Assignment 2 ID5130

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April 2024

1 Problem 1

1.1 a

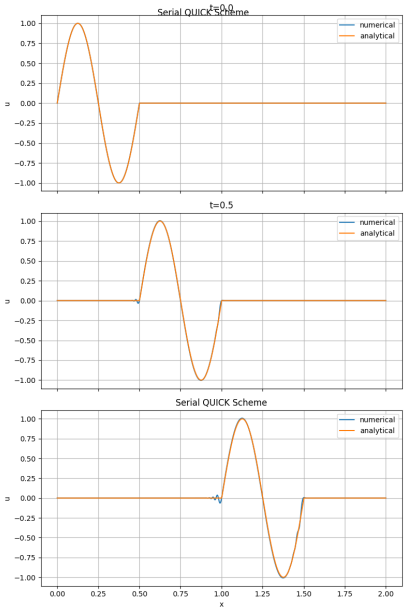

Figure 1: QUICK

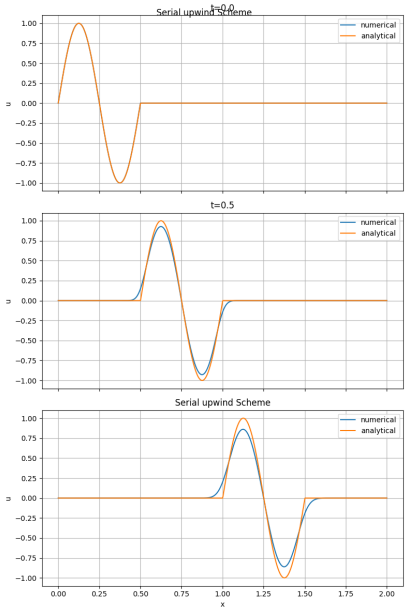

Figure 2: upwind

Figure 3: serial results

1.2 b

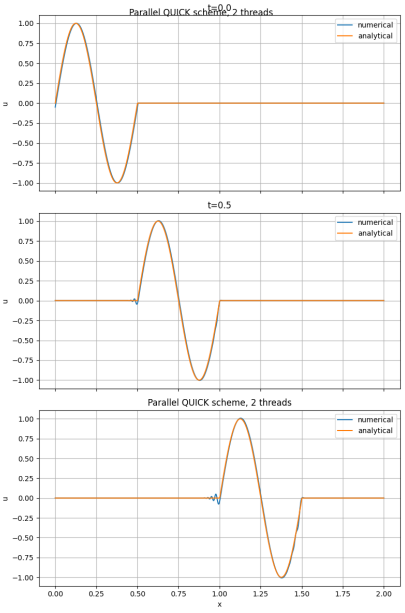

Figure 4: QUICK

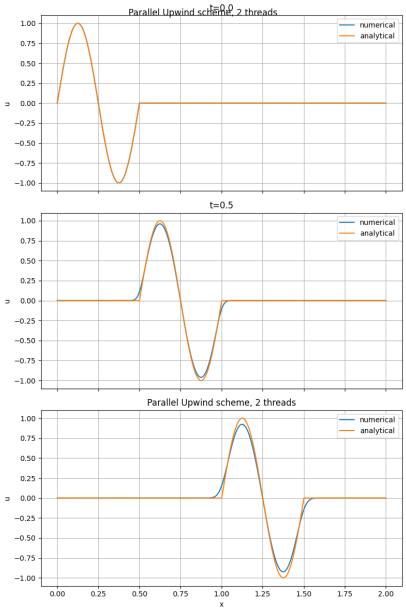

Figure 5: upwind

Figure 6: 2 processors

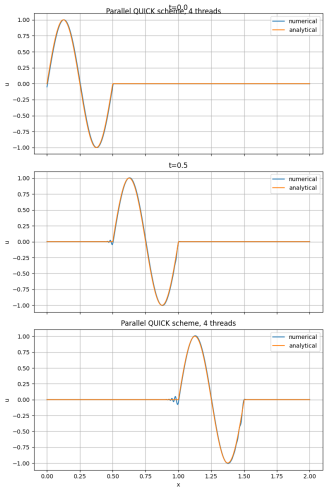

Figure 7: QUICK

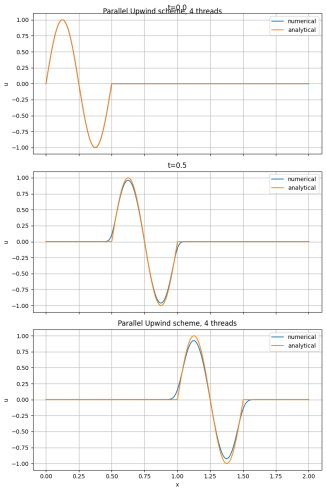

Figure 8: upwind

Figure 9: 4 processors

1.3 c

The output of question3 decays with time, and is different from the expected output. This is due to a process termed a numeric diffusion. The output of QUICK shows oscillations, due to being a higher order accurate scheme, it also follows the analytical solution more closely, with oscillations at the boundary. But for a large value of T, the scheme becomes unstable, and oscillates wildly.

2 Problem 2

2.1 a

Iterations taken - 387 iterations of Jacobi using the supremum norm, for $\epsilon = 10^{-4}$ and 1601 iterations for $\epsilon = 10^{-8}$

2.2 b

Gauss-Seidal and Jacobi schemes are applied to solve poissons equation on the square centred at the origin of side length 2. The scheme is said to have converged if the infinity norm of the difference between successive iterations drops below $\epsilon = 10^{-8}$.

