

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



مبانی بینایی کامپیوتری

درس ۱۱ ب

بازشناسی اشیاء در متلب

Object Recognition in MATLAB®

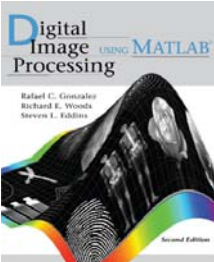
کاظم فولادی قلعه
دانشکده مهندسی، پردیس فارابی
دانشگاه تهران

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

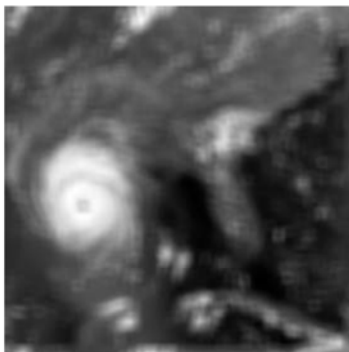
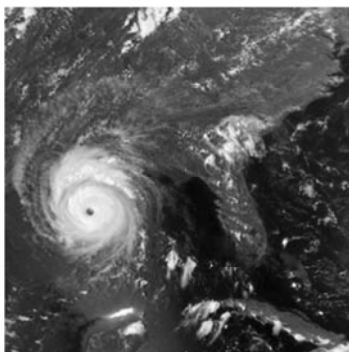
تطبیق با استفاده از همبستگی

تابع محاسبه‌ی ضریب همبستگی

$$g = \text{normxcorr2}(\text{template}, f)$$



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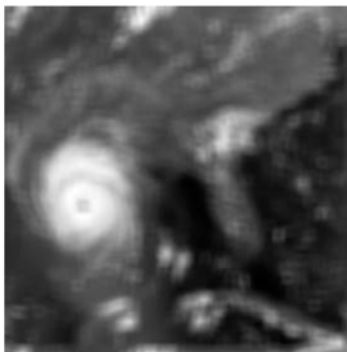
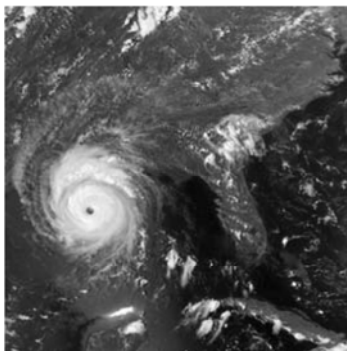
a b
c d

FIGURE 12.1

(a) Multispectral image of Hurricane Andrew.
(b) Template.
(c) Correlation of image and template.
(d) Location of the best match.
(Original image courtesy of NOAA.)

تطبیق با استفاده از همبستگی

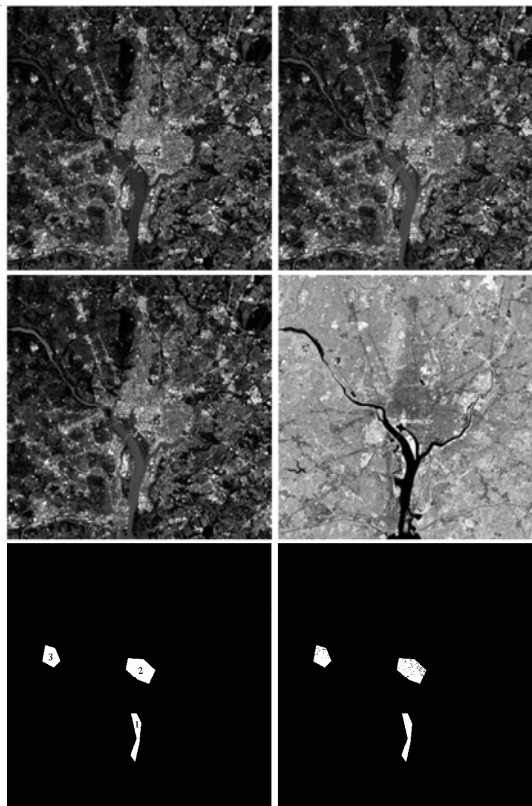
مثال



a	b
c	d

- (a) Multispectral image of Hurricane Andrew.
- (b) Template.
- (c) Correlation of image and template.
- (d) Location of the best match.

