

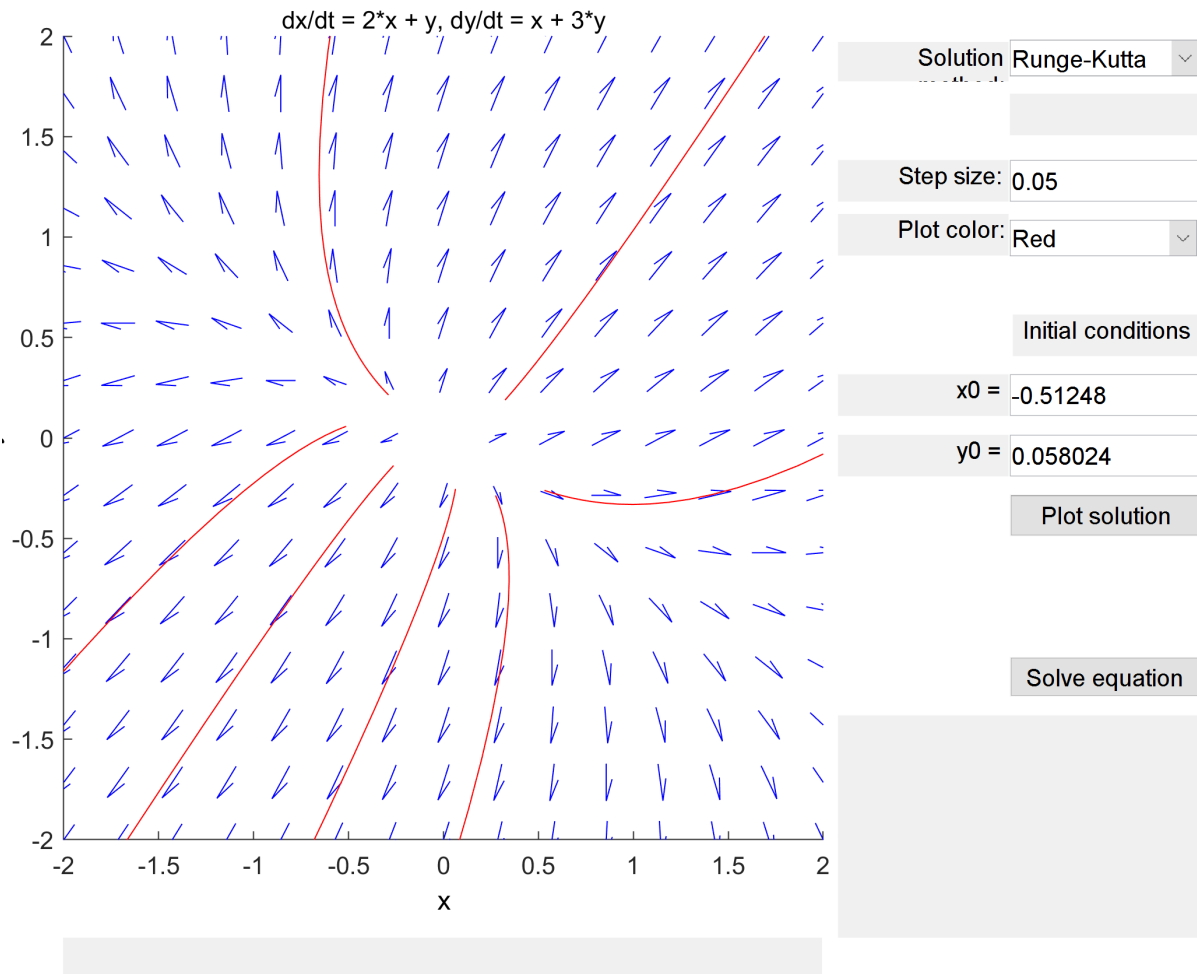
MAT292 - Lab 4 - Exercise 4

Frederick Boyd

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4

