>

実習22.1

(1)

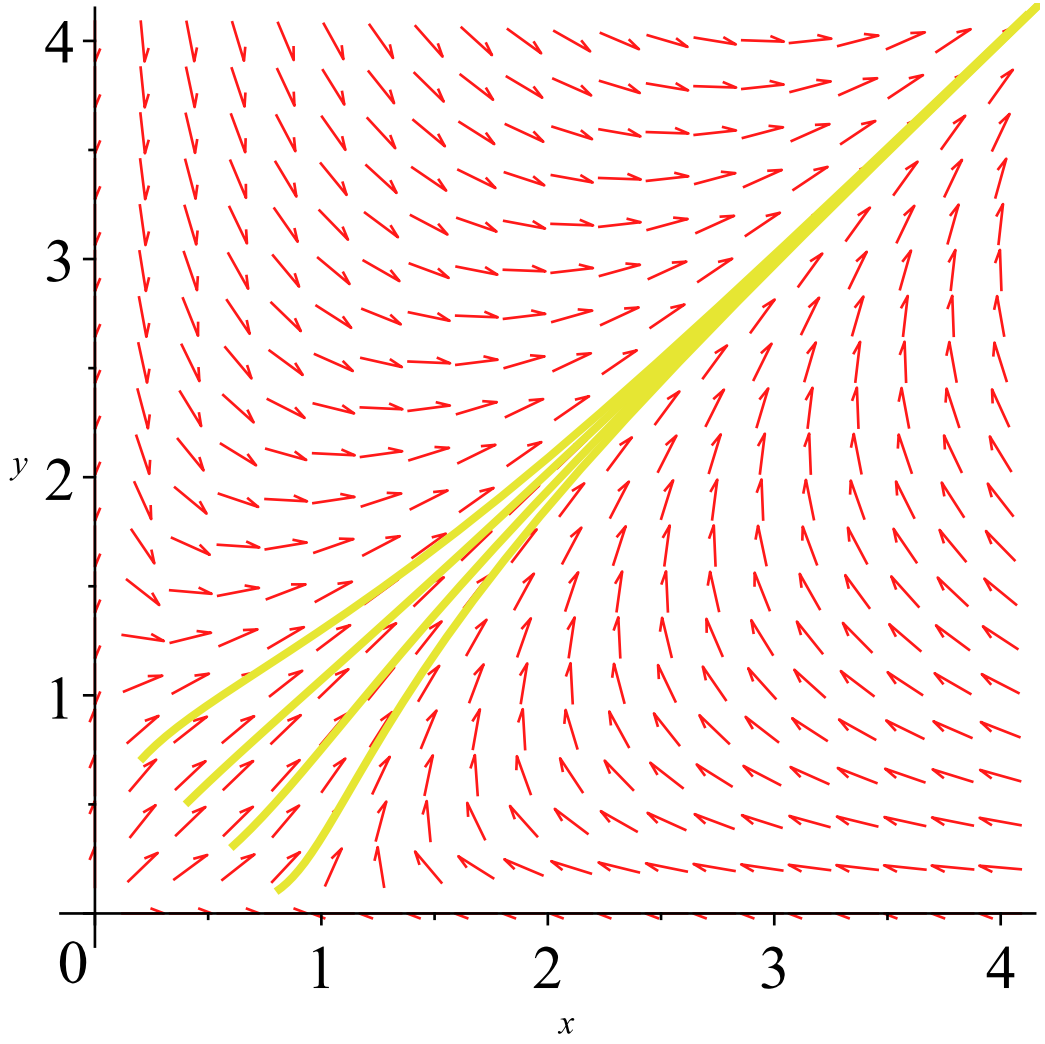
```
> with(DEtools):
> de1 := [diff(x(t),t) = x(t)·(1 - x(t) + y(t)), diff(y(t),t) = y(t)·(1 + x(t) - y(t))]
```

