# Lab 4: Q4

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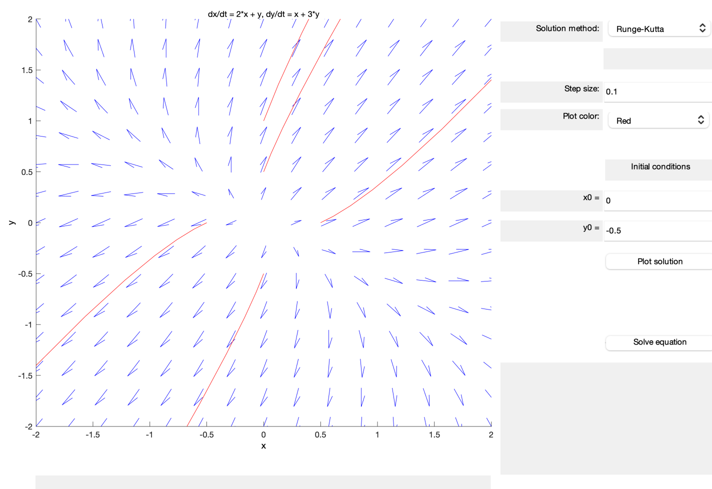
## 4.1

a)

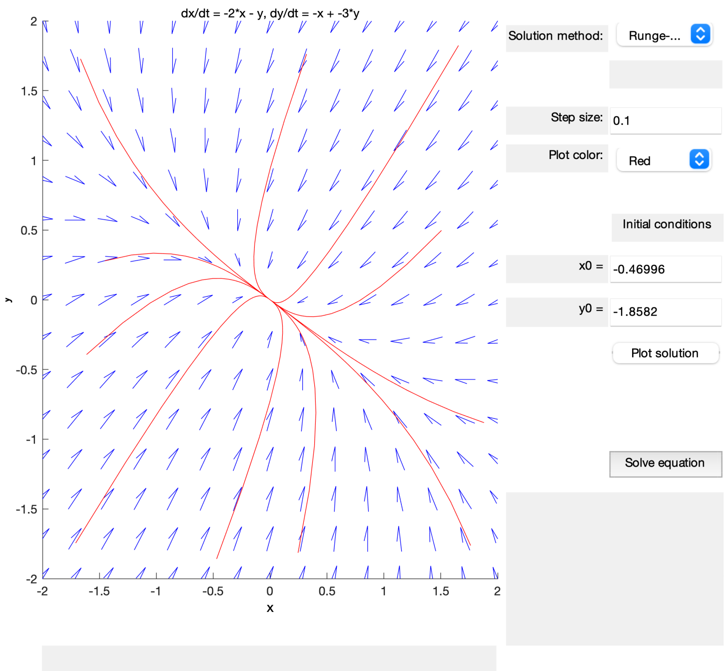



b) The ODE is unstable and a source.

c) The eigenvalues are $\lambda_1 = \frac{5+\sqrt{5}}{2}$ and $\lambda_2 = \frac{5-\sqrt{5}}{2}$. This corresponds to $\lambda_1 > \lambda_2 > 0$, which is an unstable source.

## 4.2

a)

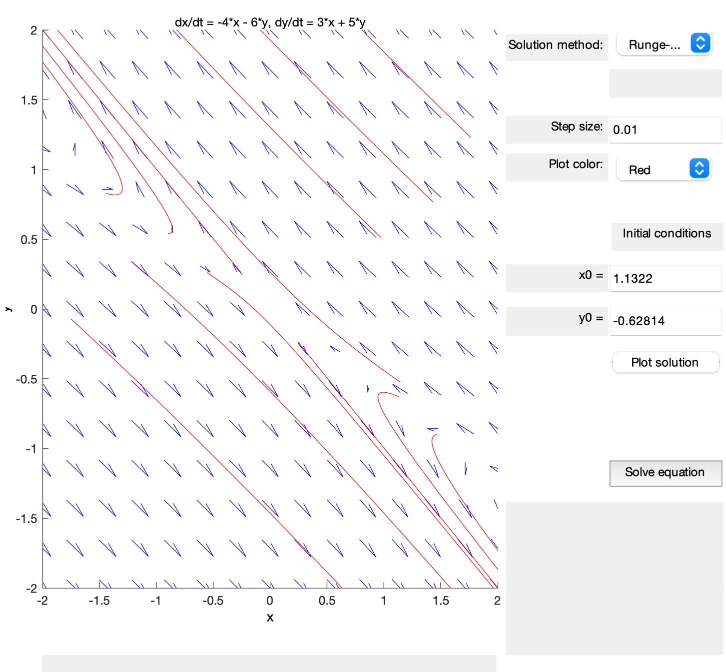



b) The ODE is stable and a sink.