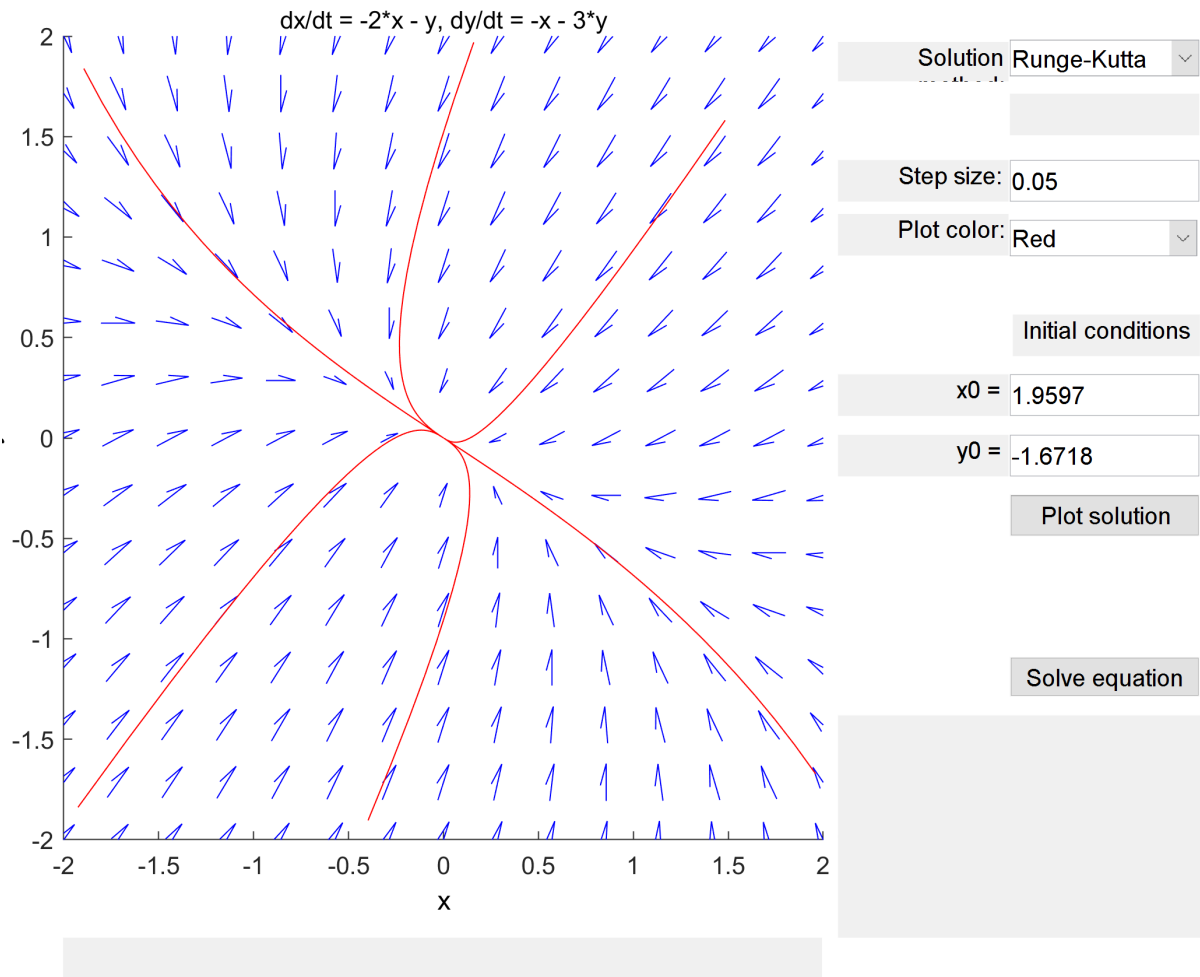
4.1



b) Source node

c) $\lambda_1 = \frac{5+\sqrt{5}}{2}, \lambda_2 = \frac{5-\sqrt{5}}{2}$
 $\lambda_1 > \lambda_2 > 0$

