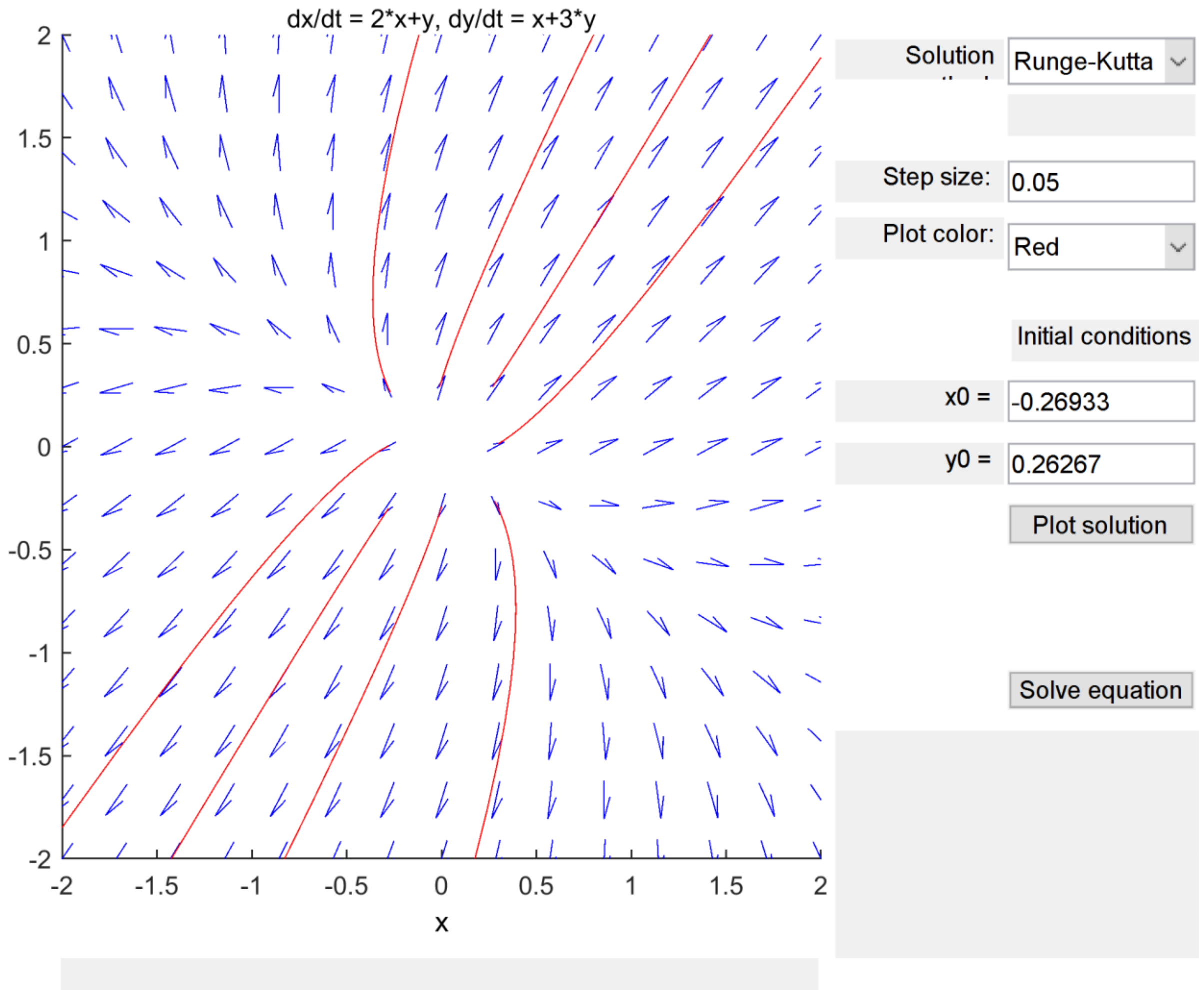
4.1

a)



