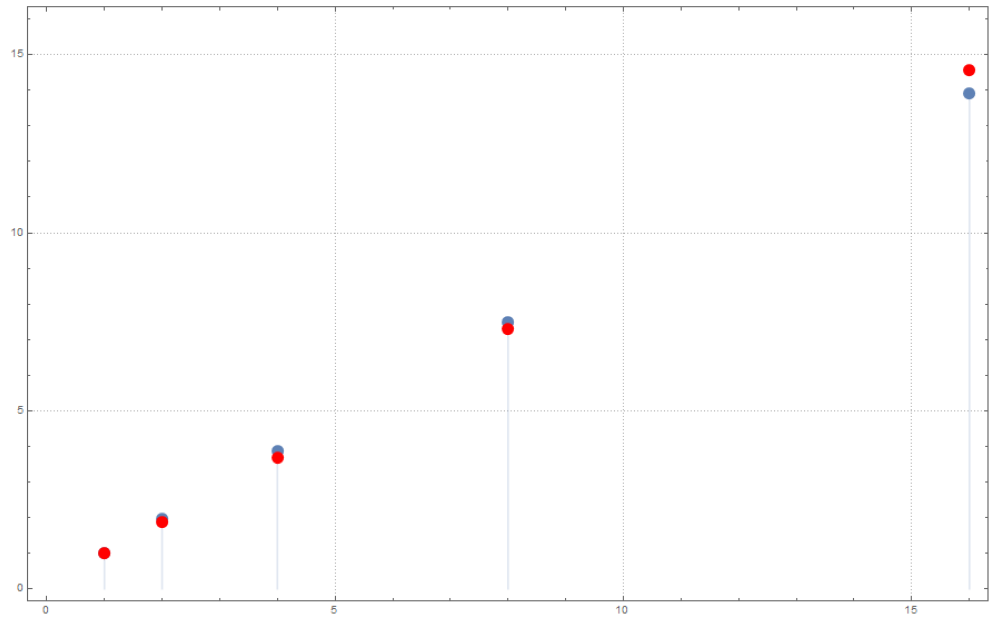
Pi performance

We ran our code on the cluster a hundred times for each configuration with 1, 2, 4, 8 and 16 threads. Red points represents the average speedup we computed.



Integral performance

Same protocol for the integral program.



Performance analysis

Pi

The effective speedup matches pretty well the expected speed up. The only exception is when the machines uses 8 threads to run the code. We did more tests, but the results were still the same. One explanation can be that it takes some time to add the results of each thread, and therefore the speedup ratio is not growing as fast as expected. Another explanation could be a proximity in memory that make the caches looses some time to keep coherence.

Integral

The effective speedup matches almost perfectly the expected one.