```
clear all
close all

n=60;

x=linspace(0,1,n);
y=linspace(0,1,n);

U=1;
dt=0.001;
endTime=0.5;
writeInterval=100; %Timesteps
h=x(2)-x(1);
nu=0.1;
[xx,yy]=meshgrid(x,y);
vort=zeros(n,n);
psi=zeros(n,n);
s=0;
t=0;
iter=0;
run=0;


for i=1:n
    for j=1:n
        psi(i,j,1)=0;
        vort(i,j,1)=0;
        if j==n
            psi(i,j,1)=0;
            vort(i,j,1)=-2*U/h;
        end
    end
end
if run==1
    while t<endTime
        vortold=vort;
        psiold=psi;
        iter=iter+1;
        t=t+dt;
        for i=1:n
            for j=1:n
                if j~=1 && j~=n && i~=1 && i~=n
                    vort(i,j)=vort(i,j)+dt*(-(psi(i,j+1)-psi(i,j-1))*(vort(i+1,j)-vort(i-
1,j))/(4*h^2)+(psi(i+1,j)-psi(i-1,j))*(vort(i,j+1)-vort(i,j-1))/(4*h^2) ...
                        +nu*(vort(i+1,j)+vort(i,j+1)+vort(i-1,j)+vort(i,j-1)-4*vort(i,j))/h^2);
                elseif j==1 && i~=1 && i~=n
                    vort(i,j)=2*(psi(i,j)-psi(i,j+1))/h^2; %Bottom
                elseif j==n && i~=1 && i~=n
                    vort(i,j)=2*(psi(i,j)-psi(i,j-1))/h^2-2*U/h; % Top
                elseif i==1 && j~=1 && j~=n
                    vort(i,j)=2*(psi(i,j)-psi(i+1,j))/h^2; % Left
                elseif i==n && j~=1 && j~=n
                    vort(i,j)=2*(psi(i,j)-psi(i-1,j))/h^2; % Right
                elseif (i==1 && j==1) %Set corners equal to neighbors or zero
                    vort(i,j)=0;
                elseif (i==n && j==1)
                    vort(i,j)=0;
                elseif (i==1 && j==n)
                    vort(i,j)=(vort(i+1,j));
                elseif (i==n && j==n)
                    vort(i,j)=(vort(i-1,j));
                end
            end
        end

        for i=1:n
            for j=1:n
                if j~=1 && j~=n && i~=1 && i~=n
                    psi(i,j)=0.25*(h^2*vort(i,j)+psi(i+1,j)+psi(i-1,j)+psi(i,j+1)+psi(i,j-1));
                else
                    psi(i,j)=0;
                end
            end
        end
        %calculate velocities
        for i=1:n
            for j=1:n
                if j~=1 && j~=n && i~=1 && i~=n
                    u(i,j)=(psi(i,j+1)-psi(i,j-1))/(2*h);
                    v(i,j)=(psi(i+1,j)-psi(i-1,j))/(2*h);
                elseif j==n
                    u(i,j)=1;
                    v(i,j)=0;
                else
                    u(i,j)=0;
                    v(i,j)=0;
                end
            end
        end
        vortresidual=max(max(abs(vort-vortold)));
        psiresidual=max(max(abs(psi-psiold)));

        if iter/writeInterval == round(iter/writeInterval)
            s=s+1;
            vortout{s}(:,:)=vort;
```

```
            psiout{s}(:,:)=psi;
            uout{s}(:,:)=u;
            vout{s}(:,:)=v;
            vortresidualout(s)=vortresidual;
            psiresidualout(s)=psiresidual;
            times(s)=t;
            fprintf('Calculating ... time = %f \n',t)
        end

    end
    save('lidDrivenCavity.mat')
else
   load('lidDrivenCavity.mat')
end


figure('name','Results')
subplot(1,4,1)
v=[0:0.05:1];
contourf(y,x,((uout{s}(:,:).^2+vout{s}(:,:).^2).^(0.5))',v,'LineColor','none' )
axis equal
axis([0 1 0 1])
xlabel('x')
ylabel('y')

subplot(1,4,2)
contourf(y,x,(psiout{s}(:,:))',10,'LineColor','none' )
axis equal
axis([0 1 0 1])
xlabel('x')
ylabel('y')

vlevels=logspace(-3,2,40);
subplot(1,4,3)
contourf(y,x,abs(vortout{s}(:,:))',vlevels,'LineColor','none' )
axis equal
axis([0 1 0 1])
xlabel('x')
ylabel('y')

subplot(1,4,4)
plot(times,vortresidualout,'r')
hold
plot(times,psiresidualout,'b')
xlabel('t')
ylabel('e')
```