$$de1 := \left[\frac{d}{dt}x(t) = x(t)\,(1 - x(t) + y(t)),\ \frac{d}{dt}y(t) = y(t)\,(1 + x(t) - y(t))\right] \tag{1}$$

```
> ini1 := seq([x(0) = 0.2·i, y(0) = 0.9 - 0.2·i], i = 1..4)
```

$$ini1 := [x(0) = 0.2, y(0) = 0.7], [x(0) = 0.4, y(0) = 0.5], [x(0) = 0.6, y(0) = 0.3], [x(0) = 0.8, y(0) = 0.1] \tag{2}$$

```
> DEplot(de1, [x(t), y(t)], t = 0..30, [ini1], x = 0..4, y = 0..4, stepsize = 0.1)
```



>

(2)

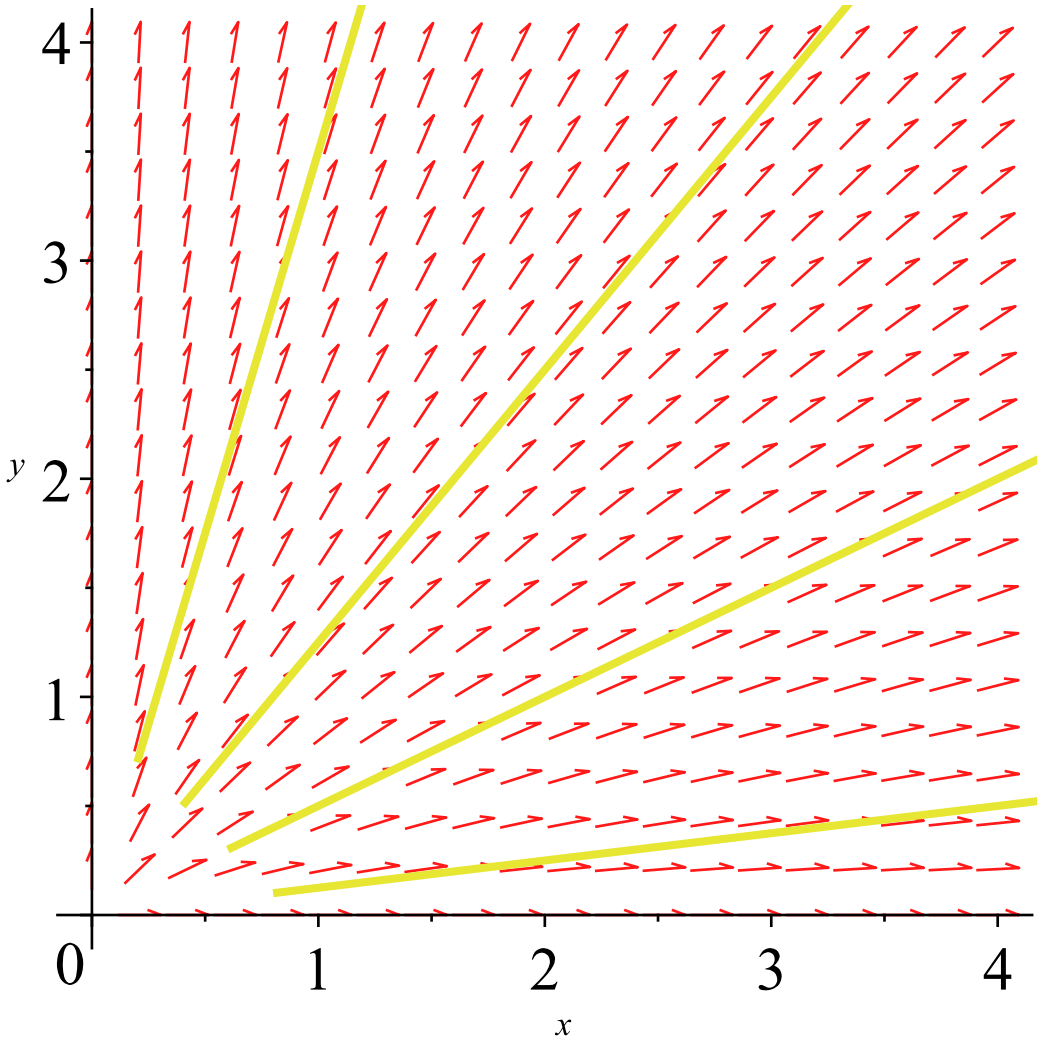
```
> de2 := [diff(x(t),t) = x(t)·(1 - -1·x(t) + y(t)), diff(y(t),t) = y(t)·(1 + x(t) - -1·y(t))]
```

