

# Linear System = System of Linear Equations

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# Review

- A system of linear equations

A diagram illustrating a linear equation:  $2x_1 + 3x_2 + 5x_3 = 5$ . The equation is enclosed in a blue rectangular box. To the left of the box is a large black curly brace. Above the box, three labels with arrows identify parts of the equation: 'coefficients' in blue with arrows pointing to 2, 3, and 5; 'variables' in red with arrows pointing to  $x_1$ ,  $x_2$ , and  $x_3$ ; and 'constant term' in green with an arrow pointing to 5. To the right of the box, the text 'A linear equation' is written.

a system of linear equations

I believe you know how to solve it.

# Review

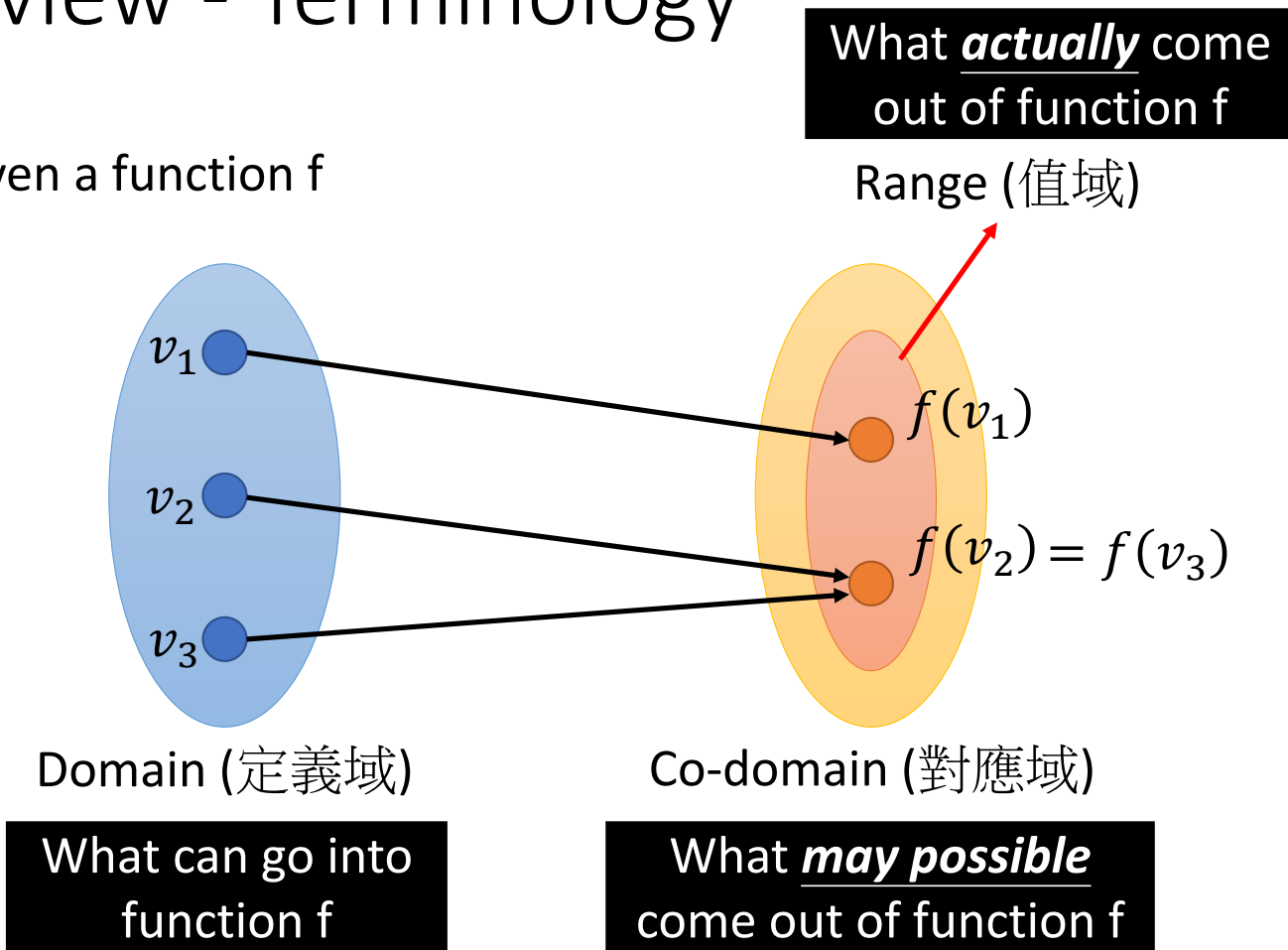
- A system of linear equations (多元一次聯立方程式)

