

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



مبانی بینایی کامپیوتری

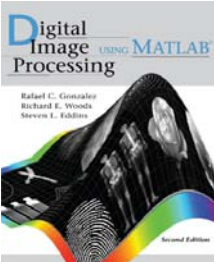
درس ۲ ب

مقدمه: متلب

Introduction: MATLAB®

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<http://courses.fouladi.ir/fcvision>



Chapter 1 Introduction

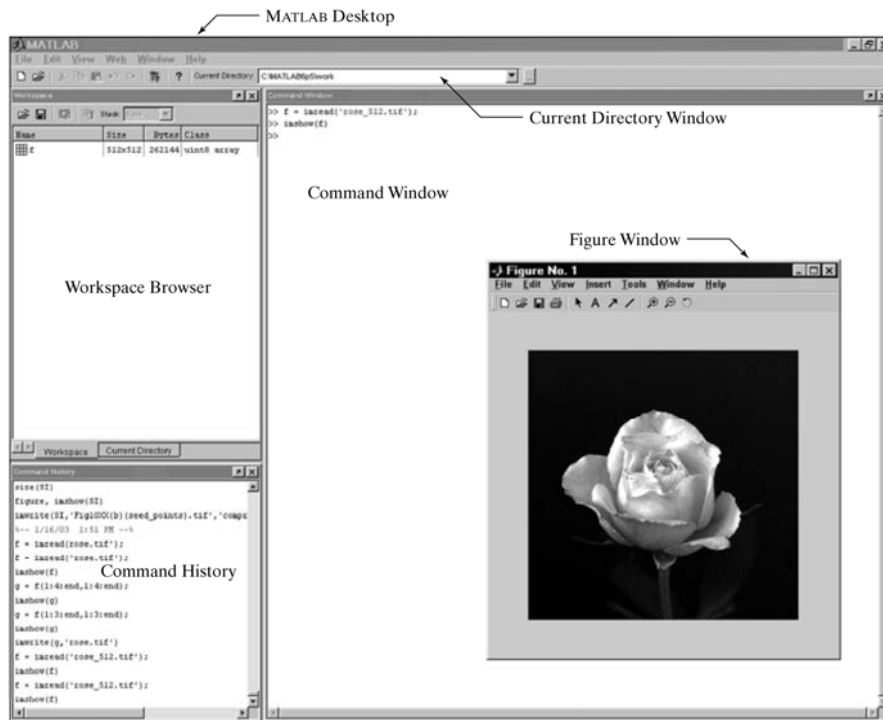


FIGURE 1.1 The MATLAB desktop and its principal components.

Chapter 1

Introduction

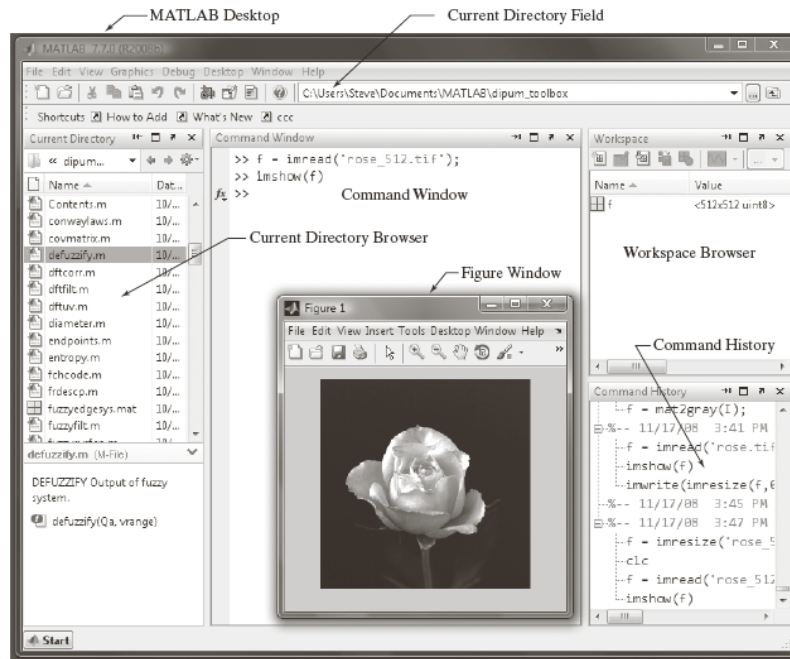
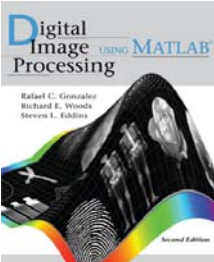


FIGURE 1.1 The MATLAB Desktop with its typical components.



