DATE: 05-03-2025 14:16:37 USER: FRTRN90 JOB: BNCHMRK PAGE: 0001

```
program lid_driven_cavity
  implicit none
   integer, parameter :: N = 50 ! grid size (NxN grid)
   real :: dx, dy, dt, Re
                            ! grid spacing, time step, Reynolds number
   real :: u(N, N), v(N, N), p(N, N) ! velocity and pressure fields
   integer :: i, j, step
   real :: start_time, end_time, elapsed_time
   ! Parameters
                      ! Grid spacing in x direction
   dx = 1.0 / (N-1)
                                                                                                                                           14
15
                      ! Grid spacing in y direction
   dy = 1.0 / (N-1)
                       ! Time step size
   dt = 0.001
                                                                                                                                           16
17
   Re = 100
                       ! Reynolds number
                                                                                                                                           18
   ! Initialize arrays
                                                                                                                                           21
22
23
   u = 0.0
   v = 0.0
   p = 0.0
                                                                                                                                           24
25
26
27
   ! Initialize the top boundary (lid) velocity
   u(N, :) = 1.0
   ! Start timing
   call cpu_time(start_time)
                                                                                                                                           34
35
   ! Main loop for time stepping
   do step = 1, 1000
                                                                                                                                           36
37
      call compute_velocity(u, v, p, dx, dy, dt, Re)
      call update_pressure(p, dx, dy)
                                                                                                                                           41
      ! Output or check convergence
                                                                                                                                           42 43
      if (mod(step, 100) == 0) then
          print *, 'Step: ', step
                                                                                                                                           44 45
      end if
   end do
                                                                                                                                           49
   ! Stop timing
   call cpu_time(end_time)
   elapsed_time = end_time - start_time
   print *, 'Elapsed time for CFD simulation: ', elapsed_time, ' seconds'
                                                                                                                                           56
57
42 contains
   ! Function to update the velocity and pressure fields (simplified)
   subroutine compute_velocity(u, v, p, dx, dy, dt, Re)
     real, dimension(:,:), intent(inout) :: u, v, p
     real, intent(in) :: dx, dy, dt, Re
     integer :: i, j
     ! Simple explicit method for velocity (simplified)
     do i = 2, N-1
         do j = 2, N-1
             u(i, j) = u(i, j) - dt * ((u(i, j) * (u(i+1, j) - u(i-1, j))) / (2*dx) + &
                                          (v(i, j) * (u(i, j+1) - u(i, j-1))) / (2*dy))
                                                                                                                                           72
73
74
75
         end do
     end do
     ! Simple velocity update for v (similar)
                                                                                                                                           78
     do i = 2, N-1
         do j = 2, N-1
```

```
v(i, j) = v(i, j) - dt * ((u(i, j) * (v(i+1, j) - v(i-1, j)))) / (2*dx) + &
                                              (v(i, j) * (v(i, j+1) - v(i, j-1))) / (2*dy))
            end do
        end do
      end subroutine compute_velocity
      ! Function to solve for pressure (simplified Poisson equation solver)
      subroutine update_pressure(p, dx, dy)
        real, dimension(:,:), intent(inout) :: p
        real, intent(in) :: dx, dy
        integer :: i, j
        ! Simple pressure Poisson equation (Jacobi iteration)
        do i = 2, N-1
            do j = 2, N-1
                 p(i, j) = 0.25 * (p(i+1, j) + p(i-1, j) + p(i, j+1) + p(i, j-1))
            end do
        end do
                                                                                                                                                   24
25
26
27
      end subroutine update_pressure
  21 end program lid_driven_cavity
23
                                                                                                                                                   32
33
34
35
                                                                                                                                                   36
37
                                                                                                                                                   42 43
                                                                                                                                                   43
44
45
46
47
                                                                                                                                                   48
49
                                                                                                                                                   56
57
58
59
```