MATLAB PROJECT 1

Please include this page in your Group file, as a front page. Type in the group number and the names of all members WHO PARTICIPATED in this project.

GROUP # \_\_3\_\_\_\_\_\_\_\_\_

FIRST & LAST NAMES (UFID numbers are NOT required):

\_1.\_\_\_\_\_\_\_Kevin Nguyen\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_2.\_\_\_\_\_\_\_Chamara Gunaratne\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ­­­

\_3.\_\_\_\_\_\_Nicolas Miller\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_4.\_\_\_\_\_\_\_Carl Lin\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_5.\_\_\_\_\_\_\_Cayle Gao\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_6.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**By signing your names above, each of you had confirmed that you did the work and agree with the work submitted**.

diary on

format compact

% Exercise #1

r = 3;

A = diag([r r r r r r]) + diag([1 1 1 1 1], 1)

A =

3 1 0 0 0 0

0 3 1 0 0 0

0 0 3 1 0 0

0 0 0 3 1 0

0 0 0 0 3 1

0 0 0 0 0 3

n = 5;

C = round(checkerboard(1, n, n));

C = C([6 7 8 9 10], [1 2 3 4 5])

C =

1 0 1 0 1

0 1 0 1 0

1 0 1 0 1

0 1 0 1 0

1 0 1 0 1

A = randi([-10 10], 5)

A =

7 -8 -7 -8 3

9 -5 10 -2 -10

-8 1 10 9 7

9 10 0 6 9

3 10 6 10 4

B = [A; mean(A)]

B =

7.0000 -8.0000 -7.0000 -8.0000 3.0000

9.0000 -5.0000 10.0000 -2.0000 -10.0000

-8.0000 1.0000 10.0000 9.0000 7.0000

9.0000 10.0000 0 6.0000 9.0000

3.0000 10.0000 6.0000 10.0000 4.0000

4.0000 1.6000 3.8000 3.0000 2.6000

C = [A; sum(A)]

C =

7 -8 -7 -8 3

9 -5 10 -2 -10

-8 1 10 9 7

9 10 0 6 9

3 10 6 10 4

20 8 19 15 13

D = [C sum(C, 2)]

D =

7 -8 -7 -8 3 -13

9 -5 10 -2 -10 2

-8 1 10 9 7 19

9 10 0 6 9 34

3 10 6 10 4 33

20 8 19 15 13 75

E = tril(triu(rand(6), -1), 1)

E =

0.7577 0.0318 0 0 0 0

0.7431 0.2769 0.9502 0 0 0

0 0.0462 0.0344 0.4898 0 0

0 0 0.4387 0.4456 0.6551 0

0 0 0 0.6463 0.1626 0.2238

0 0 0 0 0.1190 0.7513

% Exercise 2

type trial

function C=trial(A,B)

[m,p]=size(A);

[q,n]=size(B);

if p~=q

C=[];

disp('The dimensions of A and B disagree')

else

for i=1:n

C(:,i)=A\*B(:,i);

end

end

end

C=trial(randi(10,3,5),ones(3,5))

The dimensions of A and B disagree

C =

[]

C=trial(magic(4),ones(4,3))

C =

34 34 34

34 34 34

34 34 34

34 34 34

C = randi(10,3,5) \* ones(3,5)

{\_Error using <a href="matlab:matlab.internal.language.introspective.errorDocCallback('mtimes')" style="font-weight:bold"> \* </a>

Inner matrix dimensions must agree.}\_

C = magic(4) \* ones(4,3)

C =

34 34 34

34 34 34

34 34 34

34 34 34

% The reason part a doesn't work for either method is because matrix A doesn't have the same number of rows as matrix B has columns

% The reason part B work is because you are multiplying two matrices of the same dimension

% Because in part b you are multiplying all entries in a a row in matrix A by one and matrix A is a magic square, which means all rows add up to the same amount then you should end up with a matrix with the same number in each entry

% Exercise 3

type matshuffle

function C=matshuffle(A,B)

[m,n]=size(A);

[k,p]=size(B);

if m==k && n==p

C = B(:,[1;1]\*(1:size(B,2)));

C(:,1:2:end) = A;

else

C=[];

disp('Error: sizes of matrices must match')

end

end

A=ones(3,2), B=zeros(3,4)

A =

1 1

1 1

1 1

B =

0 0 0 0

0 0 0 0

0 0 0 0

C=matshuffle(A,B)

Error: sizes of matrices must match

C =

[]

A=ones(3), B=zeros(3)

A =

1 1 1

1 1 1

1 1 1

B =

0 0 0

0 0 0

0 0 0

C=matshuffle(A,B)

C =

1 0 1 0 1 0

1 0 1 0 1 0

1 0 1 0 1 0

A=magic(5), B=eye(5)