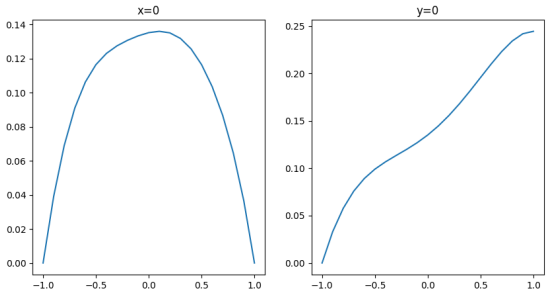

Figure 10: x=0,y=0

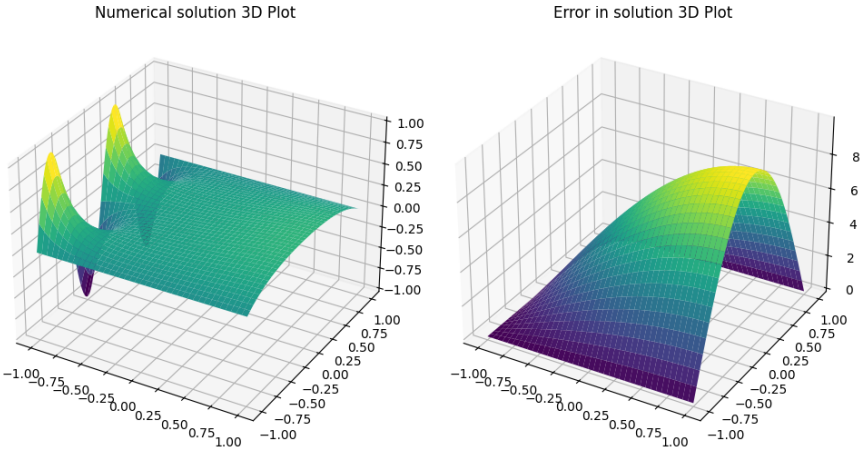

Figure 11: accurate 3d-plot, error is in units of 10^{-9}

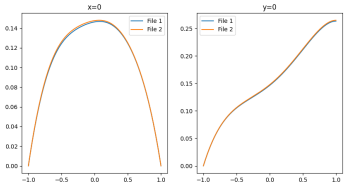

Figure 12: Jacobi p=2

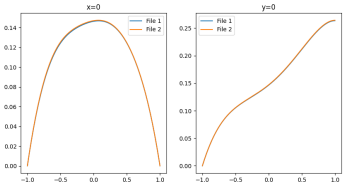

Figure 13: Jacobi p=4

Figure 14: serial results

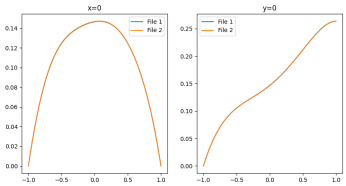

Figure 15: Jacobi p=8

2.3 c

Iterations Gauss Seidal - 53901 Iterations Jacobi - 98601 Hence, Jacobi takes nearly double the number of iterations to run as Gauss seidel

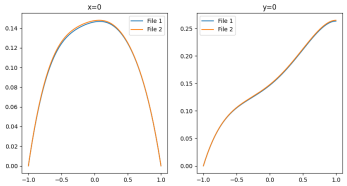

Figure 16: Gauss Seidel p=2

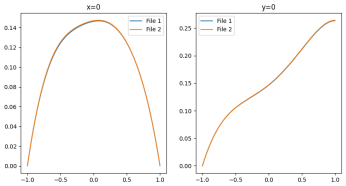

Figure 17: Gauss Seidel p=4

Figure 18: serial results

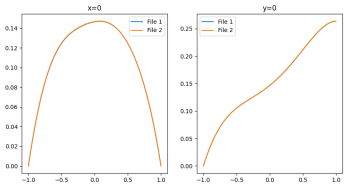

Figure 19: Gauss Seidel p=8

2.4 d

Speed up is evident with both jacobi and gauss seidel, with increase in number of processors. Gauss seidel is faster by nearly a factor of 2. As the CPU used for testing has only 10 processors, the speedup is plotted only upto p=10. Also, speedup increases with problem size, as can be seen. Speedups are shown plotted below (relative to time taken by 2 processors) for delta = 0.1, 0.01 and 0.005

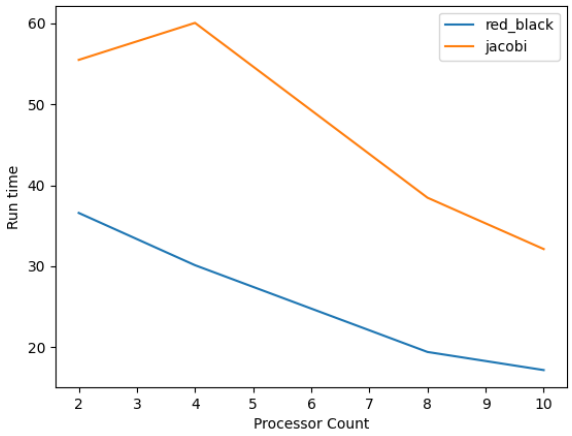

Figure 20: timing in seconds, delta = 0.005

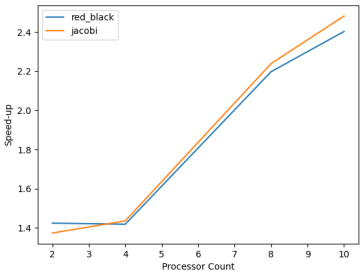

Figure 21: delta = 0.01

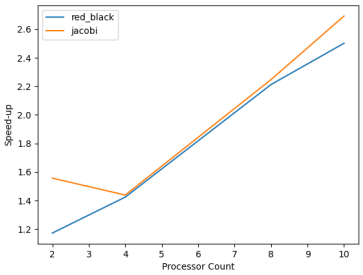

Figure 22: Gauss Seidel p=4

Figure 23: serial results