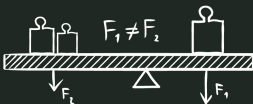
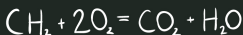
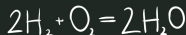




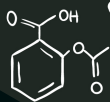
$$\begin{pmatrix} 1001 \\ 1110 \\ 1010 \\ 0001 \end{pmatrix}$$



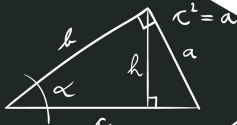
$$(\pi k, 0); k \in \mathbb{Z}$$

$$ax^2 + bx + c = 0$$

$$\sin^2 \alpha + \cos^2 \alpha = 1$$



$$\phi(x) = \frac{1}{\sqrt{2\pi\sigma^2}} \cdot e^{-\frac{x^2}{2\sigma^2}}$$



$$y = \cos x$$

$$\frac{\cos \alpha}{\sin \alpha} = \cot \alpha$$

$$f(\omega) = \int_{-\infty}^{\infty} f(x) \cdot e^{-2\pi i x \omega}$$



# Differential equation

## System of Linear Homogeneous Equations

Ali Jnadi

November 14, 2022

# Overview

1. System of linear homogeneous equations

2. QUESTIONS

The background of the slide is composed of two large, overlapping geometric shapes. A teal-colored shape occupies the upper-left portion, while a light gray shape occupies the lower-left portion. The rest of the slide is white. The text is centered in the white area.

# System of linear homogeneous equations



# System of linear homogeneous equations

## Solution using elimination

The easiest way to solve this system is to suppose that  $D = \frac{d}{dx}$  then we substitute in the equations, and try to isolate one of the variables, re-substitute  $D$  solve the resulting differential equation, and finally find the other variables.

# System of linear homogeneous equations

Solution using elimination: Example1

Solve the following system:

$$\begin{aligned}y_1' &= 2y_1 + 3y_2 \\ y_2' &= 4y_1 - 2y_2\end{aligned}\tag{1}$$

# System of linear homogeneous equations

Solution using Lambda

we can rewrite the system illustrated in 1:

$$y' = \begin{bmatrix} 2 & 3 \\ 4 & -2 \end{bmatrix} y \quad (2)$$

Then we can find the eigenvalues and eigenvectors of the matrix  $A = \begin{bmatrix} 2 & 3 \\ 4 & -2 \end{bmatrix}$

# System of linear homogeneous equations

Solution using Lambda: Eigenvalues and Eigenvectors

Calculate the eigenvalues and eigenvectors for the following matrix:

$$A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix} \quad (3)$$



# System of linear homogeneous equations

Solution using Lambda: cont.

After finding the eigenvalues  $\lambda_1, \lambda_2$  and the eigenvectors  $u_1, u_2$  the solution of the system of equation will be:

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = C_1 e^{\lambda_1 t} u_1 + C_2 e^{\lambda_2 t} u_2 \quad (4)$$

**Note:**  $u_1$  is the eigenvector related to  $\lambda_1$  and  $u_2$  is the eigenvector related to  $\lambda_2$

# System of linear homogeneous equations

Solution using Lambda: Example1

Solve the system illustrated in 2 using eigenvalues and eigenvectors.

# System of linear homogeneous equations

Solution using Lambda: Example2

Solve the following system:

$$x'(t) = \begin{bmatrix} 1 & 2 & -1 \\ 0 & 2 & 1 \\ 0 & 0 & 3 \end{bmatrix} x(t) \quad (5)$$

The background is composed of two large, overlapping geometric shapes. A teal-colored shape occupies the top-left corner, while a light gray shape occupies the bottom-left corner. The rest of the background is white. The word "QUESTIONS" is centered in the white area.

QUESTIONS