The diagram illustrates a system of linear equations. On the left, the text "m equations" is followed by a large left curly bracket. To the right of the bracket, there are three equations stacked vertically, separated by vertical ellipsis dots. Each equation is of the form: a coefficient (in blue) multiplied by a variable (in red), followed by a plus sign, another coefficient (in blue) multiplied by a variable (in red), followed by a plus sign, an ellipsis, another plus sign, and a final coefficient (in blue) multiplied by a variable (in red). This is followed by an equals sign and a constant term (in green). The equations are:  $a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n = b_1$ ,  $a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n = b_2$ , and  $a_{m1}x_1 + a_{m2}x_2 + \dots + a_{mn}x_n = b_m$ . Below the equations, the text "n variables" is centered. Three arrows point from the variables  $x_1$ ,  $x_2$ , and  $x_n$  in the bottom equation to the text "n variables".

In this course,  $m$  and  $n$  can be large

# Review - Terminology

- Given a function  $f$



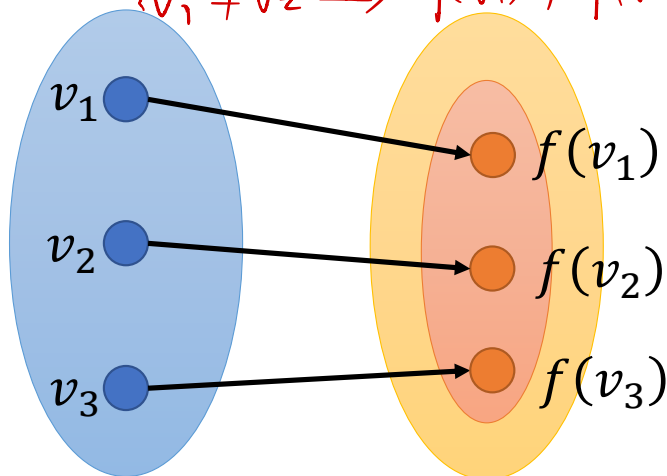
# Review - Terminology

保证无解或唯一解

- one-to-one (一對一)

