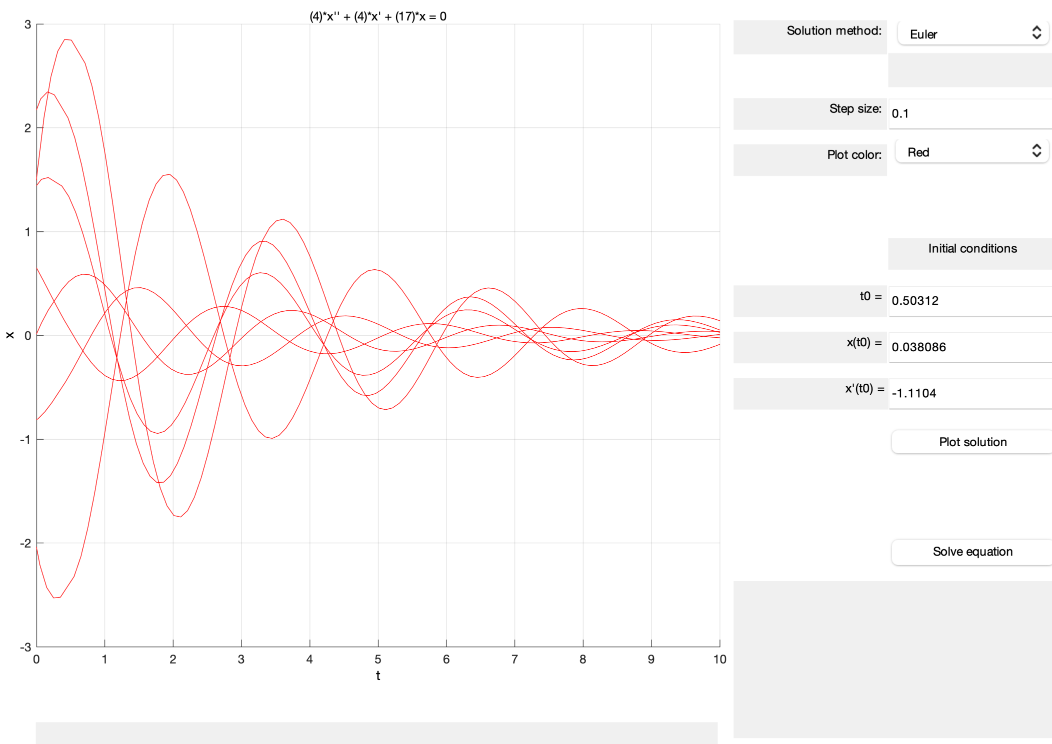
ODE Lab 5

Adam Omarali (1010132866)

November 18, 2024

Q1

a)