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a b
c d
e f

FIGURE 12.2

Bayes classification of multispectral data.

(a)–(c) Images in the blue, green, and red visible wavelengths.

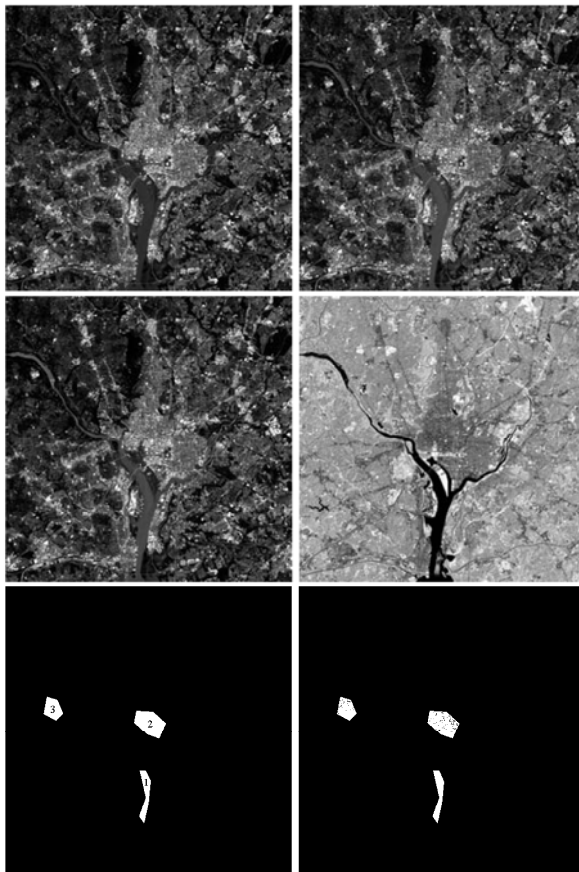
(d) Infrared image. (e) Mask showing sample regions of water (1), urban development (2), and vegetation (3). (f) Results of classification.

The black dots denote points classified incorrectly. The other (white) points in the regions were classified correctly.

(Original images courtesy of NASA.)

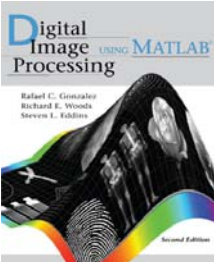
طبقه‌بندی‌کننده‌های آماری بهینه

مثال (۱ از ۲)



a	b
c	d
e	f

Bayes classification of multispectral data. (a)–(c) Images in the blue, green, and red visible wavelengths. (d) Infrared image. (e) Mask showing sample regions of water (1), urban development (2), and vegetation (3). (f) Results of classification. The black dots denote points classified incorrectly. The other (white) points in the regions were classified correctly.



Chapter 13 Object Recognition

TABLE 12.1 Bayes classification of multispectral image data.

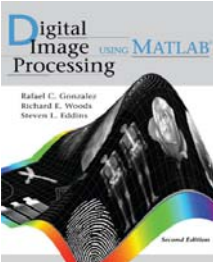
Training Patterns						Independent Patterns					
Class	No. of Samples	Classified into Class			% Correct	Class	No. of Samples	Classified into Class			% Correct
		1	2	3				1	2	3	
1	484	482	2	0	99.6	1	483	478	3	2	98.9
2	933	0	885	48	94.9	2	932	0	880	52	94.4
3	483	0	19	464	96.1	3	482	0	16	466	96.7

طبقه‌بندی‌کننده‌های آماری بهینه

مثال (۲ از ۲)

TABLE 12.1 Bayes classification of multispectral image data.

