

In[443]:= **m** = {{(σ + 1), 3}, {-2, (σ - 1)}}

Out[443]= {{1 + σ, 3}, {-2, -1 + σ}}

In[446]:= **λ** = **Eigenvalues**[m]

Out[446]= {-i √5 + σ, i √5 + σ}

In[447]:= **V** = **Eigenvectors**[m]

Out[447]= {{1/2 × (-1 + i √5), 1}, {1/2 × (-1 - i √5), 1}}

In[448]:= **Cs** = **Solve**[**C1** \* **V**[[1]] + **C2** \* **V**[[2]] == {u, v}, {**C1**, **C2**}]

Out[448]= {{C1 → -1/10 i (2 √5 u + 5 i v + √5 v), C2 → 1/10 i (2 √5 u - 5 i v + √5 v)}}

In[449]:= **c1** = **Cs**[[1]][[1]][[2]]

Out[449]= -1/10 i (2 √5 u + 5 i v + √5 v)

In[450]:= **c2** = **Cs**[[1]][[2]][[2]]

Out[450]= 1/10 i (2 √5 u - 5 i v + √5 v)

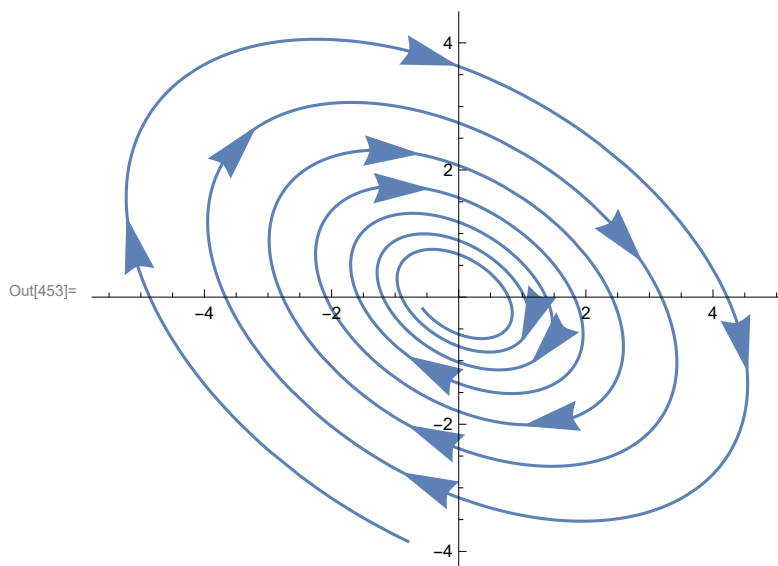
In[451]:= **S** = **c1** \* **Exp**[λ[[1]] \* t] \* **V**[[1]] + **c2** \* **Exp**[λ[[2]] \* t] \* **V**[[2]]

Out[451]= {1/20 i (-1 - i √5) e<sup>t (i √5 + σ)</sup> (2 √5 u - 5 i v + √5 v) -  
1/20 i (-1 + i √5) e<sup>t (-i √5 + σ)</sup> (2 √5 u + 5 i v + √5 v),  
1/10 i e<sup>t (i √5 + σ)</sup> (2 √5 u - 5 i v + √5 v) - 1/10 i e<sup>t (-i √5 + σ)</sup> (2 √5 u + 5 i v + √5 v)}

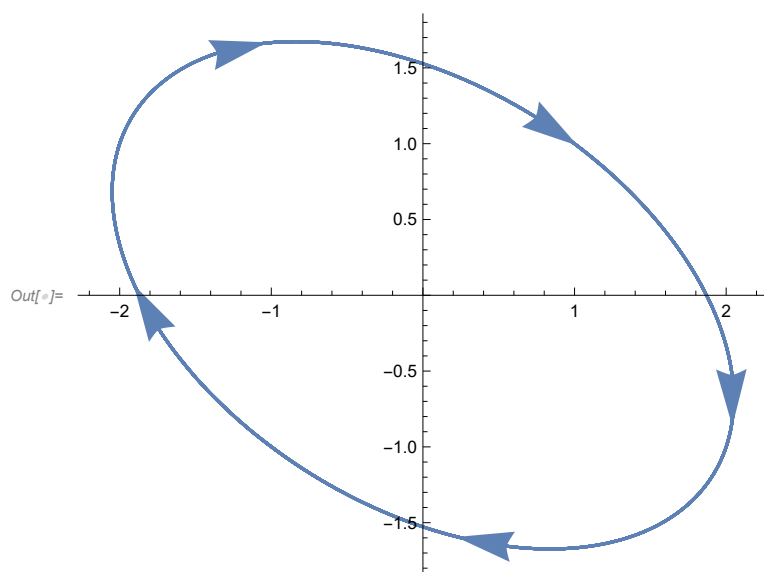
In[452]:= **sol** = **Simplify**[**ComplexExpand**[S]]