4.2

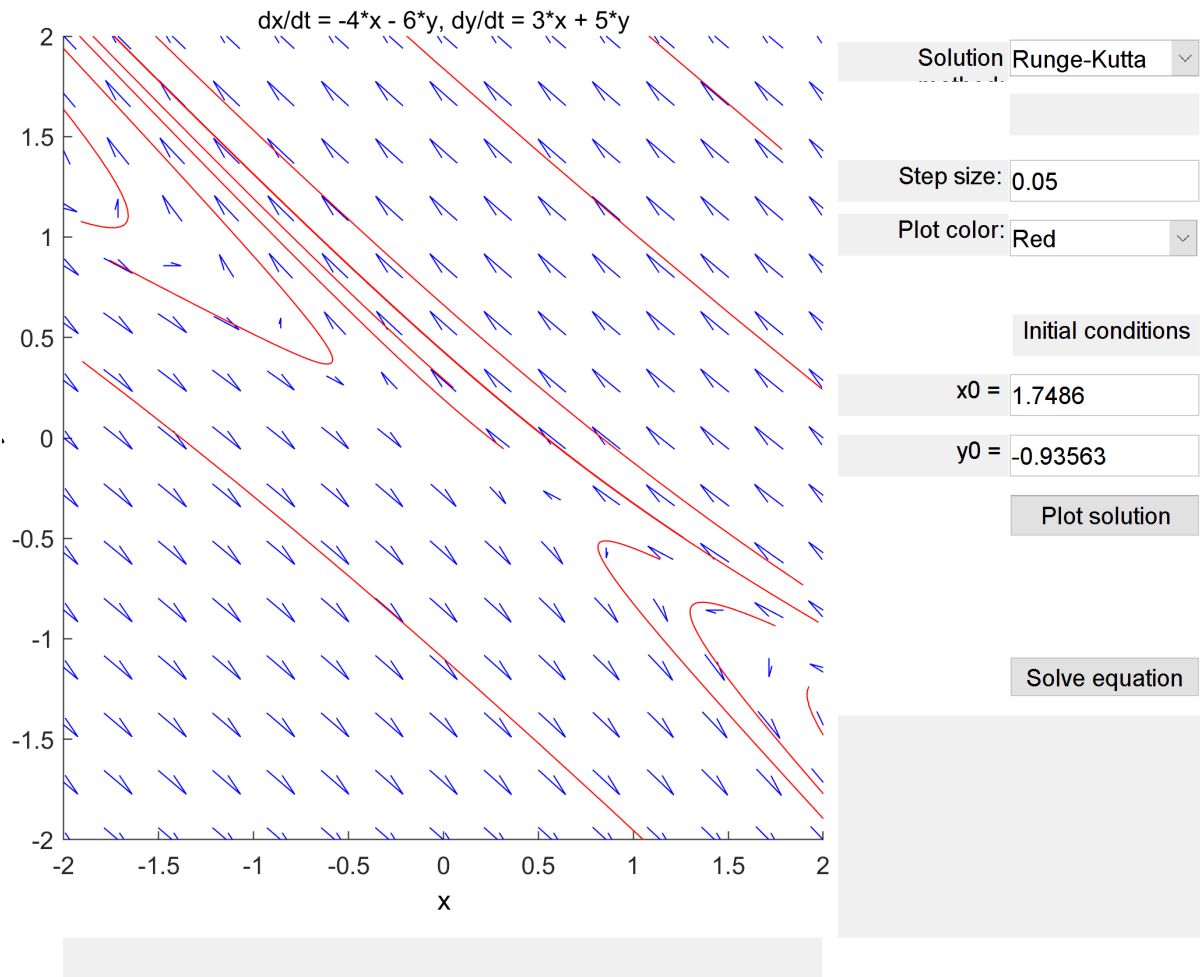


b) Sink node

c) $\lambda_1 = \frac{-5+\sqrt{5}}{2}$, $\lambda_2 = \frac{-5-\sqrt{5}}{2}$

$\lambda_1 < \lambda_2 < 0$

4.3

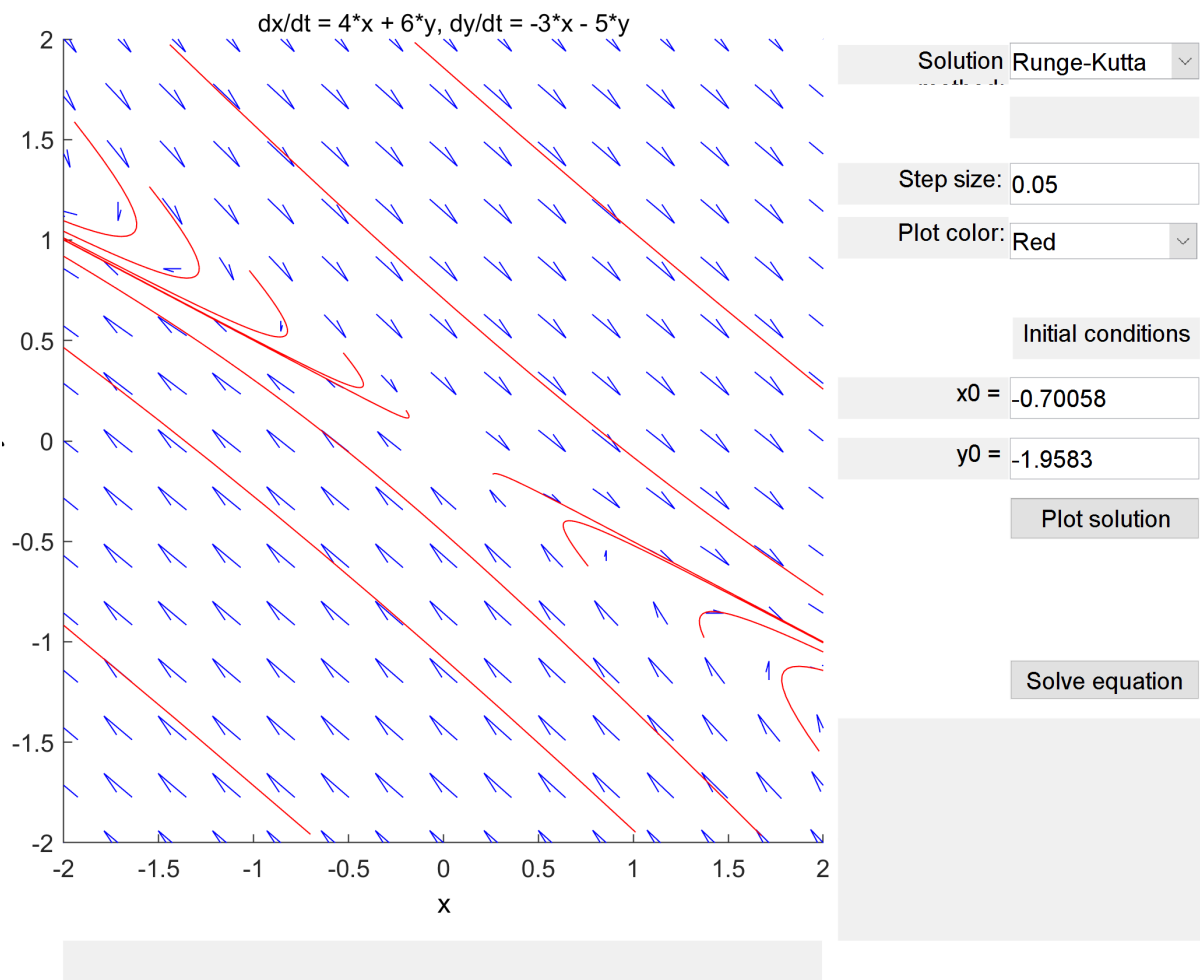


b) Saddle point (unstable)