$$de2 := \left[\frac{d}{dt}x(t) = x(t)\,(1 + x(t) + y(t)),\ \frac{d}{dt}y(t) = y(t)\,(1 + x(t) + y(t))\right] \tag{3}$$

```
> ini2 := seq([x(0) = 0.2·i, y(0) = 0.9 - 0.2·i], i = 1..4)
```

$$ini2 := [x(0) = 0.2, y(0) = 0.7], [x(0) = 0.4, y(0) = 0.5], [x(0) = 0.6, y(0) = 0.3], [x(0) = 0.8, y(0) = 0.1] \tag{4}$$

```
> DEplot(de2, [x(t), y(t)], t = 0..30, [ini2], x = 0..4, y = 0..4, stepsize = 0.1)
```



>

(3)

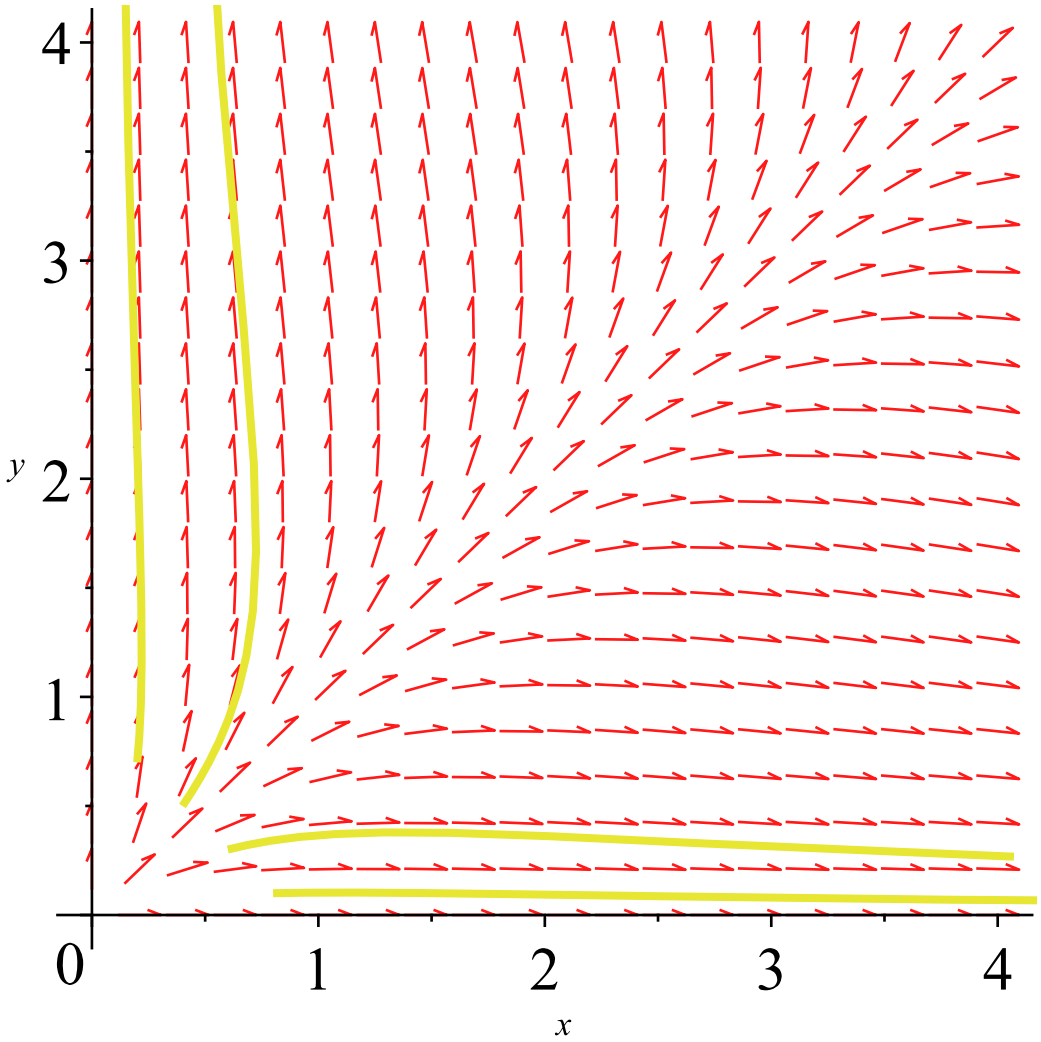
> $de3 := [diff(x(t), t) = x(t) \cdot (1 - -1 \cdot x(t) + -1 \cdot y(t)), diff(y(t), t) = y(t) \cdot (1 + -1 \cdot x(t) - -1 \cdot y(t))]$