Training Patterns						Independent Patterns					
Class	No. of Samples	Classified into Class			% Correct	Class	No. of Samples	Classified into Class			% Correct
		1	2	3				1	2	3	
1	484	482	2	0	99.6	1	483	478	3	2	98.9
2	933	0	885	48	94.9	2	932	0	880	52	94.4
3	483	0	19	464	96.1	3	482	0	16	466	96.7



Digital Image Processing Using MATLAB® 2nd edition

TABLE 12.2
MATLAB's
string-
manipulation
functions.

Category	Function Name	Explanation
General	<code>blanks</code>	String of blanks.
	<code>cellstr</code>	Create cell array of strings from character array. Use function <code>char</code> to convert back to a character string.
	<code>char</code>	Create character array (string).
String tests	<code>deblank</code>	Remove trailing blanks.
	<code>eval</code>	Execute string with MATLAB expression.
	<code>iscellstr</code>	True for cell array of strings.
	<code>ischar</code>	True for character array.
	<code>isletter</code>	True for letters of the alphabet.
String operations	<code>isspace</code>	True for whitespace characters.
	<code>lower</code>	Convert string to lowercase.
	<code>regex</code>	Match regular expression.
	<code>regexpi</code>	Match regular expression, ignoring case.
	<code>regexprep</code>	Replace string using regular expression.
	<code>strcat</code>	Concatenate strings.
	<code>strcmp</code>	Compare strings (see Section 2.10.5).
	<code>strcmpi</code>	Compare strings, ignoring case.
	<code>strfind</code>	Find one string within another.
	<code>strjust</code>	Justify string.
	<code>strmatch</code>	Find matches for string.
	<code>strncmp</code>	Compare first n characters of strings.
	<code>strncmpi</code>	Compare first n characters, ignoring case.
	<code>strread</code>	Read formatted data from a string. See Section 2.10.5 for a detailed explanation.
	<code>strrep</code>	Replace a string within another.
	<code>strtok</code>	Find token in string.
	<code>strvcat</code>	Concatenate strings vertically.
	<code>upper</code>	Convert string to uppercase.
String to number conversion	<code>double</code>	Convert string to numeric codes.
	<code>int2str</code>	Convert integer to string.
	<code>mat2str</code>	Convert matrix to a string suitable for processing with the <code>eval</code> function.
	<code>num2str</code>	Convert number to string.
	<code>sprintf</code>	Write formatted data to string.
	<code>str2double</code>	Convert string to double-precision value.
	<code>str2num</code>	Convert string to number (see Section 2.10.5).
Base number conversion	<code>sscanf</code>	Read string under format control.
	<code>base2dec</code>	Convert base B string to decimal integer.
	<code>bin2dec</code>	Convert binary string to decimal integer.
	<code>dec2base</code>	Convert decimal integer to base B string.
	<code>dec2bin</code>	Convert decimal integer to binary string.
	<code>dec2hex</code>	Convert decimal integer to hexadecimal string.
	<code>hex2dec</code>	Convert hexadecimal string to decimal integer.
	<code>hex2num</code>	Convert IEEE hexadecimal to double-precision number.

توابع کار با رشته‌ها در متلب

Category	Function Name	Explanation
General	blanks	String of blanks.
	cellstr	Create cell array of strings from character array. Use function char to convert back to a character string.
	char	Create character array (string).
	deblank	Remove trailing blanks.
String tests	eval	Execute string with MATLAB expression.
	iscellstr	True for cell array of strings.
	ischar	True for character array.
	isletter	True for letters of the alphabet.
String operations	isspace	True for whitespace characters.
	lower	Convert string to lowercase.
	regexp	Match regular expression.
	regexpi	Match regular expression, ignoring case.
	regexprep	Replace string using regular expression.
	strcat	Concatenate strings.
	strcmp	Compare strings (see Section 2.10.5).
	strcmpi	Compare strings, ignoring case.
	strfind	Find one string within another.
	strjust	Justify string.
	strmatch	Find matches for string.