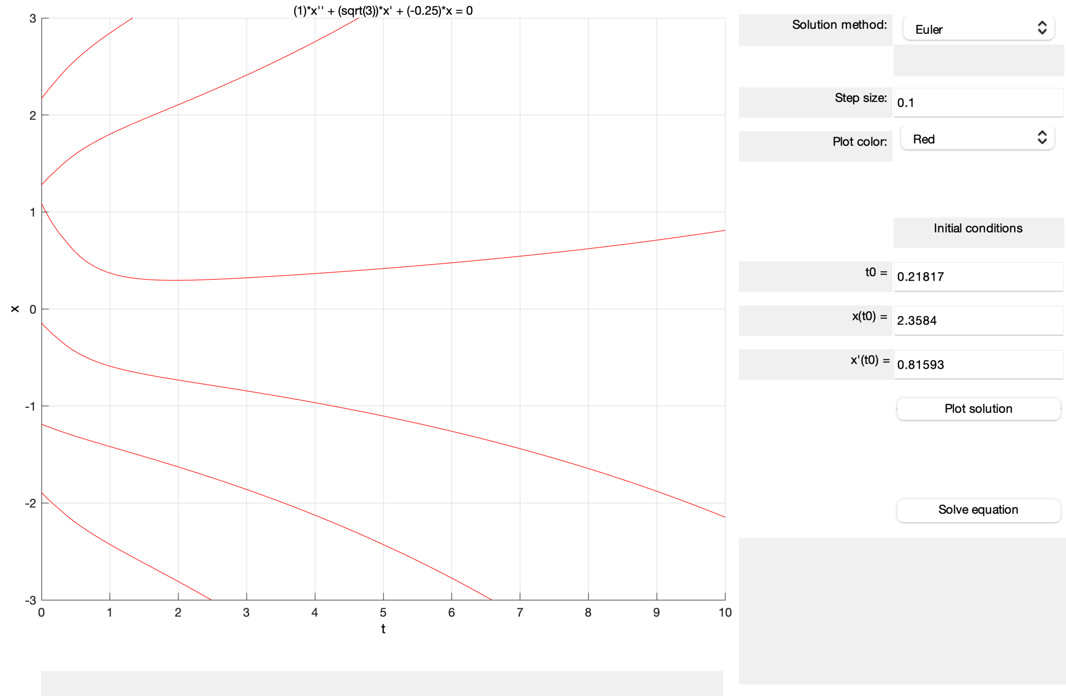


b) All solutions (100%) decay with oscillation.

c) The solution to this ODE is $y(t) = e^{-\frac{1}{2}t}\left(c_1 \cos 2t + c_2 \sin 2t\right)$. This makes sense since the $e^{-\frac{1}{2}t}$ component decays as $t \to \infty$ and the $\cos 2t$ and $\sin 2t$ components oscillate.

1 Q2

a)

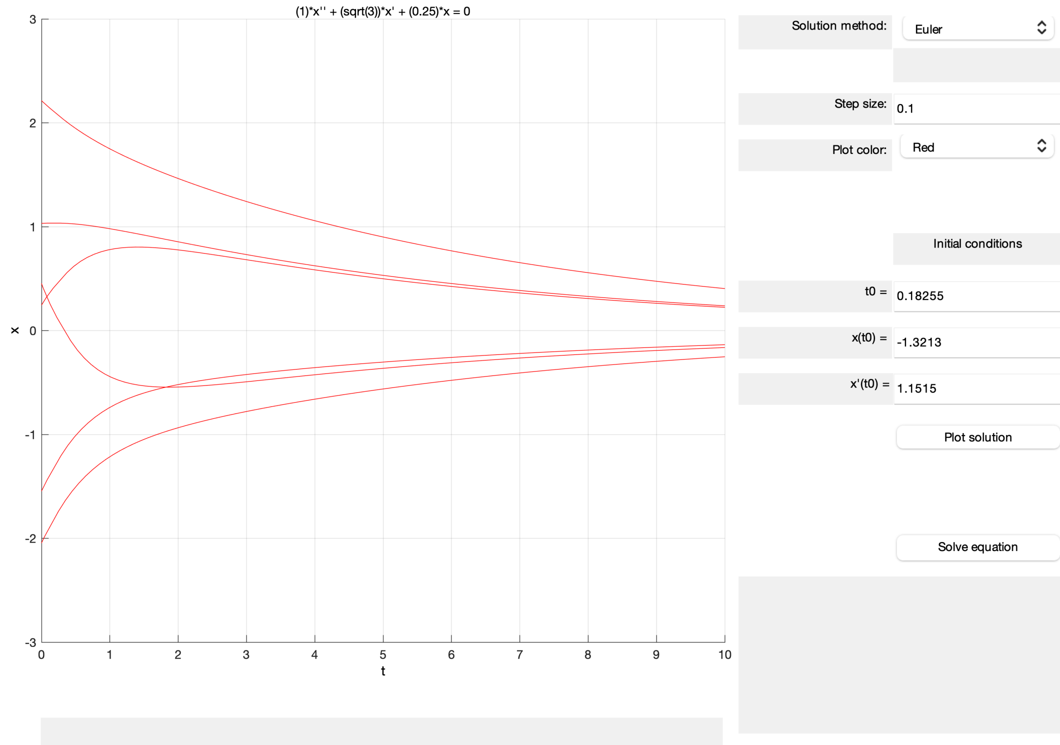


b) All solution (100%) grow.

c) The solution to this ODE is $y(t) = c_1 e^{(\frac{-\sqrt{3}}{2}+1)t} + c_2 e^{(\frac{-\sqrt{3}}{2}-1)t}$. This makes sense since as $t \to \infty$, $c_2 e^{(\frac{-\sqrt{3}}{2}-1)t} \to 0$ and $c_1 e^{(\frac{-\sqrt{3}}{2}+1)t} \to \pm\infty$ depending on the sign of c_1.