单射

$$v_1 \neq v_2 \Rightarrow f(v_1) \neq f(v_2)$$

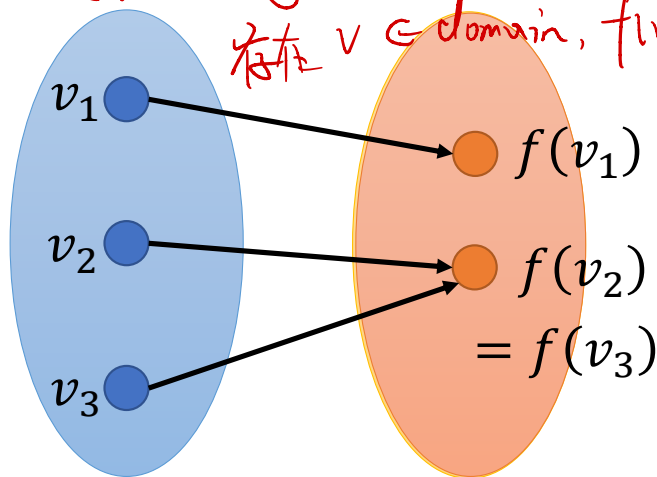


保证有解 一个或多个解

- Onto (映成) 满射

对任意  $y \in \text{Co-domain}$

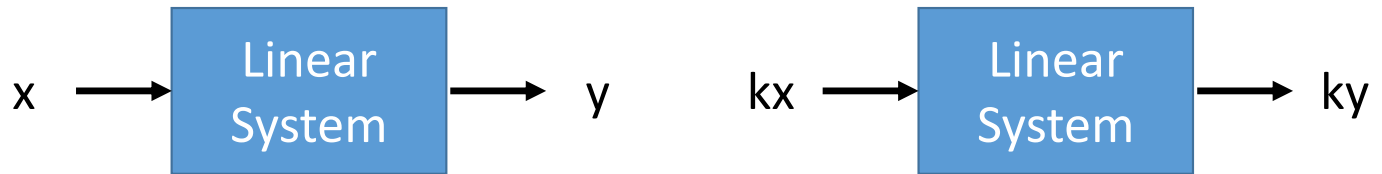
存在  $v \in \text{domain}$ ,  $f(v)=y$



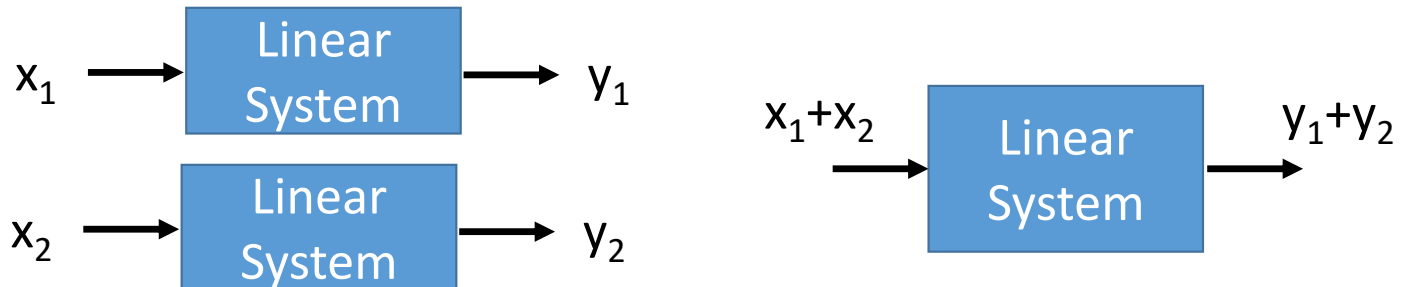