b) Nodal source, unstable

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

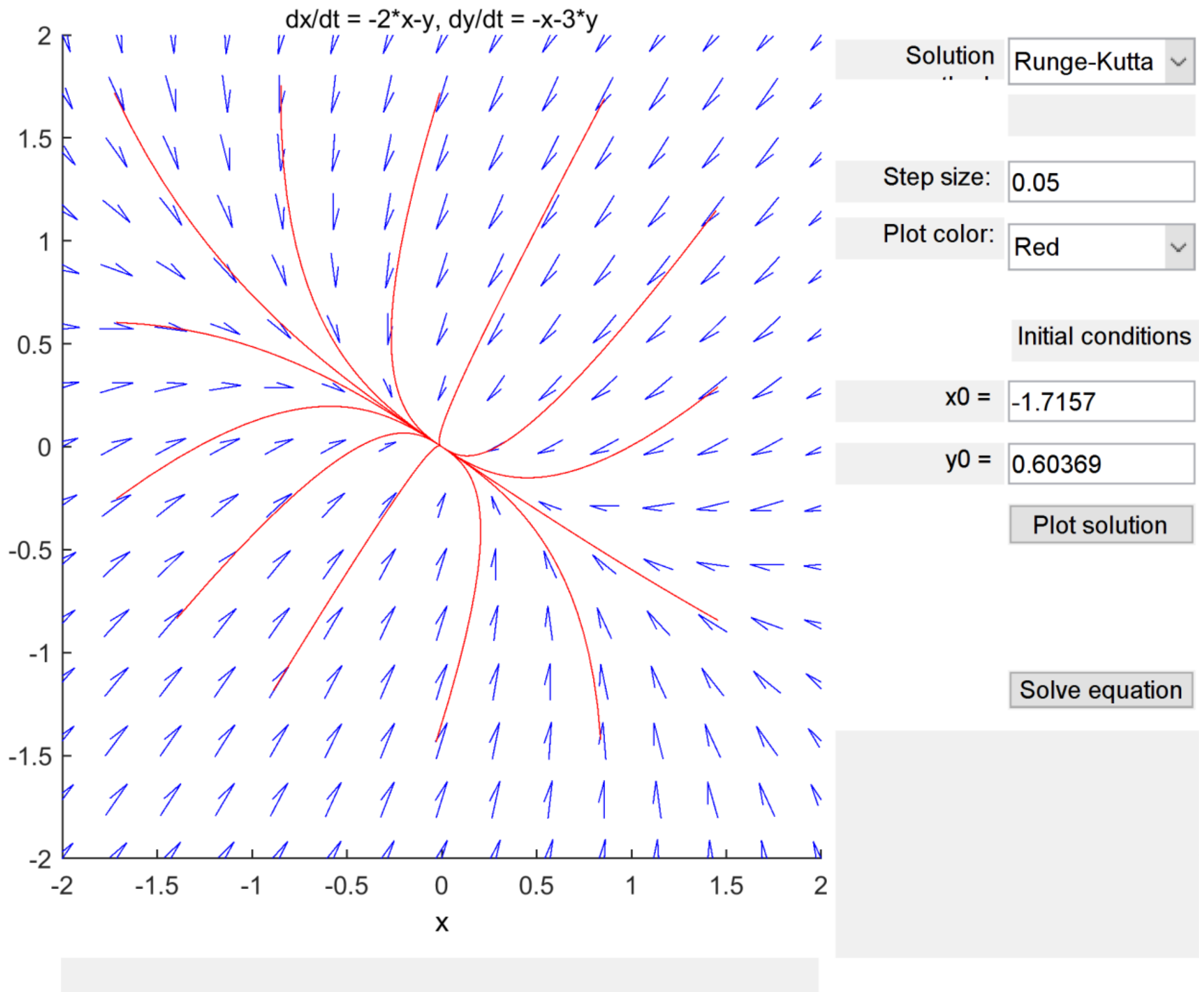
NOTE:

For the phase portrait, the trajectory matched the expected behavior as determined by the eigenvalues.

(case: two positive real eigenvalues mean unstable nodal source)

4.2

a)



b) Nodal sink, asymptotically stable

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

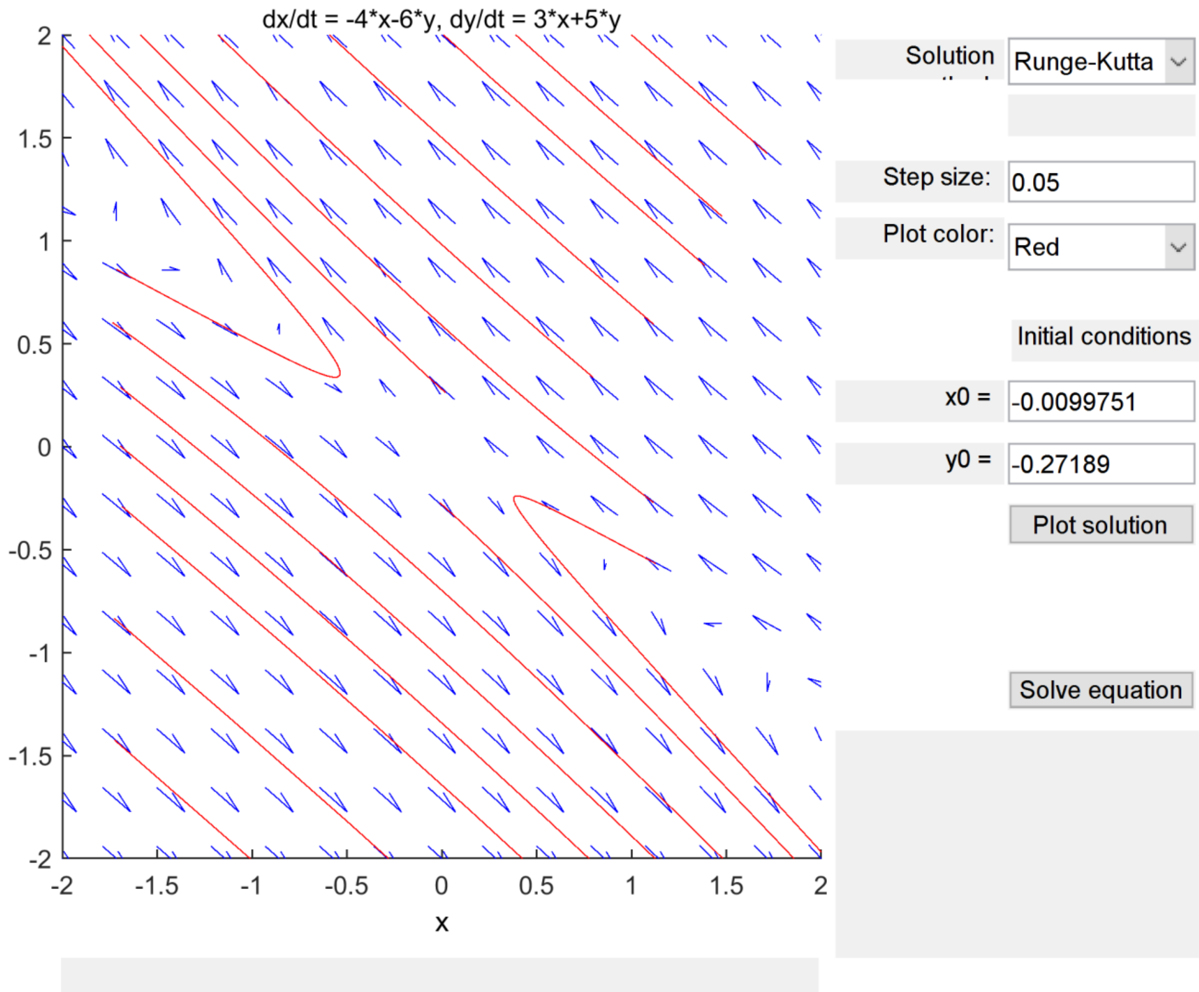
NOTE:

For the phase portrait, the trajectory matched the expected behavior as determined by the eigenvalues.

(case: two negative real eigenvalues mean asymptotically stable nodal sink)

4.3

a)



b) Saddle point, unstable

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

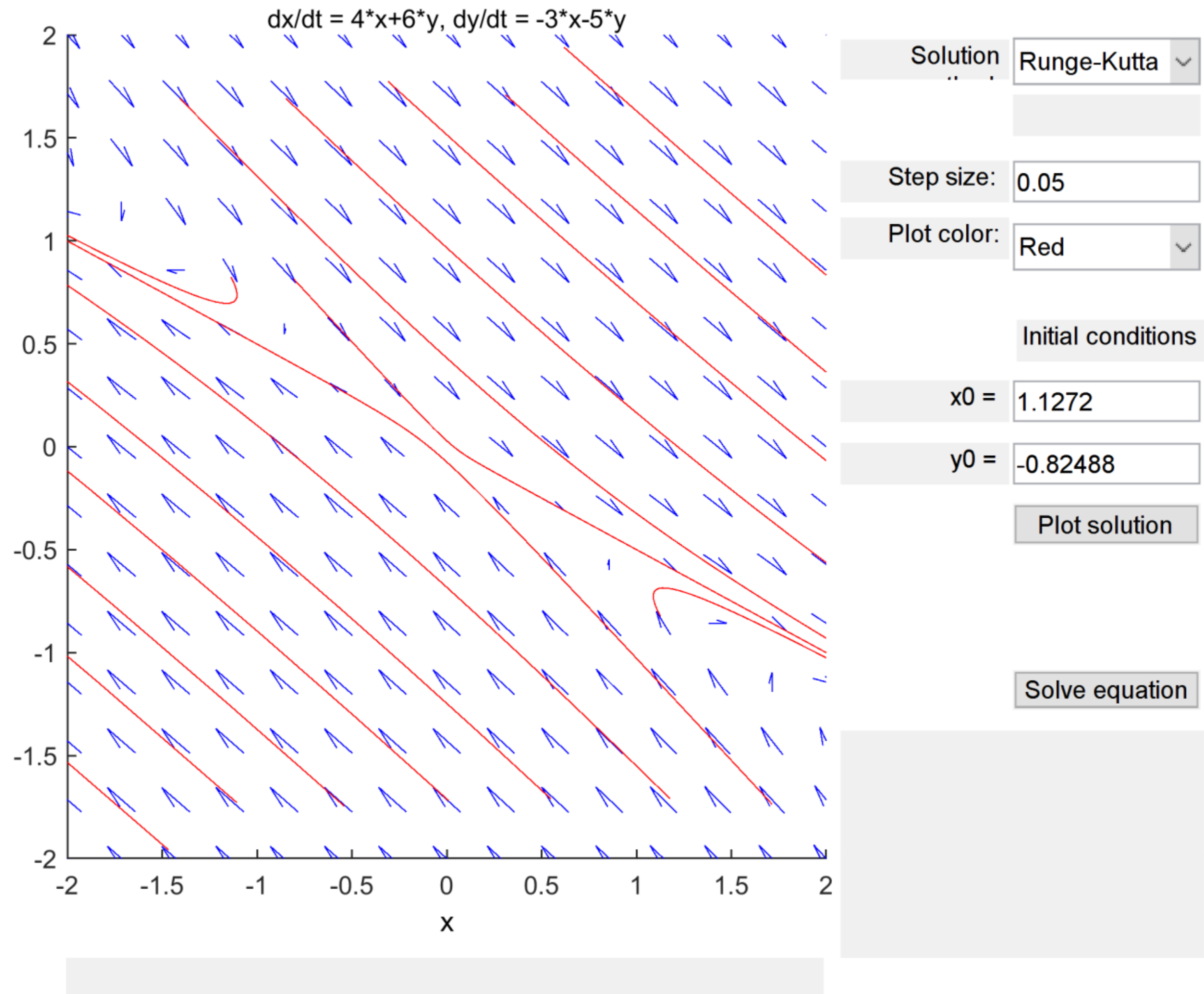
NOTE:

For the phase portrait, the trajectory matched the expected behavior as determined by the eigenvalues.