Chapter 1 Introduction

Name	Description
double	Double-precision, floating-point numbers in the approximate range $\pm 10^{308}$ (8 bytes per element).
single	Single-precision floating-point numbers with values in the approximate range $\pm 10^{38}$ (4 bytes per element).
uint8	Unsigned 8-bit integers in the range [0, 255] (1 byte per element).
uint16	Unsigned 16-bit integers in the range [0, 65535] (2 bytes per element).
uint32	Unsigned 32-bit integers in the range [0, 4294967295] (4 bytes per element).
int8	Signed 8-bit integers in the range [-128, 127] (1 byte per element).
int16	Signed 16-bit integers in the range [-32768, 32767] (2 bytes per element).
int32	Signed 32-bit integers in the range [-2147483648, 2147483647] (4 bytes per element).
char	Characters (2 bytes per element).
logical	Values are 0 or 1 (1 byte per element).

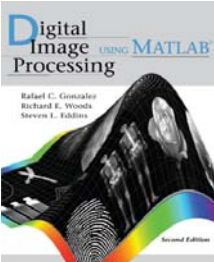
TABLE 1.1

Classes used for image processing in MATLAB. The first eight entries are referred to as *numeric* classes, the ninth entry is the *char* class, and the last entry is the *logical* class. MATLAB also supports **uint64** and **int64**, but the toolbox does not.

کلاس‌های داده در MATLAB

Name	Description
double	Double-precision, floating-point numbers in the approximate range -10^{308} to 10^{308} (8 bytes per element).
uint8	Unsigned 8-bit integers in the range [0, 255] (1 byte per element).
uint16	Unsigned 16-bit integers in the range [0, 65535] (2 bytes per element).
uint32	Unsigned 32-bit integers in the range [0, 4294967295] (4 bytes per element).
int8	Signed 8-bit integers in the range [-128, 127] (1 byte per element).
int16	Signed 16-bit integers in the range [-32768, 32767] (2 bytes per element).
int32	Signed 32-bit integers in the range [-2147483648, 2147483647] (4 bytes per element).
single	Single-precision floating-point numbers with values in the approximate range -10^{38} to 10^{38} (4 bytes per element).
char	Characters (2 bytes per element).
logical	Values are 0 or 1 (1 byte per element).

Data classes. The first eight entries are referred to as *numeric* classes; the ninth entry is the *character* class, and the last entry is of class *logical*.



Chapter 2 Fundamentals

TABLE 1.2 Array and matrix arithmetic operators. Characters *a* and *b* are scalars.

Operator	Name	Comments and Examples
+	Array and matrix addition	$a + b, A + B$, or $a + A$.
-	Array and matrix subtraction	$a - b, A - B, A - a$, or $a - A$.
.*	Array multiplication	$C = A .* B$, $C(I, J) = A(I, J) * B(I, J)$.
*	Matrix multiplication	$A * B$, standard matrix multiplication, or $a * A$, multiplication of a scalar times all elements of A .
./	Array right division [†]	$C = A ./ B$, $C(I, J) = A(I, J) / B(I, J)$.
.\	Array left division [†]	$C = A .\ B$, $C(I, J) = B(I, J) / A(I, J)$.
/	Matrix right division	A / B is the preferred way to compute $A * \text{inv}(B)$.
\	Matrix left division	$A \backslash B$ is the preferred way to compute $\text{inv}(A) * B$.
.^	Array power	If $C = A.^B$, then $C(I, J) = A(I, J)^B(I, J)$.
^	Matrix power	See <code>help</code> for a discussion of this operator.
.'	Vector and matrix transpose	A' , standard vector and matrix transpose.
'	Vector and matrix complex conjugate transpose	A' , standard vector and matrix conjugate transpose. When A is real $A' = A'$.
+	Unary plus	$+A$ is the same as $0 + A$.
-	Unary minus	$-A$ is the same as $0 - A$ or $-1 * A$.
:	Colon	Discussed later in the section.

[†] In division, if the denominator is 0, MATLAB reports the result as `Inf` (denoting infinity). If both the numerator and denominator are 0, the result is reported as `NaN` (Not a Number).