c) $\lambda_1 = -1, \lambda_2 = 2$

$\lambda_1 < 0 < \lambda_2$

4.4

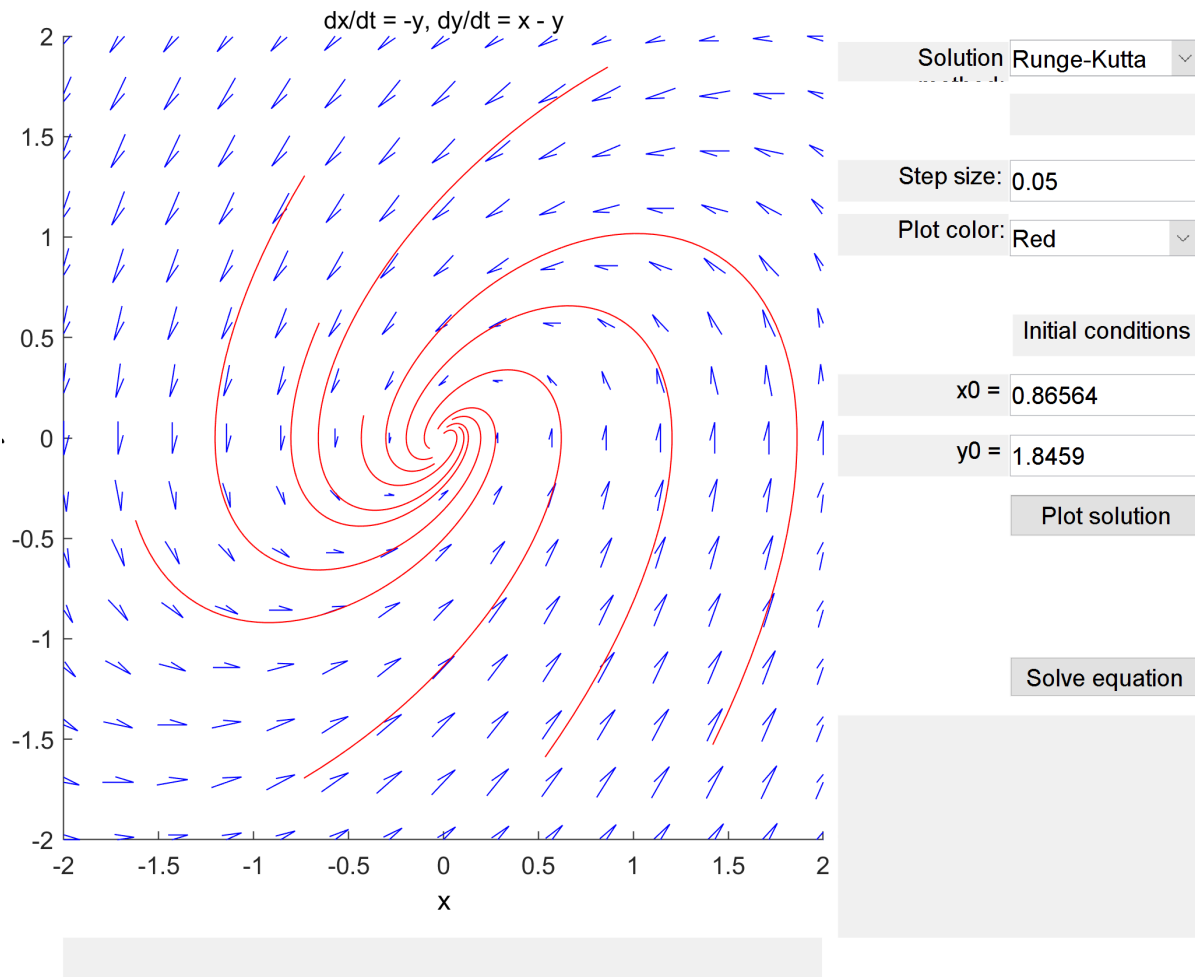


b) Saddle point (unstable)