$$de3 := \left[\frac{d}{dt} x(t) = x(t)\ (1 + x(t) - y(t)), \frac{d}{dt} y(t) = y(t)\ (1 - x(t) + y(t))\right] \quad (5)$$

> $ini3 := seq([x(0) = 0.2 \cdot i, y(0) = 0.9 - 0.2 \cdot i], i = 1..4)$

$$ini3 := [x(0) = 0.2, y(0) = 0.7], [x(0) = 0.4, y(0) = 0.5], [x(0) = 0.6, y(0) = 0.3], [x(0) = 0.8, y(0) = 0.1] \quad (6)$$

> $DEplot(de3, [x(t), y(t)], t = 0..30, [ini3], x = 0..4, y = 0..4, stepsize = 0.1)$



>

(4)

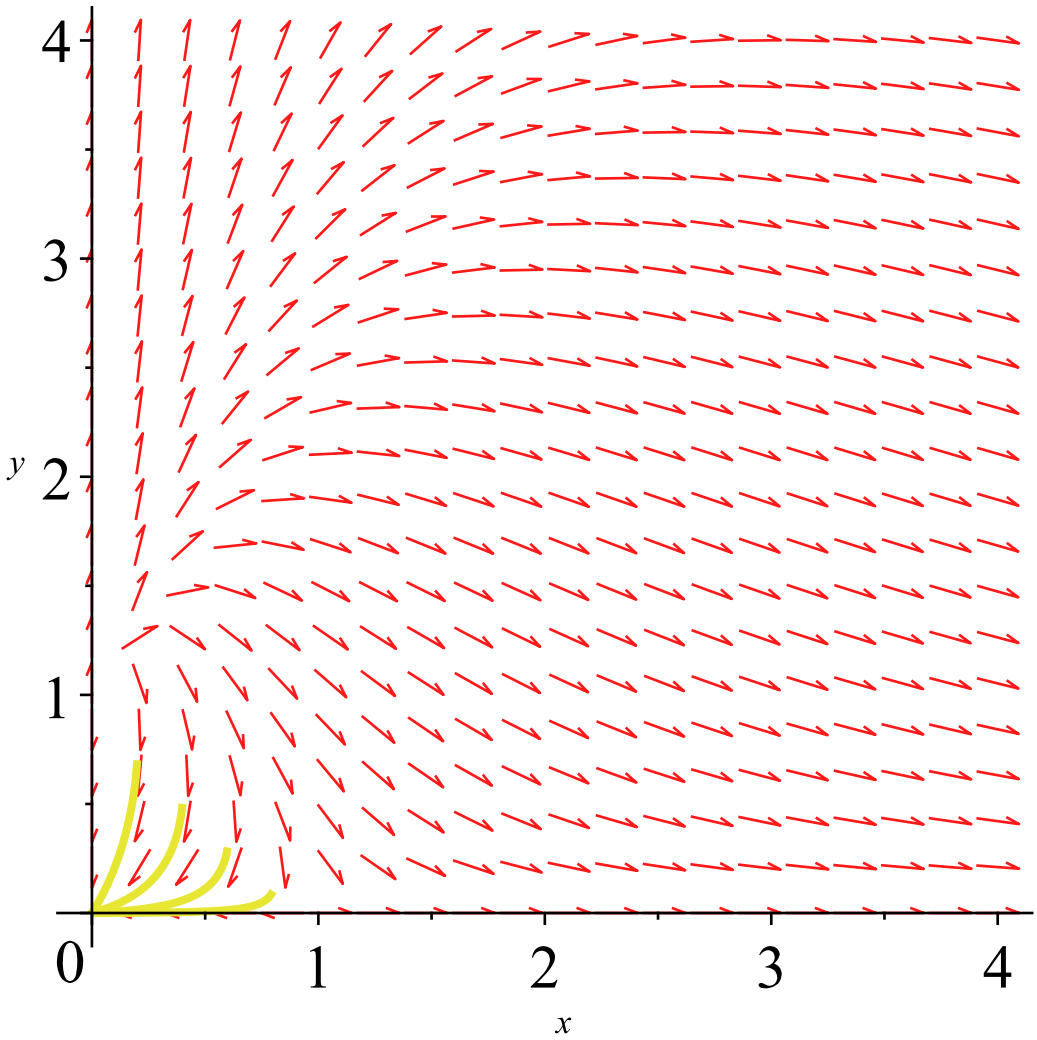
> $de4 := [diff(x(t), t) = x(t) \cdot (-1 - -1 \cdot x(t) + y(t)), diff(y(t), t) = y(t) \cdot (-1 + -1 \cdot x(t) - -1 \cdot y(t))]$

$$de4 := \left[\frac{d}{dt} x(t) = x(t)\ (-1 + x(t) + y(t)), \frac{d}{dt} y(t) = y(t)\ (-1 - x(t) + y(t))\right] \quad (7)$$

> $ini4 := seq([x(0) = 0.2 \cdot i, y(0) = 0.9 - 0.2 \cdot i], i = 1..4)$

$$ini4 := [x(0) = 0.2, y(0) = 0.7], [x(0) = 0.4, y(0) = 0.5], [x(0) = 0.6, y(0) = 0.3], [x(0) = 0.8, y(0) = 0.1] \quad (8)$$

> $DEplot(de4, [x(t), y(t)], t = 0..30, [ini4], x = 0..4, y = 0..4, stepsize = 0.1)$



>

(5)