{1/5 e<sup>t σ</sup> (5 u Cos[√5 t] + √5 (u + 3 v) Sin[√5 t]),  
1/5 e<sup>t σ</sup> (5 v Cos[√5 t] - √5 (2 u + v) Sin[√5 t])}

```
In[453]:= ParametricPlot[S /. {u → 1, v → 1, σ → -1 / 10}, {t, -10, 10}] /.  
Line[x_] → {Arrowheads[{0., 0.07, 0.07, 0.07, 0.07, 0.07,  
0.07, 0.07, 0.07, 0.07, 0.07, 0.07, 0.07, 0.}], Arrow[x]}
```



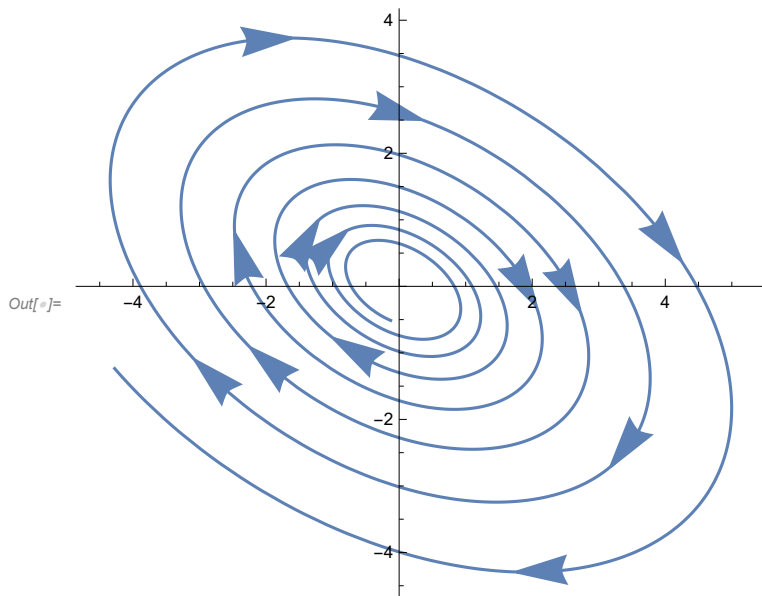
```
ParametricPlot[S /. {u → 1, v → 1, σ → 0}, {t, -10, 10}] /.  
Line[x_] → {Arrowheads[{0., 0.07, 0.07, 0.07, 0.07, 0.07, 0.}], Arrow[x]}
```



```

ParametricPlot[S /. {u → 1, v → 1, σ → 1 / 10}, {t, -10, 10}] /.
Line[x_] → {Arrowheads[{0., 0.07, 0.07, 0.07, 0.07, 0.07,
0.07, 0.07, 0.07, 0.07, 0.07, 0.07, 0.}], Arrow[x]}

```



```

In[502]:= max = FindMaximum[Norm[sol] /. {u → 1, v → 1, σ → 0}, t]
min = FindMinimum[Norm[S] /. {u → 1, v → 1, σ → 0}, t]

```

FindMaximum: The line search decreased the step size to within the tolerance specified by AccuracyGoal and PrecisionGoal but was unable to find a sufficient increase in the function. You may need more than MachinePrecision digits of working precision to meet these tolerances.

```
Out[502]= {2.25061, {t → 0.637691}}
```

```
Out[503]= {1.39095, {t → 1.34017}}
```

```
In[474]:= max / min
```

```
In[504]:= {1.6180339887498942`, {t → 0.6376910210893485`
t → 1.3401724854932913`}}
```

```
Out[504]= {1.61803, {t → 0.637691
t → 1.34017}}
```

```
In[505]:= dir = S /. {u → 1, v → 1, σ → 0, max[[2]][[1]]}
```

```
Out[505]= {1.91448 + 0. i, -1.18322 + 0. i}
```

```
In[506]:= Normalize[dir]
```

```
Out[506]= {0.850651 + 0. i, -0.525731 + 0. i}
```