(case: one positive, one negative real eigenvalues mean unstable saddle point)

4.4

a)



b) Saddle point, unstable

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

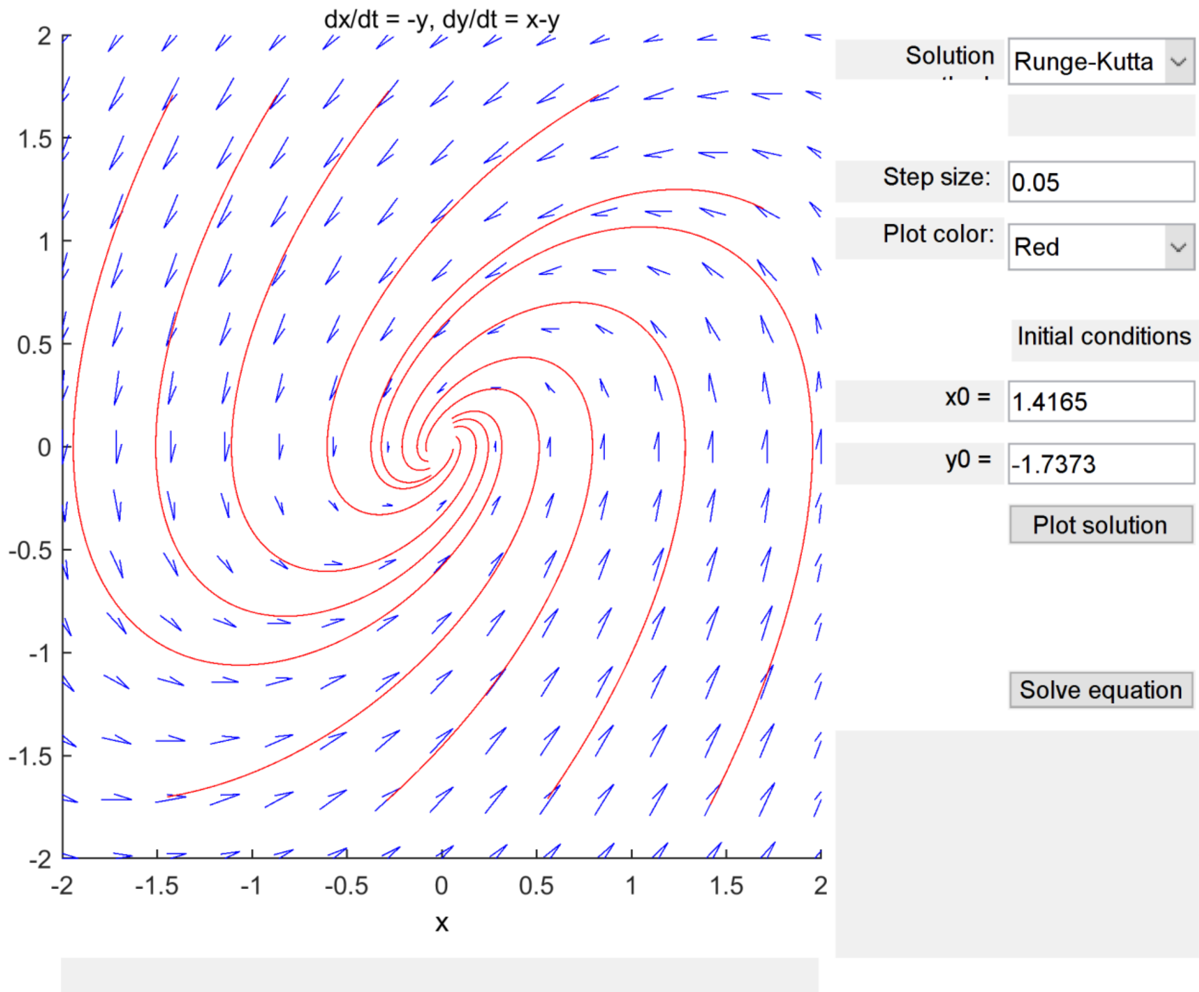
NOTE:

For the phase portrait, the trajectory matched the expected behavior as determined by the eigenvalues.