c) $\lambda_1 = 1$, $\lambda_2 = -2$

$\lambda_2 < 0 < \lambda_1$

4.5

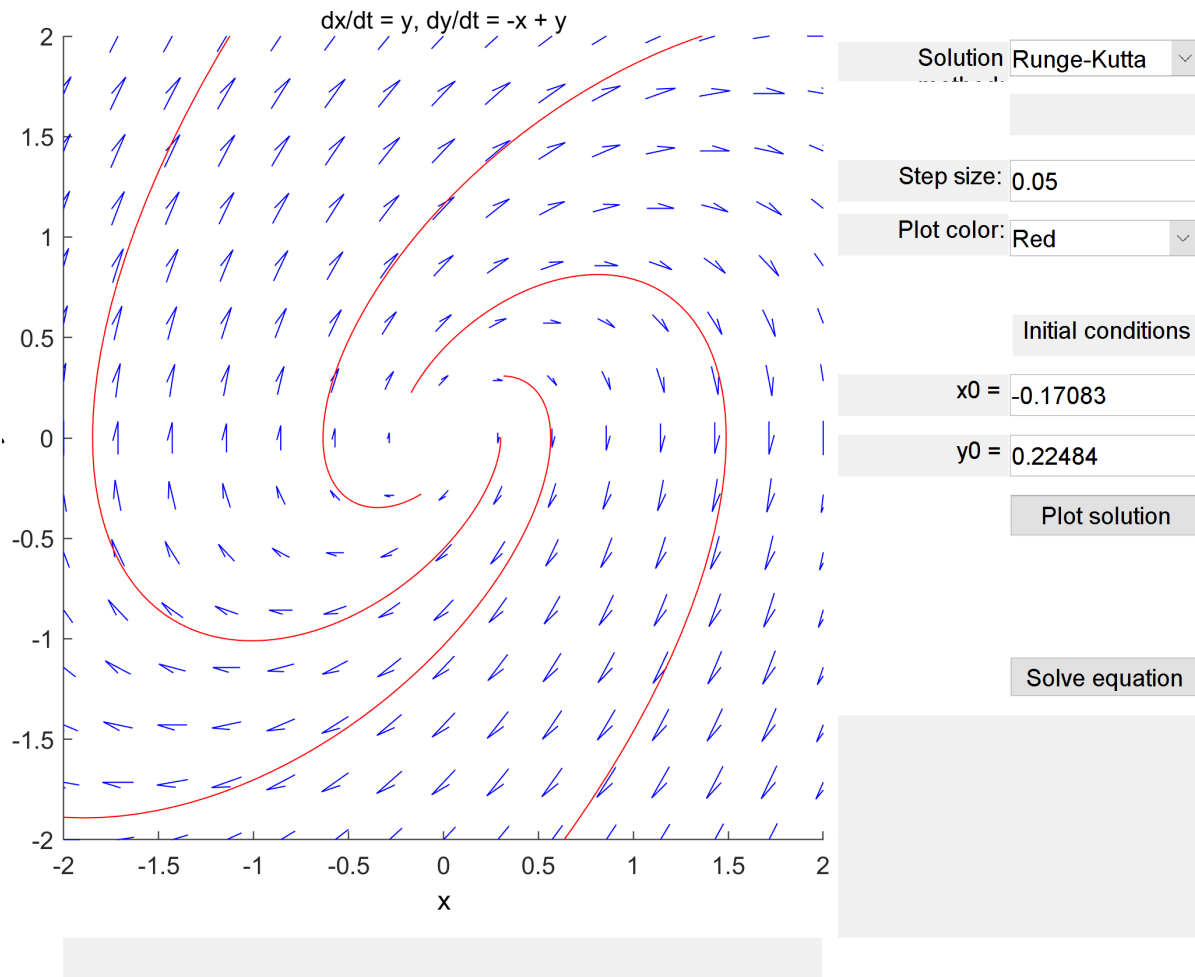


b) Spiral counterclockwise (stable)

c) $\lambda_1 = -\frac{1}{2} + i\frac{\sqrt{3}}{2}, \lambda_2 = -\frac{1}{2} - i\frac{\sqrt{3}}{2}$

