Introduction To Engineering – Tutorial - 04

#	Student ID	Student Name	Grade (10)
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Q1

. Show that $\lim_{x \to 0} \frac{\cos(2x)-1}{\cos x - 1} = 4$.

Do this by first creating a vector x that has the elements 1.0, 0.5, 0.1, 0.01, 0.001, and 0.0001.

Sol 1

```
clear, clc
format long
x=[1 .5 .1 .01 .001 .0001]
each_result=(cos(2*x)-1)./(cos(x)-1)
```

```
x =

  Columns 1 through 4

   1.000000000000000   0.500000000000000   0.100000000000000   0.010000000000000

  Columns 5 through 6

   0.001000000000000   0.000100000000000


each_result =

  Columns 1 through 4

   3.080604611736280   3.755165123780746   3.990008330556008   3.999900000832619

  Columns 5 through 6

   3.999999000133061   4.000000000000000
```

Q2

Create the following three matrices:

$$A = \begin{bmatrix} 1 & -3 & 5 \\ 2 & 2 & 4 \\ -2 & 0 & 6 \end{bmatrix} \qquad B = \begin{bmatrix} 0 & -2 & 1 \\ 5 & 1 & -6 \\ 2 & 7 & -1 \end{bmatrix} \qquad C = \begin{bmatrix} -3 & 4 & -1 \\ 0 & 8 & 2 \\ -3 & 5 & 3 \end{bmatrix}$$

(*a*) Calculate $A+B$ and $B+A$ to show that addition of matrices is commutative.

(*b*) Calculate $A+(B+C)$ and $(A+B)+C$ to show that addition of matrices is associative.

(*c*) Calculate $3(A+C)$ and $3A+5C$ to show that, when matrices are multiplied by a scalar, the multiplication is distributive.

(*d*) Calculate $A*(B+C)$ and $A*B+A*C$ to show that matrix multiplication is distributive.

Sol 2

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```
clear, clc
A=[1 -3 5; 2 2 4; -2 0 6]; B=[0 -2 1; 5 1 -6; 2 7 -1];
C=[-3 4 -1; 0 8 2; -3 5 3];
disp('Part (a)')
AplusB=A+B
BplusA=B+A
disp('Part (b)')
AplusBandC=A+(B+C)
AandBplusC=(A+B)+C
disp('Part (c)')
together=3*(A+C)
apart=3*A+3*C
disp('Part (d)')
%element by element
e_by_e_together=A.*(B+C)
e_by_e_apart=A.*B+A.*C
%matrix multiplication
mm_together=A*(B+C)
mm_apart=A*B+A*C
```

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```
Part (a)
AplusB =
    1    -5     6
    7     3    -2
    0     7     5
BplusA =
    1    -5     6
    7     3    -2
    0     7     5
Part (b)
AplusBandC =
   -2    -1     5
    7    11     0
   -3    12     8
AandBplusC =
   -2    -1     5
    7    11     0
   -3    12     8
Part (c)
together =
   -6     3    12
    6    30    18
  -15    15    27
apart =
   -6     3    12
    6    30    18
  -15    15    27
Part (d)
e_by_e_together =
   -3    -6     0
   10    18   -16
    2     0    12
e_by_e_apart =
   -3    -6     0
   10    18   -16
    2     0    12
mm_together =
  -23    35    22
    0    70     0
    0    68    12
mm_apart =
  -23    35    22
    0    70     0
    0    68    12
```

Q3

Solve the following system of three linear equations:

$$-4x + 3y + z = -18.2$$
$$5x + 6y - 2z = -48.8$$
$$2x - 5y + 4.5z = 92.5$$

Sol 3

```
clear, clc
A=[-4 3 1; 5 6 -2; 2 -5 4.5]; y=[-18.2 -48.8 92.5]';
result=A\y
```

```
result =

   2.799999999999999
  -6.399999999999999
  12.200000000000001

>>
```

Q4

A food company manufactures five types of 8 oz Trail mix packages using different mixtures of peanuts, almonds, walnuts, raisins, and M&Ms. The mixtures have the following compositions:

	Peanuts (oz)	Almonds (oz)	Walnuts (oz)	Raisins (oz)	M&Ms (oz)
Mix 1	3	1	1	2	1
Mix 2	1	2	1	3	1
Mix 3	1	1	0	3	3
Mix 4	2	0	3	1	2
Mix 5	1	2	3	0	2

How many packages of each mix can be manufactured if 128 lb of peanuts, 118 lb of almonds, 112 lb of walnuts, 112 lb of raisins, and 104 lb of M&Ms are available? Write a system of linear equations and solve.

Sol 4

```
clear, clc
R=[3 1 1 2 1; 1 2 1 3 1; 1 1 0 3 3; 2 0 3 1 2; 1 2 3 0 2];
p=16*[128 118 112 112 104]';
result=R\p
```

```
result =

  1.0e+002 *

    3.200000000000000
    2.240000000000000
    1.920000000000000
    2.560000000000000
    1.600000000000001

fx >>
```

Q5

Create a 4×4 matrix A having random integer values between 1 and 10. Call the matrix *A* and, using MATLAB, perform the following operations. For each part explain the operation.

(*a*) `A * A` (*b*) `A .*A` (*c*) `A \A`

(*d*) `A . / A` (*e*) `det (A)` (*e*) `inv (A)`

Sol 5

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```
clear, clc
A=10*rand(4,4)
disp('Part (a)')
disp('linear algebra multiplication')
R=A*A
disp('Part (b)')
disp('element-by-element multiplication')
R=A.*A
disp('Part (c)')
disp('linear algebra, left division (left multiply by inverse)')
R=A\A
disp('Part (d)')
disp('element-by element, right division')
R=A./A
disp('Part (e)')
disp('determinant')
R=det(A)
disp('Part (f)')
disp('inverse')
R=inv(A)
```

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```
A =

   8.147236863931790   6.323592462254095   9.575068354342976   9.571669482429456
   9.057919370756192   0.975404049994095   9.648885351992766   4.853756487228412
   1.269868162935061   2.784982188670484   1.576130816775483   8.002804688888002
   9.133758561390193   5.468815192049839   9.705927817606156   1.418863386272153

Part (a)
linear algebra multiplication

R =

  1.0e+002 *

   2.232404517166728   1.366999496200901   2.470194619486408   1.988841296895515
   1.392179980331340   1.116462747790527   1.584598746334662   1.755387464537812
   1.106692250104756   0.589019677625160   1.191898813072669   0.496407373582912
   1.492357858498949   0.978828090166934   1.692935309056309   1.936574332554532

Part (b)
element-by-element multiplication

R =

  66.377468517009106  39.987821628676812  91.681933990340312  91.616856680871379
  82.045903327120243   0.951413060744883  93.100988535900555  23.558952037311894
   1.612565151236066   7.756125791211839   2.484188351589351  64.044882888487791
  83.425545457768649  29.907939604795111  94.205034800581004   2.013173308903682
```

```
Part (c)
linear algebra, left division (left multiply by inverse)

R =

   1.000000000000003                   0  -0.000000000000000  -0.000000000000002
   0.000000000000000   1.000000000000000   0.000000000000000  -0.000000000000000
  -0.000000000000003                   0   1.000000000000000   0.000000000000002
   0.000000000000000                   0                   0   1.000000000000000

Part (d)
element-by element, right division

R =

     1     1     1     1
     1     1     1     1
     1     1     1     1
     1     1     1     1

Part (e)
determinant

R =

   -2.614071964442565e+002
```

```
Part (f)
inverse

R =

  -1.529969595471940   0.307606079612647   1.472345449973180   0.964451704177083
  -0.020880842214749  -0.184423560805176   0.103655271219096   0.187106586073514
   1.456936826558582  -0.193373020704231  -1.464972827740082  -0.904132705361372
  -0.036900885216296   0.053453552658496   0.143777858938292  -0.040083897647957
```