(case: one positive, one negative real eigenvalues mean unstable saddle point)

4.5

a)



b) Counterclockwise spiral sink, asymptotically stable

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

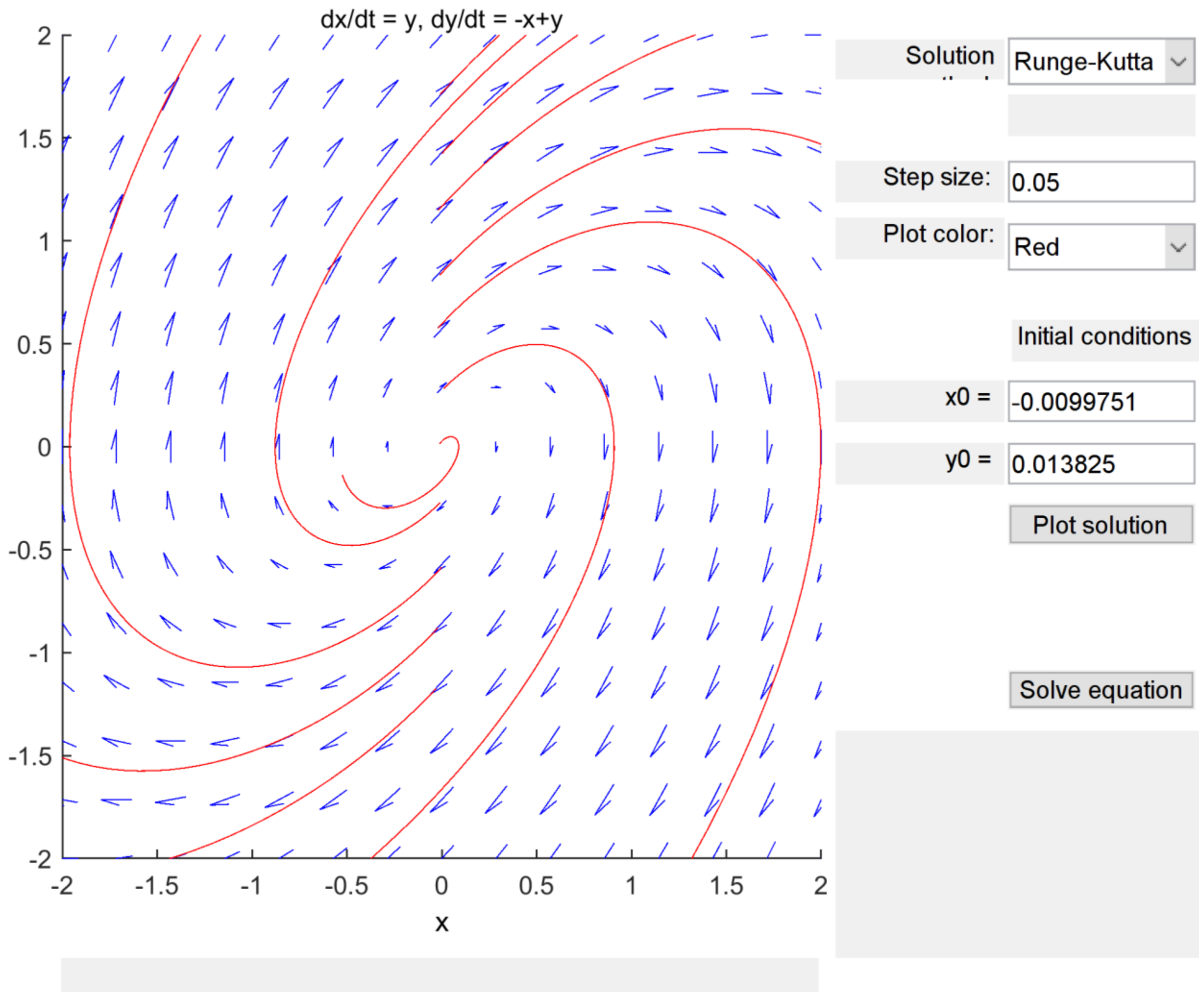
NOTE:

For the phase portrait, the trajectory matched the expected behavior as determined by the eigenvalues.

(case: two complex eigenvalues with negative real component mean asymptotically stable spiral sink)

4.6

a)



