

Introduction to Computer for Engineers

Lecture 3

Vector & Matrix in MATLAB

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Introduction to Vector

Vector vs. scalar

Row vector

$$\vec{v} = (1, 2, 3)$$

Column vector

$$\vec{v} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

Introduction to Vector

Recall arithmetic operators using with scalar

Operator

Definition

$+$

Addition

$-$

Subtraction

\times

Multiplication

$/$

Division

\wedge

Power

Introduction to Vector

Which operators are still “valid” with vector?

Division ?

Multiplication:

Scalar – Vector

Vector – Vector

Transpose

Vector & MATLAB

Store in array (row/column/indexing/ref. ele.)

All operators + introduce new operands

Element-wise multiplication `.*`

Element-wise power `.^`

Element-wise left & right division `./` `.\`

Vector & MATLAB

Vector dot product

$$\vec{u} = (u_1, u_2, u_3)$$

$$\vec{v} = (v_1, v_2, v_3)$$

$$\vec{u} \cdot \vec{v} = |u||v|\cos\alpha = u_1v_1 + u_2v_2 + u_3v_3$$

In MATLAB `dot(u,v)`

Numerical example

Vector & MATLAB

Vector cross product

$$\vec{u} = (u_1, u_2, u_3)$$

$$\vec{v} = (v_1, v_2, v_3)$$

$$\begin{aligned}\vec{u} \times \vec{v} &= \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \end{vmatrix} \\ &= \begin{vmatrix} u_2 & u_3 \\ v_2 & v_3 \end{vmatrix} \vec{i} + \begin{vmatrix} u_3 & u_1 \\ v_3 & v_1 \end{vmatrix} \vec{j} + \begin{vmatrix} u_1 & u_2 \\ v_1 & v_2 \end{vmatrix} \vec{k}\end{aligned}$$

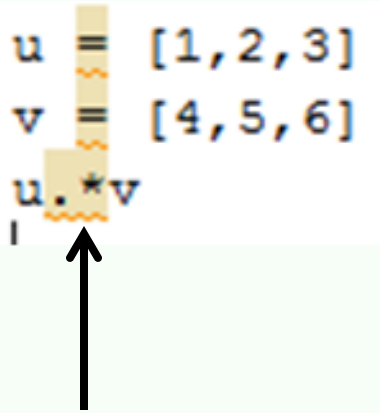
In MATLAB `cross(u,v)`

Numerical example

Vector & MATLAB

Vector – Element-wise multiplication

```
u = [1,2,3]
v = [4,5,6]
u.*v
```



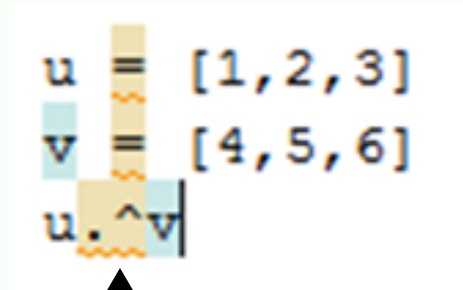
**Element-wise
Multiplication .***

```
u =  
    1    2    3  
  
v =  
    4    5    6  
  
ans =  
    4   10   18
```


Vector & MATLAB

Vector – Element-wise power

```
u = [1, 2, 3]
v = [4, 5, 6]
u.^v
```



**Element-wise
Multiplication .^**

```
u =
     1     2     3

v =
     4     5     6

ans =
     1    32   729
```

Vector & MATLAB

Vector – Element-wise left & right division

```
u = [1,2,3]
v = [4,5,6]
% right division - right direction
u./v
% left division - inverse direction
u.\v
```

Element-wise
division

```
u =
     1     2     3

v =
     4     5     6

ans =
    0.2500    0.4000    0.5000

ans =
    4.0000    2.5000    2.0000
```

Vector & MATLAB

Vector – Special Functions

Vector one, zero

Vector length, dimension, modulus

Sum of all elements in a vector

Factorial

Vector & MATLAB

Vector & Private function

Function output

Function input/variable/argument

```
function y = average(x)
    y = sum(x)/length(x);
end
```