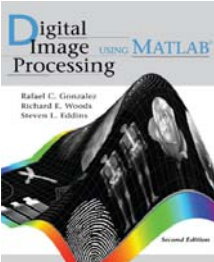
توابع کار با رشته‌ها در متلب

**String to number
conversion**

strncmp	Compare first n characters of strings.
strncmpi	Compare first n characters, ignoring case.
strread	Read formatted data from a string. See Section 2.10.5 for a detailed explanation.
strrep	Replace a string within another.
strtok	Find token in string.
strvcat	Concatenate strings vertically.
upper	Convert string to uppercase.
double	Convert string to numeric codes.
int2str	Convert integer to string.
mat2str	Convert matrix to a string suitable for processing with the eval function.

**Base number
conversion**

num2str	Convert number to string.
sprintf	Write formatted data to string.
str2double	Convert string to double-precision value.
str2num	Convert string to number (see Section 2.10.5).
sscanf	Read string under format control.
base2dec	Convert base B string to decimal integer.
bin2dec	Convert binary string to decimal integer.
dec2base	Convert decimal integer to base B string.
dec2bin	Convert decimal integer to binary string.
dec2hex	Convert decimal integer to hexadecimal string.
hex2dec	Convert hexadecimal string to decimal integer.
hex2num	Convert IEEE hexadecimal to double-precision number.



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Metacharacters	Usage
.	Matches any one character.
[ab . . .]	Matches any one of the characters, (a, b, . . .), contained within the brackets.
[^ab . . .]	Matches any character except those contained within the brackets.
?	Matches any character zero or one times.
*	Matches the preceding element zero or more times.
+	Matches the preceding element one or more times.
{num}	Matches the preceding element num times.
{min, max}	Matches the preceding element at least min times, but not more than max times.
	Matches either the expression preceding or following the metacharacter .
^chars	Matches when a string begins with chars.
chars\$	Matches when a string ends with chars.
\<chars	Matches when a word begins with chars.
chars\>	Matches when a word ends with chars.
\<word\>	Exact word match.

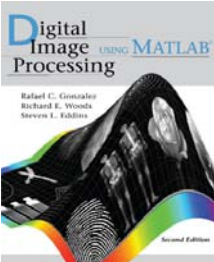
TABLE 12.3

Some of the metacharacters used in regular expressions for matching. See the regular expressions help page for a complete list.

عبارت‌های منظم در متلب

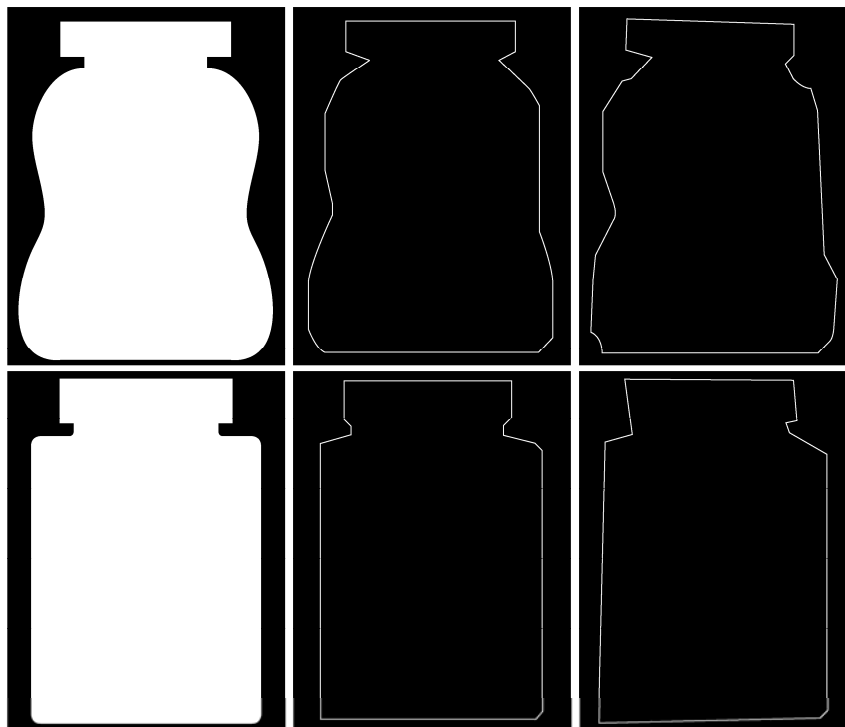
Metacharacters	Usage
.	Matches any one character.
[ab . . .]	Matches any one of the characters, (a, b, . . .), contained within the brackets.
[^ab . . .]	Matches any character except those contained within the brackets.
?	Matches any character zero or one times.
*	Matches the preceding element zero or more times.
+	Matches the preceding element one or more times.
{num}	Matches the preceding element num times.
{min, max}	Matches the preceding element at least min times, but not more than max times.
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^chars	Matches when a string begins with chars.
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\<chars	Matches when a word begins with chars.
chars\>	Matches when a word ends with chars.
\<word\>	Exact word match.

