

Introduction to Scientific and Engineering Computing, BIL108E

INTRODUCTION TO SCIENTIFIC & ENGINEERING COMPUTING BIL 108E, CRN24023

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Tentative Course Schedule, CRN 24023

ntroduction o Scientific and Engineering Computing,			
BIL108E	Week	Date	Topics
Karaman	1	Feb. 08	Introduction to Scientific and Engineering Computing
Naraman	2	Feb. 15	Introduction to Program Computing Environment
	3	Feb. 22	Variables, Operations and Simple Plot
	4	Mar. 01	Algorithms and Logic Operators
	5	Mar. 08	Flow Control, Errors and Source of Errors
	6	Mar. 15	Functions
	6	Mar. 20	Exam 1
	7	Mar. 22	Arrays
	8	Mar. 29	Solving of Simple Equations
	9	Apr. 05	Polynomials Examples
	10	Apr. 12	Applications of Curve Fitting
	11	Apr. 19	Applications of Interpolation
	11	Apr. 24	Exam 2
	12	Apr. 26	Applications of Numerical Integration
	13	May 03	Symbolic Mathematics
	14	May 10	Ordinary Differential Equation (ODE) Solutions with Built-in Functions

LECTURE # 6

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LECTURE # 6 LINEAR ALGEBRA **1** INNER PRODUCT OF VECTORS **2** OUTER PRODUCT OF VECTORS **3** MATRIX DEFINITION MATRIX OPERATIONS SQUARE MATRIX

- TRANSPOZE OF A MATRIX
- SYMMETRIC MATRIX
- IDENTITY MATRIX
- INVERSE MATRIX
- EXAMPLES
- **4** LINEAR EQUATIONS
- **5** SOLUTIONS
- **6** EXAMPLES



VECTORS

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VECTORS

A vector is an ordered list of numbers (one-dimensional). In MATLAB they can be represented as a row-vector or a column-vector $(1 \times n)$ or $(n \times 1)$.



VECTOR INNER PRODUCT

VECTOR INNER PRODUCT

In physics, analytical geometry, and engineering, the dot product has a geometric interpretation.
 a·b = a₁ b₁ + a₂ b₂ + ... + a_n b_n

$$c = dot(a, b)$$

- Returns the scalar product of the vectors a and b.
- a and b must be vectors of the same length.
- When a and b are both column vectors, dot(a,b) is the same as a * b'.



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VECTOR INNER PRODUCT

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VECTOR INNER PRODUCT

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VECTOR INNER PRODUCT

- The rules of linear algebra impose compatibility requirements on the inner product.
- The inner product of x and y requires that x be a row vector y be a column vector.

$$a = \begin{bmatrix} x_1 & x_2 & \dots & x_n \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ \dots \\ y_n \end{bmatrix} =$$

$$= x_1y_1 + x_2y_2 + \ldots x_ny_n$$



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VECTOR OUTER PRODUCT

VECTOR OUTER PRODUCT

- The outer product creates a matrix.
- $A = \mu v^T$

$$a(i,j) = a_{ij} = u(i)v(j)$$

$$A = \begin{bmatrix} u_{1} \\ u_{2} \\ \vdots \\ u_{m} \end{bmatrix} \begin{bmatrix} v_{1} & v_{2} & \dots & v_{n} \end{bmatrix}$$
$$= \begin{bmatrix} u_{1}v_{1} & u_{1}v_{2} & \dots & u_{1}v_{n} \\ u_{2}v_{1} & u_{2}v_{2} & \dots & u_{2}v_{n} \\ \vdots & \vdots & \vdots & \vdots \\ u_{m}v_{1} & u_{m}v_{2} & \dots & u_{m}v_{n} \end{bmatrix}$$



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VECTOR INNER PRODUCT

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VECTOR INNER PRODUCT

- The * operator performs the inner product if two vectors are compatible.
- The inner product result is a scalar.

