Math 240 Matlab Project 1

Spring 2021

Section 0212

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Type/paste Matlab commands for a particular problem/part right below

the correspondingly labelled line, above the next double % sign.

Contents

Problem 1

(a)

```
format short

x = pi/10
A = [cos(x) -sin(x);
     sin(x)  cos(x)]
v = [1;1]

v = A*v
```

```
x =

    0.3142


A =

    0.9511   -0.3090
    0.3090    0.9511


v =

     1
     1


v =

    0.6420
    1.2601
```

(b)

```
x = pi/11
B = [cos(x) -sin(x);
     sin(x) cos(x)]

 A*B
 B*A


% AB = BA
```

```
x =

    0.2856


B =

    0.9595   -0.2817
    0.2817    0.9595
```

```
ans =

    0.8255   -0.5644
    0.5644    0.8255


ans =

    0.8255   -0.5644
    0.5644    0.8255
```

(c) they are linear transformations, thus have the property of comutivity

(d)

```
C = A*B

format rat

t = acos(C(1, 1))

t/pi
```

```
C =

    0.8255   -0.5644
    0.5644    0.8255


t =

     496/827


ans =

      21/110
```

```
%(e)
format short

x = pi/10
A1 = [cos(x) -sin(x);
     sin(x)  cos(x)]


inv(A1)

x = -pi/10
A2 = [cos(x) -sin(x);
     sin(x)  cos(x)]
% inv(A1) = A2
```

```
x =

    0.3142


A1 =

    0.9511   -0.3090
    0.3090    0.9511


ans =

    0.9511    0.3090
   -0.3090    0.9511


x =

   -0.3142


A2 =

    0.9511    0.3090
   -0.3090    0.9511
```

```
%(f)

L = [1 0;
     0 -1]

x = pi/10
Rtheta = [cos(x) -sin(x);
         sin(x)  cos(x)]

R_theta = inv(Rtheta) % R -theta


Ltheta = Rtheta * L * R_theta
```

```
L =

     1     0
     0    -1


x =

    0.3142


Rtheta =

    0.9511   -0.3090
    0.3090    0.9511


R_theta =

    0.9511    0.3090
   -0.3090    0.9511


Ltheta =

    0.8090    0.5878
    0.5878   -0.8090
```

```
%(g)

L_piOver10 = Rtheta * L

L_piOver10 * L

L * L_piOver10

% L_piOver10 * L does not equal L * L_piOver10
```

```
L_piOver10 =

    0.9511    0.3090
    0.3090   -0.9511


ans =

    0.9511   -0.3090
    0.3090    0.9511


ans =

    0.9511    0.3090
   -0.3090    0.9511
```

```
%(h)

C = L_piOver10 * L

format rat

t = acos(C(1, 1))

t/pi
```

```
C =
```

```
    0.9511   -0.3090
    0.3090    0.9511


t =

      71/226


ans =

       1/10
```

Problem 2

(a)

```
A = [3 2 1;
     7 2 4;
     7 1 6]

M = [A eye(3)]

M = rref(M)

A_inverse = M(:, 4:6)
```

```
A =

       3              2              1
       7              2              4
       7              1              6


M =

  Columns 1 through 5

       3              2              1              1              0
       7              2              4              0              1
       7              1              6              0              0

  Column 6

       0
       0
       1


M =

  Columns 1 through 5

       1              0              0             -8/11           1
       0              1              0             14/11          -1
       0              0              1              7/11          -1

  Column 6

      -6/11
       5/11
       8/11


A_inverse =

      -8/11           1             -6/11
      14/11          -1              5/11
       7/11          -1              8/11
```

(b)

```
inv(A)
```

```
ans =

      -8/11           1             -6/11
      14/11          -1              5/11
       7/11          -1              8/11
```

Problem 3

(a)

```
format rat

A = [-2 0 0 0;
     16 2 0 0;
     3 -7 -1 0;
     9 3  4 5]

B = [2 0 1 -1;
     1 3 2  3;
     0 2 3  2;
     3 3 1 0]

A_det = det(A)
B_det = det(B)
```

```
A =

      -2              0              0              0
      16              2              0              0
       3             -7             -1              0
       9              3              4              5


B =

       2              0              1             -1
       1              3              2              3
       0              2              3              2
       3              3              1              0


A_det =

      20


B_det =

     -28
```

