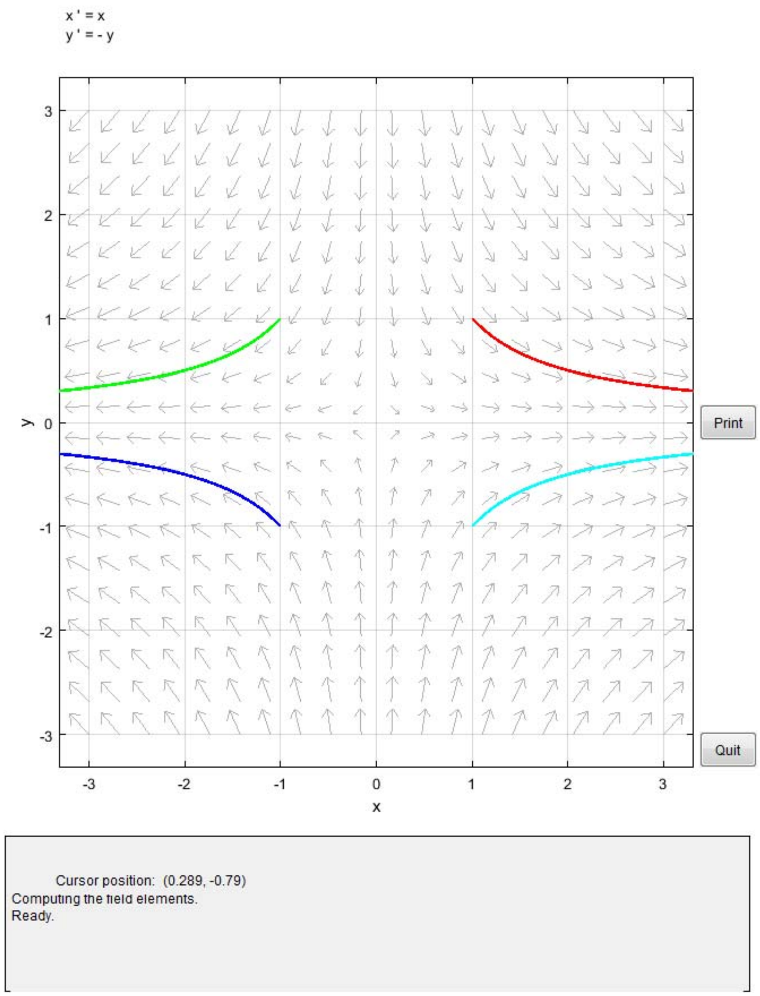
The matlab codes for solving and showing the solution to the equation $\frac{dx}{dt} = Ax$ with four different initial positions.

The vector field is created using pplane.

```
A = [1,0;0,-1];
x1 = [1;1];
x2 = [-1;1];
x3 = [-1;-1];
x4 = [1;-1];
df = @(t,x) A*x;
[~,x] = ode45(df, [0,2], x1);
plot(x(:,1),x(:,2),'-r','linewidth',2)
[~,x] = ode45(df, [0,2], x2);
plot(x(:,1),x(:,2),'-g','linewidth',2)
[~,x] = ode45(df, [0,2], x3);
plot(x(:,1),x(:,2),'-b','linewidth',2)
[~,x] = ode45(df, [0,2], x4);
plot(x(:,1),x(:,2),'-c','linewidth',2)
```