Co-domain = range

# Review - Linear System

- Linear system have two properties
  - 1. Persevering Multiplication



- 2. Persevering Addition

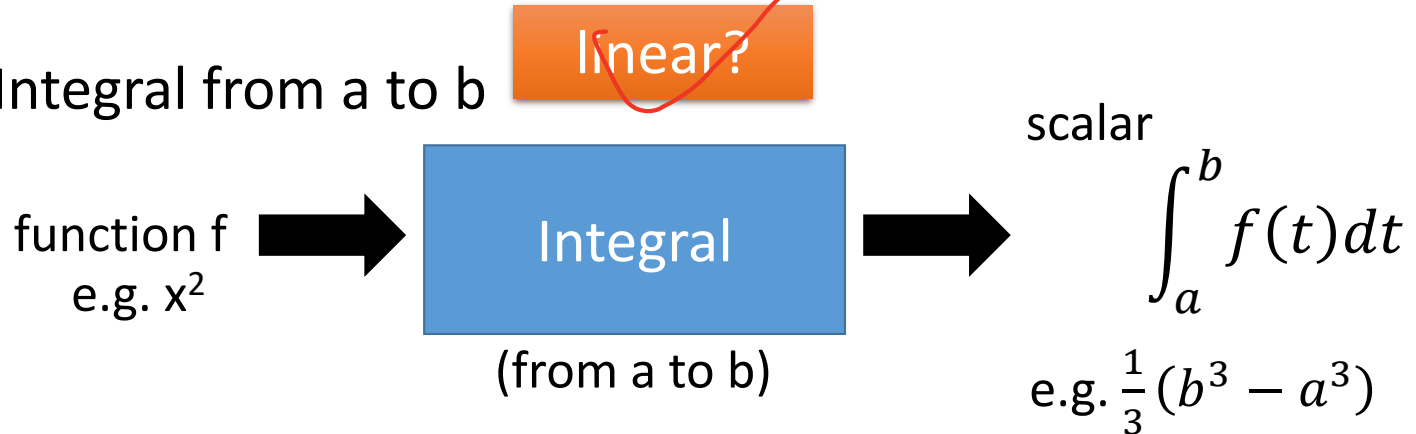


# Question

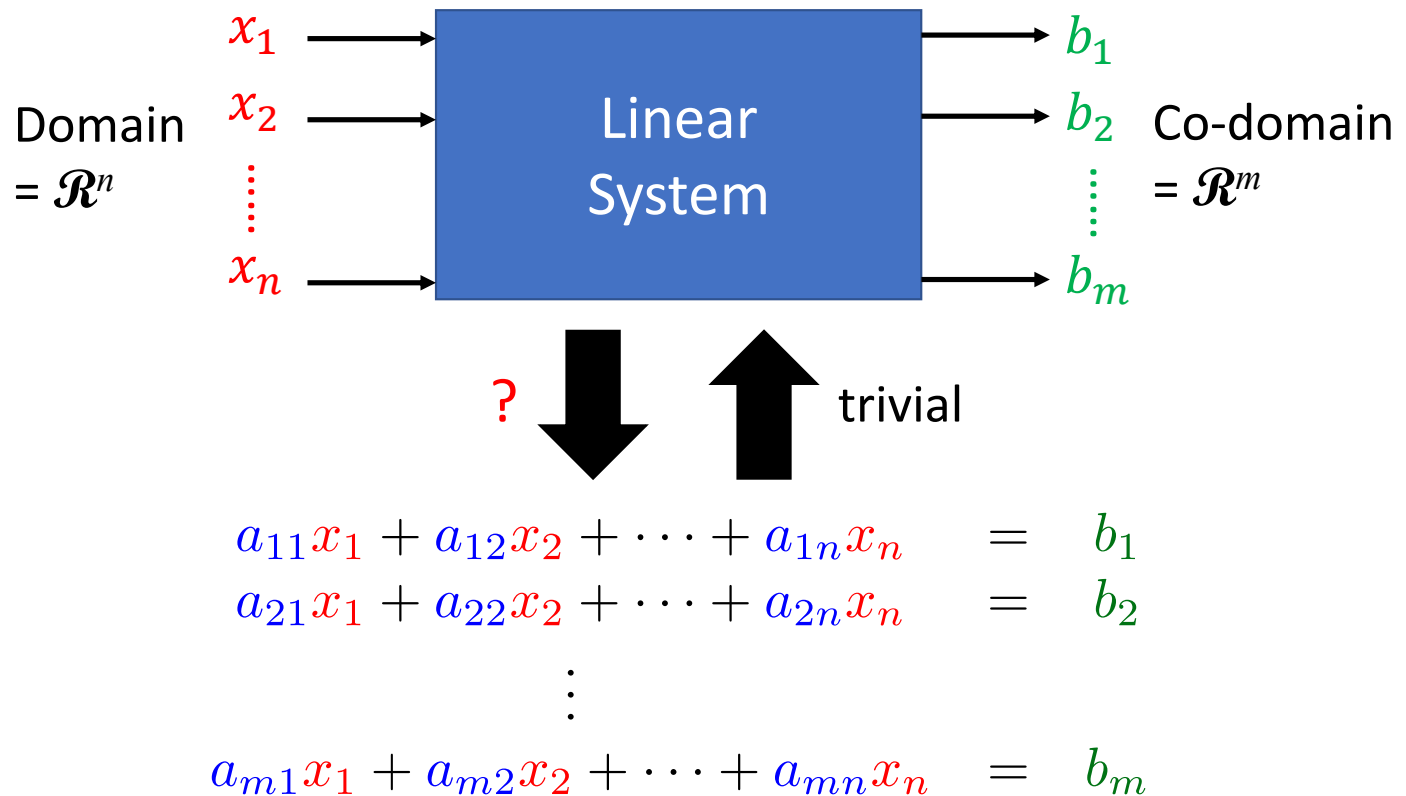
- Derivative:



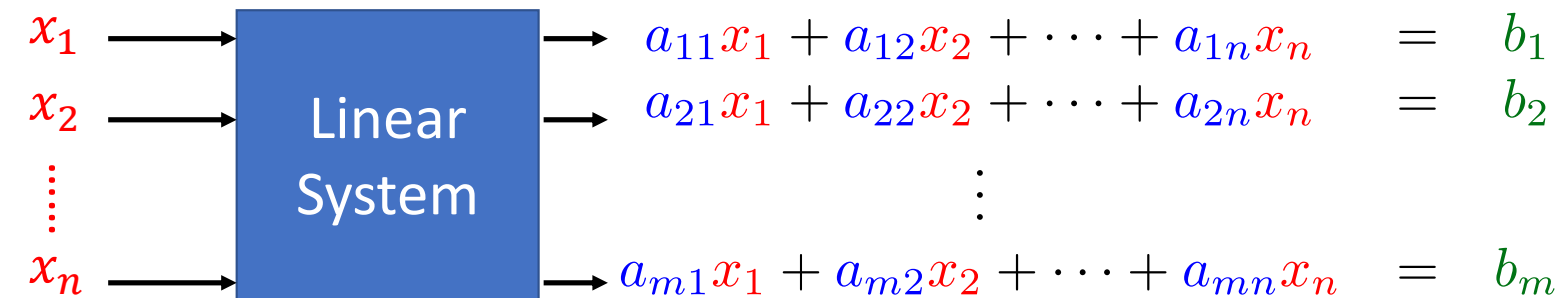
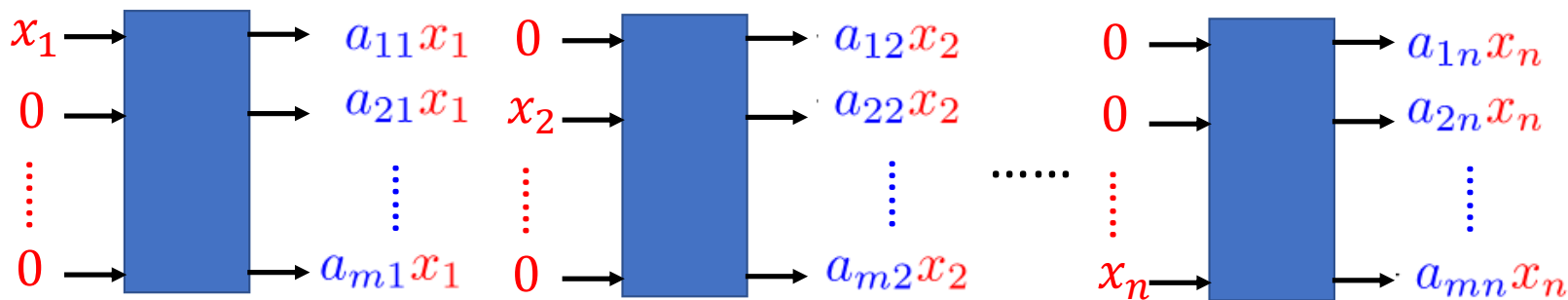
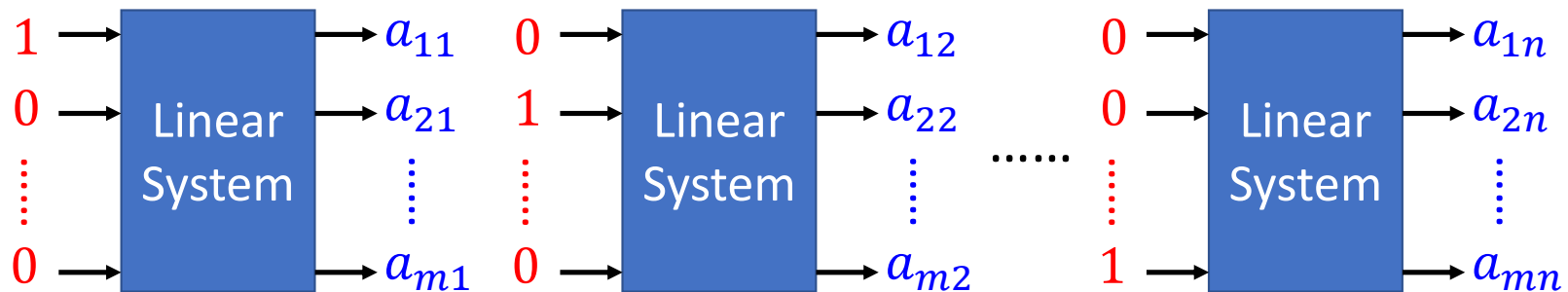
- Integral from a to b



# Linear System v.s. System of Linear Equations







**A linear system is described by a system of linear equations**