

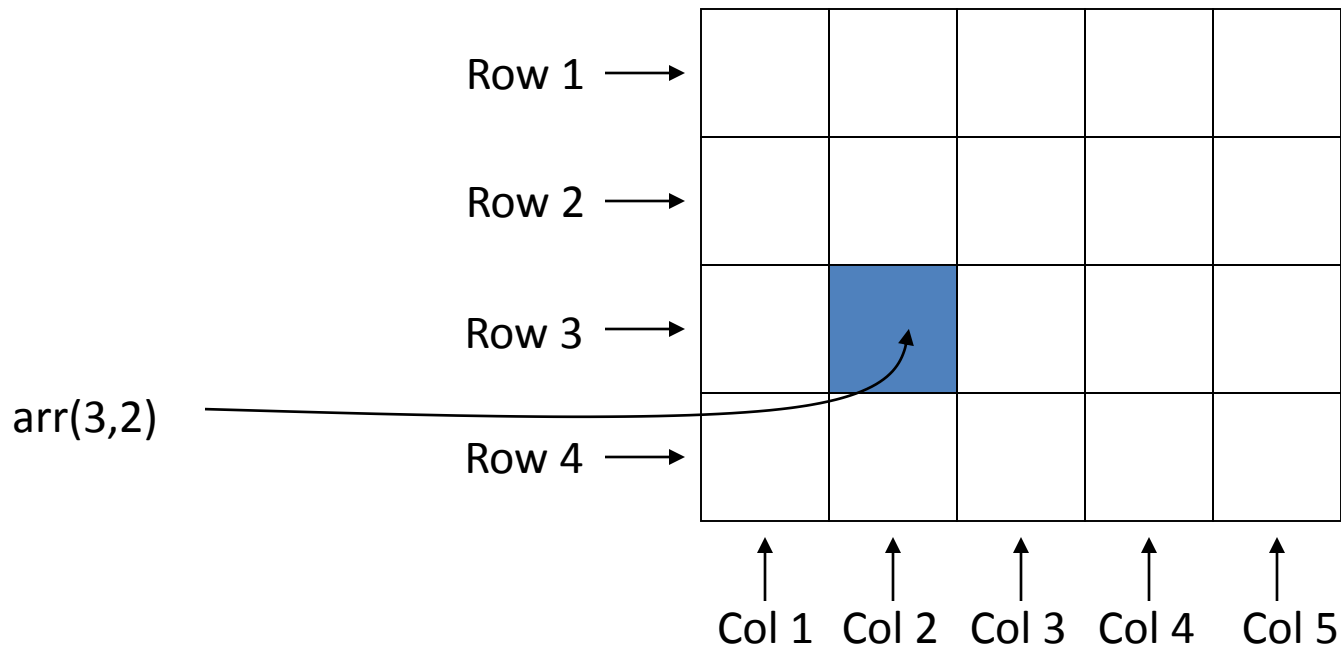
MATLAB Constants, Variables & Expression

Introduction

- MATLAB can be used as a powerful programming language.
- It do have **IF**, **WHILE**, **FOR** lops similar to other programming languages.
- It has its own vocabulary and grammar.
- All MATLAB in line commands can be used in M-files.

Variables and Arrays

- **Array:** A collection of data values organized into rows and columns, and known by a single name.



Variables and Arrays cont...

Arrays

- The fundamental unit of data in MATLAB
- Scalars are also treated as arrays by MATLAB (1 row and 1 column).
- Row and column indices of an array start from 1.
- Arrays can be classified as **vectors** and **matrices**.

Variables and Arrays cont...

- **Vector:** Array with one dimension
- **Matrix:** Array with more than one dimension
- **Size** of an array is specified by the number of rows and the number of columns, with the number of rows mentioned first (For example: $n \times m$ array).

Total number of elements in an array is the product of the number of rows and the number of columns.