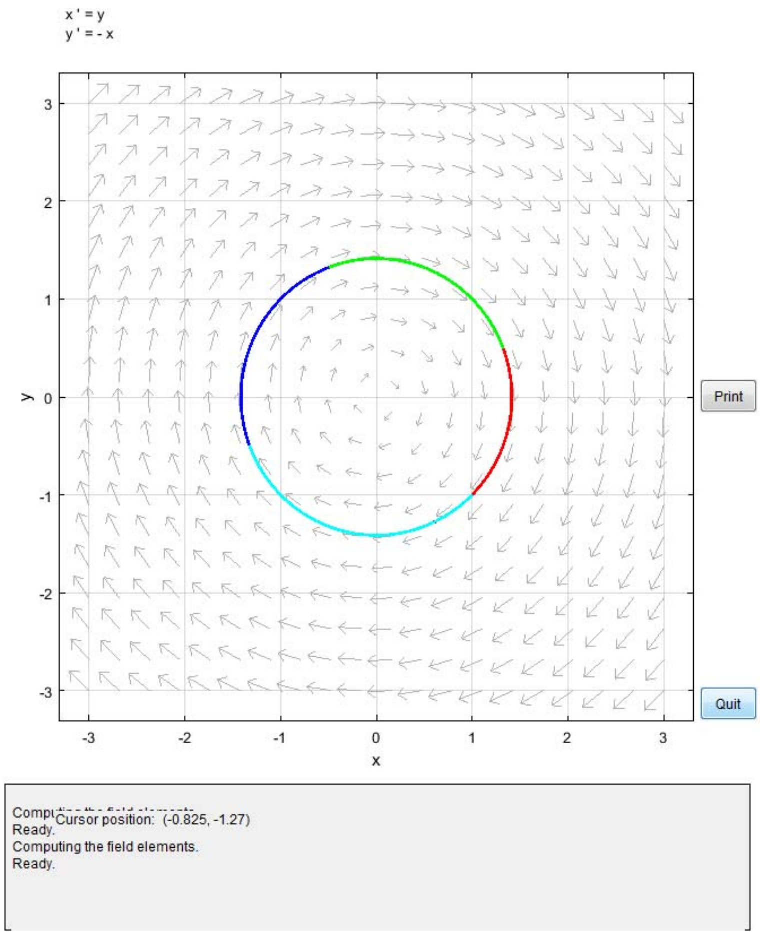
Case 1. Saddle point

We choose $A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$, $\det A = -1$, $tr(A) = 0$, the result is



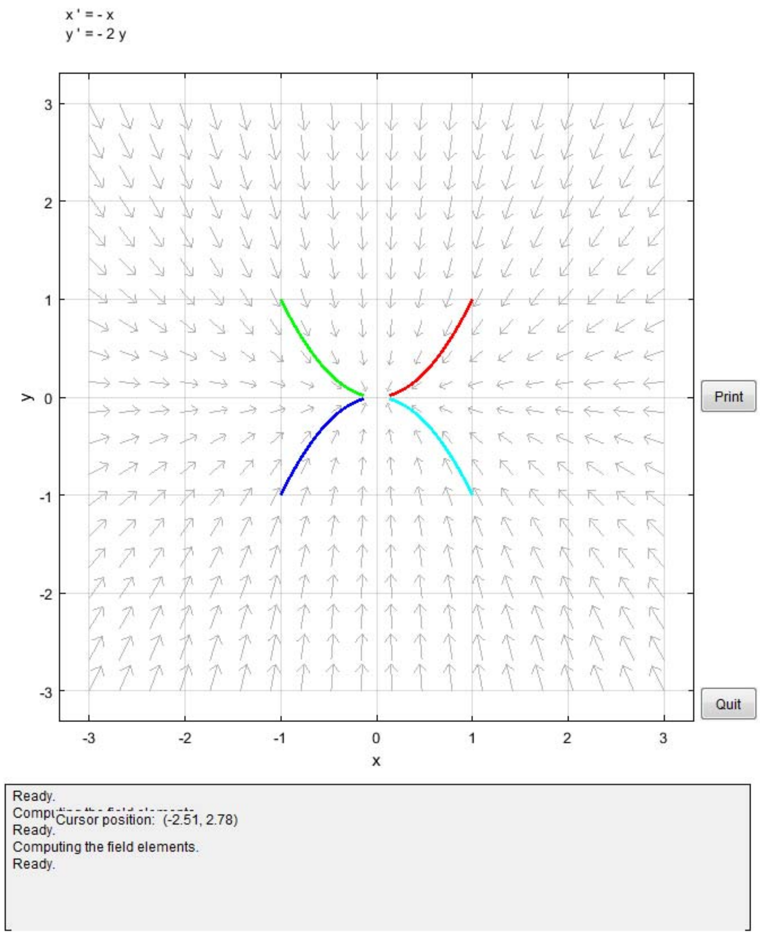
Case 2. Center

We choose $A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$, $\det A = 1$, $tr(A) = 0$, the result is