VECTOR OUTER PRODUCT





VECTOR OUTER PRODUCT

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MATRICES

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MATRICES

- Columns and Rows of a Matrix are Vectors
- Addition and Subtraction
- Multiplication by a scalar
- Transpose
- Linear Combinations of Vectors
- Matrix Vector Product
- Matrix Matrix Product



MATRIX OPERATIONS

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MATRIX OPERATIONS

- Addition and subtraction
 C = A + B
 c(i,j) = a(i,j) + b(i,j)
 i = 1, 2, ..., m and j = 1, 2, ..., n
- Multiplication by a scalar $B = \lambda A$ $b(i,j) = \lambda a(i,j)$ i = 1, 2, ..., m and j = 1, 2, ..., n



MATRIX OPERATIONS

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EXAMPLE:

filename: $ex_- 06_- 03.m$

% ex_06_03.m
A= magic(3)
B= [1 2 3; 5 8 13; 21 34 55]
C = A + B
C = B + A
C = A - B
B = [1 2 3; 5 8 13]
C = A + B



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MATRIX OPERATIONS

Introduction to Scientific and





SQUARE MATRIX

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SQUARE MATRIX

If the number of rows are equal to number of columns, than the matrix is a square matrix.

EXAMPLE:

filename: ex_ 06_ 04.m

```
% SQUARE MATRIX EXAMPLE
A = magic(4)
dimA = size(A)
dimA_row = dimA(1)
dimA_column = dimA(2)
A'
```



SQUARE MATRIX

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SQUARE MATRIX

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EXAMPLE:

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SQUARE MATRIX

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EXAMPLE:





MATRIX TRANSPOSE

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MATRIX TRANSPOSE

 $B = A^T$ b(i,j) = a(j,i) $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$

MATRIX MULTIPLICATION

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MATRIX MULTIPLICATION

$$c_{ij} = \sum_{k=1}^{p} a_{ik} b_{kj}$$
$$i = 1, 2, \dots, m, j = 1, 2, \dots, n$$

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MATRIX MULTIPLICATION

EXAMPLE: Introduction to Scientific and filename: ex_ 06_ 05.m Engineering Computing, BIL108E % MATRIX MULTIPLICATION EXAMPLE $A = [1 \ 2 \ 1; \ 0 \ 1 \ 2; \ 0 \ 0 \ 2]$ B = [1 2 0; -1 1 2; 0 1 2]C = A * BC = B * A $B = [1 \ 2 \ 0; \ -1 \ 1 \ 2]$ C = A * B $A = [1 \ 2 \ 1]$ B = [1 2 0; -1 1 2; 0 1 2]C = A * B $A = [1 \ 2 \ 1; \ 0 \ 1 \ 2; \ 0 \ 0 \ 2]$ $B = [1 \ 2 \ 0]$ C = A * B



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Merile	$C = A \times R$	
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	C = A * B	
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	B = [1 2 0; -1 1 2]	
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	C = B * A	
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EXAMPLE:

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ex_06_lineau	M-file		1221 00010040		
		>> C =	A * B		
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		0	2	4	
D = LI Z	U; -I .	ľ	2 .		
C = A * B					
		>>			
4 Start					



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		2	× * L **
	All Files ∠ Type		
	<pre>Mex_06_01.m M-file >> C = A * B</pre>		
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	ex_06_03.m M-file		
	ex_06_04.m M-file		
	ex_06_05.m M-file	6	
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	Nex 06 08 m M-file	8	
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	🕙 ex_06_linequ M-file		
	>> C = B ** A		
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	C = A * B	0	
	C = B * A		
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Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLE:

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]ex_06_06.m	M-file			
]ex_06_07.m	M-file	1 4	5	
ex_06_08.m	M-file	-1 -1	5	
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		>> B = [1 2 0]	-1 1 2]	
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C = B * A		-1 1	2	
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ex_06_03.m M-file		
🖺 ex_06_04.m M-file	-1 -1 3	
<pre>ex_06_05.m M-file</pre>	0 1 6	
ex_06_06.m M-file		
ex_06_07.m M-file	>> B = [1 2 0; -1 1 2]	
ex_06_08.m M-file		
Nex_06_09.ml M-file	B =	
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	-1 1 2	
4	$\mathbf{P} \rightarrow \mathbf{C} = \mathbf{A} \times \mathbf{B}$	
Command History 🗰 🖬 🕷	× 222 Error using mtimes	
с = в А	Tanan anticia diamatana materia	
B = [1 2 0; -1]	Inner matrix dimensions must agree.	
C = A * B	× .	
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Introduction to Scientific Engineering Computing, BIL108E

