Friday 9/21 - Solving higher order.

Given a constant coefficient equation

$$y'' + py' + qy = 0$$

we can guess solutions of the form $y = e^{rx}$.

We get the characteristic equation

$$r^2 + pr + q = 0.$$

If there are two real roots $r_{\pm}$, we get a general solution $y = c_+ e^{r_+ x} + c_- e^{r_- x}$.

If we have one root, the second solution is $x e^{rx}$ instead (see "reduction of order").

There is a strong existence - uniqueness theorem, at least for linear equations.

3.2 A lot translates to higher order: superposition, solving with n initial conditions, etc.

Ex. $y''' + 2y'' - y' - 2y = 0$ has characteristic polynomial $r^2 + 2r - r - 2 = 0$.

It factors as $(r-1)(r+1)(r+2)$

$\longrightarrow r = 1, -1, -2.$

General solution is $y = c_1 e^{x} + c_2 e^{-x} + c_3 e^{-2x}$.