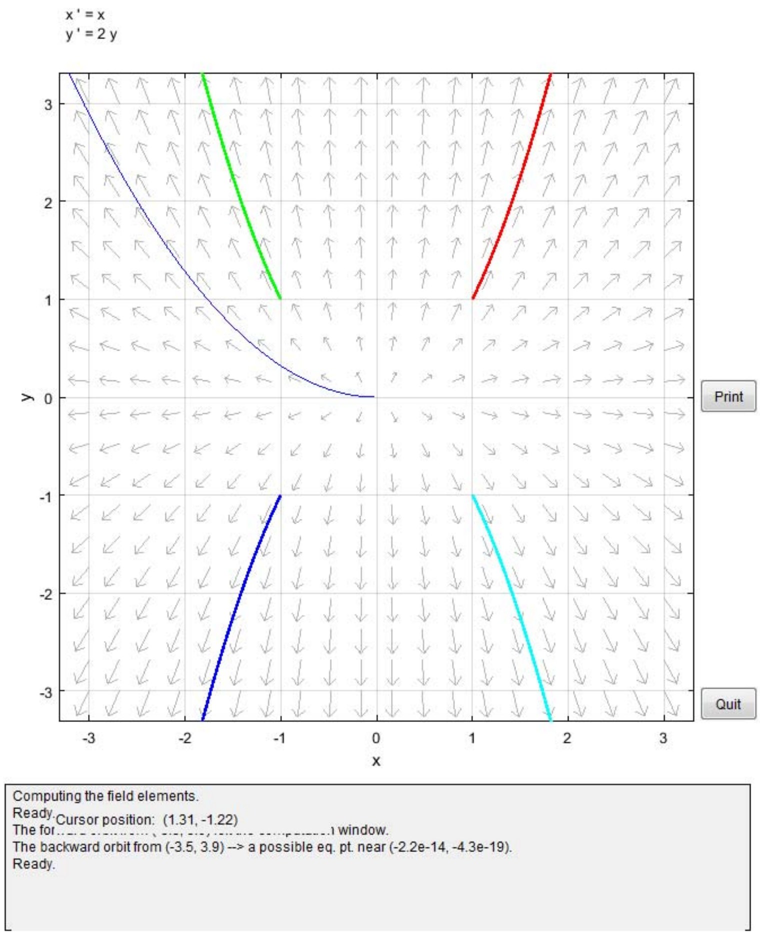
Case 3. Stable Node

We choose $A = \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix}$, $\det A = 2$, $tr(A) = -3$, the result is



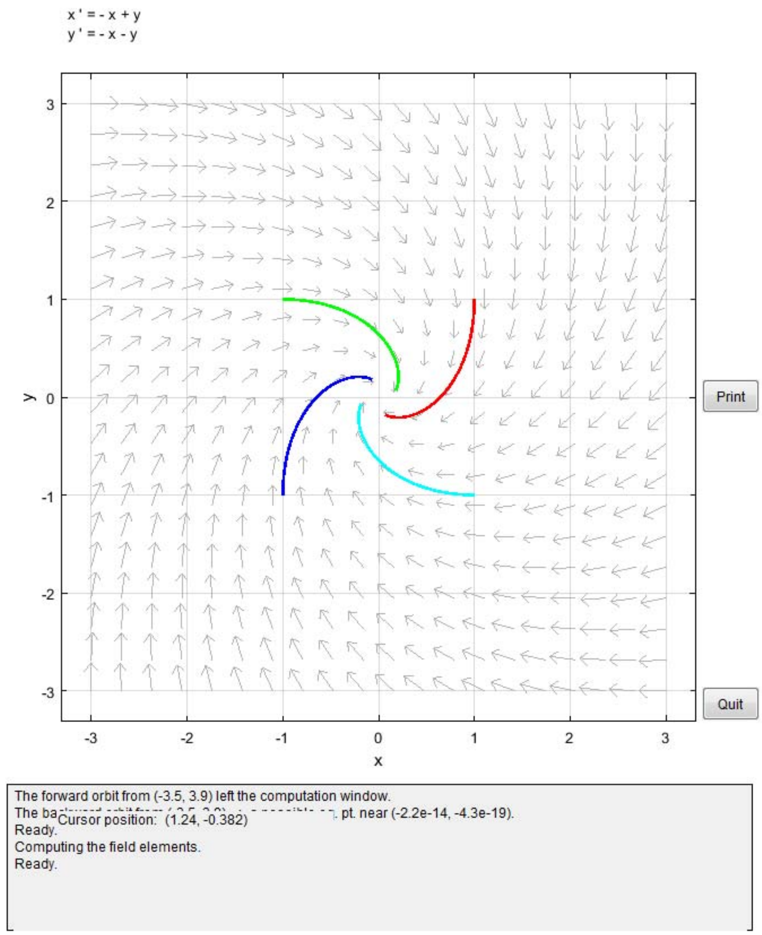
Case 4 Unstable Node

We choose $A = \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}$, $\det A = 2$, $tr(A) = 3$, the result is