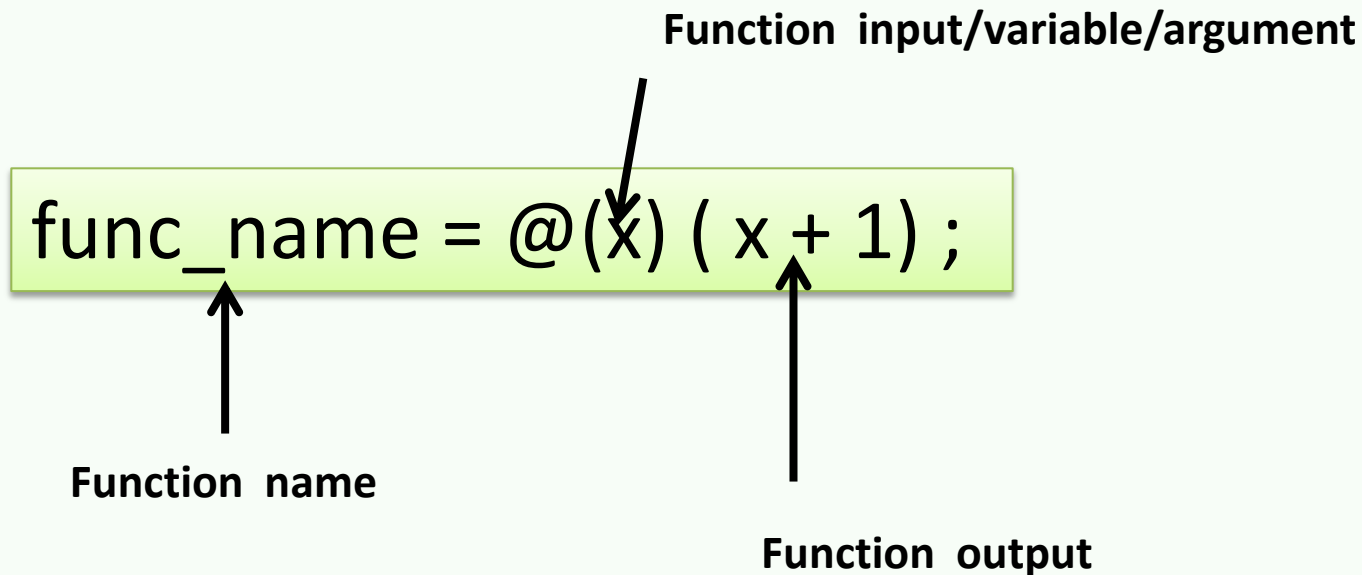
Function name

Input & Output of a private function could be in vector

**Demo a function with vector in/scalar out
vector in / vector out, scalar in /vector out**

Vector & MATLAB

Vector & anonymous function



The same concerns in the case of anonymous function

Vector & MATLAB

Vectorization : (Vector + Function + Element-wise)

Application of vector computation in expression and function evaluation. An optimization in

Resource allocation

Computational time

Code size (more compact, no loop ...)

Vector & MATLAB

Vector & Plotting

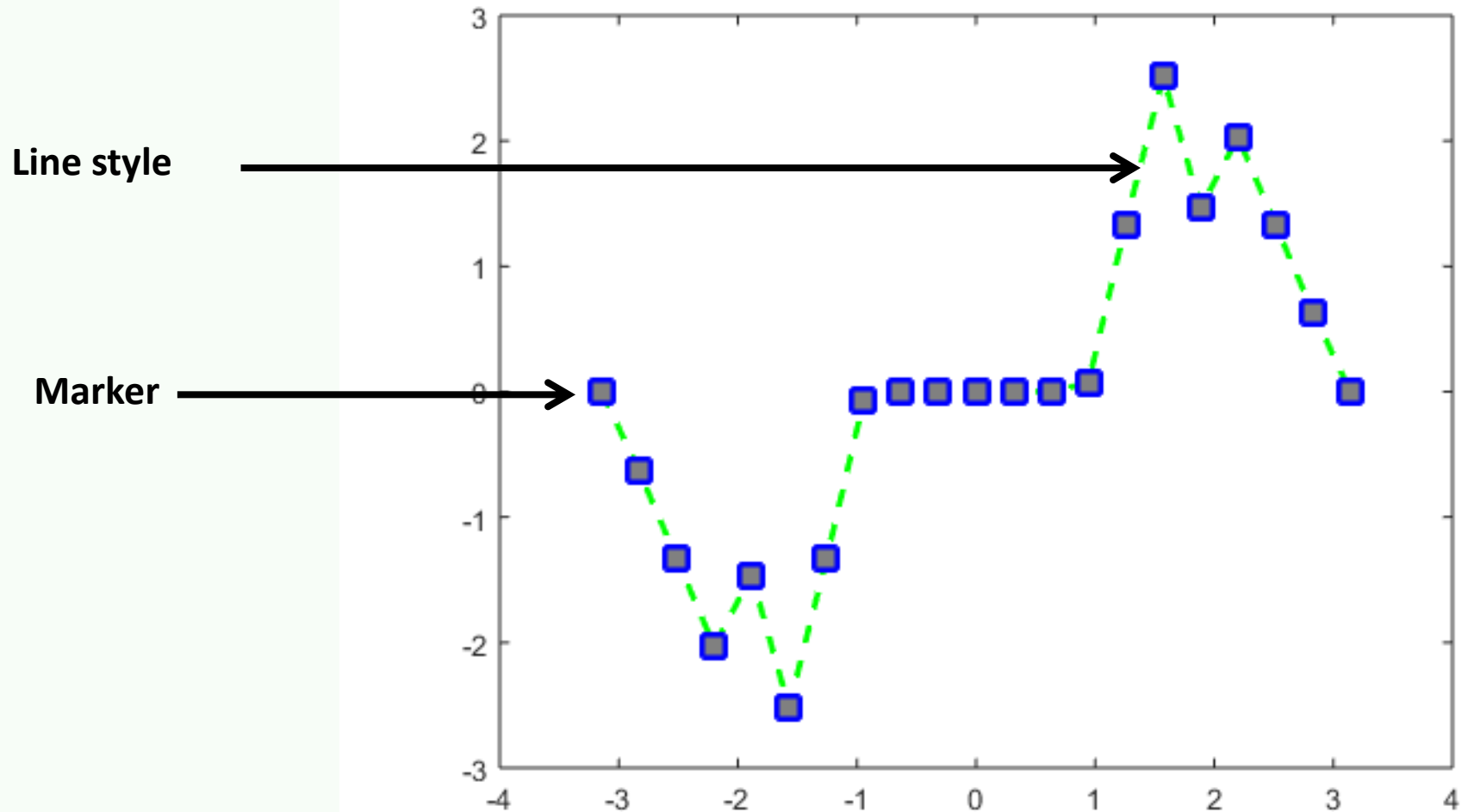
Concept of plot function in MATLAB

Plot a line

**Plot options : marker, line style, line width
colors**

Vector & MATLAB

Vector & Plotting – Demo



End of Lecture 3