

Linear System =
System of Linear Equations

李宏毅

Hung-yi Lee

Review

- A system of linear equations

A linear equation is shown within a blue rectangular box: $2x_1 + 3x_2 + 5x_3 = 5$. The equation is enclosed in a large black curly brace on the left side. Labels with arrows point to specific parts of the equation: "coefficients" (blue) points to the numbers 2, 3, and 5; "variables" (red) points to the terms x_1 , x_2 , and x_3 ; and "constant term" (green) points to the number 5 on the right side of the equals sign. The text "A linear equation" is written to the right of the box.

a system of linear equations

I believe you know how to solve it.

Review

- A system of linear equations (多元一次聯立方程式)

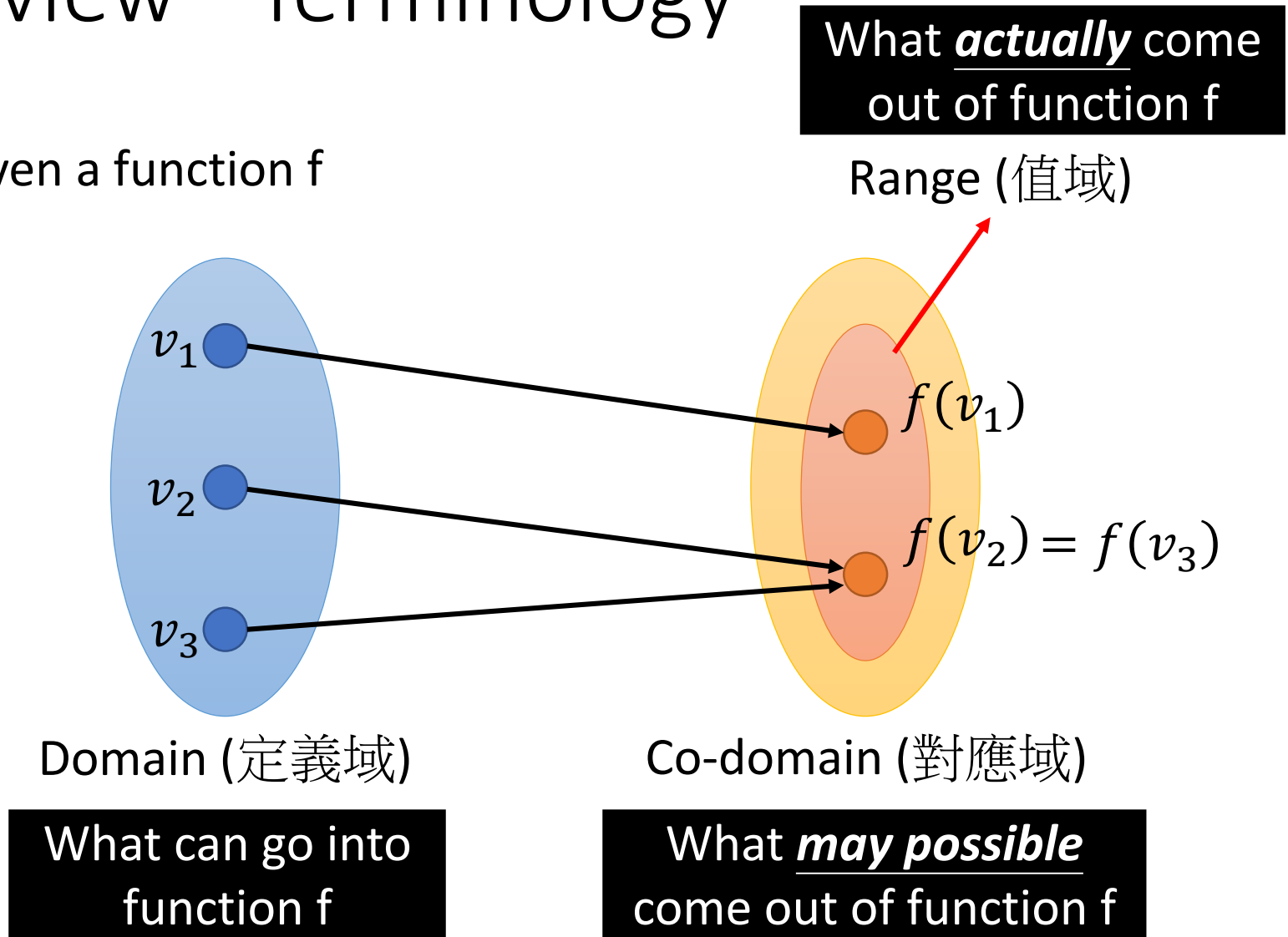
$$\begin{array}{l} \text{m} \\ \text{equations} \end{array} \left\{ \begin{array}{l} a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n = b_1 \\ a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n = b_2 \\ \vdots \\ a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n = b_m \end{array} \right.$$