EXAMPLE:

A	MATLAB 7.6.0 (R2008a)	
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Current Directory 🛏 🗖 🔻 🗙	Work Command Window	* 🗆 🕅 ×
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All Files ∠ Type		
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🖺 ex_06_03.m M-fil	e Tanon matrix dimensions must agree	
🖺 ex_06_04.m M-fil	e Inner matrix dimensions must agree.	
<pre>ex_06_05.m M-fil</pre>	e	
≦ex_06_06.m M-fil	e >> size(A)	
ex_06_07.m M-fil	e	
Mex_06_08.m M-fil	e ans =	
ex_06_09.m M-fil	e	
mex_06_nnequ M-m	^e 3 3	
	>> size(B)	
4		
Command History + 🗖		
C = A * B		
	2 3	
size(A)		
	>>	
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MATRIX MULTIPLICATION

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iting,	Com	mand ¹	Windo	ow				
nan		2		3				
	>>	A =	[1	2 1]				
	A =							
		1		2	1			
	>>	B =	[1	2 0;	-11	2;	01	2]
	В =							
		1		2	0			
		-1		1	2			
		•		1	2			

>>



Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLE:





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MATRIX MULTIPLICATION

Introduction to Scientific and Engineering

*	MATLAB 7.6.0 (R2008a)	ii:
<u>File Edit Debug D</u> esktop	Window Help	
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Current Directory 🏎 🗖 🐐 🗙	Wolf Command Window	
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All Files ∠ Type		
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🖺 ex_06_02.m M-fi	e _1 1 2	
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@ex_06_05.m M-fi	e	
ex_06_06.m M-fi	e >> C = A ** B	
ex_06_07.m M-fi	e	
ex_06_08.m M-fi	e C =	
Mer 06 lineau M-fi	e.	
area contraction of the	-1 5 6	
	>> A = [1 2 1; 0 1 2; 0 0 2];	
	A = [1 2 0]	
4	\rightarrow \sim C = A * B	
Command History 🗰 🗖	* × 222 Error using mtimes	
A = [1 2 1, 0	Tanan metain dimensional much anno	
B = [1 2 0];	Inner matrix dimensions must agree.	
C = A * B	×	



MATRIX MULTIPLICATION

Introduction to Scientific Engineering Computing, BIL108E

EXAMPLE:

1		MATLAB 7.6.0 (R2008a)	
Eile Edit Debug De	esktop <u>W</u> indo	w Help	
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Current Directory 🗰 🗖	4 W X 5	Command Window	** 🗆 🕅 🗧
🖻 🖆 🖪 🖥 🔹 🔹		>> C = A * B	
All Files 💪	Туре	<pre>??? Error using ==> mtimes</pre>	
🖞 ex_06_01.m	M-file	Inner matrix dimensions must agree.	
🖺 ex_06_02.m	M-file	alterna, Davida in Franciscus Local Local Section	
ex_06_03.m	M-file	>> A = [1 2: 0 1: 0 2]:	
ex_06_04.m	M filo	>> B = [1 2 0; -1 1 2];	
Dex 06 06 m	M-file	>> size(A)	
1ex_06_07.m	M-file		
<pre>ex_06_08.m</pre>	M-file	ans =	
🖺 ex_06_09.m	M-file		
▲ex_06_linequ	M-file	3 2	
		>> size(B)	
4	•		
Command History	H D A X	ans =	
D = LT Z V	, - <u>-</u> .		
size(A)		2 5	
size(B)			
	,	>>	
📣 Start			0.4

