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Matrix Methods in Data Analysis, Signal Processing, and Machine Learning



The banner features the MIT logo and the text "Massachusetts Institute of Technology". To the right is a photograph of the Great Dome at night, overlaid with a grid of small squares representing a matrix.

18.065, Spring 2018
Matrix Methods in Data Analysis, Signal Processing, and Machine Learning
Gilbert Strang texto
Lecture 1: The Column Space of A Contains All Vectors Ax

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Lecture 1:

The columns space of A contains all vectors Ax

- Independent columns = basis for the column space

Rank = number of independent columns

$A=CR$ leads to: Row rank equals column rank

- Related section in textbook: I.1

Lecture 1:

The columns space of A contains all vectors Ax

18.065 Stellar
math.mit.edu/learningfromdata
Gilbert Strang + 2 TAs
2 graders
No TESTS ! (?) NO FINAL

Lecture 1

$$\begin{bmatrix} 2 & 1 & 3 \\ 3 & 1 & 4 \\ 5 & 7 & 12 \end{bmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} = x_1 \begin{bmatrix} 2 \\ 3 \\ 5 \end{bmatrix} + x_2 \begin{bmatrix} 1 \\ 1 \\ 7 \end{bmatrix} + x_3 \begin{bmatrix} 3 \\ 4 \\ 12 \end{bmatrix}$$

$\overset{A}{\text{all } Ax = \text{Column space}} = C(A)$

 ① dot products (Row), x

$$A = CR \quad \overset{OR}{A = CU \tilde{R}}$$

$\underset{Ax}{x = \text{rand}(m, 1)}$

 $A(BC)x$

$$\begin{bmatrix} 2 & 1 & 3 \\ 3 & 1 & 4 \\ 5 & 7 & 12 \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 3 & 1 \\ 5 & 7 \end{bmatrix} \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

\leftarrow basis for row space
 \leftarrow basis for col space

$\overset{A}{=} \begin{bmatrix} \text{Column rank} \\ r=2 \end{bmatrix} = \text{row rank}$

$$A = \begin{bmatrix} 1 & 3 & 8 \\ 1 & 3 & 8 \\ 1 & 3 & 8 \end{bmatrix}$$

$C(A) = \text{line}$
 $\text{rank}(A) = 1$

Lecture 1



Comb Columns \times rows

$$[AB] = \begin{bmatrix} \text{col} \\ A \end{bmatrix} \begin{bmatrix} \text{row} \\ B \end{bmatrix} = \text{dot products}$$

(col 1)(row 1)

$$\left[\begin{array}{c|c} \text{(Col } k\text{)} & \text{(row } k\text{)} \\ \hline \text{row } A & \text{row } B \\ m \times 1 & 1 \times p \end{array} \right] = \sum_{k=1}^p (\text{col } k)(\text{row } k) A B$$

32-141 Fri 5-7-

Julia / Python
 $(m \times n)(n \times p) = (m \times p)$
 $n \times (m \times p) =$

function
m n p mult

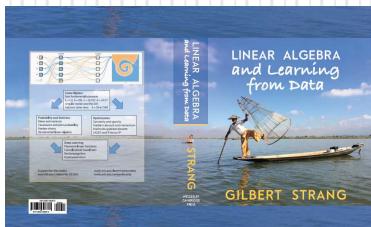


<https://github.com/aegiloru/lald>

Credits



[Gilbert Strang Web Site](#)



<https://ocw.mit.edu/courses/mathematics/18-065-matrix-methods-in-data-analysis-signal-processing-and-machine-learning-spring-2018/index.htm>

<http://www.math.mit.edu/~gs/>

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