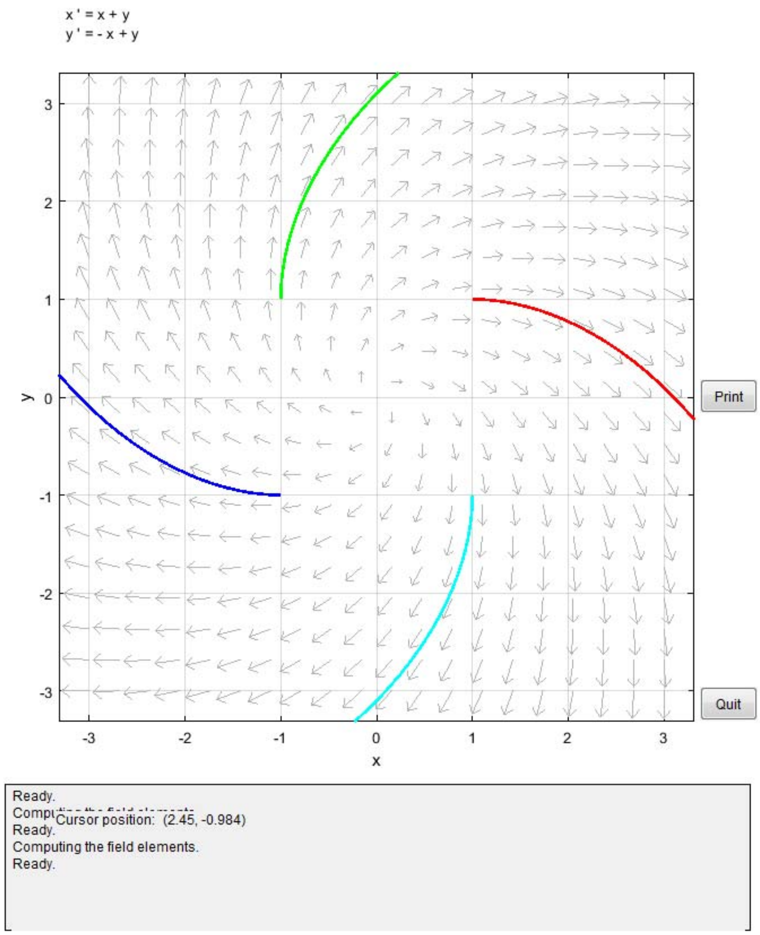
Case 5. Stable Spiral

We choose $A = \begin{bmatrix} -1 & 1 \\ -1 & -1 \end{bmatrix}$, $\det A = 2$, $tr(A) = -2$, the result is



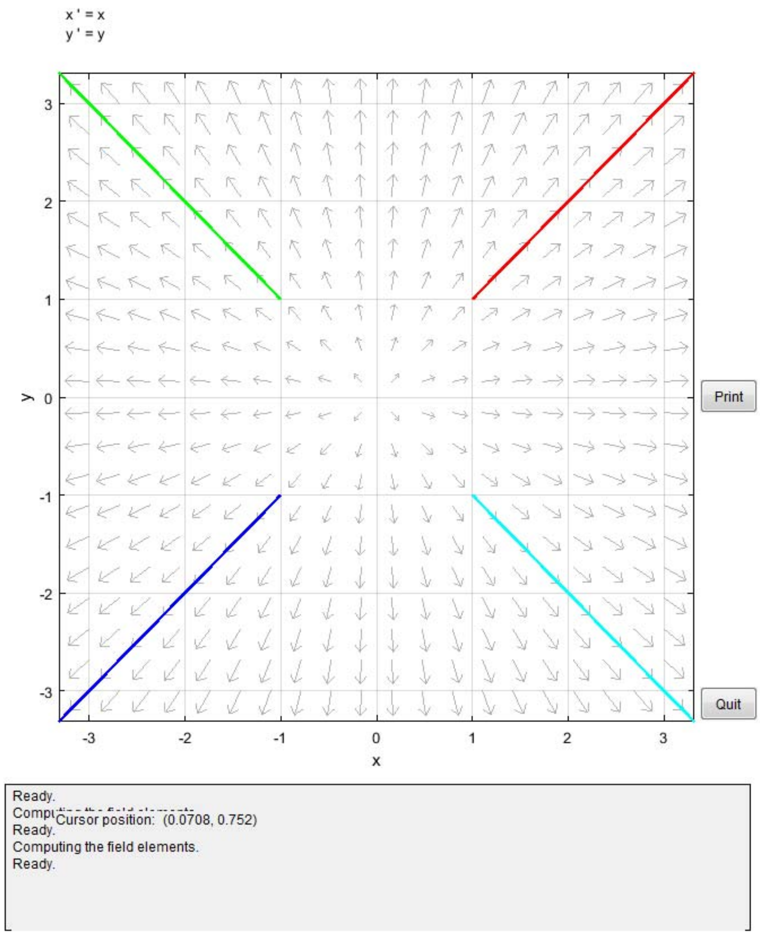
Case 6 Unstable Spiral

We choose $A = \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}$, $\det A = 2$, $tr(A) = 2$, the result is



Case 7. Star

We choose $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, $\det A = 1$, $tr(A) = 2$, the result is



Case 8. Degenerate Node

We choose $A = \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$, $\det A = 0$, $tr(A) = 1$, the result is