Course 1: Linear Algebra for Machine Learning & Data Science
Overview

Trần Đức Mạnh

Ngày 4 tháng 2 năm 2023

Mục lục

1 System of linear equations: 2 variables

1.1 System of sentences

1.1.1 What is a system of sentences?

- A system of sentences is just a group of sentences
- Example 1: A system of 2 sentences

System 1	System 2	System 3
The dog is **Black**	The dog is **Black**	The dog is **Black**
The cat is **Orange**	The dog is **Black**	The dog is **White**

- Example 2: A system of 3 sentences

System 1	System 2	System 3	System 4
The dog is **Black**	The dog is **Black**	The dog is **Black**	The dog is **Black**
The cat is **Orange**	The dog is **Black**	The dog is **Black**	The dog is **White**
The bird is **Red**	The bird is **Red**	The dog is **Black**	The bird is **Red**

1.1.2 New concepts

1. Complete, Redundant, Contradictory
   - **Complete:** when *number of pieces of information = number of sentences*
     Example: Ex1 - System 1, Ex2 - System 1
   - **Redundant:** when there are same sentences
     Example: Ex1 - System 2, Ex2 - System 2, Ex2 - System 3
   - **Contradictory:** when there are sentences contradict each other
     Example: Ex1 - System 3, Ex2 - System 4
2. Singular & non-Singular
   - **Singular**: when the system is Complete
   - **non-Singular**: when the system is not Complete

1.2 System of equations

1.2.1 From sentences to equations

Sentences	**Sentences with numbers**	**Equations**
The dog is black	The price of an apple and a banana is \$10	$a + b = 10$

1.2.2 Systems of equations

System 1	**System 2**	**System 3**
$a + b = 10$ $a + 2b = 12$	$a + b = 10$ $2a + 2b = 20$	$a + b = 10$ $2a + 2b = 24$
Unique Solution	**Infinite solutions**	**No solution**
$a = 8$ $b = 2$	$a = 8, 7, 6, ...$ $b = 2, 3, 4, ...$	
Complete	**Redundant**	**Contradictory**
Non-singular	*Singular*	*Singular*

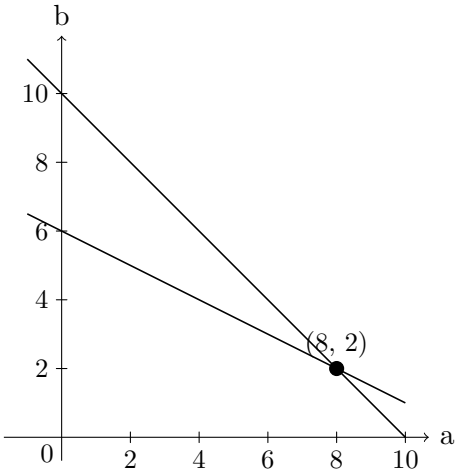
1.2.3 What is a linear equation?

Linear	non-Linear
$a + b = 10$	$a^2 + b^2 = 20$
$3.4a - 48.99b + 2c = 122.5$	$ab^2 + \frac{b}{a} - \frac{3}{b} - \log c = 4^a$

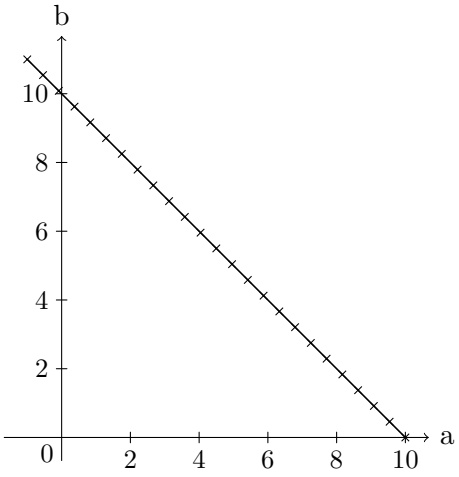
→ Linear Algebra is the study of Linear equations

1.3 System of equations as lines

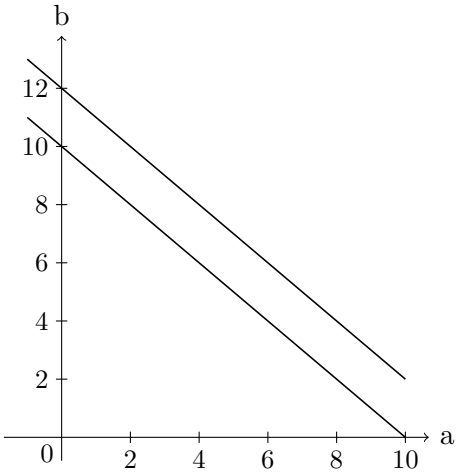
System 1	System 2	System 3
$a + b = 10$ $a + 2b = 12$	$a + b = 10$ $2a + 2b = 20$	$a + b = 10$ $2a + 2b = 24$
Unique Solution	**Infinite solutions**	**No solution**
$a = 8$ $b = 2$	$a = 8, 7, 6, ...$ $b = 2, 3, 4, ...$	
Complete	**Redundant**	**Contradictory**
Non-singular	*Singular*	*Singular*



Hình 1: System 1



Hình 2: System 2



Hình 3: System 3

1.4 Singular vs non-singular matrices

$a + b = 0$ $a + 2b = 0$	$\begin{pmatrix} 1 & 1 \\ 1 & 2 \end{pmatrix}$
Non-singular system	Non-singular matrix

$a + b = 0$ $2a + 2b = 0$	$\begin{pmatrix} 1 & 1 \\ 2 & 2 \end{pmatrix}$
Singular system	Singular matrix

2 System of linear equations: 3 variables