$\lambda_1, \lambda_2 = \mu \pm \alpha i \rightarrow \mu < 0$

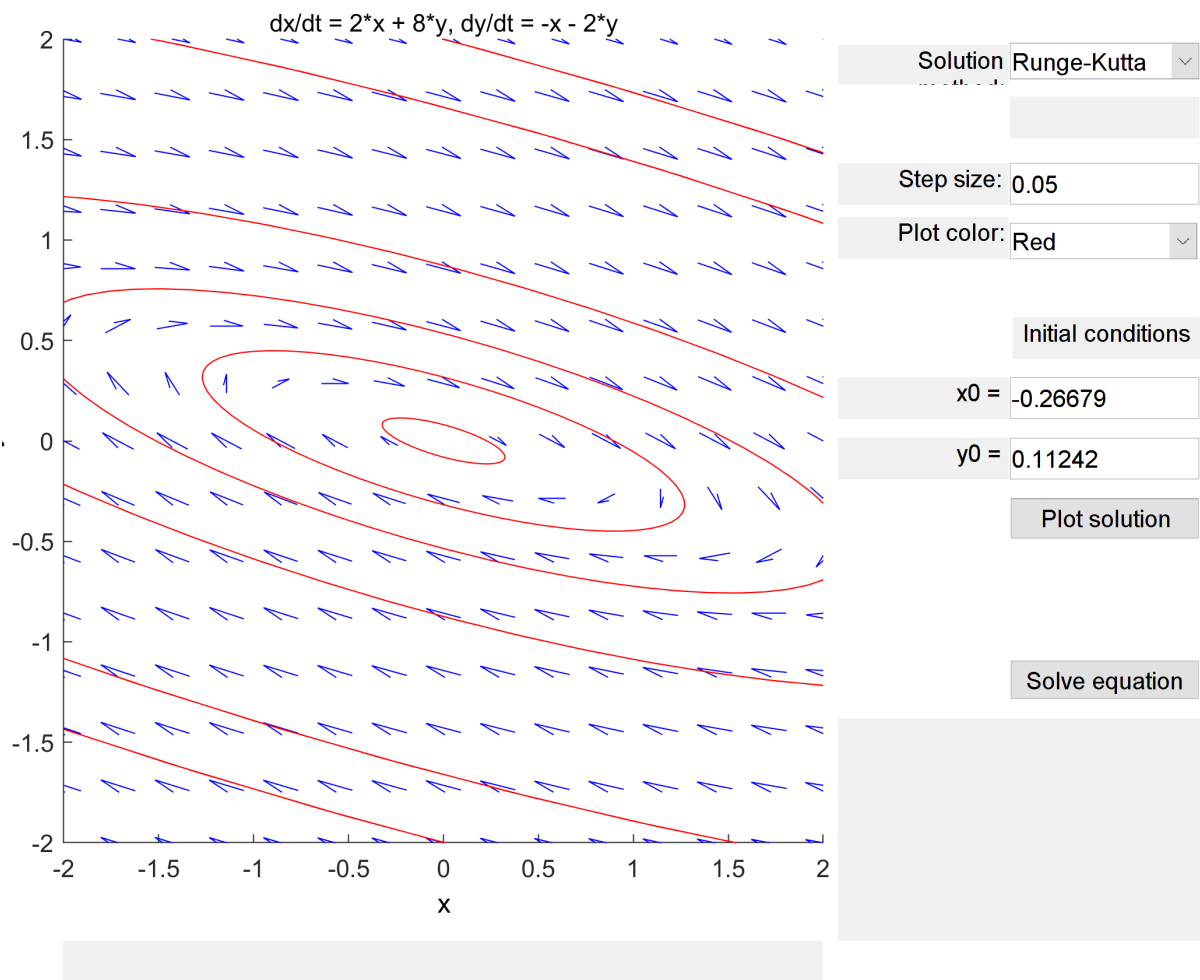
4.6



b) Spiral clockwise (unstable)

c) $\lambda_1 = \frac{1}{2} + i\frac{\sqrt{3}}{2}, \lambda_2 = \frac{1}{2} - i\frac{\sqrt{3}}{2}$
 $\lambda_1, \lambda_2 = \mu \pm \alpha i \rightarrow \mu > 0$