Variables and Arrays cont...

$$a = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$$

3x2 matrix → 6 elements

$$b = [1 \ 2 \ 3 \ 4]$$

1x4 array → 4 elements, **row vector**

$$c = \begin{bmatrix} 1 \\ 3 \\ 5 \end{bmatrix}$$

3x1 array → 3 elements, **column vector**

$$a(2,1)=3$$

Row 2 Column 1

$$b(3)=3$$

$$c(2)=3$$

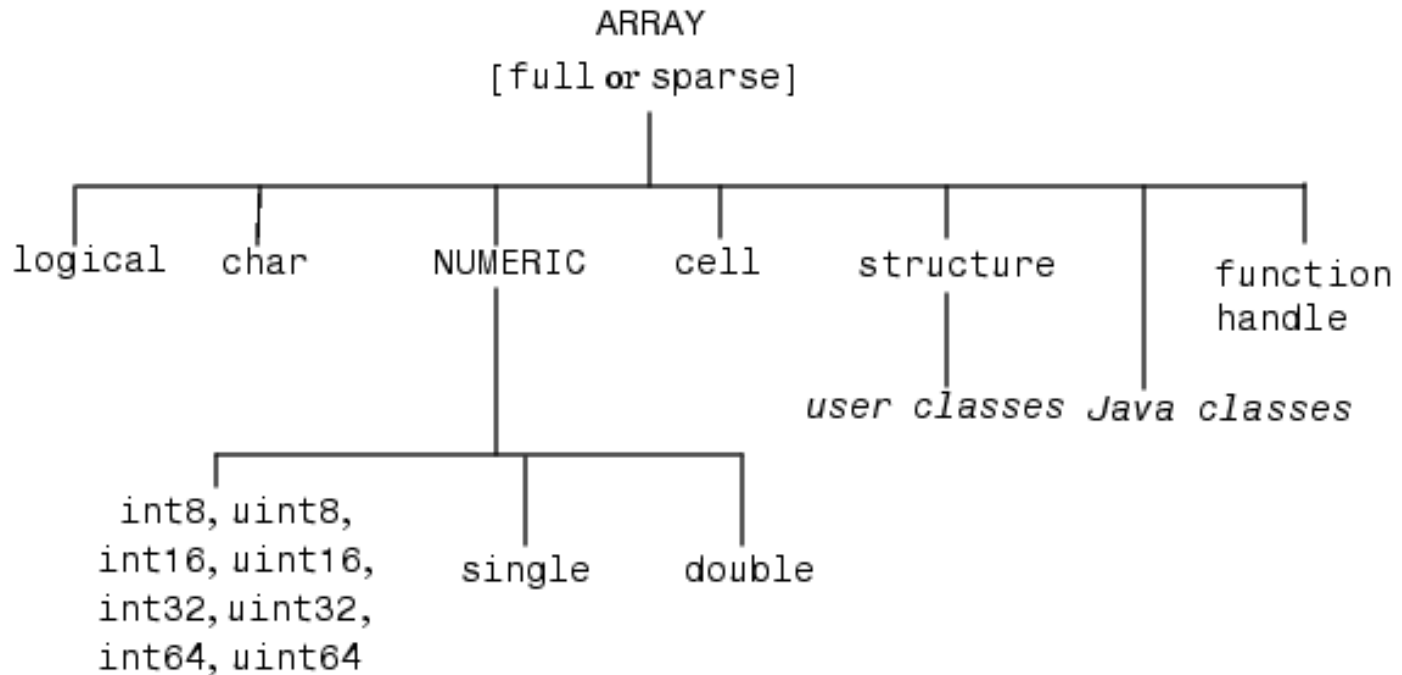
Character Set

In character set we have

1. Alphabets :A,B,C.....Z & a,b,c...z
2. Numerals :0,1,2,3,4,5,6,7,8,9
3. Special Characters :@, #, \$, % etc
4. White Space :

Data Types

- There are 14 fundamental data types in MATLAB



Default Numeric Data Type - double

Data Types cont...