c) The eigenvalues are $\lambda_1 = \frac{-5+\sqrt{5}}{2}$ and $\lambda_2 = \frac{-5-\sqrt{5}}{2}$. This corresponds to $\lambda_1 < \lambda_2 < 0$, which is a stable sink.

**4.3**

a)

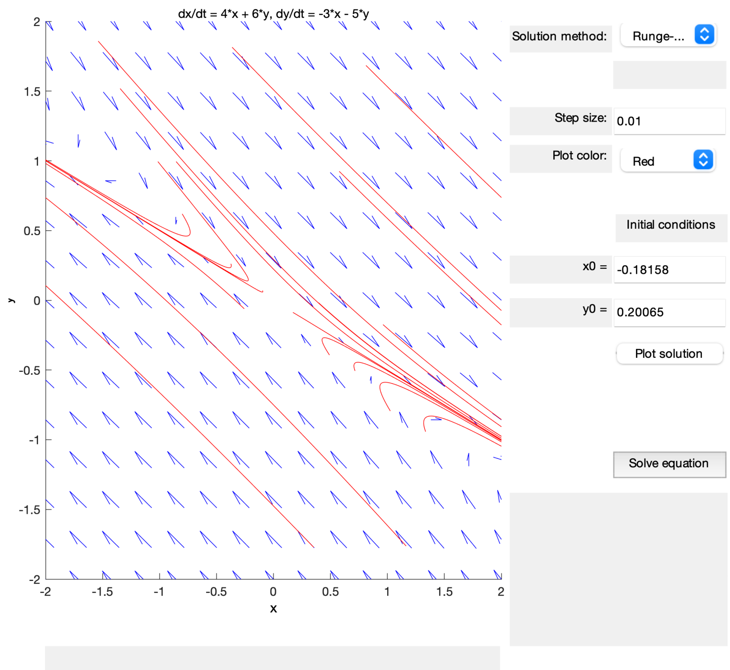



b) The ODE is an unstable saddle point.

c) The eigenvalues are $\lambda_1 = 2$ and $\lambda_2 = -1$. This corresponds to $\lambda_1 > 0 > \lambda_2$, which is an unstable saddle point.

## 4.4

a)

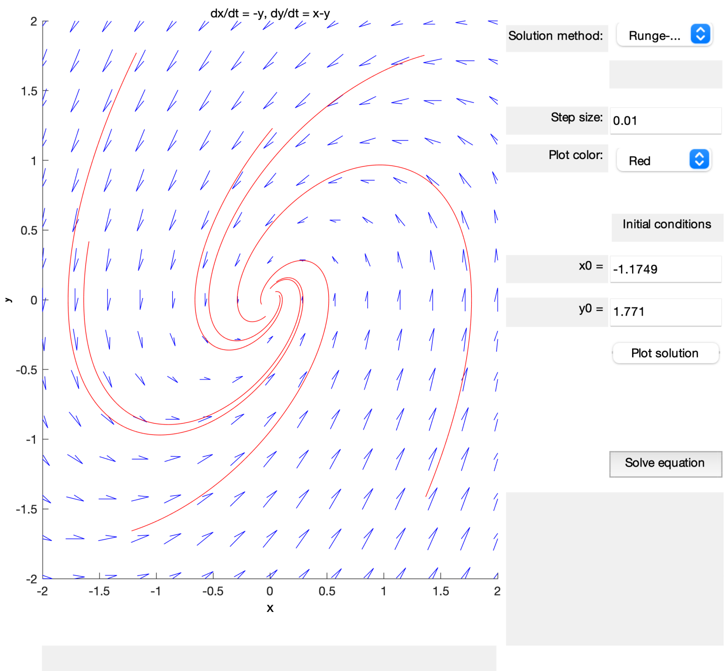



b) The ODE is an unstable saddle point.

c) The eigenvalues are $\lambda_1 = 1$ and $\lambda_2 = -2$. This corresponds to $\lambda_1 > 0 > \lambda_2$, which is an unstable saddle point.

