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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
   dx = 1.0 / (N-1)
                       ! Grid spacing in x direction
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                      ! Grid spacing in y direction
   dy = 1.0 / (N-1)
                       ! Time step size
   dt = 0.001
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   Re = 100
                       ! Reynolds number
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   ! Initialize arrays
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   u = 0.0
   v = 0.0
   p = 0.0
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   ! Initialize the top boundary (lid) velocity
   u(N, :) = 1.0
   ! Start timing
   call cpu_time(start_time)
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   ! Main loop for time stepping
   do step = 1, 1000
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      call compute_velocity(u, v, p, dx, dy, dt, Re)
      call update_pressure(p, dx, dy)
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      ! Output or check convergence
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      if (mod(step, 100) == 0) then
          print *, 'Step: ', step
                                                                                                                                           44 45
      end if
   end do
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   ! Stop timing
   call cpu_time(end_time)
   elapsed_time = end_time - start_time
   print *, 'Elapsed time for CFD simulation: ', elapsed_time, ' seconds'
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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))
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         end do
     end do
     ! Simple velocity update for v (similar)
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     do i = 2, N-1
         do j = 2, N-1
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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
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      end subroutine update_pressure
  21 end program lid_driven_cavity
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