MATRIX MULTIPLICATION

Introduction to Scientific

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		×
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	Mex_06_06.m M-file Mex_06_07.m M-file Mex_06_08.m M-file Mex_06_09.m M-file 2 3	
	$ \sum_{k=1}^{\infty} e_{k} \sum_{j=1}^{\infty} e_{k} \sum_{j=1}^{$	
	-1 4 4 Command History ++ -> × -1 1 2	
	size(A) -2 2 4	
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Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLE:

Δ		MATLAB 7.6.0 (R2008a)	
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Current Directory H	I P X NOF	Command Window	* D * X
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All Files 4	Type	2 3	
ex_06_01.m	M-file		
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]ex_06_03.m	M-file		
]ex_06_04.m	M-file	C -	
ex_06_05.m	M-file	C -	
ex_06_06.m	M_file	1 4 4	
Dex 06 08 m	M-file	-1 4 4	
1 ex 06 09.m	M-file	-1 1 2	
ex_06_linequ	. M-file	-2 2 4	
		177 - HAL HE - H	
		>> C = B * A	
		C =	
Command History	+ × ×	1 4	
size(B)	-	-1 3	
C = A * I	B		
C = B * /	A 📮	>>	
A Start			



Computing, BIL108E

DIAGONAL MATRICES

Introduction to Scientific and Engineering

DIAGONAL MATRICES

Diagonal matrices have non-zero elements only on the main diagonal.

$C = diag(c_1, c_2, \ldots, c_n)$

$$C = \begin{bmatrix} c_1 & 0 & \dots & 0 \\ 0 & c_2 & \dots & 0 \\ \vdots & \vdots & \dots & \vdots \\ 0 & 0 & \dots & c_n \end{bmatrix}$$

DIAGONAL MATRICES



EXAMPLE:

	MATLAB 7.6.0 (R2008a)	
<u>Eile E</u> dit De <u>b</u> ug	Desktop Window Help	
06 8 6	🤊 😢 🐞 🗊 🗐 🥹 Current Directory: /media/Transcend/source 👻 🛄 😰	
Current Directory H	Command Window	** = * ×
🖻 🗃 🖪 🖥 🔹 🔹	>> type ex_06_06.m	
All Files ∠	Type	
🖺 ex_06_01.m	M-file % DTAGONAL MATRICES	
🖺 ex_06_02.m	$M_{\text{file}} = [1, 2, 3, 5, 8]$	
🖺 ex_06_03.m	$M-file \qquad (f = diag(x))$	
🖺 ex_06_04.m	M_{-file} C = d1ag(x)	
ex_06_05.m	M-file >>	
ex_06_06.m	M-file	
ex_06_07.m	M file	
10x 06 09 m	M file	
Aex 06 lineau	M-file	
Elevico intega.	. In the	
4	5	
Command History	+ ×	
C - P *		
CIC		
type ex_	06_06.m 😴	
▲ Start		0



DIAGONAL MATRICES

Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLE:

filename: $ex_- 06_- 06.m$

% DIAGONAL MATRICES
x = [1 2 3 5 8];
C = diag(x)



DIAGONAL MATRICES

Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLE:

Δ	MATLAB 7.6.0 (R200Ba)	
Eile Edit Debug Desktop Wir D 😂 🖌 🐂 🛍 🔊 (*) 💩 E Gurrent Directory II: D A X	dow Help ⑦ ② ● Current Directory /media/Transcend/source ♥ €	
Image Type Dex.06.01.m M-file Dex.06.02.m M-file Dex.06.03.m M-file Dex.06.04.m M-file Dex.06.07.m M-file Dex.06.07.m M-file Dex.06.07.m M-file Dex.06.07.m M-file Dex.06.08.m M-file Dex.06.09.m M-file Dex.06.09.m M-file Dex.06.01.meq M-file	<pre>>> ex_06_06 C =</pre>	
command History +- + > > -ex_06_04 -c1c -ex_06_06		101



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to Scientific

and

Engineering

Computing, BIL108E

IDENTITY MATRICES

IDENTITY MATRICES

An identity matrix is a square matrix with ones on the main diagonal.

An identity matrix is special because

$$AI = IA = A$$

for any compatible matrix A. This is like multiplying by one in scalar arithmetic.