n variables

In this course, m and n can be large

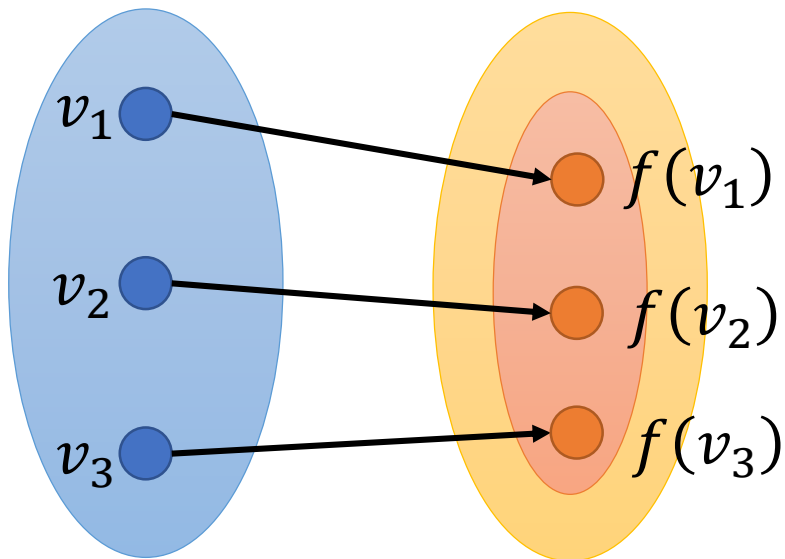
Review - Terminology

- Given a function f

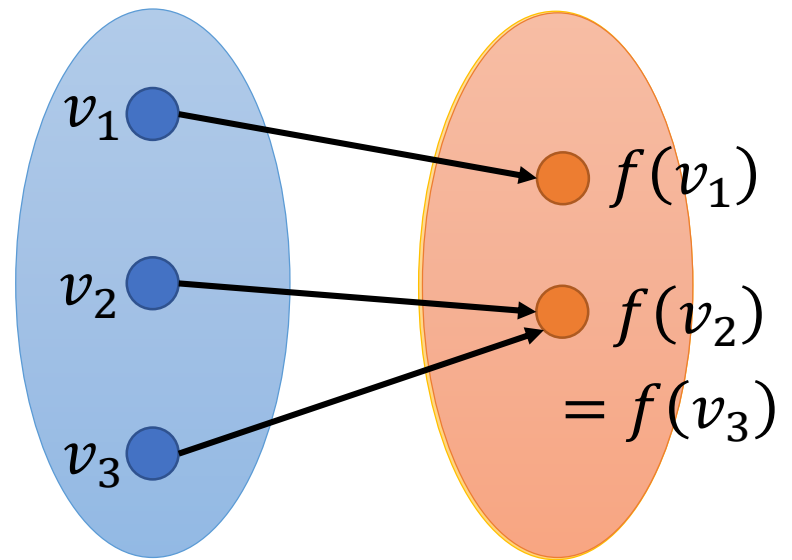


Review - Terminology

- one-to-one (一對一)



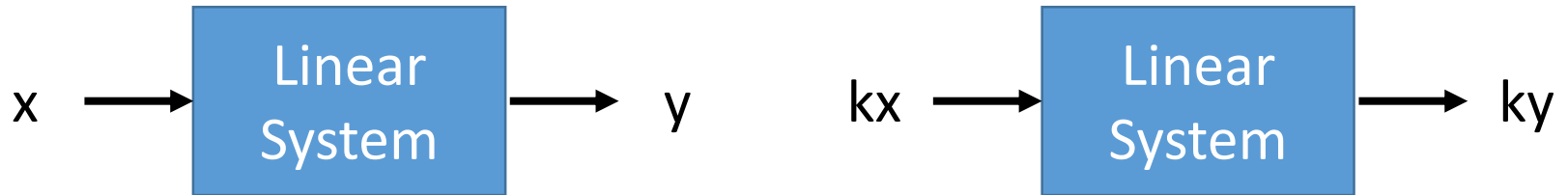
- Onto (映成)