4.7

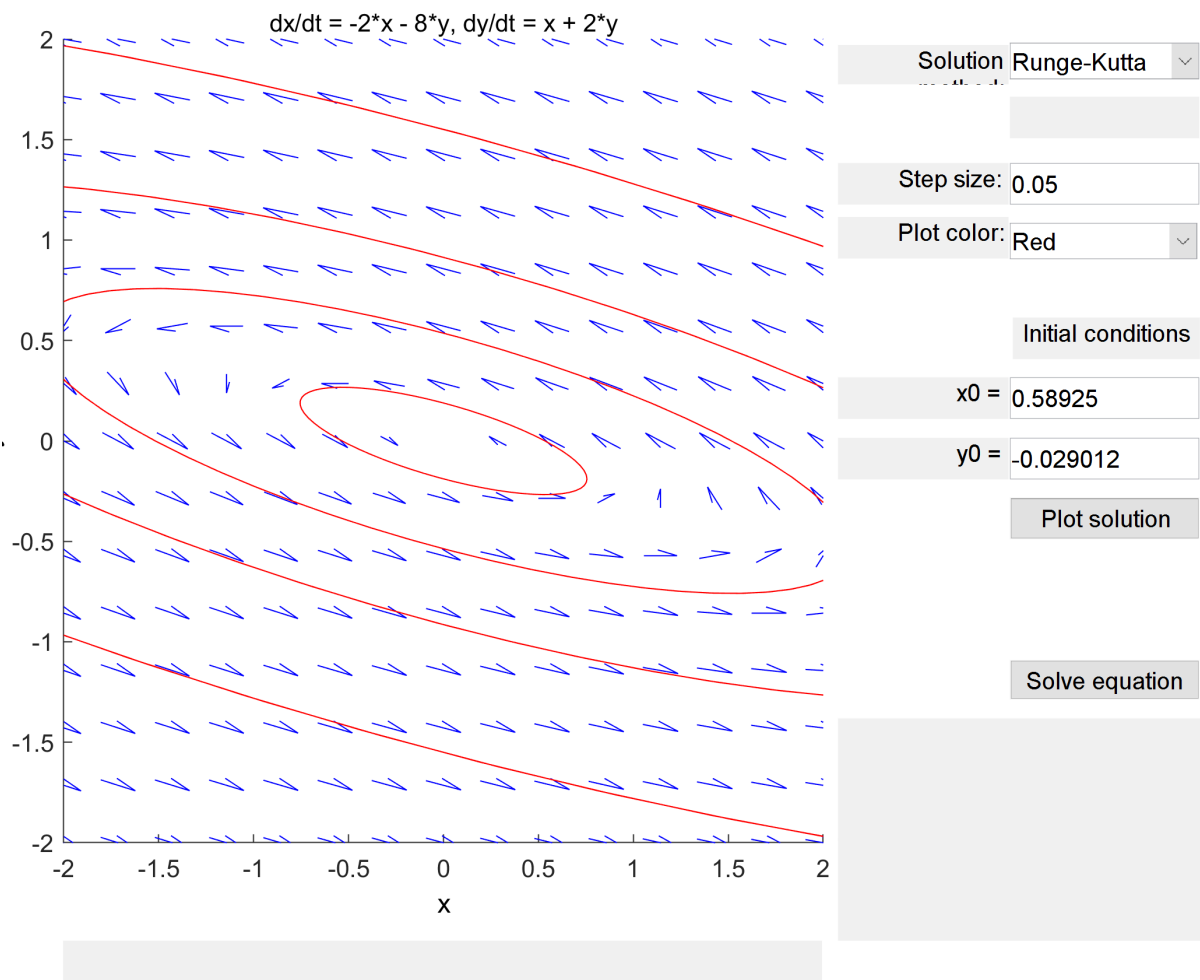


b) Stable center (clockwise)

c) $\lambda_1 = 2i, \lambda_2 = -2i$

$\lambda_1, \lambda_2 = \pm \alpha i$

4.8

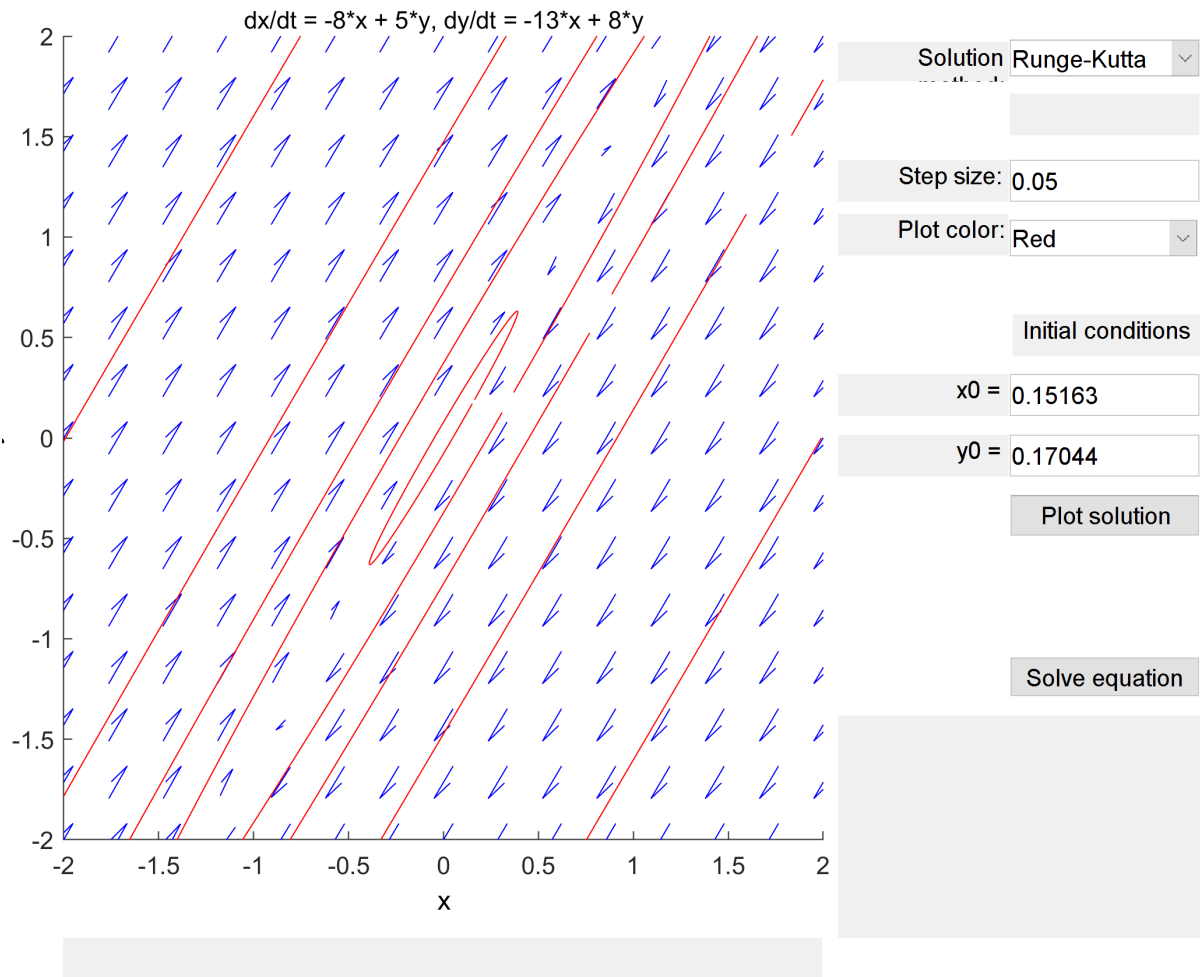


b) Stable center (counterclockwise)