Some of the metacharacters used in regular expressions for matching. See the regular expressions help page for a complete list.



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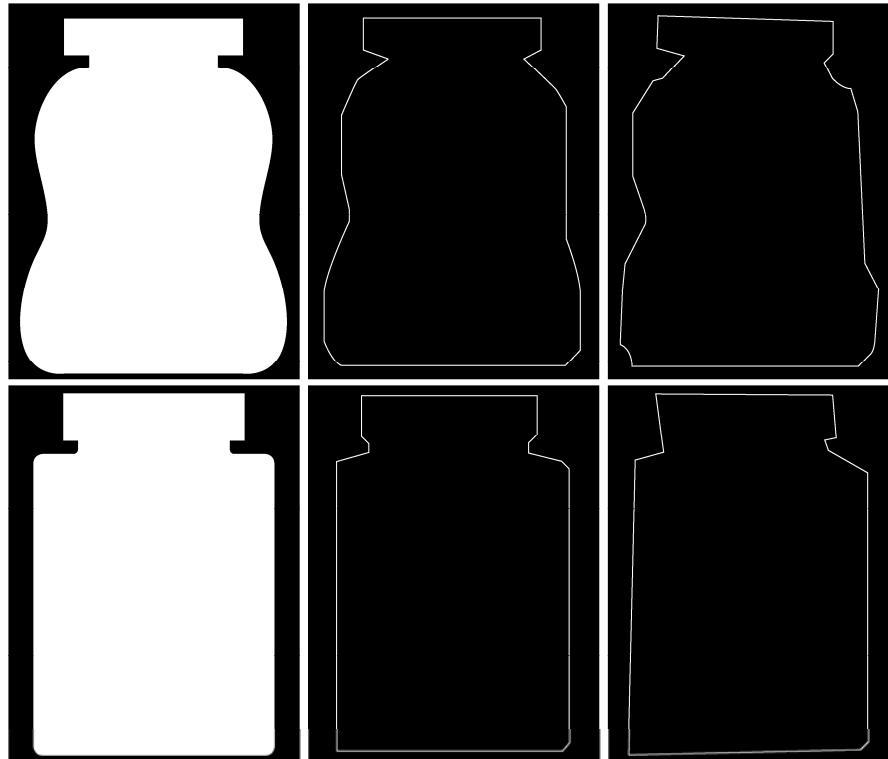


a b c
d e f

FIGURE 12.3 (a) An object. (b) Its minimum perimeter polygon obtained using function `minperpoly` with a cell size of 8. (c) A typical noisy boundary. (d)–(f) The same sequence for another object.

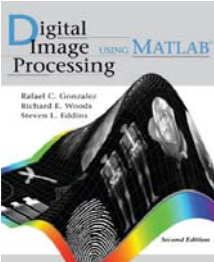
بازشناسی شیء با تطابق رشته

مثال (۱ از ۲)



a b c
d e f

FIGURE (a) An object. (b) Its minimum perimeter polygon obtained using function `minperpoly` with a cell size of 8. (c) A typical noisy boundary. (d)–(f) The same sequence for another object.



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R	s_{11}	s_{12}	s_{13}	s_{14}	s_{15}
s_{11}	Inf				
s_{12}	9.33	Inf			
s_{13}	26.25	12.31	Inf		
s_{14}	16.36	9.33	14.16	Inf	
s_{15}	22.22	14.17	14.01	19.02	Inf

TABLE 12.4

Values of similarity measure, R , between the strings of class 1. (All values shown are $\times 10$.)

