

# Matrices & Vectors in MATLAB

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Taking Advantage of MATLAB's Strengths



# What are Matrices & Vectors?

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## Collections of Numbers

On Paper:

$$b = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_n \end{bmatrix}$$

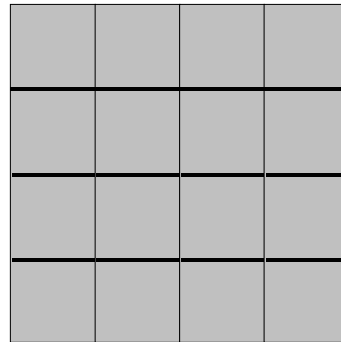
$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}$$

Graphical Representation:

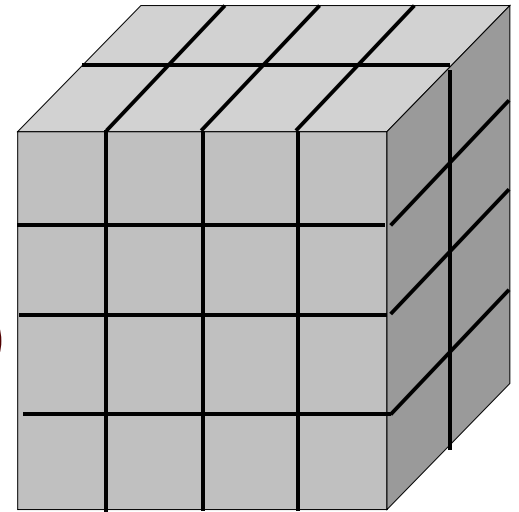
1-D



2-D



3-D



Address in  
MATLAB:

$b(i)$

$A(i,j)$

$C(i,j,k)$

Array: an n-dimensional collection of numbers



# Creating Matrices & Vectors in MATLAB

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- **Direct Assignment - Useful for small arrays**

- ▶ **Vectors**

- $b = [b_1 \ b_2 \ b_3 \ \dots \ b_n];$

- Creates a row-vector

- $b = [b_1; b_2; \dots b_n;]$  or  $b = [b_1 \ b_2 \ b_3 \ \dots \ b_n]';$

- Creates a column vector

- ▶ **Matrices**

- $A = [a_{11} \ a_{12} \ \dots \ a_{1n}; \ a_{21} \ a_{22} \ \dots \ a_{2n}; \ \dots; \ a_{m1} \ a_{m2} \ \dots \ a_{mn}];$

- Creates an  $m \times n$  array ( $m$  rows,  $n$  columns)

- **Special Matrices (see page 44 of text)**

- ▶ `ones(m,n); zeros(m,n); eye(m,n); rand(m,n);`

- ▶ `linspace(start, end, number of entries);`

- ▶ Using “:” to make arrays

- ▶ “help elmat” for more information



# Working with Matrices & Vectors

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Array Operations (see page 51 of text)

- Adding & Subtracting ( $a+b$   $a-b$ )
  - ▶ What are the restrictions on sizes of  $a$  &  $b$ ?
- Multiplication & Division
  - ▶ Elemental multiplication  $C = A .* B$ ;
    - Elements of  $A$  multiplied by the corresponding elements in  $B$
    - $C_{ij} = A_{ij} * B_{ij}$
    - Size Restrictions?
  - ▶ Matrix (vector) multiplication  $C = A * B$ ; (More later...)
    - Size restrictions?
  - ▶ Elemental Division  $C = A ./ B$ ;
- Exponentiation  $A.^B$
- Other elemental operators:  $\exp(A)$ ;  $\log(A)$ ;  $\cos(A)$ ;



# Array Manipulation

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## Commonly Used Features

- **Transpose ( $A^T$ )**
  - ▶ Exchange rows & columns
  - ▶ In MATLAB, use the apostrophe  $\Rightarrow A^T = A'$
- **Get Dimension(s) of an array**
  - ▶  $l = \text{length}(a)$ ;  $[\text{rows}, \text{cols}] = \text{size}(A)$ ;
- **Array Addressing**
  - ▶  $A(i,j) \Rightarrow i^{\text{th}}$  row and  $j^{\text{th}}$  column of  $A$ 
    - Extendable to higher dimensionality



# EXAMPLE: Temperature Conversion

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Create a MATLAB code to convert temperatures between Celcius and Fahrenheit.

$$T_{\circ F} = \frac{9}{5} T_{\circ C} + 32$$

Print a table showing the conversions...

