

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);
```

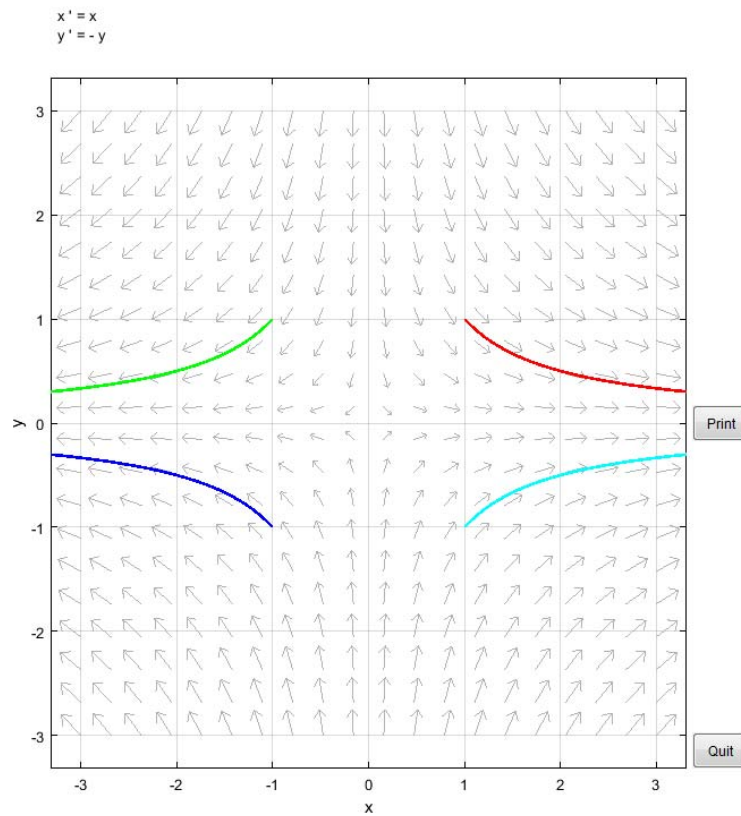
```
plot(x(:,1),x(:,2),'-b','linewidth',2)
```

```
[~,x] = ode45(df, [0,2], x4);
```

```
plot(x(:,1),x(:,2),'-c','linewidth',2)
```

Case 1. Saddle point

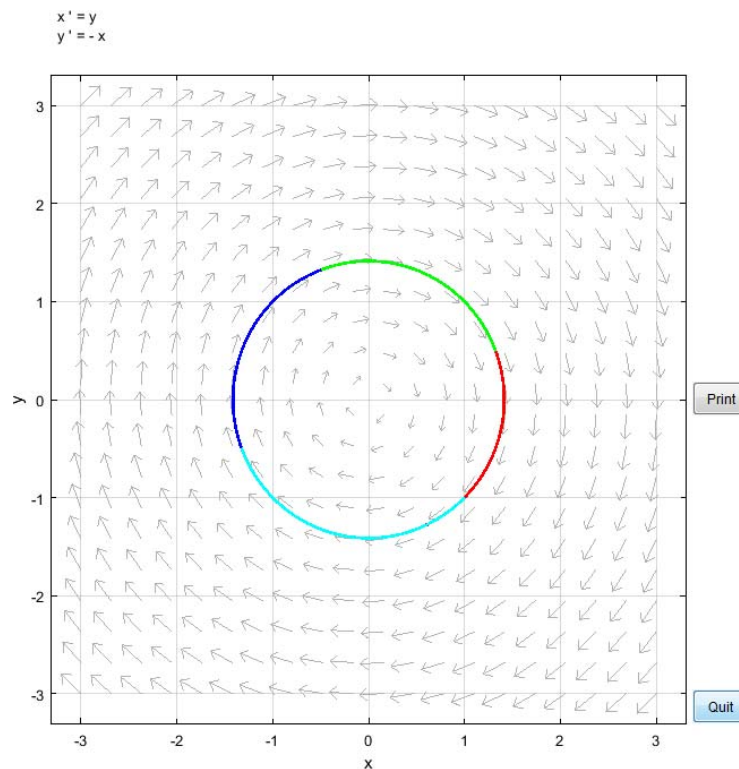
We choose $A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$, $\det A = -1$, $\text{tr}(A) = 0$, the result is



Cursor position: (0.289, -0.79)
Computing the field elements.
Ready.

