

Linear Algebra Exercises for *Linear Algebra
and Its Applications* /David C. Lay. -5th Ed.

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¹Thanks Donald Knuth for the LaTeX

CHAPTER 1 SUPPLEMENTARY EXERCISES

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This is the contents.

0.1 Matrix Notation

The following linear system can be compactly recorded in a rectangular array called matrix

$$\begin{cases} x_1 - 2x_2 + x_3 = 0 \\ 2x_2 - 8x_3 = 8 \\ 5x_1 - 5x_3 = 10 \end{cases} \quad (1)$$

The matrix with the coefficients of each variable aligned in columns, the matrix

$$\begin{bmatrix} 1 & -2 & 1 \\ 0 & 2 & -8 \\ 5 & 0 & -5 \end{bmatrix} \quad (2)$$

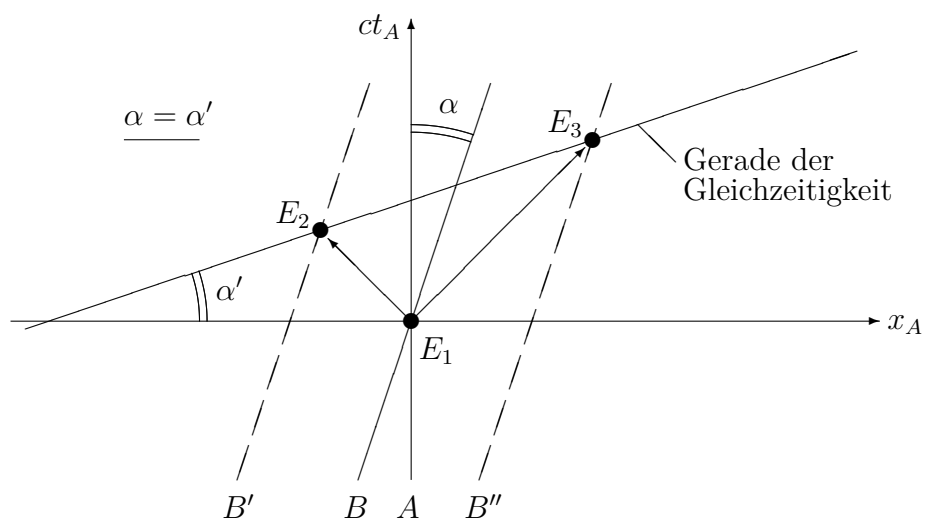
is called the **coefficient matrix** (or **matrix of coefficients**) of the linear system (1), and the following matrix is called **augmented matrix** of the system.

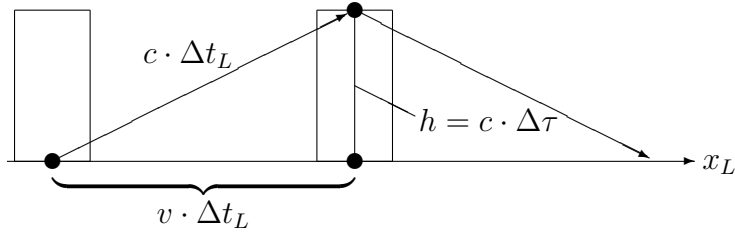
$$\begin{bmatrix} 1 & -2 & 1 & 0 \\ 0 & 2 & -8 & 8 \\ 5 & 0 & -5 & 10 \end{bmatrix} \quad (3)$$

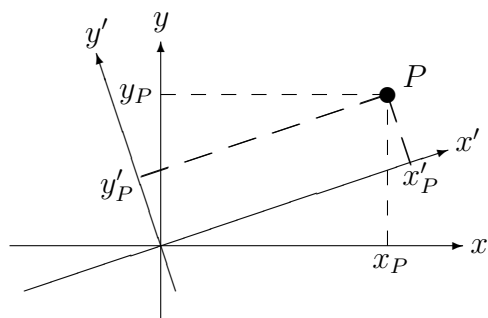
ex. 1. Mark each statement True or False. Justify each answer. (If true, cite appropriate facts or theorems. If false, explain why or give a counterexample that shows why the statement is not true in every case.

