MATH96012 Project 3

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Question 2

We compare the different implimentations for different M,N and Nt values. We would expect as Nt increases a linear increase in time taken this is shown in figure 3 with fortran implimentations being faster as they can optimise over the for loop unlike a interpreted language. OMP+F90 the fastest but as we increase Nt they all increase linearly with Nt. We see for large N and M in figures 1 and 2 that the OpenMP implimentation offers a speed up over fortran and python except for large N. The speed up of the parallelisation is greater with increasing M than increasing N. The increase suggests the code is very parallelisable though as the differences between the F90+OMP implimentation and the F90 implimentation is large. This is as most of the parallel loops are over M not N. The slowdown of fortran implimentations vs the python implimentation is likely caused by fortran using column-major array storage and C using row-major changing the positions of each element in memory. We would ideally like to average these to check but that would take too long. So for very large M and/or Nt we should use the fortran+OMP implimentation for large N python is faster. To find the exact point we should switch over we could do a grid search of values but this would take a very long time.

Figures

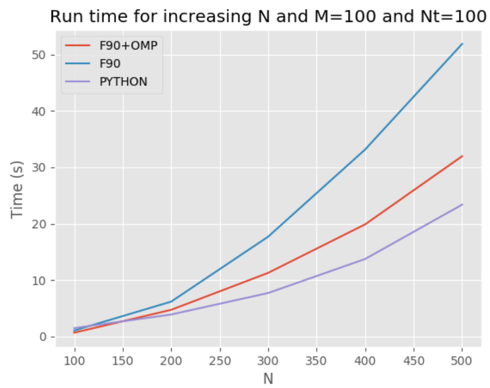

Figure 1: Time to run for varying N

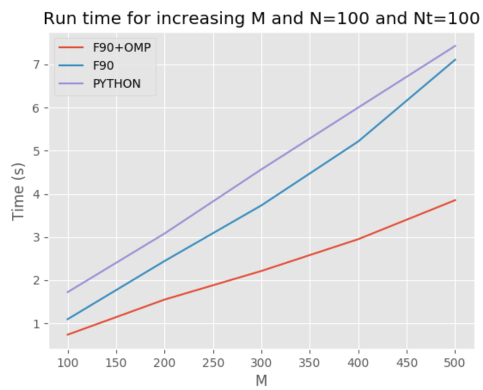

Figure 2: Time to run for varying M

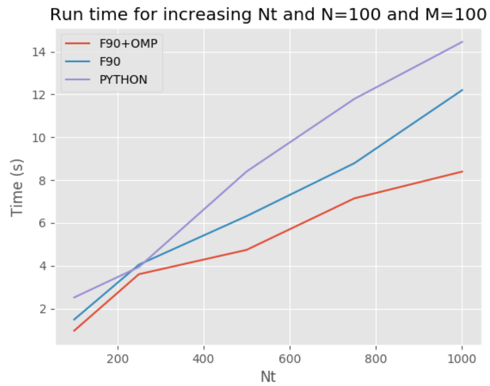

Figure 3: Time to run for varying Nt

Question 3

We see that as τ increases the correlation decreases. We expect this as although random they interact with one another making them correlated for small lags but as they disperse they will interact less with each other making their positions less correlated. This shows that particles tend to disperse over time. The correlation overall is very low though this is due to the large random element caused by A.

Increasing M will just make the function more smooth as alpha is averaged over M.

Figures

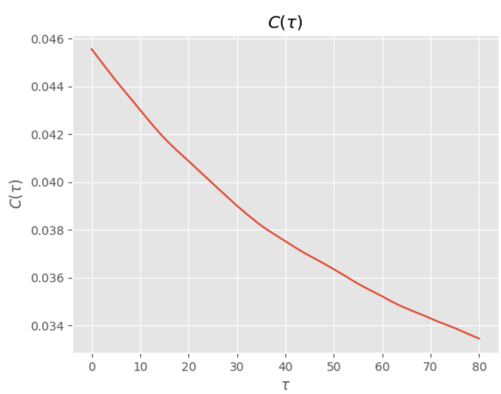

Figure 4: Correlation for lag τ