For the system $x' = Ax$, the matrix e^{At} (called the exponential matrix) will give solutions to the system when multiplied by any constant vector $\tilde{u}$.

What is e^{At}? need to use taylor series

recall: $e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!} = 1 + x + \frac{x^2}{2} + \frac{x^3}{6} \cdots$ etc

so: $e^{At} = I + At + \frac{A^2 t^2}{2} + \frac{A^3 t^3}{6} \cdots$ etc

This gives approximation for e^{At}.

Note: this is not necessarily practical for computations (matrices can be very large)

- Multiplying by a constant vector $\tilde{u}$ will give a particular solution to $x' = Ax$:

plug in $\hat{x} = u e^{At}$ to the ODE

Homogeneous soln: $\vec{x}' = \vec{u} e^{At} \cdot A$ RHS: $A \vec{u} e^{At}$