R	s_{21}	s_{22}	s_{23}	s_{24}	s_{25}
s_{21}	Inf				
s_{22}	10.00	Inf			
s_{23}	13.33	13.33	Inf		
s_{24}	7.50	13.31	18.00	Inf	
s_{25}	13.33	7.51	18.12	10.01	Inf

TABLE 12.5

Values of similarity measure, R , between the strings of class 2. (All values shown are $\times 10$.)

R	s_{11}	s_{12}	s_{13}	s_{14}	s_{15}
s_{21}	2.03	0.01	1.15	1.17	0.75
s_{22}	1.15	1.61	1.16	0.75	2.07
s_{23}	2.08	1.15	2.08	2.06	2.08
s_{24}	1.60	1.62	1.59	1.14	2.61
s_{25}	1.61	0.36	0.74	1.60	1.16

TABLE 12.6

Values of similarity measure, R , between the strings of classes 1 and 2. (All values shown are $\times 10$.)

بازشناسی شیئی با تطابق رشته

مثال (۲ از ۲)

R	s_{11}	s_{12}	s_{13}	s_{14}	s_{15}
s_{11}	Inf				
s_{12}	9.33	Inf			
s_{13}	26.25	12.31	Inf		
s_{14}	16.36	9.33	14.16	Inf	
s_{15}	22.22	14.17	14.01	19.02	Inf

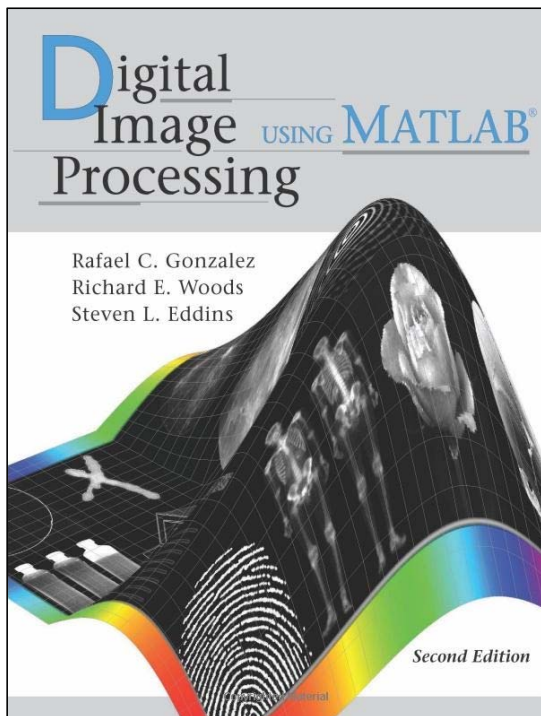
Values of similarity measure, R , between the strings of class 1. (All values shown are $\times 10$.)

R	s_{21}	s_{22}	s_{23}	s_{24}	s_{25}
s_{21}	Inf				
s_{22}	10.00	Inf			
s_{23}	13.33	13.33	Inf		
s_{24}	7.50	13.31	18.00	Inf	
s_{25}	13.33	7.51	18.12	10.01	Inf

Values of similarity measure, R , between the strings of class 2. (All values shown are $\times 10$.)

R	s_{11}	s_{12}	s_{13}	s_{14}	s_{15}
s_{21}	2.03	0.01	1.15	1.17	0.75
s_{22}	1.15	1.61	1.16	0.75	2.07
s_{23}	2.08	1.15	2.08	2.06	2.08
s_{24}	1.60	1.62	1.59	1.14	2.61
s_{25}	1.61	0.36	0.74	1.60	1.16

Values of similarity measure, R , between the strings of classes 1 and 2. (All values shown are $\times 10$.)



Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins,
Digital Image Processing Using MATLAB[®],
Second Edition, Pearson Prentice Hall, 2008.
Chapter 13