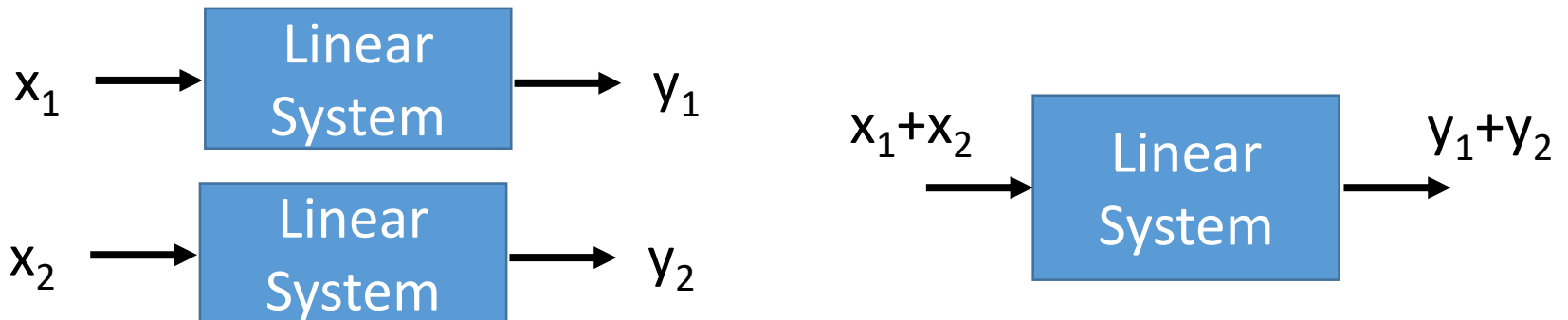
Co-domain = range

Review - Linear System

- Linear system have two properties
 - 1. Persevering Multiplication



- 2. Persevering Addition



Question

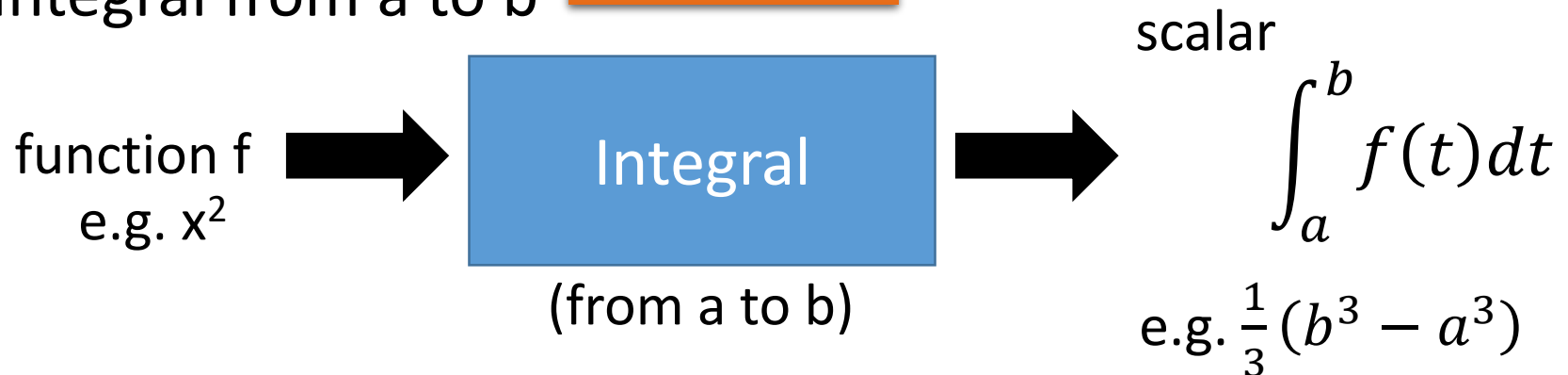
- Derivative:

linear?

