

Homework # 2: due 10/21/09

Consider the serial FTCS scheme to the one-dimensional heat conduction problem

State vector $u(0 : n)$

$$u(0) = 0$$

$$u(n) = 0$$

$$t = 0$$

$$u = \text{initcond}(x, n)$$

do while ($t < \text{tend}$)

do $i = 1 : n - 1$

$$\text{unext}(i) = (1 - 2 * s) * u(i) + s * (u(i - 1) + u(i + 1)) + dt * f(x(i), t)$$

end do

$$u(1 : n - 1) = \text{unext}(1 : n - 1)$$

$$t = t + dt$$

end do

In the numerical experiments use

$$n = 10000, \quad dx = 1/n, \quad s = 0.5, \quad dt = s * (dx)^2, \quad \text{tend} = 1$$

$$u_0(x) = x * (1 - x)$$

$$f(x, t) = 2 * \cos(t) - x * (1 - x) * \sin(t)$$

PROVIDE:

(20 points) A parallel implementation using a 2-time step communication

(10 points) Comparative performance analysis with the standard parallel implementation using 1-time step communication for $np = 2, 4, 8$ and $n = 1000, 5000, 10000$ (a total of 9 runs for each implementation).