Case 2. Center

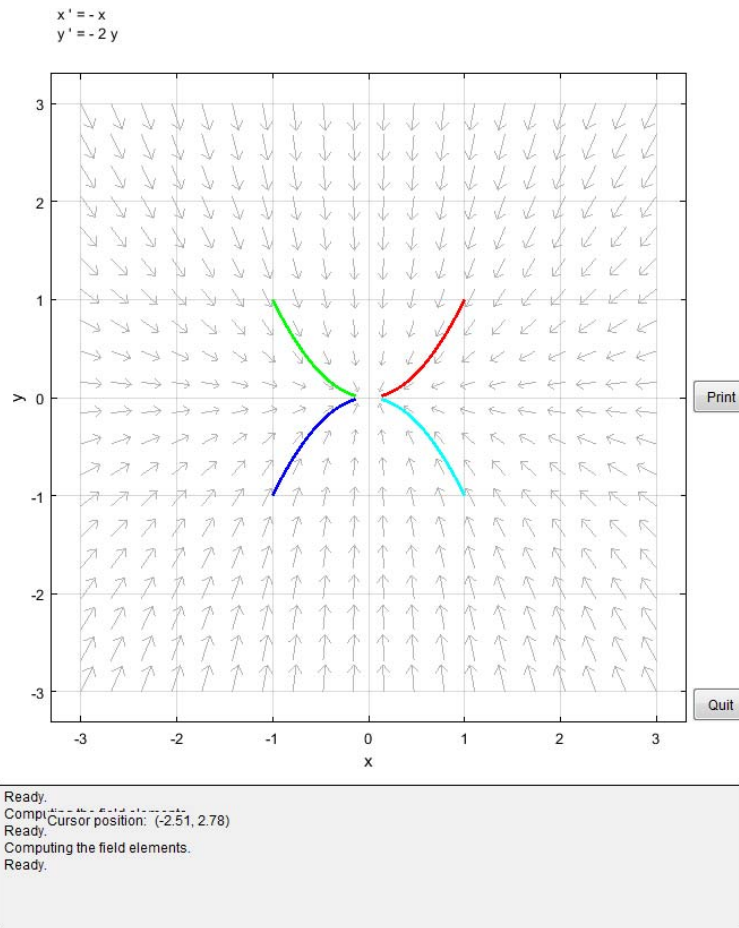
We choose $A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$, $\det A = 1$, $\text{tr}(A) = 0$, the result is



Computing the field elements.
Ready.
Cursor position: (-0.825, -1.27)
Ready.

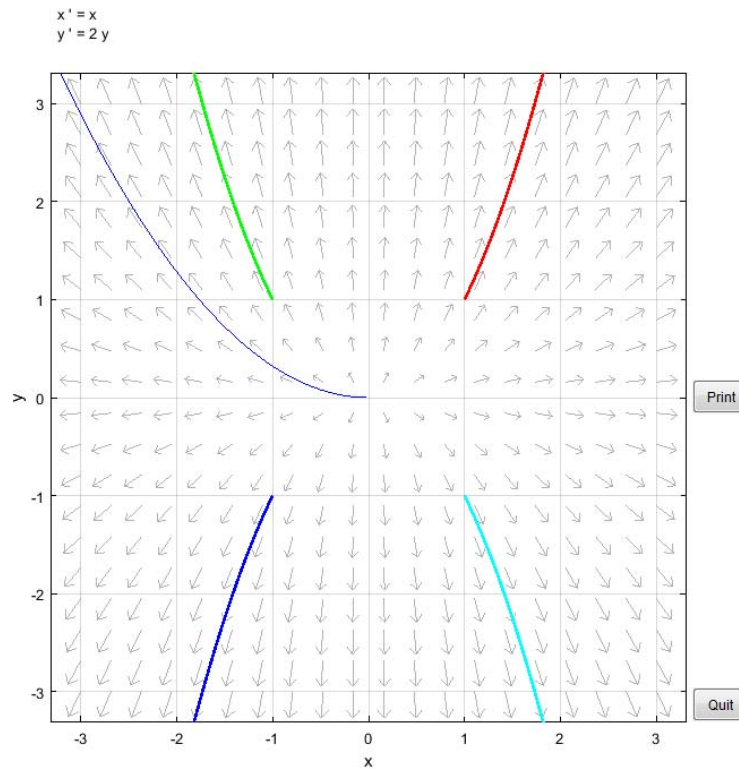
Case 3. Stable Node

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



Case 4 Unstable Node

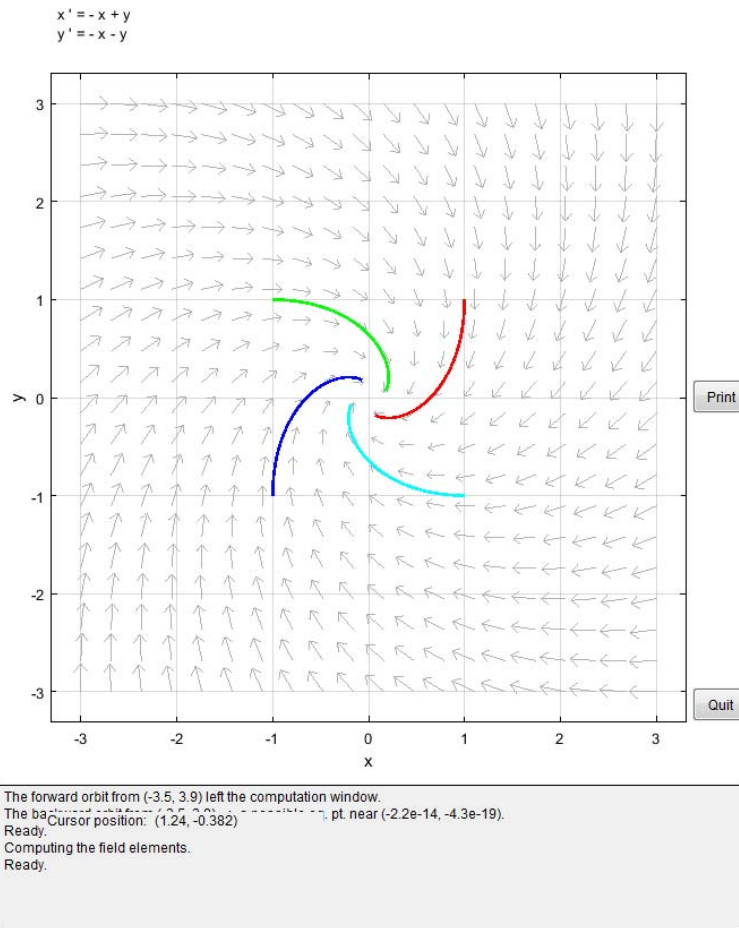