A =

17 24 1 8 15

23 5 7 14 16

4 6 13 20 22

10 12 19 21 3

11 18 25 2 9

B =

1 0 0 0 0

0 1 0 0 0

0 0 1 0 0

0 0 0 1 0

0 0 0 0 1

C=matshuffle(A,B)

C =

Columns 1 through 8

17 1 24 0 1 0 8 0

23 0 5 1 7 0 14 0

4 0 6 0 13 1 20 0

10 0 12 0 19 0 21 1

11 0 18 0 25 0 2 0

Columns 9 through 10

15 0

16 0

22 0

3 0

9 1

A=ones(4), B=eye(5)

A =

1 1 1 1

1 1 1 1

1 1 1 1

1 1 1 1

B =

1 0 0 0 0

0 1 0 0 0

0 0 1 0 0

0 0 0 1 0

0 0 0 0 1

C=matshuffle(A,B)

Error: sizes of matrices must match

C =

[]

% Exercise 4

type dotcross

function [] =dotcross(a,b)

n=cross(a,b);

if ~any(n(:));

    disp('a and b are parallel')

    disp('The line through the origin parallel to vector a (or b) is')

    syms r(t)

    syms t

    r(t)=t\*a

else

    disp('a and b are not parallel')

    disp('The plane through the origin parallel to both a and b is L(x,y,z)=0,where')

    syms L(x,y,z)

    syms x y z v

    v=[x,y,z];

    L(x,y,z)=dot(n,v)

end

end

% a

a=[1,2,3],b=a

a =

       1              2              3

b =

       1              2              3

dotcross(a,b)

a and b are parallel

The line through the origin parallel to vector a (or b) is

r(t) =

[ t, 2\*t, 3\*t]

% b

a=[1,2,3], b=-a

a =

       1              2              3

b =

      -1             -2             -3

dotcross(a,b)

a and b are parallel

The line through the origin parallel to vector a (or b) is

r(t) =

[ t, 2\*t, 3\*t]

% c

a=ones(1,3),b=[1,2,3]

a =

       1              1              1

b =

       1              2              3

dotcross(a,b)

a and b are not parallel

The plane through the origin parallel to both a and b is L(x,y,z)=0,where

L(x, y, z) =

x - 2\*y + z

% d

a=[1,0,0],b=[0,1,0]

a =

       1              0              0

b =

       0              1              0

dotcross(a,b)

a and b are not parallel

The plane through the origin parallel to both a and b is L(x,y,z)=0,where

L(x, y, z) =

z

% e

a=[0,1,0],b=[1,0,0]

a =

       0              1              0

b =

       1              0              0

dotcross(a,b)

a and b are not parallel

The plane through the origin parallel to both a and b is L(x,y,z)=0,where

L(x, y, z) =

-z

% The planes are the same because the vectors that made them are also the same. The negative sign comes from the fact that, when taking the cross product, the two vectors are switched in order. This results in the normal vector to the plane being negative.

%Exercise 5

type closetozeroroundoff

function B=closetozeroroundoff(A)

[m,n]=size(A);

for i=1:m

for j=1:n

if abs(A(i,j))<10^(-5)

A(i,j)=0;

end

end

end

B=A;

end

type homobasis

function C = homobasis(A)

m = size(A,1);

n = size(A,2);

format rat

red\_ech\_form = rref(A)

[~, pivot\_c] = rref(A);

S = 1:n;

P = setdiff(S,pivot\_c); %nonpivot columns

q = length(P);

%i=1:q;

%fprintf('A free variable is x%i\n',P(i));

p\_rows = any(red\_ech\_form,2);

B = -red\_ech\_form(p\_rows,P);

if q == 0

fprintf('the homogeneous system has only the trivial solution\n');

C = zeros(n,1);

else

C(pivot\_c,:) = B;

C(P,:) = eye(q);

logic = closetozeroroundoff(A\*C) == 0;

if size(C,1) == n && size(C,2) == q && rank(C) == q && all(logic(:))

fprintf('C is a basis for the solution set of the homogenous system\n');

else

fprintf('Not a basis? Impossible!\n');

end

end

A = [-3 4 -8 2; -2 5 4 4]

A =

-3 4 -8 2

-2 5 4 4

C = homobasis(A)

red\_ech\_form =

1 0 8 6/7

0 1 4 8/7

C is a basis for the solution set of the homogenous system

C =

-8 -6/7

-4 -8/7

1 0

0 1

A = [1 2 -3]

A =

1 2 -3

C = homobasis(A)

red\_ech\_form =

1 2 -3

C is a basis for the solution set of the homogenous system

C =

-2 3

1 0

0 1

A=magic(3)

A =

8 1 6

3 5 7

4 9 2

C = homobasis(A)

red\_ech\_form =

1 0 0

0 1 0

0 0 1

the homogeneous system has only the trivial solution

C =

0

0

0

A=magic(4)

