Math 2280-2

Monday March 26

Phase portraits for first order linear systems of DE's.

These portraits illustrate various cases from the table on page 396 which categorizes the possible ways in which zero is an equilibrium solution for a homogeneous system of two first order differential equations, based on the eigenvalues of the coefficient matrix

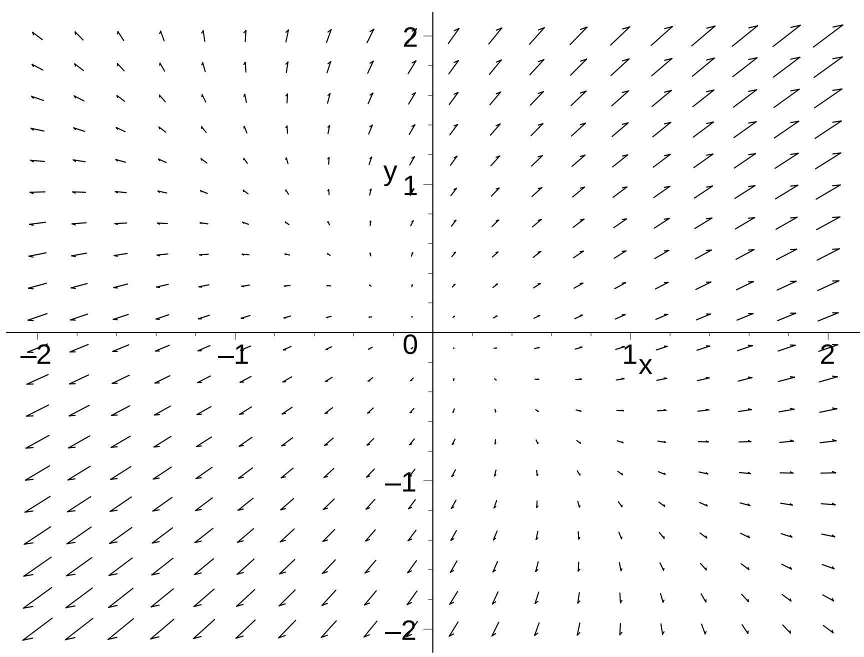
```
>
> with(plots):with(linalg):
> A:=matrix(2,2,[2,1,1,2]);
```

$$A := \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$$

```
> eigenvects(A);
```

[3, 1, {[1, 1]}], [1, 1, {[-1, 1]}]

```
> fieldplot([2*x+y,x+2*y],x=-2..2,y=-2..2);
  #an unstable improper node
```



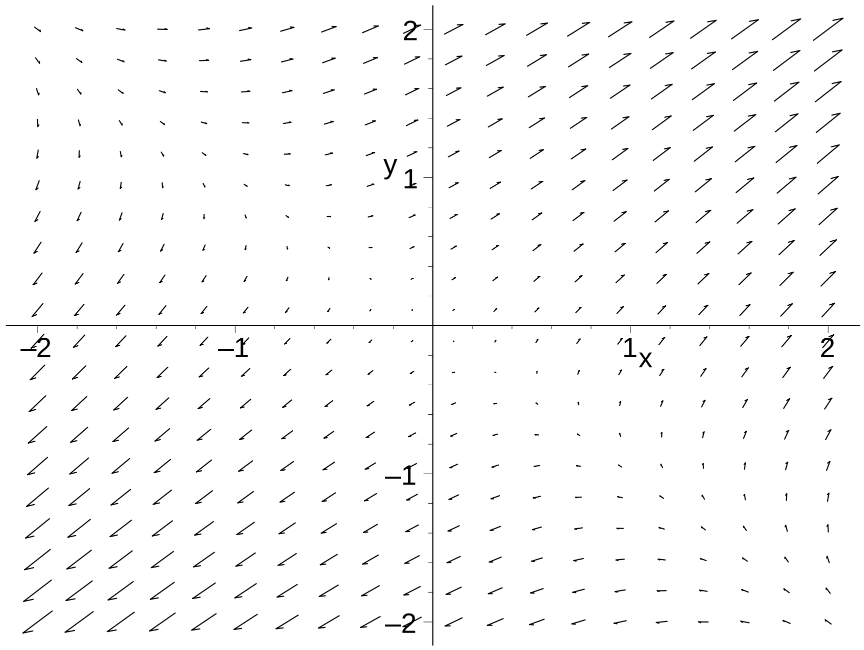

```
>
> A:=matrix(2,2,[2,3,3,2]);
```

$$A := \begin{bmatrix} 2 & 3 \\ 3 & 2 \end{bmatrix}$$

```
> eigenvects(A);
```

[-1, 1, {[1, -1]}], [5, 1, {[1, 1]}]

```
> fieldplot([2*x+3*y,3*x+2*y],x=-2..2,y=-2..2);
  #unstable saddle point
```