b) Clockwise spiral source, unstable

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

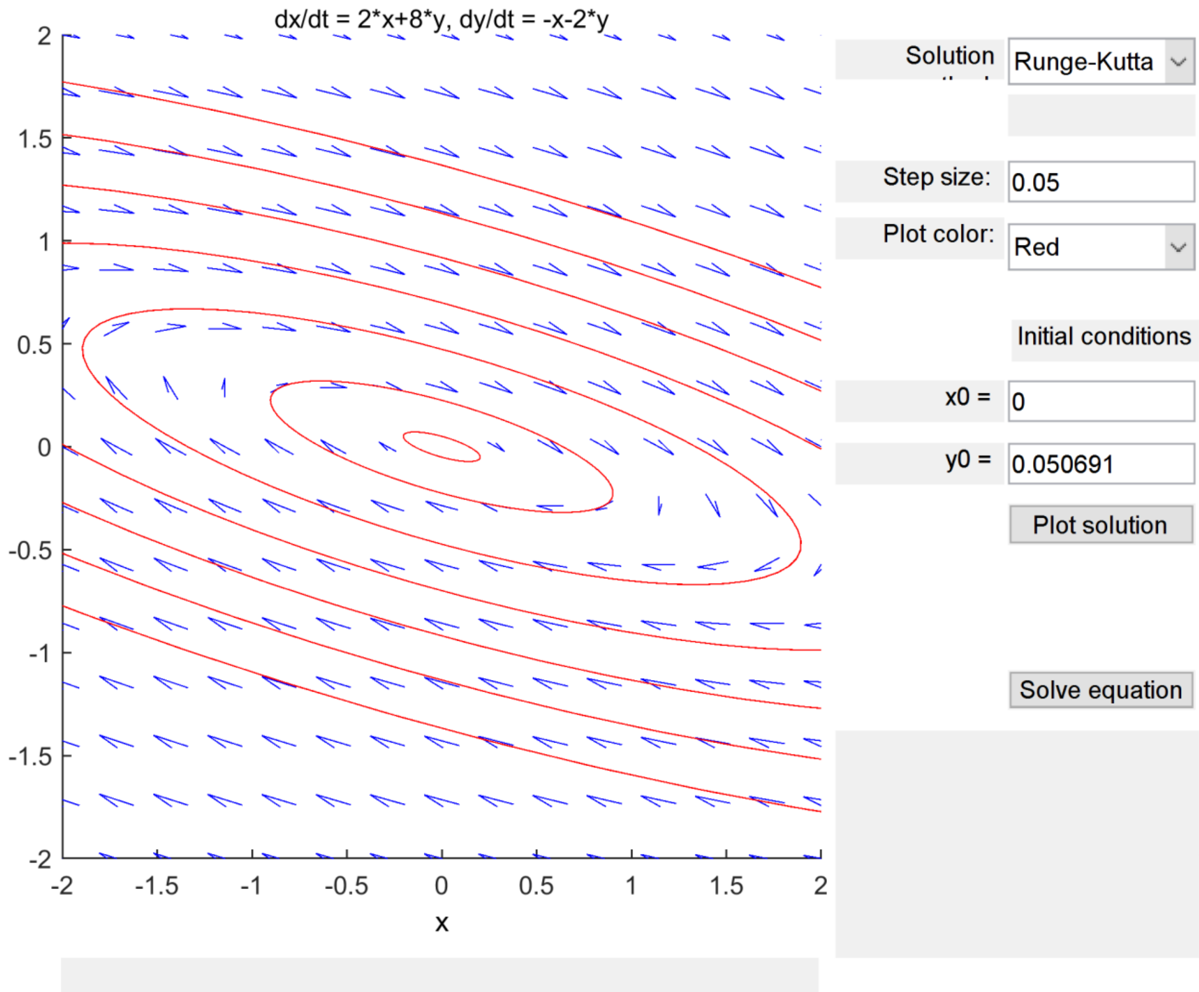
NOTE:

For the phase portrait, the trajectory matched the expected behavior as determined by the eigenvalues.

(case: two complex eigenvalues with positive real component mean unstable spiral source)

4.7

a)



b) Clockwise centre, stable

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

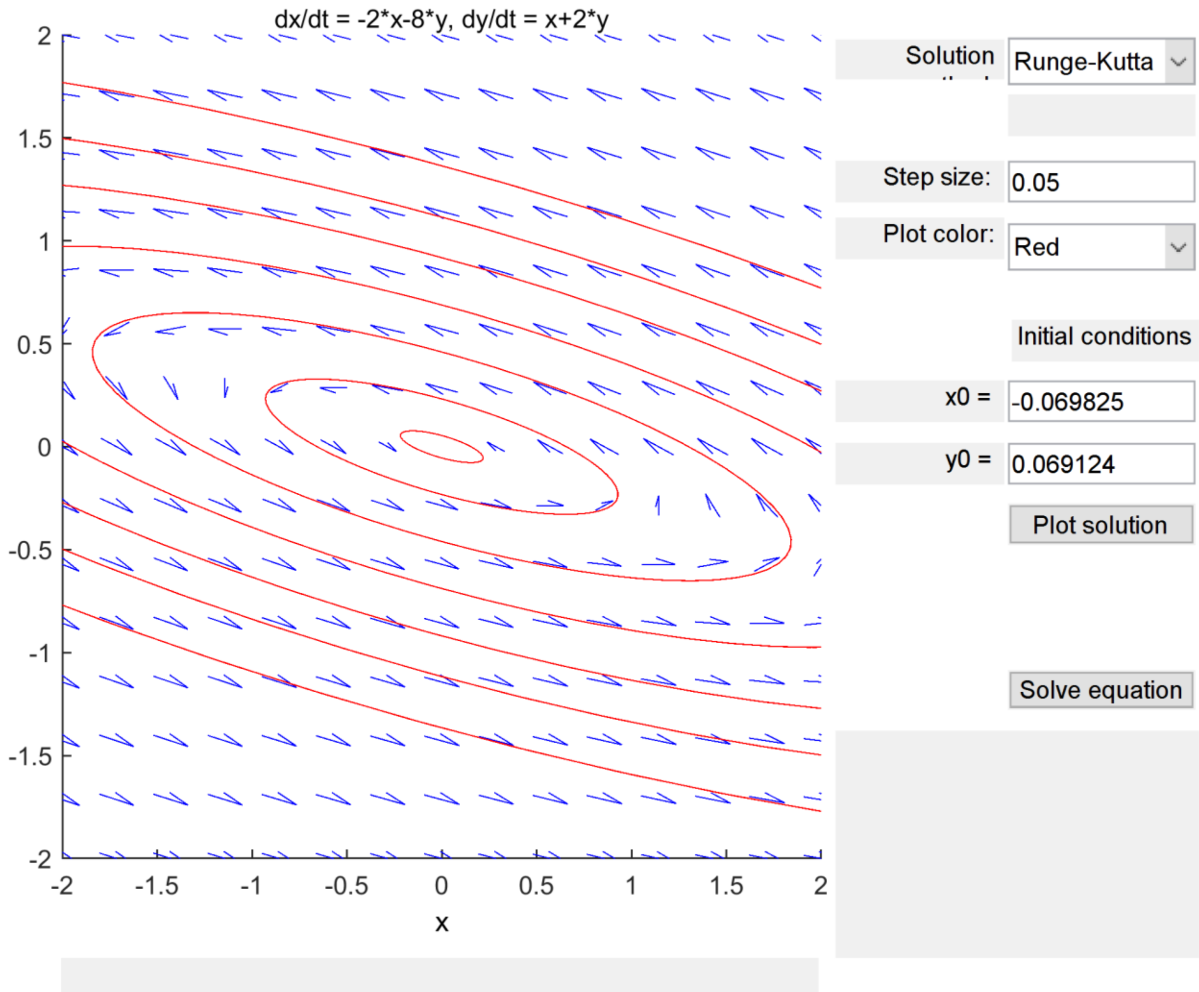
NOTE:

