

8. [2360/043022 (20 pts)] Consider the linear system of differential equations given by $\dot{\mathbf{x}} = \mathbf{A}\mathbf{x}$ where $\mathbf{A} = \begin{pmatrix} a & 1 & 1 \\ a & 2 & 1 \end{pmatrix}$ (a is a real number) and with equilibrium solution $\mathbf{x} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$.

- (a) Is \mathbf{x} the only possible equilibrium solution? Justify your answer.
- (b) For what value(s) of a , if any, will the equilibrium solution \mathbf{x} be a saddle?
- (c) For what value(s) of a , if any, will the equilibrium solution \mathbf{x} be unstable?
- (d) For what value(s) of a , if any, will the equilibrium solution \mathbf{x}