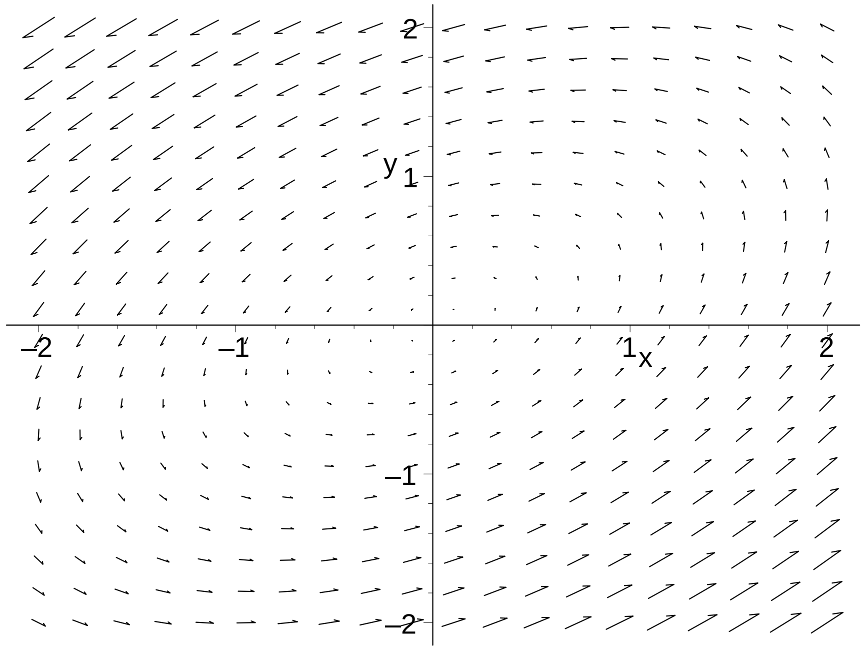

```
> A:=matrix(2,2,[2,-5,4,-2]);
```

$$A := \begin{bmatrix} 2 & -5 \\ 4 & -2 \end{bmatrix}$$

```
> eigenvects(A);
```

$$\left[4\,I,\,1,\,\left\{\left[\frac{1}{2}+I,\,1\right]\right\}\right],\,\left[-4\,I,\,1,\,\left\{\left[\frac{1}{2}-I,\,1\right]\right\}\right]$$

```
> fieldplot([2*x-5*y,4*x-2*y],x=-2..2,y=-2..2);
  #stable center
```



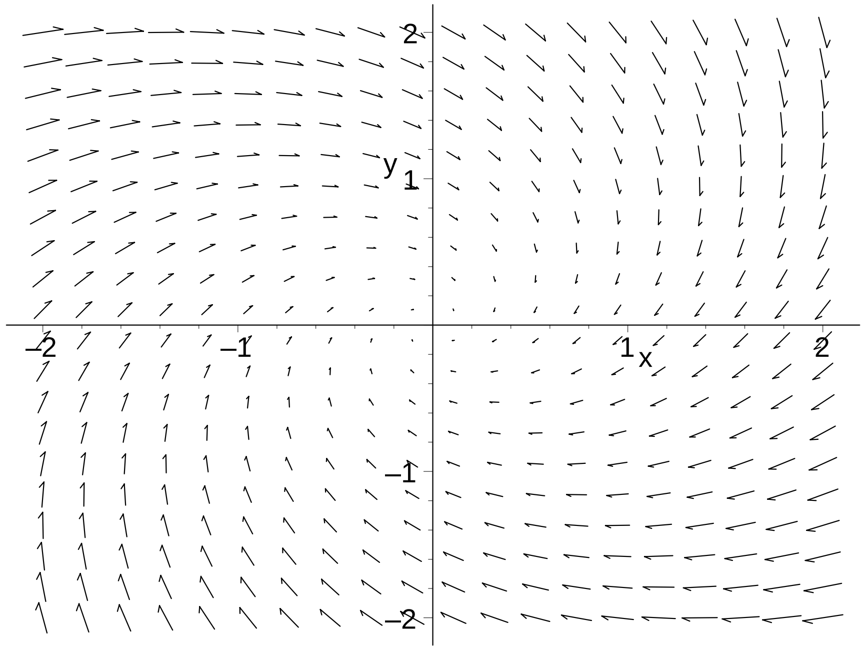

```
> A:=matrix(2,2,[-2,3,-3,-2]);
```

$$A := \begin{bmatrix} -2 & 3 \\ -3 & -2 \end{bmatrix}$$

```
> eigenvects(A);
```

$$[-2+3\,I,\ 1,\ \{[1,\ I]\}],\ [-2-3\,I,\ 1,\ \{[1,\ -I]\}]$$

```
> fieldplot([-2*x+3*y,-3*x-2*y],x=-2..2,y=-2..2);
  #stable spiral
```


2
y
1
−2
−1
1
x
2
−1
−2

>