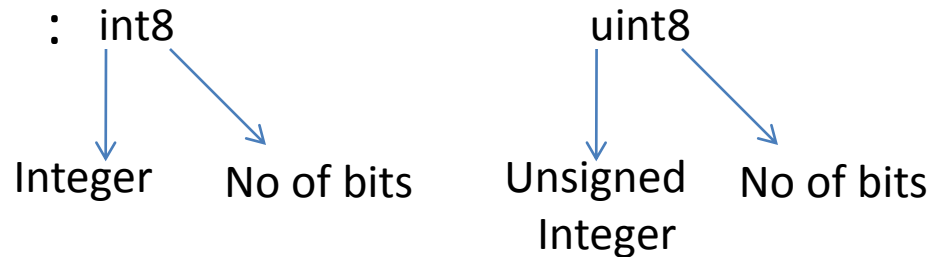
- **Note:**

- **Sparse:** Most of the element in the array are equal to zero, that is the array contains very few non zero elements. So it is not advisable to store all the elements. To reserve memory space and increase the computation speed, only non-zero elements and their indices are stored. Such format is called sparse.
- **Full:** All elements and their indices are stored.

Data Types cont...

- **Logical** : True or False i.e `>>a=40>50 =>a=0`
- **Char** : `>>a='hello'` or `a='Hello how are you'`
So char is a 1-by-n array of character

- **Numerical**



- Single means less space
Double means more space
Conversion- `>>x=890.47637`
`>>y=int8(x);` or `y=single(x)` or `y= double(x)`

Data Types cont...

- **Cell** : used for storing dissimilar kinds of data i.e.
 - >>A=[1 2 3 4]; matrix A
 - >>B=[2 3 1; 4 5 3; 5 7 3]; matrix B
 - >>C=zeros(2,3,3); C= Three zero matrix of 2x3 each
 - >>D_cell={A B C};

Accessing data

 - >>D_cell{1} => matrix A
- **Structure:** similar to cell but here data is stored in named field rather than cells. i.e.
 - >>abc.name='Ram Kumar Verma';
 - >>abc.age=20;
 - >>abc.sex='male';

Data Types cont...

- **Java Classes** :MATLAB provides interface to java programming language
- **Function Handle** :Handle to MATLAB function, see “feval” for evaluating of function

Constants & Variables

- **Constants:** Fixed value

- 1. Numeric constant:**

- i. Integer :234 -233 23563
- ii. Real :10.23419 0.0028938
- iii. Complex :3+j*5 -45+j*55.12 (i or j both valid)

Try it

```
>>x=56.4-j*33.67;
```

```
>>x_real=real(x);
```

```
>>x_imag=imag(x);
```

```
>>x_mag=abs(x) %magnitude of x
```

```
>>x_rad=angle(x) %angle of x
```

```
>>y=conj(x); %y=conjugate of x
```

Constants & Variables cont...

```
>>[theta, r]=cart2pol(x,y)
```

```
% cartesian coordinate x & y into polar coordinate  
theta & r, similarly reverse of it
```

```
>>[x, y]=pol2cart(theta,r)
```

2. Character constant:

- i. Single character constant: 'A', 'g', '1', ' '
- ii. String constant: 'Hello', '19738', 'How is 3G'
- iii. Space sequence constant: '\t' => tab, '\n' => new line

Constants & Variables cont...

- **Variables:**

- Variable starts with an alphabet followed by a number of alphabets or numerals or an underscore.
- Some valid variables names are name, x, sex, polynomial_degree, p12 etc.
- MATLAB does not require any variable or constant to be declared in advance at the start of a program.
- Variables can be defined at any step in the M-file by simply assigning values to them and the types of data assigned to the variable determines the type of variable.

```
>>x=22;      % x is an integer variable
```

```
>>y=45.67;  %y is a float variable.
```

Note: MATLAB is case sensitive, n & N are different variables

Constants & Variables cont...