A =

16 2 3 13

5 11 10 8

9 7 6 12

4 14 15 1

C = homobasis(A)

red\_ech\_form =

1 0 0 1

0 1 0 3

0 0 1 -3

0 0 0 0

C is a basis for the solution set of the homogenous system

C =

-1

-3

3

1

A = [0 1 2 3; 0 2 4 6]

A =

0 1 2 3

0 2 4 6

C = homobasis(A)

red\_ech\_form =

0 1 2 3

0 0 0 0

C is a basis for the solution set of the homogenous system

C =

1 0 0

0 -2 -3

0 1 0

0 0 1

A=[0 1 0 2 0 3; 0 2 0 4 0 6; 0 4 0 8 0 6]

A =

Columns 1 through 4

0 1 0 2

0 2 0 4

0 4 0 8

Columns 5 through 6

0 3

0 6

0 6

C = homobasis(A)

red\_ech\_form =

Columns 1 through 4

0 1 0 2

0 0 0 0

0 0 0 0

Columns 5 through 6

0 0

0 1

0 0

C is a basis for the solution set of the homogenous system

C =

1 0 0 0

0 0 -2 0

0 1 0 0

0 0 1 0

0 0 0 1

0 0 0 0

A=[0 0 1 2 3;0 0 2 4 5]

A =

Columns 1 through 4

0 0 1 2

0 0 2 4

Column 5

3

5

C = homobasis(A)

red\_ech\_form =

Columns 1 through 4

0 0 1 2

0 0 0 0

Column 5

0

1

C is a basis for the solution set of the homogenous system

C =

1 0 0

0 1 0

0 0 -2

0 0 1

0 0 0

A=[0 0 1 2 3;0 0 2 4 6]

A =

Columns 1 through 4

0 0 1 2

0 0 2 4

Column 5

3

6

C = homobasis(A)

red\_ech\_form =

Columns 1 through 4

0 0 1 2

0 0 0 0

Column 5

3

0

C is a basis for the solution set of the homogenous system

C =

1 0 0 0

0 1 0 0

0 0 -2 -3

0 0 1 0

0 0 0 1

% h is only able to span a single line in 3D space because all the columns are multiples of each other. The matrix in g can span a plane. This is shown by the fact that part h has only one basic variable while part g has two basic variables.

% Exercise 6

type stochastic

function P=stochastic(A)

if all(A>=0)

S1=sum(A,1);

S2=transpose(sum(A,2));

if ~all(S1, 2) && ~all(S2, 2)

disp('A is not stochastic and cannot be scaled to stochatic')

S1

S2

P=[];

elseif all(S1==1) && all(S2==1)

disp('Matrix A is doubly stochastic matrix')

P=A;

elseif all(S2==1)

disp('Matrix A is a right stochastic matrix')

P=A;

elseif all(S1==1)

disp('Matrix A is a left stochastic matrix')

P=A;

else

disp('neither right nor left stochastic but can be scaled to stochastic')

if all(S1,2)

S1=1./S1;

P=A.\*S1;

else

S2=transpose(1./S2);

P=A.\*S2;

end

end

else

disp('All entries in matrix A must be nonnegative')

end

A=[.5 0 .5;0 0 1;.5 0 .5]

A =

0.5000 0 0.5000

0 0 1.0000

0.5000 0 0.5000

P=stochastic(A)

Matrix A is a right stochastic matrix

P =

0.5000 0 0.5000

0 0 1.0000

0.5000 0 0.5000

A=transpose(A)

A =

0.5000 0 0.5000

0 0 0

0.5000 1.0000 0.5000

P=stochastic(A)

Matrix A is a left stochastic matrix

P =

0.5000 0 0.5000

0 0 0

0.5000 1.0000 0.5000

A=[.5 0 .5;0 0 1;0 0 .5]

A =

0.5000 0 0.5000

0 0 1.0000

0 0 0.5000

P=stochastic(A)

neither right nor left stochastic but can be scaled to stochastic

P =

0.5000 0 0.5000

0 0 1.0000

0 0 1.0000

A=transpose(A)

A =

0.5000 0 0

0 0 0

0.5000 1.0000 0.5000

P=stochastic(A)

neither right nor left stochastic but can be scaled to stochastic

P =

0.5000 0 0

0 0 0

0.5000 1.0000 1.0000

A=[.5 0 .5;0 .5 .5;.5 .5 0]

A =

0.5000 0 0.5000

0 0.5000 0.5000

0.5000 0.5000 0

P=stochastic(A)

Matrix A is doubly stochastic matrix

P =

0.5000 0 0.5000

0 0.5000 0.5000

0.5000 0.5000 0

A=magic(3)