For the phase portrait, the trajectory matched the expected behavior as determined by the eigenvalues.

(case: two complex eigenvalues with no real component mean stable centre)

4.8

a)



b) Counterclockwise centre, stable

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

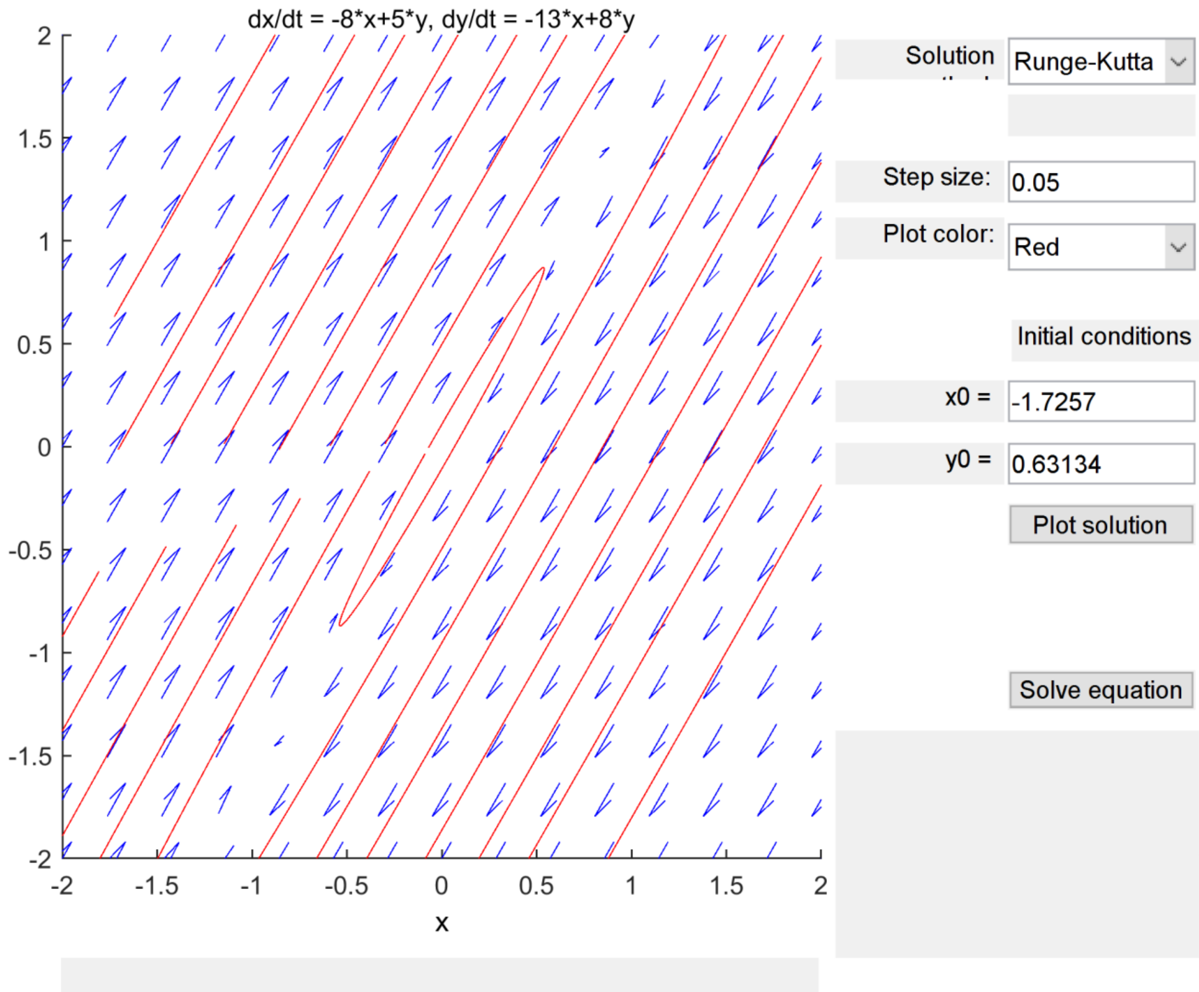
NOTE:

For the phase portrait, the trajectory matched the expected behavior as determined by the eigenvalues.