## 4.5

a)

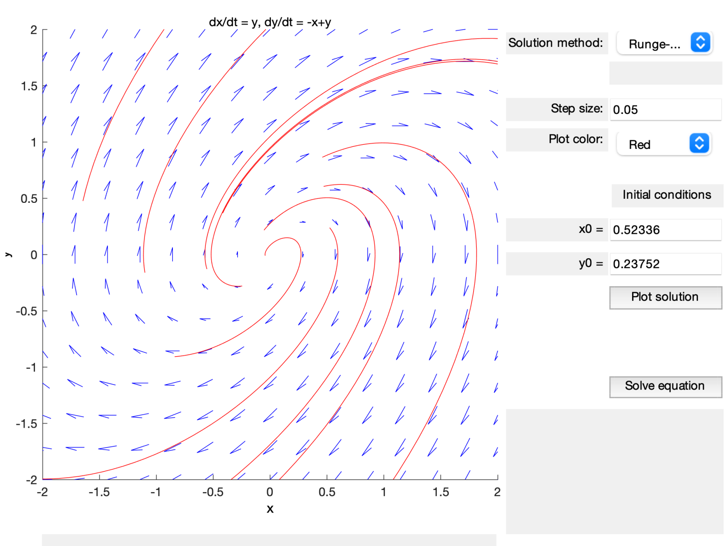



b) The ODE is a stable spiral point.

c) The eigenvalues are $\lambda_1 = \lambda_2 = -2$. This corresponds to $\lambda_1 = \lambda_2 < 0$, which is a stable spiral point.

**4.6**

a)

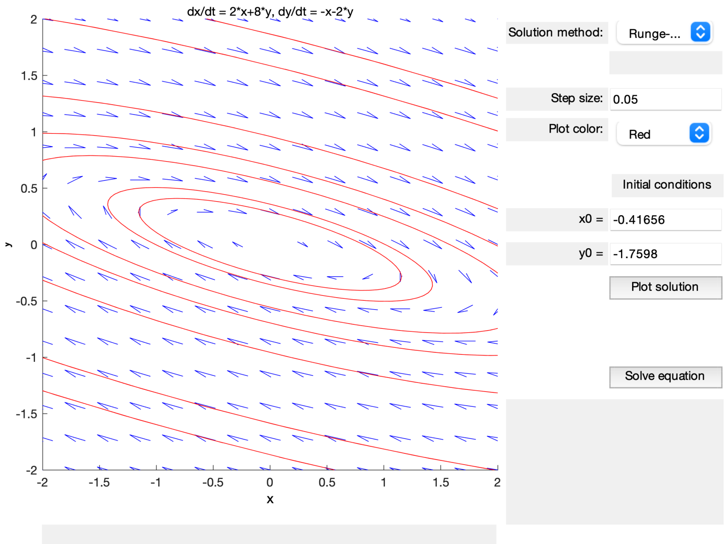



b) The ODE is an unstable spiral point.

c) The eigenvalues are $\lambda_1 = \lambda_2 = 2$. This corresponds to $\lambda_1 = \lambda_2 > 0$, which is an unstable spiral point.

### 4.7

a)