c) $\lambda_1 = 2i, \lambda_2 = -2i$

$\lambda_1, \lambda_2 = \pm \alpha i$

4.9

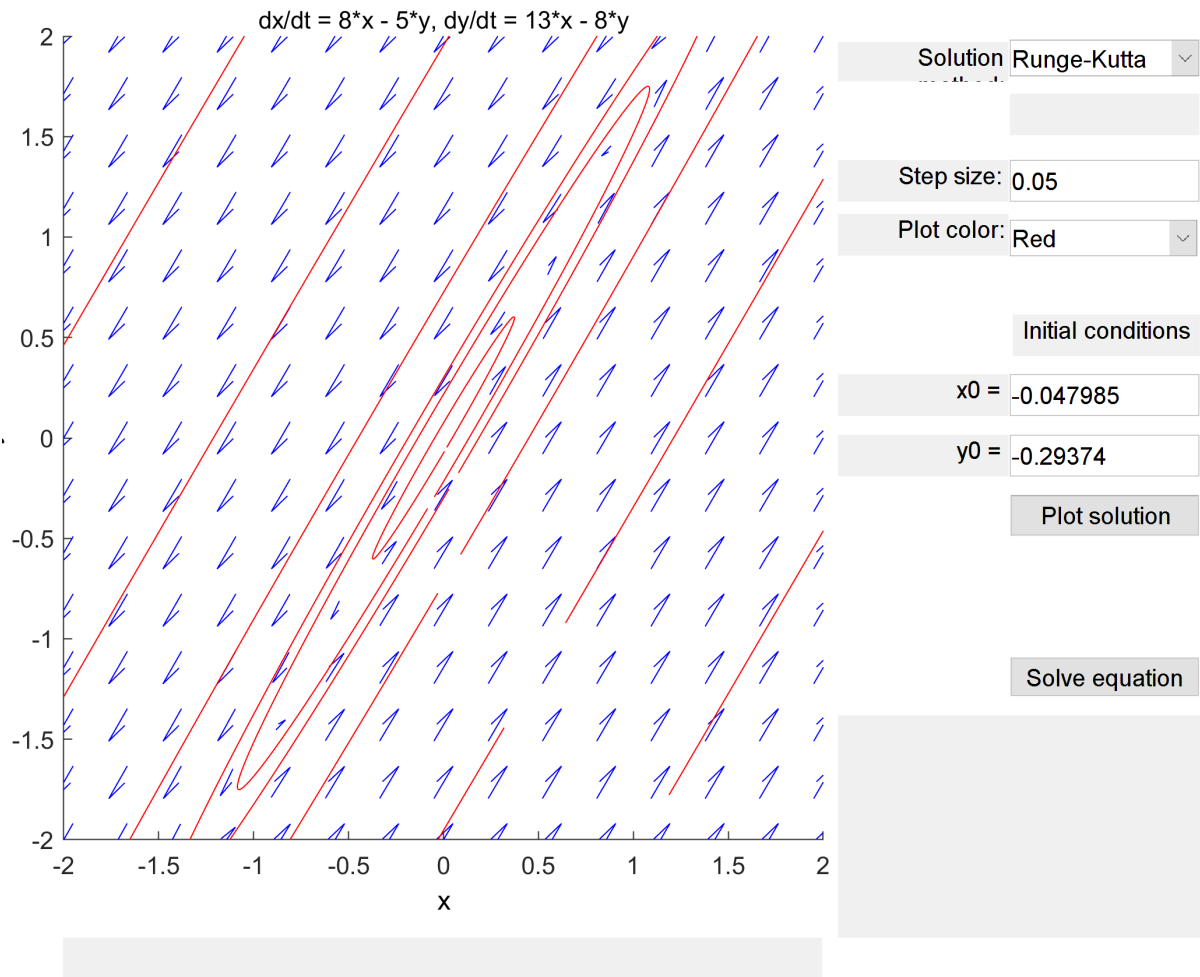


b) Stable center (clockwise)

c) $\lambda_1 = i, \lambda_2 = -i$

$\lambda_1, \lambda_2 = \pm \alpha i$

4.10



b) Stable center (counterclockwise)

c) $\lambda_1 = i, \lambda_2 = -i$

$\lambda_1, \lambda_2 = \pm \alpha i$