(case: two complex eigenvalues with no real component mean stable centre)

4.9

a)



b) Clockwise centre, stable

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

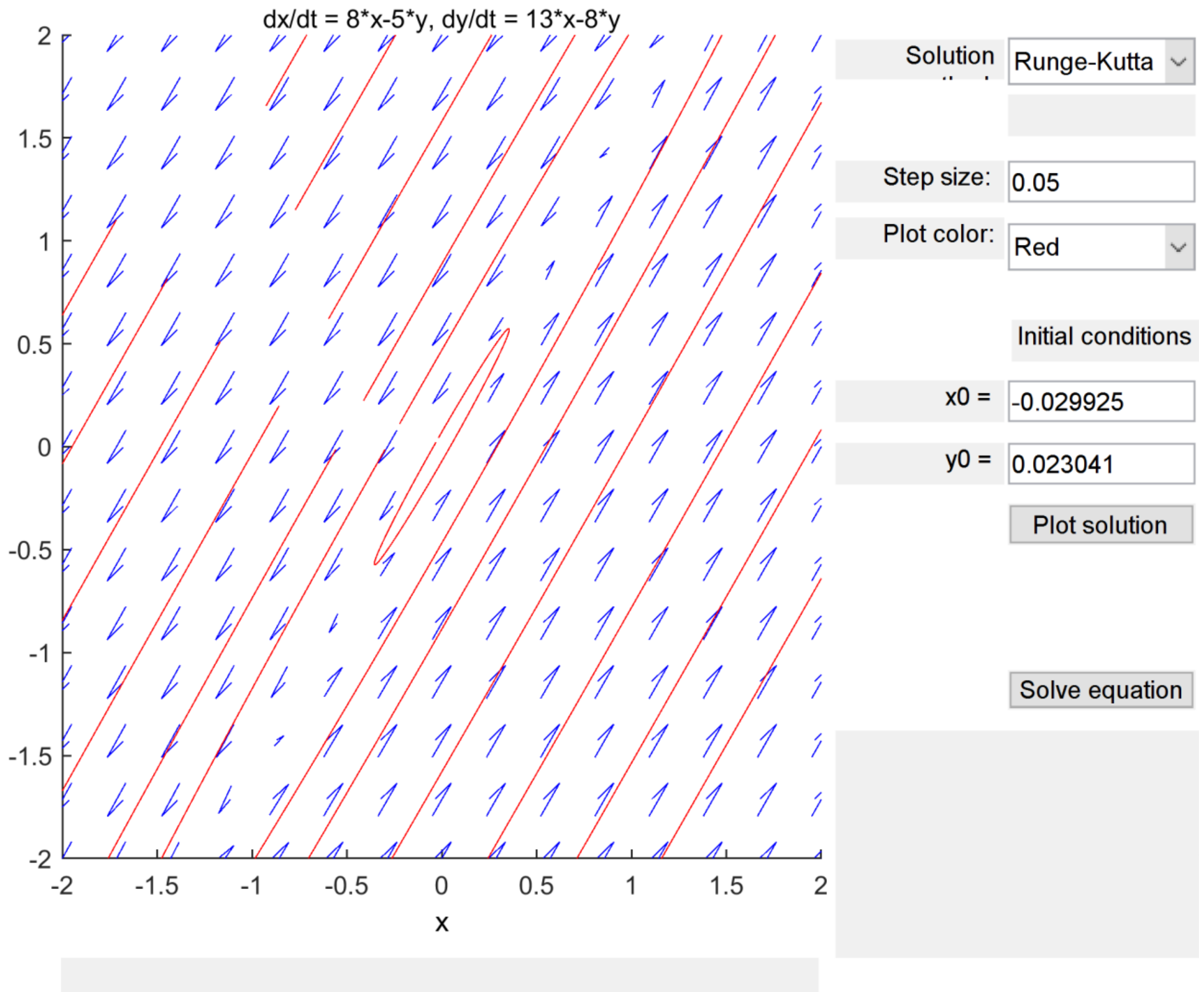
NOTE:

For the phase portrait, the trajectory matched the expected behavior as determined by the eigenvalues.

(case: two complex eigenvalues with no real component mean stable centre)

4.10

a)



b) Counterclockwise centre, stable

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

NOTE:

For the phase portrait, the trajectory matched the expected behavior as determined by the eigenvalues.

(case: two complex eigenvalues with no real component mean stable centre)