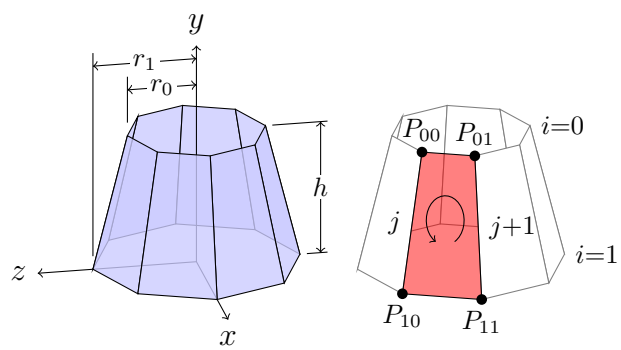
- (a) Any system of n linear equations in n variables has at most n solutions.
- (b) If a system of linear equations has two different solutions, it must have infinitely many solutions.
- (c) If a system of linear equations has no free variables, then it has a unique solution.
- (d) If an augmented matrix $[A \ b]$ is transformed into $[C \ d]$ by elementary row operations, then the equations $Ax = b$ and $Cx = d$ have exactly the same solution sets.
- (e) If a system $Ax = b$ has more than one solution, then so does the system $Ax = 0$.
- (f) If A is an $m \times n$ matrix and the equation $Ax = b$ is consistent for some b , then the columns of A span \mathbb{R}^m .

Ex01 Table	
Item	Answer (\$)
a	True
b	True
c	True
d	True
e	True
f	True









$$v=v^1e_1+v^2e_2+v^3e_3=v^ie_i, i=1,2,3$$

or

$$v=v^1e_1+v^2e_2+v^3e_3=v^ie_i, i=1,2,3 \tag{4}$$

$$f(x)=\sum_{n=0}^{10}\frac{x}{n!}$$

$$f(x)=\sum_{n=0}^{10}\frac{x}{n!}$$

In-line math components can be set with independent math display style

$$f(x)=\sum_{n=0}^{10}\frac{x}{n!}, \text{ and vice versa:}$$

$$f(x)=\sum_{n=0}^{10}\frac{x}{n!}$$

$$x^2+y^2=z^2 \tag{5}$$

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$$x_1,x_2,\cdots,x_N$$

$$\left[\begin{array}{cc} v^ie_i & v^ie_j \\ v^je_i & v^je_j \end{array}\right]$$

$$\left\{\begin{array}{lcl} (f+g)(x) & = & f(x)+g(x) \\ (\alpha f)(x) & = & \alpha f(x) \\ (fg)(x) & = & f(x)g(x) \end{array}\right.$$

1

2

2

1

2

Table 1: Timeline of something.

1947	•	AT and T Bell Labs develop the idea of cellular phones.
1968	•	Xerox Palo Alto Research Centre envisage the 'Dynabook'.
1971	•	Busicom 'Handy-LE' Calculator.
1973	•	First mobile handset invented by Martin Cooper.
1978	•	Parker Bros. Merlin Computer Toy.
1981	•	Osborne 1 Portable Computer.
1982	•	Grid Compass 1100 Clamshell Laptop.
1983	•	TRS-80 Model 100 Portable PC.
1984	•	Psion Organiser Handheld Computer.
1991	•	Psion Series 3 Minicomputer.

$$w(0) = 0 \tag{6}$$

$$\frac{\partial w}{\partial x} \Big|_{x=0} = 0 \tag{7}$$

$$(8)$$

$$s = \int_a^b |\dot{x}(t)| dt$$

$$r'(t) = \lim_{\Delta t \rightarrow 0} \frac{r(t + \Delta t) - r(t)}{\Delta t}$$

$$\frac{\partial w}{\partial x} \Big|_{x=0} = 0$$

The square root of 100 is $\sqrt{100} = 10$.
The cubic root of 64 is $\sqrt[3]{64} = 4$.

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Bibliography

- [1] Helmut Kopka and Patrick W. Daly. *A Guide to L^AT_EX*. Addison-Wesley, Fourth edition, 2004.
- [2] Michel Goossens, Frank Mittelbach, and Alexander Samarin. *The L^AT_EX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.
- [3] Albert Einstein. *Zur Elektrodynamik bewegter Körper*. (German) [*On the electrodynamics of moving bodies*]. Annalen der Physik, 322(10):891–921, 1905.

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \end{pmatrix} \tag{9}$$

$$\begin{matrix} & 1 & 2 \\ \begin{matrix} 1 \\ 2 \\ 3 \end{matrix} & \begin{pmatrix} x_1 & x_2 \\ x_3 & x_4 \\ x_5 & x_6 \end{pmatrix} \end{matrix}$$

$$\begin{pmatrix} 1 & -2 & 1 & 0 \\ 0 & 1 & -4 & 4 \\ 0 & 0 & 1 & 3 \end{pmatrix} \quad (10)$$

$$\begin{pmatrix} 0 & 1 & -4 & 8 \\ 2 & -3 & 2 & 1 \\ 5 & -8 & 7 & 1 \end{pmatrix} \quad (11)$$

- [4] Knuth: Computers and Typesetting,
<http://www-cs-faculty.stanford.edu/~uno/abcde.html>