,	1 0	0 1	· · · ·	0 0	
I =	: 0	: 0	:	: 1 _	

A CONTRACTOR OF CONTRACTOR OF

IDENTITY MATRIX

Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLE:

filename: ex_ 06_ 07.m

% IDENTITY MATRIX I = eye (4); A = magic(4); C = A * I C = I * A I = eye (4,3)



IDENTITY MATRIX

Scientific and ngineering omputing, BIL108E	I
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4	MATLAB: 7.6.0 (R2008a)
<u>File Edit Debug Desktop Wind</u>	dow Help
🗋 🖆 🕷 🐃 🛍 🤊 (°) 🍓 🖆	🕈 🛃 🥹 Current Directory: /media/Transcend/source 👻 🛄 💼
Current Directory III a * × World	Command Window
At Files ∠ Type Att Files ∠ Type Ex.206.02.m M-file Ex.206.03.m M-file Ex.206.03.m M-file Ex.206.03.m M-file Ex.206.05.m M-file Ex.206.06.m M-file	<pre>>> type ex_06_07.m % IDENTITY MATRIX I = eye (4); A = magic(4); C = A * I C = I * A I = eye (4,3) >> </pre>
Command History III A X	
ex_06_06 clc type ex_06_07.m	



IDENTITY MATRIX

Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLE:

A	MATLAB 7.6.0 (R2008a)	
<u>File Edit Debug Desktop Wind</u>	ow Help	
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Current Directory III a X Work	Command Window	× * 🗆 **
🖻 🗂 🖬 🛛 🗸 -	>> type ex_06_07.m	-
All Files ∠ Type		
ex_06_01.m M-file	% IDENTITY MATRIX	
ex_06_02.m M-file	I = eye (4);	
Nex 06 04 m M-file	A = magic(4):	
≦ex_06_05.m M−file	C = A * I	
<pre>ex_06_06.m M-file</pre>	C = I * A	
ex_06_07.m M-file	I = eye (4,3)	
ex_06_08.m M-file	>> ex_06_07	
Nex 06 lineau M-file		
Electroopiniedani in the	C =	
	16 2 3 13	
	5 11 10 8	
	9 7 6 12	
Command History + ×	4 14 15 1	
CIC		
type ex_06_07.m		
ex_06_07	C =	×
▲ <u>S</u> tart		0



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EVAININTE:

Δ			MATLAB	7.6.0 (R20	08a)		91
<u>Eile Edit Debug D</u> esktop	<u>W</u> indow <u>H</u> elp						
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Current Directory 🛏 🗖 🔻 🗙	Wolf Command Wi	ndow					 *
🖻 🖆 🖪 🗟 🔹	C = I *	Α					2
All Files ∠ Type Dex.06.01.m M-fil Dex.06.02.m M-fil Dex.06.03.m M-fil Dex.06.03.m M-fil Dex.06.04.m M-fil Dex.06.06.m M-fil Dex.06.06.m M-fil Dex.06.08.m M-fil Dex.06.09.m M-fil Dex.06.09.m M-fil Dex.06.09.m M-fil	I = eye le >> ex_06 le C = le 16 le 5 le 9 le 4	(4,3) 5_07 2 11 7 14	3 10 6 15	13 8 12 1			
Command History ++ _ - Clc - type ex_06_07 -ex_06_07	C = * × 16 5 9 	2 11 7 14	3 10 6 15	13 8 12 1			
4 Carrie							Tol.
4 Start							101



IDENTITY MATRIX

Introduction to Scientific Engineering Computing, BIL108E

EXAMPLE:

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Image: Directory Image: Directory <td< th=""><th>Eile Edit Debug Desktop Win</th><th>ow <u>H</u>elp</th><th></th><th></th><th></th></td<>	Eile Edit Debug Desktop Win	ow <u>H</u> elp			
urrent Directory ** • * * with the set of the	1 🖆 🕹 🐂 🛅 🤊 🗢 🚺 🖆	📄 🛛 🥑 Current Directory	/media/Tran	iscend/source 👻 💼	
4 14 15 1 Writes 4 Type Yope 4 14 15 1 Dex.06.02.m M-file C = 1 0 1	Current Directory I+ 🗆 🛪 🗙 World	Command Window			+ □ * ×
W Fies / Type ex.06.0.1m M-file ex.06.0.3m M-file ex.06.0.5Xm M-file	n 🖻 📓 🗟 🔹	4 14	15	1	-
Ex.06_01.m M-file Ex.06_02.m M-file Ex.06_02.m M-file Ex.06_06.m M-file Ex.06_07.m M-file Ex.06_07.m M-file Ex.06_07.m M-file Ex.06_07.m M-file Ex.06_07.m M-file Ex.06_07.m M-file Ex.06_09.m M-file Ex.06_09.m M-file Image: Ex.06_07.m					
ex_06_02:m M-file ex_06_03:m M-file ex_06_05:m M-file ex_06_05:m M-file ex_06_07:m M-file ex_06_07:m M-file ex_06_09:m M-file ex_06_09:m M-file ex_06_07:m M-file	Nex 06 01 m M-file				
ex.06.03.m M-file ex.06.04.m M-file ex.06.05.m M-file ex.06.06.m M-file ex.06.07.m M-file ex.06.08.m M-file ex.06.09.m M-file ex.06.01 M-file ex.06.01 M-file isotarrow M-file ex.06.01 M-file isotarrow M-file isotarow <td< td=""><td>Nex 06 02.m M-file</td><td>C</td><td></td><td></td><td></td></td<>	Nex 06 02.m M-file	C			
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¹ = 16 2 3 13 ¹ = x.06.05.m M-file 5 11 10 8 ¹ = x.06.07.m M-file 9 7 6 12 ¹ = x.06.07.m M-file 4 14 15 1 ¹ = x.06.01.m M-file 4 14 15 1 ¹ = x.06.01.mequ M-file 1 0 0 1 0 ¹ = 1 0 0 1 0 0 1 0 <td< td=""><td>ex_06_04.m M-file</td><td></td><td>-</td><td></td><td></td></td<>	ex_06_04.m M-file		-		
	ex_06_05.m M-file	16 2	3	13	
ex_06_007.m M-file 9 7 6 12 ex_06_007.m M-file 4 14 15 1 ex_06_008.m M-file 4 14 15 1 ex_06_010.equ M-file 1 0 0 for any file 1 0 0 1 command History If any file 0 0 1 color color 0 0 0	🖞 ex_06_06.m M-file	5 11	10	8	
	ex_06_07.m M-file	9 7	6	12	
■ ex_06_09.m M-file ■ ex_06_linequ M-file I = 1 0 0 0 1 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0	Mex_06_08.m M-file	4 14	15	1	
I = 1 0 0 0 1 0 Command History ··· C × clc 0 0 0 1 clc 0 0 0 0 command History ··· C × 0 0 0 1 clc 0 0 0 command History ··· C × 0 0 0 0 0 command History ··· C × 0 0 0 0 0 command History ··· C × 0 0 0 0 0 0 command History ··· C × 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Mex_06_09.m M-file	10 U.S.			
I I 0 0 Command History Image: Command History Image: Command History Image: Command History Cold Command History Image: Command History Image: Command History Cold Command History Image: Command History Image: Command History Command History <	Sex_06_linequ M-file				
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1 0 0 Command History ** 0 0 clc 0 0 1 type ex_06_07.m >> >>					
I 0 0 1 0 Command History ** 0 0 1 0 0 1 0 0 1 0 0 0 1 0		1 0	٥		
Command History + C * X 0 0 1 0 C1c 0 0 1 c1c 0 0 0 1 cype ex_06_07.m ex_06_07			0		
clc 0 0 1 cype ex_06_07.m 0 0 0	Command History # * *	0 1	0		
cic 0 0 0 type ex_06_07.m		0 0	1		
type ex_06_07.m ex_06_07	CIC	0 0	0		
ex 06 07	type ex_06_07.m				
	ex_06_07	>>			-
4 Start	▲ Start	1			0