عملگرهای حسابی آرایه‌ای و ماتریسی در MATLAB

۱ از ۲

Operator	Name	MATLAB Function	Comments and Examples
+	Array and matrix addition	<code>plus(A, B)</code>	$a + b, A + B, \text{ or } a + A.$
-	Array and matrix subtraction	<code>minus(A, B)</code>	$a - b, A - B, A - a, \text{ or } a - A.$
.*	Array multiplication	<code>times(A, B)</code>	$C = A .* B, C(I, J) = A(I, J) * B(I, J).$
*	Matrix multiplication	<code>mtimes(A, B)</code>	$A * B$, standard matrix multiplication, or $a * A$, multiplication of a scalar times all elements of A .
./	Array right division	<code>rdivide(A, B)</code>	$C = A ./ B, C(I, J) = A(I, J) / B(I, J).$
.\	Array left division	<code>ldivide(A, B)</code>	$C = A .\ B, C(I, J) = B(I, J) / A(I, J).$
/	Matrix right division	<code>mrdivide(A, B)</code>	A/B is roughly the same as $A * \text{inv}(B)$, depending on computational accuracy.
\	Matrix left division	<code>mldivide(A, B)</code>	$A \backslash B$ is roughly the same as $\text{inv}(A) * B$, depending

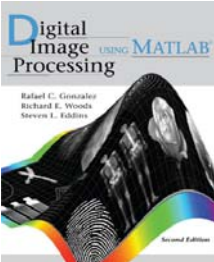
Array and matrix arithmetic operators. Computations involving these operators can be implemented using the operators themselves, as in $A + B$, or using the MATLAB functions shown, as in `plus(A, B)`. The examples shown for arrays use matrices to simplify the notation, but they are easily extendable to higher dimensions.

عملگرهای حسابی آرایه‌ای و ماتریسی در MATLAB

۲ از ۲

Operator	Name	MATLAB Function	Comments and Examples
.^	Array power	power(A, B)	If $C = A.^B$, then $C(I, J) = A(I, J)^B(I, J)$.
^	Matrix power	mpower(A, B)	See online help for a discussion of this operator.
.'	Vector and matrix transpose	transpose(A)	$A.'$. Standard vector and matrix transpose.
'	Vector and matrix complex conjugate transpose	ctranspose(A)	A' . Standard vector and matrix conjugate transpose. When A is real $A.' = A'$.
+	Unary plus	uplus(A)	$+A$ is the same as $0 + A$.
-	Unary minus	uminus(A)	$-A$ is the same as $0 - A$ or $-1 * A$.
:	Colon		Discussed in Section 2.8.

Array and matrix arithmetic operators. Computations involving these operators can be implemented using the operators themselves, as in $A + B$, or using the MATLAB functions shown, as in `plus(A, B)`. The examples shown for arrays use matrices to simplify the notation, but they are easily extendable to higher dimensions.



Chapter 2 Fundamentals

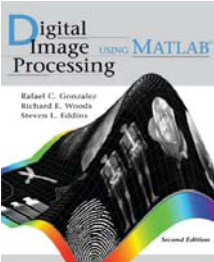
TABLE 1.3
Relational
operators.

Operator	Name
<	Less than
<=	Less than or equal to
>	Greater than
>=	Greater than or equal to
==	Equal to
~=	Not equal to

عملگرهای رابطه‌ای در MATLAB

Operator	Name
<	Less than
<=	Less than or equal to
>	Greater than
>=	Greater than or equal to
==	Equal to
~=	Not equal to

Relational operators.



Chapter 2 Fundamentals

Operator	Description
&	Elementwise AND
	Elementwise OR
~	Elementwise and scalar NOT
&&	Scalar AND
	Scalar OR

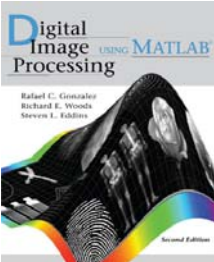
TABLE 1.4

Logical operators.

عملگرهای منطقی در MATLAB

Operator	Name
&	AND
	OR
~	NOT

Logical operators.



Chapter 2 Fundamentals

Function	Comments
xor (exclusive OR)	The xor function returns a 1 only if both operands are <i>logically different</i> ; otherwise xor returns a 0.
all	The all function returns a 1 if all the elements in a vector are nonzero; otherwise all returns a 0. This function operates columnwise on matrices.
any	The any function returns a 1 if any of the elements in a vector is nonzero; otherwise any returns a 0. This function operates columnwise on matrices.

