Date: February 5, 1998
Due Date: February 17, 1998

CS 522 Advanced Methods in Scientific Computing

Assignment 3

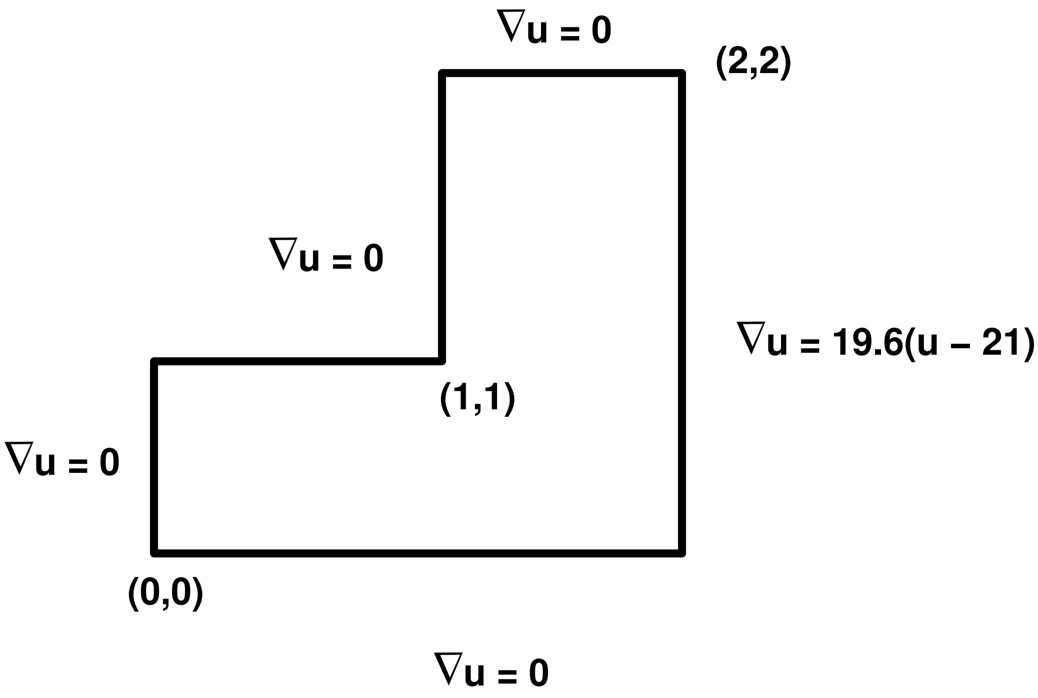
1 The Physical Problem

Consider the time-dependent temperature profile for the conductive heat flow problem in the geometrical region given below. The heat equation is given as:

$$\frac{\partial u}{\partial t} = \frac{k}{c\rho}\nabla^2 u \tag{1}$$

where $k = 0.52$, $c = 0.226$, and $\rho = 2.70$ in cgs units. The initial condition is $u(x, y, 0) = 500$ degrees centigrade. Assume that heat is lost from the uninsulated face on the right side according to

$$\nabla u = 19.6(u - 21) \tag{2}$$



2 Assignment

1. Solve the heat equation using an explicit finite differene scheme. What is the stability condition? Solve the problem using different values of Δt and h (including ones that do not meet the stability condition).

2. Solve the heat equation using the Crank Nicoloson finite difference scheme for several different values of Δt and h.

3. Compare the CPU time and storage costs for the explicit and implicit methods. Which is best? Why?