SYMMETRIC MATRICES

Introduction to Scientific and Engineering Computing,	SYMMETRIC MATRICES
DILIUGE	a _{lj} — a _{ji}
Karaman	EXAMPLE:
	filename:ex_ 06_ 08.m
	<pre>% SYMMETRIC MATRIX A = [1 2 4; 2 1 8; 4 8 1]; dimA = size(A); m = dimA(1); n = dimA(2);</pre>
	<pre>if (isequal(A, A') == 1) disp('A IS A SYMMETRIC MATRIX.') else</pre>

disp('A IS NOT A SYMMETRIC MATRIX.') end



SYMMETRIC MATRICES

Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLE:

A	MATLAB 7.6.0 (R2008a)
<u>File Edit Debug Dest</u>	np <u>Window</u> Help
1 6 × h 6 9 (🐌 🗊 🗐 V Current Directory. /media/Transcend/source 👻 🔞
Current Directory 🗰 🖬 🕈	X Command Window ** 🗆
🖻 🖆 🖪 🗟 🔹	>> type ex 06 08.m
All Files ∠ T	e e
Mex_06_01.m N	file % SYMMETRIC MATRIX
🖺 ex_06_02.m 🛛 🛚 🔊	$file$ $A = \begin{bmatrix} 1 & 2 & 4 & 2 & 1 \\ 2 & 4 & 2 & 1 \end{bmatrix}$
≦ex_06_03.m N	file A - LI Z T, Z I O, T O I],
≦ex_06_04.m N	file dTmA = stze(A);
≦ex_06_05.m N	file $\mathbf{m} = \mathbf{d}\mathbf{m}\mathbf{A}(1);$
ex_06_06.m N	$\frac{1}{n} = \dim A(2);$
ex_06_07.m N	
1 ax 06 09 m	ile if (isequal(A, A') == 1)
Mex_06_linequ N	disp('A IS A SYMMETRIC MATRIX.')
Elex_oo_intequ	else
	disp('A TS NOT A SYMMETRIC MATRIX ')
	and
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CIC	
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and

SYMMETRIC MATRICES

Introduction to Scientific EXAMPLE: Engineering Computing, BIL108E Eile Edit Debug Desktop Window Help 🞦 🗃 🐇 🐂 🖄 🤊 💌 谢 🗊 🖹 🥹 Current Directory /media/Transcend/source 💌 🛄 😰 Current Directory + C ? × Work Com ۰ 🛃 🖪 🔁 🖻 >> type ex_06_08.m All Files ∠ ▲ ex_06_01.m Type M-file % SYMMETRIC MATRIX 🖺 ex_06_02.m M-file A = [1 2 4; 2 1 8; 4 8 1];ex_06_03.m M-file dimA = size(A); ex_06_04.m ex_06_05.m ex_06_06.m M-file m = dimA(1);M-file M-file n = dimA(2);■ex_06_06.m M-file ■ex_06_07.m M-file ■ex_06_08.m M-file ■ex_06_09.m M-file if (isequal(A, A') == 1) disp('A IS A SYMMETRIC MATRIX.') ex_06_linequ... M-file else disp('A IS NOT A SYMMETRIC MATRIX.') end >> ex_06_08 4 . A IS A SYMMETRIC MATRIX. Command History * • • × >> clc type ex_06_08.m ex_06_08 **▲** Start



INVERSE OF A MATRIX

Introduction to Scientific and Engineering Computing, BIL108E

INVERSE OF A MATRIX

Inverse of matrix A is A^{-1} . $AA^{-1} = A^{-1}A = I$

Ax = b

 $A^{-1}Ax = A^{-1}b$

So, the solution of Ax = b is

$$x = A^{-1} b$$



Introduc

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INVERSE OF A MATRIX

ion ific	
ing ng, E	EXAMPLE:
	filename: ex_ 06_ 09.m
	A = [2 -1 0; 1 2 1; 0 -1 2] B = inv(A) A * B B * A



INVERSE OF A MATRIX

Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLE:

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ex_06_07.m	M-file		
🖺 ex_06_08.m	M-file		
🖞 ex_06_09.m	M-file		
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INVERSE OF A MATRIX

