Introduction to Week Three

Gaussian Elimination

Operation Counts

Eigenvalues and Eigenvectors

Matrix Algebra in MATLAB

Systems of Nonlinear Equations

Quiz

Programming Assignment: Fractals from the Lorenz Equations

Video: Fractals from the Lorenz Equations | Lecture 35
9 min

Ungraded External Tool: Fractals from the Lorenz Equations (audit)

Reading: Reference Solution to "Fractals from the Lorenz Equations (audit)"
1 min

Graded External Tool: Fractals from the Lorenz Equations
1h

Reading: Reference Solution to "Fractals from the Lorenz Equations"
1 min

Reference Solution to "Fractals from the Lorenz Equations (audit)"

```
r=28; sigma=10; beta=8/3;
x1=0; y1=0; z1=0;
x2=sqrt(beta*(r-1)); y2=sqrt(beta*(r-1)); z2=r-1;
x3=-sqrt(beta*(r-1)); y3=-sqrt(beta*(r-1)); z3=r-1;

nx=500; nz=500;
xmin=-40; xmax=40; zmin=-40; zmax=40;
x_grid=linspace(xmin,xmax,nx); z_grid=linspace(zmin,zmax,nz);
[X,Z]=meshgrid(x_grid,z_grid);

RelTol=1.e-06; AbsTol=1.e-08;
for ix=1:nx
  for iz=1:nz
    x=X(iz,ix); y=3*sqrt(2); z=Z(iz,ix);
    error=Inf;
    while error > max(RelTol*max(abs([x,y,z])),AbsTol)
      J=[-sigma, sigma, 0; r-z, -1, -x; y, x, -beta];
      rhs = -[sigma*(y-x); r*x-y-x*z; x*y-beta*z];
      delta_xyz=J\rhs;
      x = x + delta_xyz(1);
      y = y + delta_xyz(2);
      z = z + delta_xyz(3);
      error=max(abs(delta_xyz));
    end
    X(iz,ix)=x; Z(iz,ix)=z;
  end
end
eps=1.e-03;
X1 = abs(X-x1) < eps; X2 = abs(X-x2) < eps; X3 = abs(X-x3) < eps;
X4 = ~(X1+X2+X3);

figure;
map = [1 0 0; 0 1 0; 0 0 1; 0 0 0]; colormap(map); %[red;green;blue;black]
X=(X1+2*X2+3*X3+4*X4);
image([xmin xmax], [zmin zmax], X); set(gca,'YDir','normal');
xlabel('$x$', 'Interpreter', 'latex', 'FontSize',14);
ylabel('$z$', 'Interpreter', 'latex', 'FontSize',14);
title('Fractal from the Lorenz Equations', 'Interpreter', 'latex','FontSize', 16)
```

Completed **Go to next item**

Like **Dislike** **Report an issue**