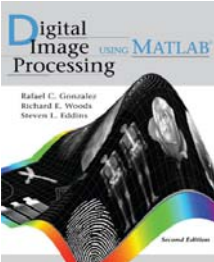
TABLE 2.8

Logical functions.

توابع منطقی در MATLAB

Function	Comments
xor (exclusive OR)	The xor function returns a 1 only if both operands are <i>logically different</i> ; otherwise <i>xor</i> returns a 0.
all	The all function returns a 1 if all the elements in a vector are nonzero; otherwise all returns a 0. This function operates columnwise on matrices.
any	The any function returns a 1 if any of the elements in a vector is nonzero; otherwise any returns a 0. This function operates columnwise on matrices.

Logical functions.



Chapter 2 Fundamentals

Function	Description
<code>iscell(C)</code>	True if <code>C</code> is a cell array.
<code>iscellstr(s)</code>	True if <code>s</code> is a cell array of strings.
<code>ischar(s)</code>	True if <code>s</code> is a character string.
<code>isempty(A)</code>	True if <code>A</code> is the empty array, <code>[]</code> .
<code>isequal(A, B)</code>	True if <code>A</code> and <code>B</code> have identical elements and dimensions.
<code>isfield(S, 'name')</code>	True if <code>'name'</code> is a field of structure <code>S</code> .
<code>isfinite(A)</code>	True in the locations of array <code>A</code> that are finite.
<code>isinf(A)</code>	True in the locations of array <code>A</code> that are infinite.
<code>isletter(A)</code>	True in the locations of <code>A</code> that are letters of the alphabet.
<code>islogical(A)</code>	True if <code>A</code> is a logical array.
<code>ismember(A, B)</code>	True in locations where elements of <code>A</code> are also in <code>B</code> .
<code>isnan(A)</code>	True in the locations of <code>A</code> that are NaNs (see Table 2.10 for a definition of NaN).
<code>isnumeric(A)</code>	True if <code>A</code> is a numeric array.
<code>isprime(A)</code>	True in locations of <code>A</code> that are prime numbers.
<code>isreal(A)</code>	True if the elements of <code>A</code> have no imaginary parts.
<code>isspace(A)</code>	True at locations where the elements of <code>A</code> are whitespace characters.
<code>issparse(A)</code>	True if <code>A</code> is a sparse matrix.
<code>isstruct(S)</code>	True if <code>S</code> is a structure.

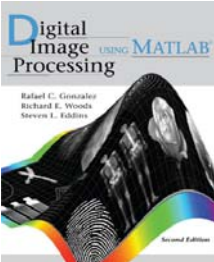
TABLE 2.9

Some functions that return a logical 1 or a logical 0 depending on whether the value or condition in their arguments are true or false. See online help for a complete list.

برخی توابع منطقی در MATLAB

Function	Description
<code>iscell(C)</code>	True if <code>C</code> is a cell array.
<code>iscellstr(s)</code>	True if <code>s</code> is a cell array of strings.
<code>ischar(s)</code>	True if <code>s</code> is a character string.
<code>isempty(A)</code>	True if <code>A</code> is the empty array, <code>[]</code> .
<code>isequal(A, B)</code>	True if <code>A</code> and <code>B</code> have identical elements and dimensions.
<code>isfield(S, 'name')</code>	True if 'name' is a field of structure <code>S</code> .
<code>isfinite(A)</code>	True in the locations of array <code>A</code> that are finite.
<code>isinf(A)</code>	True in the locations of array <code>A</code> that are infinite.
<code>isletter(A)</code>	True in the locations of <code>A</code> that are letters of the alphabet.
<code>islogical(A)</code>	True if <code>A</code> is a logical array.
<code>ismember(A, B)</code>	True in locations where elements of <code>A</code> are also in <code>B</code> .
<code>isnan(A)</code>	True in the locations of <code>A</code> that are NaNs (see Table 2.10 for a definition of NaN).
<code>isnumeric(A)</code>	True if <code>A</code> is a numeric array.
<code>isprime(A)</code>	True in locations of <code>A</code> that are prime numbers.
<code>isreal(A)</code>	True if the elements of <code>A</code> have no imaginary parts.
<code>isspace(A)</code>	True at locations where the elements of <code>A</code> are whitespace characters.
<code>issparse(A)</code>	True if <code>A</code> is a sparse matrix.
<code>isstruct(S)</code>	True if <code>S</code> is a structure.

Some functions that return a logical 1 or a logical 0 depending on whether the value or condition in their arguments are true or false. See online help for a complete list.