Q3

a)



b) All solutions (100%) decay.

c) The solution to this ODE is $y(t) = c_1 e^{\frac{-\sqrt{3}+\sqrt{2}}{2}t} + c_2 e^{\frac{-\sqrt{3}-\sqrt{2}}{2}t}$. This makes sense since both terms approach 0 as $t \to \infty$.

Q4

a) Solving for the roots of characteristic equation gives the general solution $y(t) = c_1 e^{-t} cos 2t + c_2 e^{-t} sin 2t + c_3 cost + c_4 sint$.

b) Both of the exponential terms will decay to zero as $t \to \infty$. The $\cos 2t$ and $\sin 2t$ terms will oscillate indefinitely. Therefore, the solution decays while oscillationing, but never approaches 0. Therefore, no solutions (0%) decay, grow, decay with oscillation or grow with oscillation. Nearly all solutions (100%) oscillate indefinitely aside from initial conditions where $c_3 = c_4 = 0$.

Q5

(a) $0 < r_1 < r_2$. The solution will grow.

(b) $r_1 < 0 < r_2$. The solution will grow.

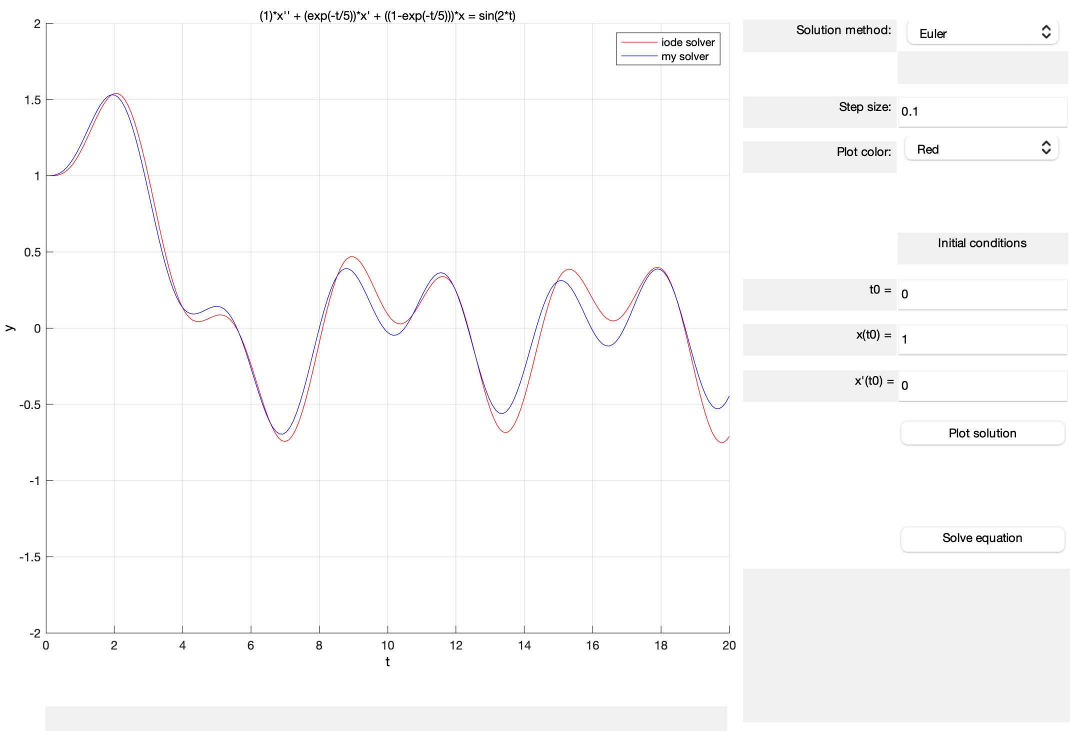
(c) $r_1 < r_2 < 0$. The solution will decay.

(d)$r_1 = \alpha + \beta i,\ r_2 = \alpha - \beta i \mid \alpha < 0.$ The solution will decay with oscillation.

(e) $r_1 = \alpha + \beta i,\ r_2 = \alpha - \beta i \mid \alpha = 0.$ The solution will oscillate indefinitely.

(f) $r_1 = \alpha + \beta i,\ r_2 = \alpha - \beta i \mid \alpha > 0.$ The solution will grow with oscillation.

Q7



The solution osciallates accurately but begins to diverge from the iode solution more and more as t increases. This could be improved with a smaller step size (currently h = 0.1).