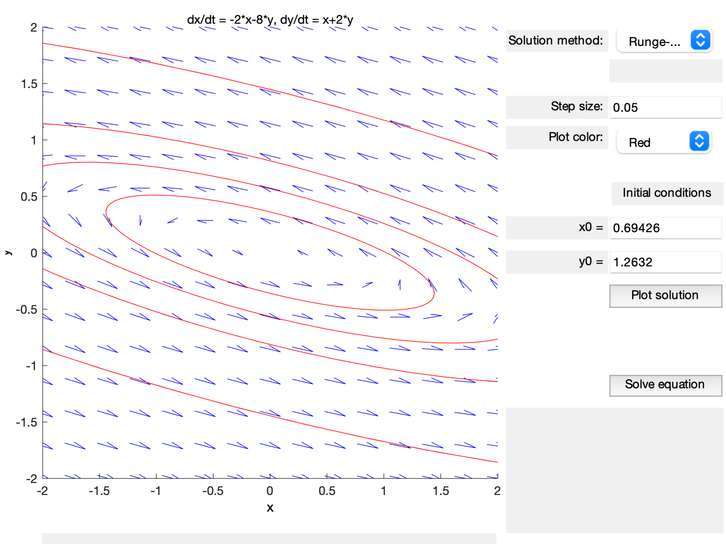



b) The ODE is a stable center.

c) The eigenvalues are $\lambda_1 = 2i$ and $\lambda_2 = -2i$. This corresponds to $\lambda_1 = -\lambda_2$, which is a stable center.

### 4.8

a)

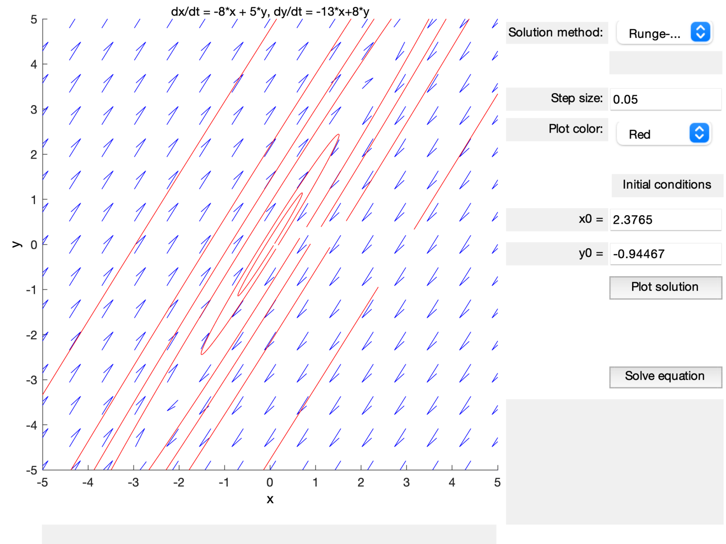



b) The ODE is an stable center.

c) The eigenvalues are $\lambda_1 = 2i$ and $\lambda_2 = -2i$. This corresponds to $\lambda_1 = -\lambda_2$, which is an stable center.

## 4.9

a)

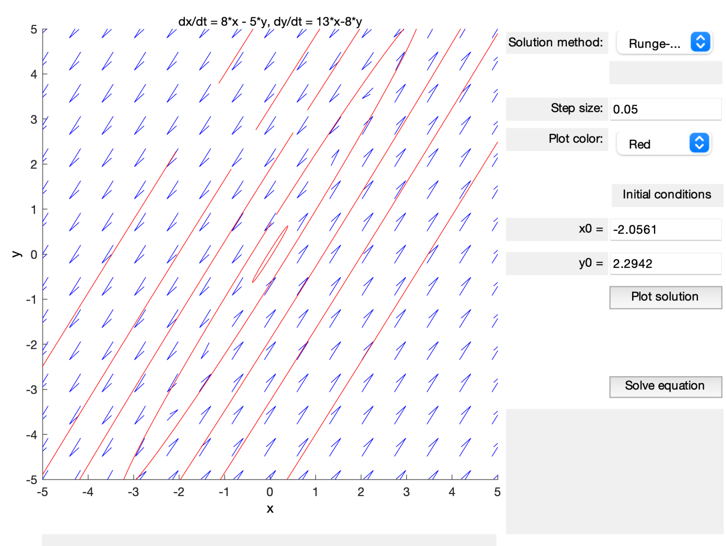



b) The ODE is a stable center.

c) The eigenvalues are $\lambda_1 = i$ and $\lambda_2 = -i$. This corresponds to $\lambda_1 = -\lambda_2$, which is a stable center.

## 4.10

a)




b) The ODE is an stable center.

c) The eigenvalues are $\lambda_1 = i$ and $\lambda_2 = -i$. This corresponds to $\lambda_1 = -\lambda_2$, which is a stable center.