

Python Code:

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import cvxpy as cp
import numpy as np
from numpy.linalg import eig

# Define the A matrices for each system
A1 = np.array([[ -7, 5],
               [ 3, -4]])

A2 = np.array([[ -6, 4, -2],
               [ 3, -8, 1],
               [-1, 5, -7]])

# Create optimization variables
n1 = A1.shape[0] # Assuming square matrices
P1 = cp.Variable((n1, n1), symmetric=True)
n2 = A2.shape[0] # Assuming square matrices
P2 = cp.Variable((n2, n2), symmetric=True)

# Define the constraints for each system
constraints = []

# A1 eigenvalues to the left of s = -2
constraint1 = [A1 @ P1 + P1 @ A1.T <= -2 * np.eye(n1)]

# A2 eigenvalues to the left of s = -2
constraint2 = [A2 @ P2 + P2 @ A2.T <= -2 * np.eye(n2)]

# Create the feasibility problem
problem1 = cp.Problem(cp.Minimize(0), constraint1)
problem2 = cp.Problem(cp.Minimize(0), constraint2)

# Solve the problem
problem1.solve()
problem2.solve()

# Check if the problem is feasible
if problem1.status == cp.OPTIMAL:
    print("System 1 has eigenvalues to the left of s = -2.")
else:
    print("System 1 does not have eigenvalues to the left of s = -2.")
if problem2.status == cp.OPTIMAL:
    print("System 2 has eigenvalues to the left of s = -2.")
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else:
    print("System 2 does not have eigenvalues to the left of  $s = -2$ .")

# Confirm actual eigenvalues of both systems
w1, v1 = eig(A1)
print('Eigenvalues of System 1 are:', w1)
w2, v2 = eig(A2)
print('Eigenvalues of System 2 are:', w2)

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Output:

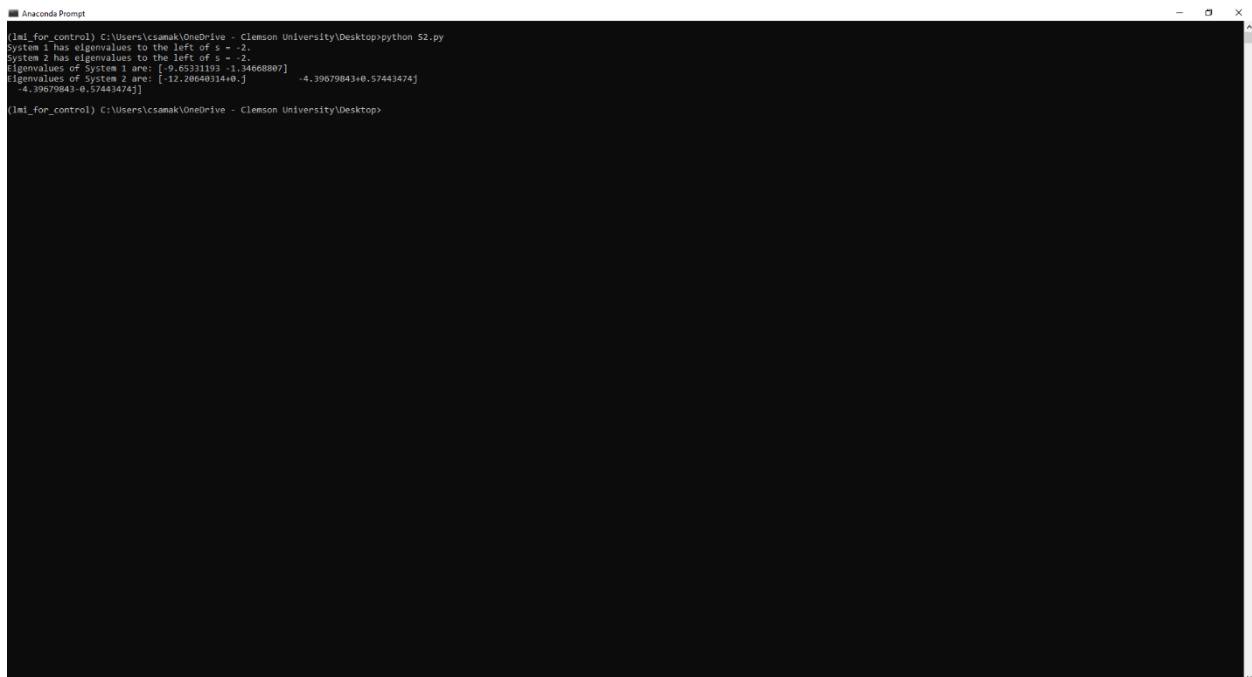
System 1 has eigenvalues to the left of $s = -2$.

System 2 has eigenvalues to the left of $s = -2$.

Eigenvalues of System 1 are: [-9.65331193 -1.34668807]

Eigenvalues of System 2 are: [-12.20640314+0.j -4.39679843+0.57443474j -4.39679843-0.57443474j]

Screenshot:



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Anaconda Prompt
(lai_for_control) C:\Users\csamak\OneDrive - Clemson University\Desktop>python 52.py
System 1 has eigenvalues to the left of  $s = -2$ .
System 2 has eigenvalues to the left of  $s = -2$ .
Eigenvalues of System 1 are: [-9.65331193 -1.34668807]
Eigenvalues of System 2 are: [-12.20640314+0.j -4.39679843+0.57443474j
-4.39679843-0.57443474j]
(lai_for_control) C:\Users\csamak\OneDrive - Clemson University\Desktop>

```