Chapter 2 Fundamentals

Function	Value Returned
ans	Most recent answer (variable). If no output variable is assigned to an expression, MATLAB automatically stores the result in ans.
eps	Floating-point relative accuracy. This is the distance between 1.0 and the next largest number representable using double-precision floating point.
i (or j)	Imaginary unit, as in $1 + 2i$.
NaN or nan	Stands for Not-a-Number (e.g., $0/0$).
pi	3.14159265358979
realmax	The largest floating-point number that your computer can represent.
realmin	The smallest floating-point number that your computer can represent.
computer	Your computer type.
version	MATLAB version string.

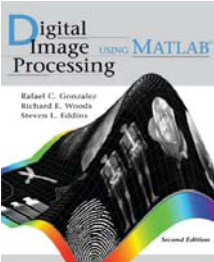
TABLE 2.10

Some important variables and constants.

برخی متغیرها و ثابت‌های مهم در MATLAB

Function	Value Returned
ans	Most recent answer (variable). If no output variable is assigned to an expression, MATLAB automatically stores the result in ans.
eps	Floating-point relative accuracy. This is the distance between 1.0 and the next largest number representable using double-precision floating point.
i (or j)	Imaginary unit, as in $1 + 2i$.
NaN or nan	Stands for Not-a-Number (e.g., $0/0$).
pi	3.14159265358979
realmax	The largest floating-point number that your computer can represent.
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Some important variables and constants.



Chapter 2 Fundamentals

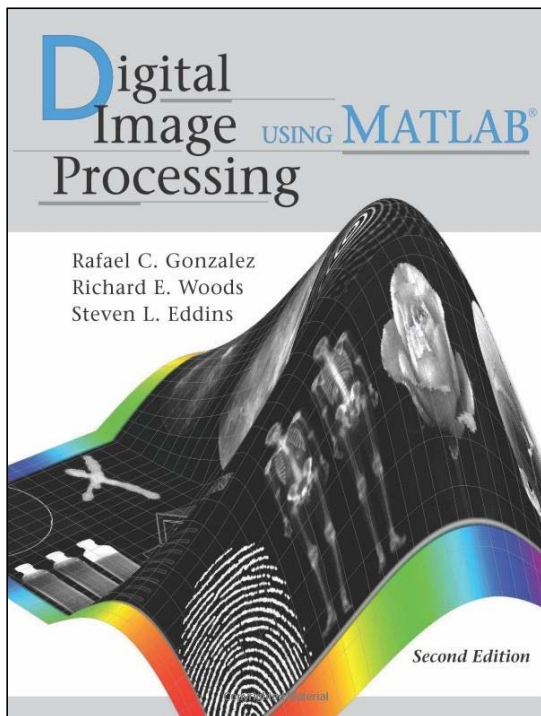
Statement	Description
<code>if</code>	<code>if</code> , together with <code>else</code> and <code>elseif</code> , executes a group of statements based on a specified logical condition.
<code>for</code>	Executes a group of statements a fixed (specified) number of times.
<code>while</code>	Executes a group of statements an indefinite number of times, based on a specified logical condition.
<code>break</code>	Terminates execution of a <code>for</code> or <code>while</code> loop.
<code>continue</code>	Passes control to the next iteration of a <code>for</code> or <code>while</code> loop, skipping any remaining statements in the body of the loop.
<code>switch</code>	<code>switch</code> , together with <code>case</code> and <code>otherwise</code> , executes different groups of statements, depending on a specified value or string.
<code>return</code>	Causes execution to return to the invoking function.
<code>try...catch</code>	Changes flow control if an error is detected during execution.

TABLE 2.11

Flow control statements.

دستورهای کنترل جریان در MATLAB

Statement	Description
if	if, together with else and elseif, executes a group of statements based on a specified logical condition.
for	Executes a group of statements a fixed (specified) number of times.
while	Executes a group of statements an indefinite number of times, based on a specified logical condition.
break	Terminates execution of a for or while loop.
continue	Passes control to the next iteration of a for or while loop, skipping any remaining statements in the body of the loop.
switch	switch, together with case and otherwise, executes different groups of statements, depending on a specified value or string.
return	Causes execution to return to the invoking function.
try...catch	Changes flow control if an error is detected during execution.



Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins,
Digital Image Processing Using MATLAB®,
Second Edition, Pearson Prentice Hall, 2008.
Chapters 1, 2