We choose $A = \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}$, $\det A = 2$, $\text{tr}(A) = 3$, the result is



Computing the field elements.
Ready. Cursor position: (1.31, -1.22)
The following window.
The backward orbit from (-3.5, 3.9) -> a possible eq. pt. near (-2.2e-14, -4.3e-19).
Ready.

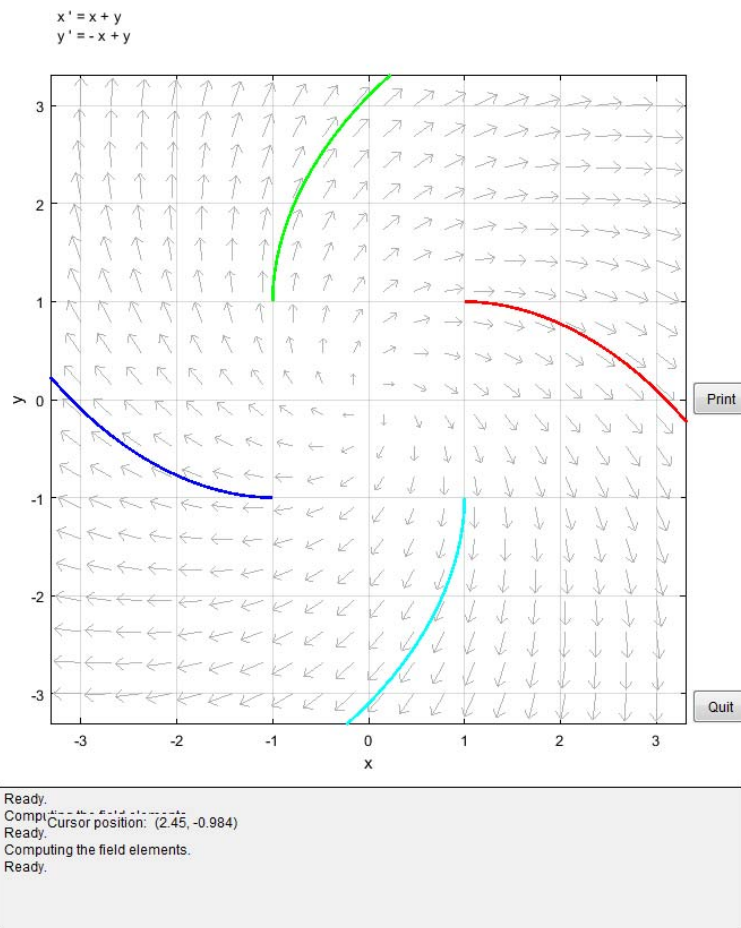
Case 5. Stable Spiral

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



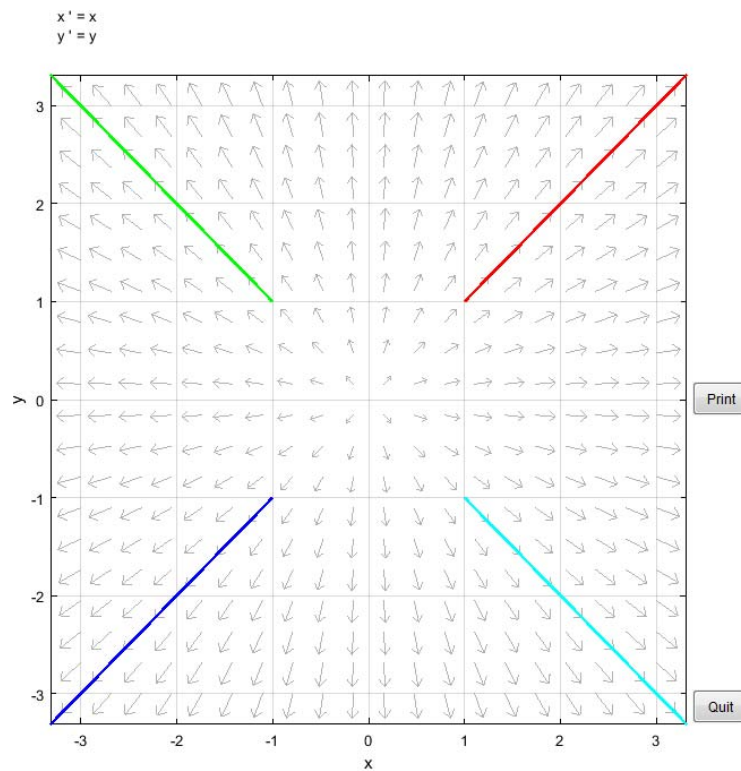
Case 6 Unstable Spiral

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