Introduction to Scientific and

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Image: Second	
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INVERSE OF A MATRIX

Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLE:

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Introduction

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SOME MATRIX FUNCTIONS

SOME MATRIX FUNCTIONS

- zeros: creates a matrix that all elements are equal to zero.
- ones: creates a matrix that all elements are equal to one.
- size: returns the dimension of the matrix.
- eye: creates an identity matrix.
- diag: creates a diagonal matrix
- inv: creates the inverse of a given matrix.
- trace: returns the sum of the diagonal terms of a matrix.
- det: returns the determinant of a matrix.
- \blacksquare \: left division
- /: right division



SOME MATRIX FUNCTIONS

Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLES:

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SOME MATRIX FUNCTIONS

Introduction to Scientific EXAMPLES: Engineering Computing, BIL108E

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🖺 ex_06_05.m	M-file	3	5	7			
🖺 ex_06_06.m	M-file	4	9	2			
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Introduction to Scientific Engineering Computing, BIL108E

SOME MATRIX FUNCTIONS

EXAMPLES:

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SOME MATRIX FUNCTIONS

Introduction to Scientific

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SOME MATRIX FUNCTIONS

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EXAMPLES:

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SOME MATRIX FUNCTIONS

Introduction to Scientific and EXAMPLES: Engineering



Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLES:

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🖺 ex_06_06.m M-file	>> size(A)	
🖞 ex_06_07.m M-file		
🖺 ex_06_08.m M-file	ans =	
🖞 ex_06_09.m M-file		
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SOME MATRIX FUNCTIONS

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		>> A = ones(3,3)	
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SOME MATRIX FUNCTIONS

Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLES:

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>> det(A) ans = Command History ** ** ** A = zeros(3,3) A = magic(3); det(A) ** >>

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SOME MATRIX FUNCTIONS

Introduction to Scientific and Engineering Computing, BIL108E

EXAMPLES:

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Introduction to Scientific and

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	■ ex_05_01.m M-File ● ex_06_02.m M-File ● ex_06_03.m M-File ans =	
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	■ ex_05_00,m M-file ■ ex_05_09,m M-file ■ ex_05_09,m M-file = ex_05_09,m M-file	
	<pre>>> diag(A(:,1))</pre>	
	ans =	
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	-inv(A) diag(A(:,1)) ->>	•
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LINEAR EQUATIONS

LINEAR EQUATIONS

 $a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n = b_1$ $a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n = b_2$... $a_{n1}x_1 + a_{n2}x_2 + \ldots + a_{nn}x_n = b_n$

A x = b

Unknowns could be calculated with matrix operations. $x = A^{-1} \times b$



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SOLUTION OF LINEAR EQUATIONS

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EXAMPLE:

 Use matrix operations to solve the following systems of linear equations.

4x - 2y + 6z = 82x + 8y + 2z = 46x + 10y + 3z = 0

SOLUTION OF LINEAR EQUATIONS

Introduction to Scientific and Engineering

Computing, BIL108E

$A = [4 -2 6; \dots$
2 8 2;
6 10 3];
b = [8;4;0];
% ***
% SOLVING BY USING LEFT DIVISION
% ***
$X_{left} = A \setminus b$
% ***

% SOLVING BY USING INVERSE % *** X_inv = inv(A) * b



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SOLUTION OF LINEAR EQUATIONS

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	<pre>>> type ex_06_linequ_1.m</pre>	
All Files ∠ Type		
ex_06_01.m M-file	$A = [4 - 2 6; \dots$	
ex_06_02.m M-file	2 8 2;	
Pax 06 04 m M file	6 10 3]:	
1 ex 06 05 m M-file	b = [8:4:0]:	
ex_06_06.m M-file	% ***	
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	87 stated	
7		
2	% SOLVING BY USING INVERSE	
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Command History	X_inv = inv(A) * b	
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SOLUTION OF LINEAR EQUATIONS

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EXAMPLE:

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🖻 🗂 🖪 🚽 🔸	% ***	-
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ex_06_linegM_file	2.6341	
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References

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References for Week 6

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