A =

8 1 6

3 5 7

4 9 2

P=stochastic(A)

neither right nor left stochastic but can be scaled to stochastic

P =

0.5333 0.0667 0.4000

0.2000 0.3333 0.4667

0.2667 0.6000 0.1333

A=diag([1,2,3])

A =

1 0 0

0 2 0

0 0 3

P=stochastic(A)

neither right nor left stochastic but can be scaled to stochastic

P =

1 0 0

0 1 0

0 0 1

A=[0 0 0;0 .5 .5;0 .5 .5]

A =

0 0 0

0 0.5000 0.5000

0 0.5000 0.5000

P=stochastic(A)

A is not stochastic and cannot be scaled to stochatic

S1 =

0 1 1

S2 =

0 1 1

P =

[]

A=randi(10,5,5);A(:,1)=0;A(1,:)=0

A =

0 0 0 0 0

0 3 1 6 10

0 7 3 10 1

0 7 10 1 8

0 8 2 5 9

P=stochastic(A)

A is not stochastic and cannot be scaled to stochatic

S1 =

0 25 16 22 28

S2 =

0 20 21 26 24

P =

[]

%Exercise 7

type economy

function [C,x] = economy(A)

%This purpose of this function is to

%take a matrix A=randi(100,4,4) as

%the input.

P=stochastic(A);

B = P - eye(size(A,2));

C=homobasis(B);

syms x4

x = x4\*C;

n=([1:4])';

Q=[P,n];

T=array2table(Q,...

 'VariableNames',{'Sector1','Sector2','Sector3','Sector4','n'});

disp(T,false)

end

type stochastic

function P=stochastic(A)

if all(A>=0)

S1=sum(A,1);

S2=transpose(sum(A,2));

if ~all(S1, 2) && ~all(S2, 2)

    disp('A is not stochastic and cannot be scaled to stochatic')

    S1

    S2

    P=[];

elseif all(S1==1) && all(S2==1)

        disp('Matrix A is doubly stochastic matrix')

        P=A;

elseif all(S2==1)

    disp('Matrix A is a right stochastic matrix')

    P=A;

elseif all(S1==1)

    disp('Matrix A is a left stochastic matrix')

    P=A;

else

    disp('neither right nor left stochastic but can be scaled to stochastic')

    if all(S1,2)

        S1=1./S1;

        P=A.\*S1;

    else

        S2=transpose(1./S2);

        P=A.\*S2;

    end

end

else

    disp('All entries in matrix A must be nonnegative')

end

type homobasis

function C = homobasis(A)

m = size(A,1);

n = size(A,2);

format rat

red\_ech\_form = rref(A)

[~, pivot\_c] = rref(A);

S = 1:n;

P = setdiff(S,pivot\_c); %nonpivot columns

q = length(P);

%i=1:q;

%fprintf('A free variable is x%i\n',P(i));

p\_rows = any(red\_ech\_form,2);

B = -red\_ech\_form(p\_rows,P);

if q == 0

    fprintf('the homogeneous system has only the trivial solution\n');

    C = zeros(n,1);

else

    C(pivot\_c,:) = B;

    C(P,:) = eye(q);

    logic = closetozeroroundoff(A\*C) == 0;

    %size(C,1) == n, size(C,2) == q, all(logic(:)), rank(C) == q

    if size(C,1) == n && size(C,2) == q && rank(C) == q && all(logic(:))

        fprintf('C is a basis for the solution set of the homogenous system\n');

    else

        fprintf('Not a basis? Impossible!\n');

    end

end

function B=closetozeroroundoff(A)

[mm,nn]=size(A);

for i=1:mm

 for j=1:nn

 if abs(A(i,j))<10^(-5)

 A(i,j)=0;

 end

 end

end

B=A;

end

end

A=randi(100,4,4)

A =

      43             66             68             66

      92              4             76             18

      80             85             75             71

      96             94             40              4

[C,x] = economy(A)

neither right nor left stochastic but can be scaled to stochastic

red\_ech\_form =

       1              0              0          -1606/1297

       0              1              0          -1694/1795

       0              0              1           -932/609

       0              0              0              0

C is a basis for the solution set of the homogenous system

    Sector1    Sector2     Sector3    Sector4     n

    \_\_\_\_\_\_\_    \_\_\_\_\_\_\_\_    \_\_\_\_\_\_\_    \_\_\_\_\_\_\_\_    \_

    0.13826     0.26506    0.26255     0.41509    1

    0.29582    0.016064    0.29344     0.11321    2

    0.25723     0.34137    0.28958     0.44654    3

    0.30868     0.37751    0.15444    0.025157    4

C =

    1606/1297

    1694/1795

     932/609

       1

x =

   (348534128553079\*x4)/281474976710656

 (2125096993065733\*x4)/2251799813685248

 (3446102032350809\*x4)/2251799813685248

                                     x4

diary off