Unit 4 Lesson 1

- A system of differential equations is fairly obvious to describe; a first ord~~e~~r ~~any~~ linear system is of the form (two-by-two)

$$\dot{x} = ax + by$$
$$\dot{y} = cx + dy$$

- In ~~the se cases~~ very specific cases, we can ~~manipulate~~ manipulate the above ~~the above DEs~~ such that you can just solve one.

Example Problem

Consider the system

$$\dot{x} = 0.3x + 0.1y \quad (1)$$
$$\dot{y} = 0.2x + 0.4y \quad (2)$$

By (1),

$$0.1y = \dot{x} - 0.3x \quad (3)$$

$$y = 10\dot{x} - 3x \Rightarrow \dot{y} = 10\ddot{x} - 3\dot{x}$$

and thus (2) becomes

$$10\ddot{x} - 3\dot{x} = 0.2x + 0.4(10\dot{x} - 3x)$$

or

$$10\ddot{x} - 7\dot{x} + x = 0$$

and via the characteristic polynomial,

$$x = e^{0.5t}, e^{0.2t}$$

via (3) we get

$$y = 2e^{0.5t}, -e^{2t}$$