Special constant & Variables:

pi : 3.14159

i or j : $\sqrt{-1}$

inf : ∞

NaN : Not a number

eps : Number small enough equivalent to zero

ans : Default output variable

nargin : Number of input arguments of a function

nargout : Number of output arguments of a function

realmax : Largest real number

Operators

1. Arithmetic operator: let $p=3$, $q=2$

Operator	Operation	Algebraic form	MATLAB form	Result
+	Addition	$p+q$	$p+q$	5
-	Subtraction	$p-q$	$P-q$	1
*	Multiplication	$p \times q$	$p * q$	6
/	Division	p/q	p/q	1.5
\	Division	$p \backslash q$	$p \backslash q$	0.6667
^	Exponentiation	p^q	p^q	9

Operators cont...

Operator	Operation	Algebraic form	MATLAB form	Result
.*	Element by element multiplication	$p \times q$	$p.*q$	6
./	Element by element right division	p/q	$p./q$	1.5
.\	Element by element left division	$p \backslash q$	$p.\backslash q$	0.6667
.^	Element by element exponentiation	p^q	$p.^q$	9

Example: Repeat above with $p=[1 \ 2; 3 \ 4]$ & $q=[1 \ 2; 3 \ 4]$ & check the results

Operators cont...

2. Relational operator

comparison operator	meaning
<code>==</code>	is equal to
<code>!=</code>	is not equal to
<code><</code>	is less than
<code><=</code>	is less than or equal to
<code>></code>	is greater than
<code>>=</code>	is greater than or equal to

Operators for logical comparisons

Operators cont...

3. Logical operator:

Logical Operator	Description
&	AND
	OR
~	NOT

Operator	Description
xor(x,y)	Exclusive OR operation. Returns ones where either x or y is nonzero (True). Returns zeros if both x and y are zero (False) or nonzero (True)
any(x)	Return one if any element of the vector x is nonzero. Return one for each column in a matrix x that has nonzero elements.
all(x)	Return one if all elements are nonzero

Hierarchy of operations

- Order in which the arithmetic operations are executed, and the hierarchy is
 1. Parentheses starting from innermost
 2. Transpose, Power
 3. Unary + (+A), Unary - (-A), Logical NOT (~)
 4. Multiplication, Division
 5. Addition, subtraction
 6. Colon operator (:)
 7. Relational operators (<, <= etc)
 8. Logical AND (&)
 9. Logical OR (|)

Hierarchy of operations cont...

- Example: if $i=2, j=3, k=4$ & $l=5$, evaluate
 - i. $i*j+k*l$
 - ii. $i*(j+k)*l$
 - iii. $(i*j)+(k/l)$
 - iv. $(i+j)*i^j$

Built-in function

- `>>x=15.5,y=2.45,z=4.5`

- `>>a=log(sqrt(x/(y*z)))`

`a =`

`0.1703`

- Here `log` \Rightarrow $\log_e()$ & `sqrt()` are two built in functions.

- Syntax of built in function

`function_name(variable_name or expression)`

Built-in function

- sin - Sine in radian
- sind - Sine in degree
- sinh - Hyperbolic sine.
- asin - Inverse sine.
- asinh - Inverse hyperbolic sine.
- exp - Exponential.
- log - Natural logarithm.
- log10 - Common (base 10) logarithm.
- rand - to generate random numbers.
- sqrt - Square root.
- fix - Round towards zero.
- floor - Round towards minus infinity.
- ceil - Round towards plus infinity.
- round - Round towards nearest integer.
- mod - Modulus (signed remainder after division).
- rem - Remainder after division.
- Etc..... a lots of functions are available

List of some commands

- Abs :Returns absolute number. In case of complex no returns magnitude
- Any :Returns True if any element of vector is non zero
- Angle :Returns phase angle in radians
- All :Returns true if all element of vector are non-zero
- Atan2 :Give tangent inverse
- Cart2pol:Convert cartesian to polar coordinates
- Pol2cart :Converts polar to cartesian coordinates
- Conj :Gives conjugate of a complex number
- Factorial :Gives factorial of a number
- Imag :Returns imaginary part of a complex number
- Real :Return real part of complex number
- Etc.....

Questions?