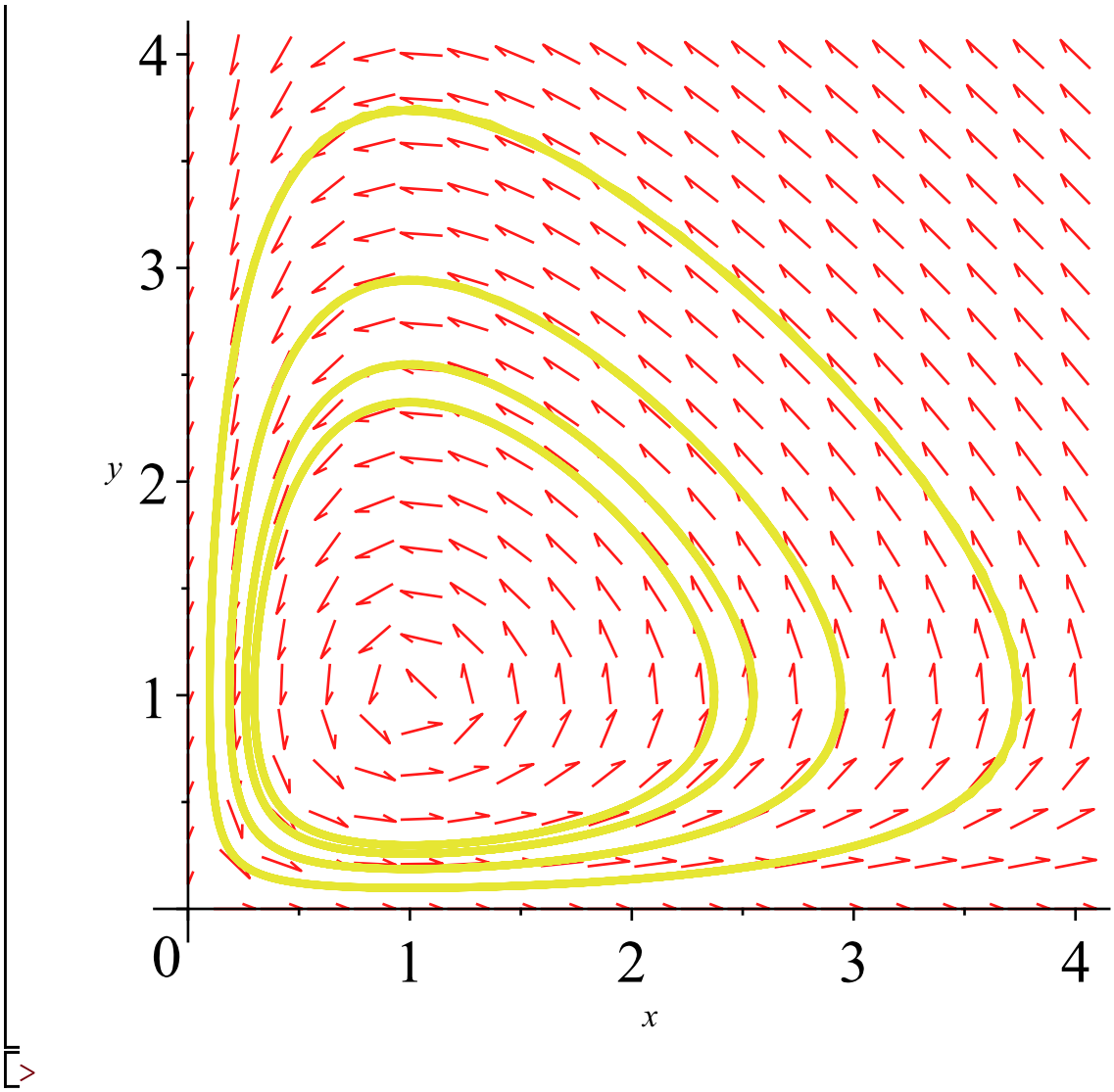
> $de5 := [diff(x(t), t) = x(t) \cdot (1 - 0 \cdot x(t) + -1 \cdot y(t)), diff(y(t), t) = y(t) \cdot (-1 + x(t) - 0 \cdot y(t))]$

$$de5 := \left[\frac{d}{dt} x(t) = x(t)\ (1 - y(t)), \frac{d}{dt} y(t) = y(t)\ (-1 + x(t))\right] \quad (9)$$

> $ini5 := seq([x(0) = 0.2 \cdot i, y(0) = 0.9 - 0.2 \cdot i], i = 1..4)$

$$ini5 := [x(0) = 0.2, y(0) = 0.7], [x(0) = 0.4, y(0) = 0.5], [x(0) = 0.6, y(0) = 0.3], [x(0) = 0.8, y(0) = 0.1] \quad (10)$$

> $DEplot(de5, [x(t), y(t)], t = 0..30, [ini5], x = 0..4, y = 0..4, stepsize = 0.1)$


4
3
y
2
1
0
1
2
3
4
x