(b)

```
% Based on theorem 2 (section 3.1), the determinant is the product of the
% entries at the main diagonal because A is a triangular matrix.
% So, A_det = 5 * (-1) * 2 * (-2) = 20
```

(c)

```
C = A * B

det(C)
```

```
C =

      -4              0             -2              2
      34              6             20            -10
      -1            -23            -14            -26
      36             32             32              8


ans =

    -560
```

(d)

```
% If A and B are n × n matrices, then
% det(AB) = (det A)(det B).
% So, det(C) = det(A) * det(B) = 20 * (-28) = -560
```

Problem 4

(a)

```
A = [8 2 0 6;
     1 0 6 4;
```

```
     5 -1 2 0;
     5 3 7 8]

 A_det = det(A)
```

```
A =

       8           2           0           6
       1           0           6           4
       5          -1           2           0
       5           3           7           8


A_det =

    -426
```

(b)

```
%Since A is an nxn matrix:

% B_det = A_det * (-1) = 426 (swapping two rows changes the sign)

% C_det = A_det * (-2) = 852 (multiplying a row or column with a scalar
% results in multiplying the determinant by the scaler, -2 in this case)

% D_det = A_det = -426 (adding a row multiplied by a scaler to
% another row does not change determinant)
```

(c)

```
B = A
B([3 2], :) = B([2 3], :)

C = A
C(3, :) = -2 * C(3, :)

D = A
D(1, :) = D(1, :) - (6*D(4, :))
```

```
B =

       8           2           0           6
       1           0           6           4
       5          -1           2           0
       5           3           7           8


B =

       8           2           0           6
       5          -1           2           0
       1           0           6           4
       5           3           7           8


C =

       8           2           0           6
       1           0           6           4
       5          -1           2           0
       5           3           7           8


C =

       8           2           0           6
       1           0           6           4
     -10           2          -4           0
       5           3           7           8


D =

       8           2           0           6
       1           0           6           4
       5          -1           2           0
       5           3           7           8


D =

     -22         -16         -42         -42
       1           0           6           4
```

```
     5           -1           2           0
     5            3           7           8
```

(d)

```
% yes, they are the same as predicted in part b above
B_det = det(B)
C_det = det(C)
D_det = det(D)
```

```
B_det =

     426


C_det =

     852


D_det =

    -426
```

Problem 5

(a)

```
syms a b c d

A = [a b;
     c d]
```

```
A =

[a, b]
[c, d]
```

(b)

```
A_inverse = inv(A)
```

```
A_inverse =

[ d/(a*d - b*c), -b/(a*d - b*c)]
[-c/(a*d - b*c),  a/(a*d - b*c)]
```

(c)

```
syms e f g h i

B = [a b c;
     d e f;
     g h i]

 B_inverse = inv(B)
```

```
B =

[a, b, c]
[d, e, f]
[g, h, i]


B_inverse =

[ (e*i - f*h)/(a*e*i - a*f*h - b*d*i + b*f*g + c*d*h - c*e*g), -(b*i - c*h)/(a*e*i - a*f*h - b*d*i + b*f*g + c*d*h - c*e*g),  (b*f - c*e)/(a*e*i - a*f*h - b*d*i + b
[-(d*i - f*g)/(a*e*i - a*f*h - b*d*i + b*f*g + c*d*h - c*e*g),  (a*i - c*g)/(a*e*i - a*f*h - b*d*i + b*f*g + c*d*h - c*e*g), -(a*f - c*d)/(a*e*i - a*f*h - b*d*i + b
[ (d*h - e*g)/(a*e*i - a*f*h - b*d*i + b*f*g + c*d*h - c*e*g), -(a*h - b*g)/(a*e*i - a*f*h - b*d*i + b*f*g + c*d*h - c*e*g),  (a*e - b*d)/(a*e*i - a*f*h - b*d*i + b
```

(d)

```
adj_B = det(B) * B_inverse
```

```
adj_B =

[e*i - f*h, c*h - b*i, b*f - c*e]
[f*g - d*i, a*i - c*g, c*d - a*f]
[d*h - e*g, b*g - a*h, a*e - b*d]
```

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