Case 7. Star

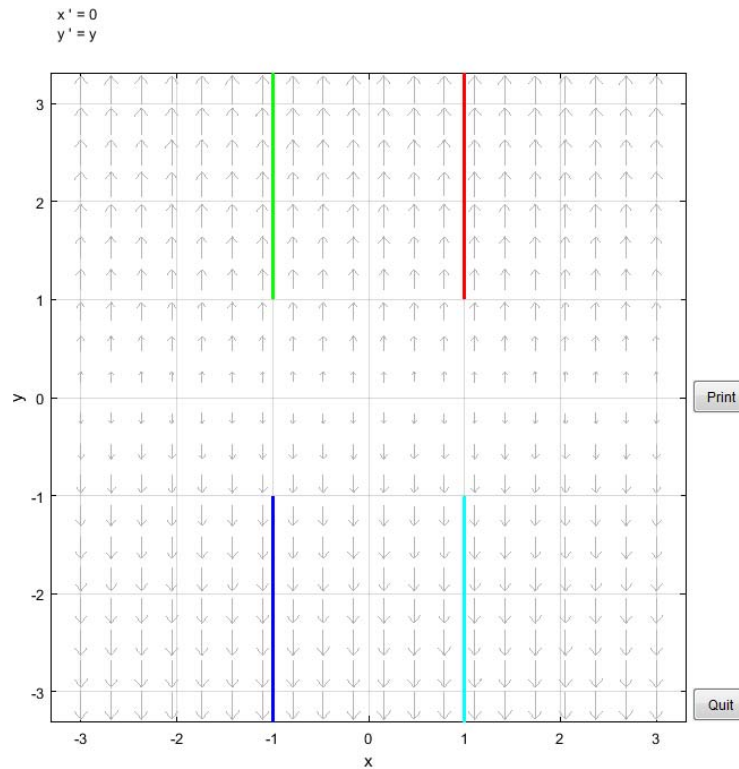
We choose $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, $\det A = 1$, $\text{tr}(A) = 2$, the result is



Ready.
Computing the field elements.
Ready.
Cursor position: (0.0708, 0.752)
Ready.

Case 8. Degenerate Node

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



Ready.
Computing the field elements.
Ready.
Cursor position: (-0.389, 0.023)
Computing the field elements.
Ready.