**Preparation for October 30**

We turn now to Chapter 7. In the remainder of the course, we will be considering situations where there are two or more dependent variables. Here is an example:

$$x' = 3x - y$$
$$y' = x + 2y$$

One approach that one could take would be to transform the pair of equations into a single second order equation. To do this

- Solve for $y$ in terms of $x$ and $x'$ using the first equation.
- Compute $y'$ using what you just got.
- Plug the expressions for $y$ and $y'$ into the second equation.
- Simplify

In the example above,

- Using the equation $x' = 3x - y$, we get
$$y = 3x - x'.$$
- Thus, $y' = 3x' - x''$.
- Plugging these into $y' = x + 2y$, we get
$$(3x' - x'') = x + 2(3x - x')$$
- This simplifies to
$$x'' - 5x' + 7x = 0$$

The roots of the characteristic equation $r^2 - 5r + 7 = 0$ are $r = \frac{5\pm\sqrt{-3}}{2}$, so we get

$$x = Ce^{5t/2}\cos\left(\frac{\sqrt{3}t}{2}\right) + De^{5t/2}\sin\left(\frac{\sqrt{3}t}{2}\right)$$

We could then find $y$ by computing $3x - x'$. After simplifying, we get

$$y = \left(\frac{C - \sqrt{3}D}{2}\right)e^{5t/2}\cos\left(\frac{\sqrt{3}t}{2}\right) + \left(\frac{\sqrt{3}C + D}{2}\right)e^{5t/2}\sin\left(\frac{\sqrt{3}t}{2}\right)$$