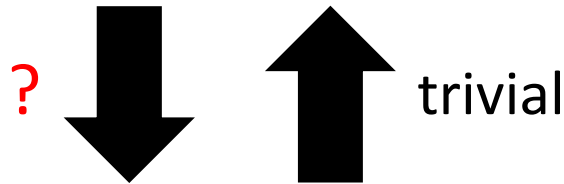


- Integral from a to b

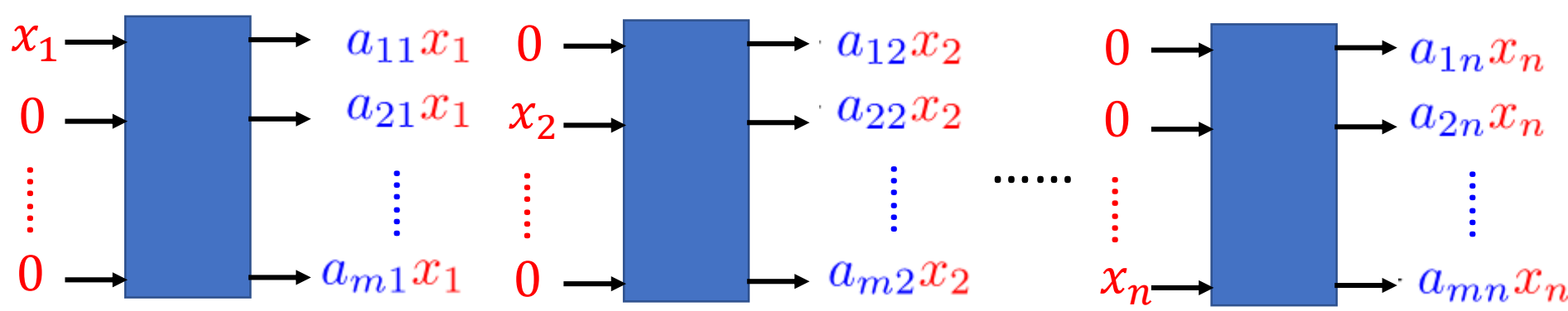
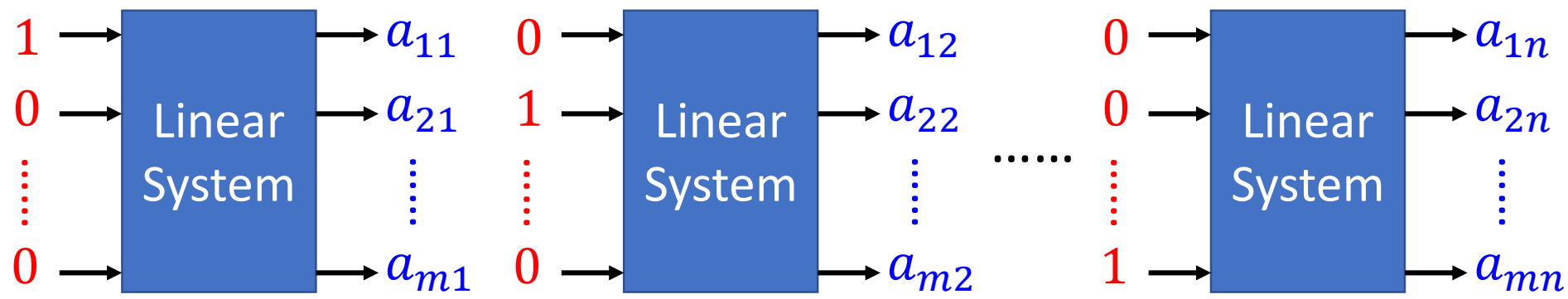
linear?



Linear System v.s. System of Linear Equations



$$\begin{aligned} a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n &= b_1 \\ a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n &= b_2 \\ &\vdots \\ a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n &= b_m \end{aligned}$$



A single linear system is shown, represented by a blue box labeled "Linear System".

- Inputs: x_1, x_2, \dots, x_n
- Outputs:
 - $a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n = b_1$
 - $a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n = b_2$
 - \vdots
 - $a_{m1}x_1 + a_{m2}x_2 + \dots + a_{mn}x_n = b_m$

A linear system is described by a system of linear equations