Assignment 3
Juan Silva
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Problem Set 4

Problem Set 4-1:

Enter the matrices and vectors:

$$A = \begin{bmatrix} 2 & 3 & 7 \\ 1 & 2 & 0 \\ 4 & 1 & 5 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 0 & 9 \\ 2 & 1 & 4 \\ 3 & 1 & 2 \end{bmatrix} \quad c = [1\ 2\ 4] \ d = \begin{bmatrix} 2 \\ 0 \\ 3 \end{bmatrix}$$

Find the products (where they exist): c*A, c*B, A*B, d*A

```
c * A
c * B
A*B
% d * A
display('d * A does not exist')
```

Results

```
ans =
    20    11    27
ans =
    17     6    25
ans =
    29    10    44
     5     2    17
    21     6    50
d * A does not exist
```

Problem Set 4-2:

If x is the column vector [x1;x2;x3], solve the system of the equations Ax=d.

```
x = inv(A) * d
```

Results

```
x =
    0.5000
   -0.2500
    0.2500
```

Problem Set 4-3:

Solve the system of equations:

```
3x1 + 2x2 + x3 = 10
5x1 + x2 - x3 = -1
4x1 - 2x2 + 2x3 = 2
```

```
m = [3,2,1;5,1,-1;4,-2,2];
v = [10,-1,2]';
y = inv(m) * v
```

Results

```
y =
    0.0000
    3.0000
    4.0000
```

Problem Set 4-4:

Compute: A - B

```
      A - B
```

Results

```
ans =
     1     3    -2
    -1     1    -4
     1     0     3
```

Problem Set 4-5:

Use scalar expansion to create a new matrix, A_new, such that each element of A (from problem 1) is decreased by 4.

```
      A_new =  A – 4
```

Results

```
A_new =
    -2    -1     3
    -3    -2    -4
     0    -3     1
```

Problem Set 4-6:

For matrix A (in problem 1), find:

```
%a. the determinant
detA = det(A)
%b. the inverse
inverseA = inv(A)
%c. the eigenvalue and eigenvector
[v, lamda] = eig(A)
```

Results

```
detA =
   -44
inverseA =
   -0.2273    0.1818    0.3182
    0.1136    0.4091   -0.1591
    0.1591   -0.2273   -0.0227
v =
   -0.7124   -0.8704   -0.0589
   -0.0984    0.2021   -0.9177
   -0.6949    0.4489    0.3928
```

```
lamda =
    9.2423         0         0
         0   -2.3064         0
         0         0    2.0641
```

Problem Set 4-7:

For vector c (in problem 1) use MATLAB to compute

```
%a. the number of element or entries
size(c)
%b. the geometric (or Euclidean length)
length(c)
```

Results

```
ans =
     1     3
ans =
     3
```

Problem Set 4-8:

Create a row vector with 3 entries containing

```
% a. the sum of the entries for the 3 columns given
% in matrix A (from problem 1).
A
R = sum(A)
% b. the product of the entries for the 3 columns
% given in matrix A (from problem 1).
A
R = prod(A)
```

Results

```
A =
     2     3     7
     1     2     0
     4     1     5
R =
     7     6    12
A =
     2     3     7
     1     2     0
     4     1     5
R =
     8     6     0
```

Problem Set 4-9:

```
% 9a. Create a 4 x 5 matrix of all 0's.
zeros(4,5)

% 9b. Create a row vector containing twenty 1's.
ones(1,20)
```

```
% 9c. Create a 5 x 5 identity matrix.
eye(5)
```

Results

```
ans =
     0     0     0     0     0
     0     0     0     0     0
     0     0     0     0     0
     0     0     0     0     0
ans =
  Columns 1 through 10
     1     1     1     1     1     1     1     1     1     1
  Columns 11 through 20
     1     1     1     1     1     1     1     1     1     1
ans =
     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
```

Problem Set 4-10:

Consider the vectors cur = [4 5 6 7] and volt = [2 8 9 3] containing the currents (in Amps) through and the voltages (in Volts) across 4 particular resistors at some point in time. Create a vector containing the power dissipated by the 4 resistors.

```
%P = iV

cur = [4:7];          %Amps
volt = [2,8,9,3];     %Volts

pwr = cur .* volt     %Watts
```

Results

```
pwr =
     8    40    54    21
```

Problem Set 4-11:

Consider two functions: s(t) = t^3+ 5 and w(t) = 2t^4. Create a 3-column table, showing t, s(t) and w(t), for t values 0, .25, ..., 2.

```
t = [0:0.25:2]';
disp('------------------------------')
disp('       t       s(t)      w(t)')
disp('------------------------------')
[ t t.^3+5 2*t.^4]
```

Results

```
------------------------------
       t       s(t)      w(t)
------------------------------
ans =
         0    5.0000         0
```

```
0.2500    5.0156    0.0078
0.5000    5.1250    0.1250
0.7500    5.4219    0.6328
1.0000    6.0000    2.0000
1.2500    6.9531    4.8828
1.5000    8.3750   10.1250
1.7500   10.3594   18.7578
2.0000   13.0000   32.0000
```

Problem Set 4-12:

A company manufactures 5 disks with radii given (in inches) in the following vector: rad = [2 2.5 3 5 7]. Create a 2-column table, showing the radii for the manufactured disks in column 1 and the corresponding areas (in sq. in.) in column 2.

```
rad = [2, 2.5, 3, 5, 7]';

disp('------------------------------')
disp('      Radii   Area')
disp('------------------------------')

area = 2*pi .* rad;
[rad  area]
```

Results

```
------------------------------
      Radii   Area
------------------------------
ans =
    2.0000   12.5664
    2.5000   15.7080
    3.0000   18.8496
    5.0000   31.4159
    7.0000   43.9823
```

Problem Set 4-13:

Create a matrix, say H, whose first row lists 0., 1, ...,9, whose second row lists 10, 11, ..., 19, ..., and whose 10th row lists 90, 91, ..., 99.

```
row = [0:9];
col = [0: 10: 90];
H = row + col'

sum = sum(H)
prod = prod(sum)
```

Results

```
H =
     0     1     2     3     4     5     6     7     8     9
    10    11    12    13    14    15    16    17    18    19
    20    21    22    23    24    25    26    27    28    29
```

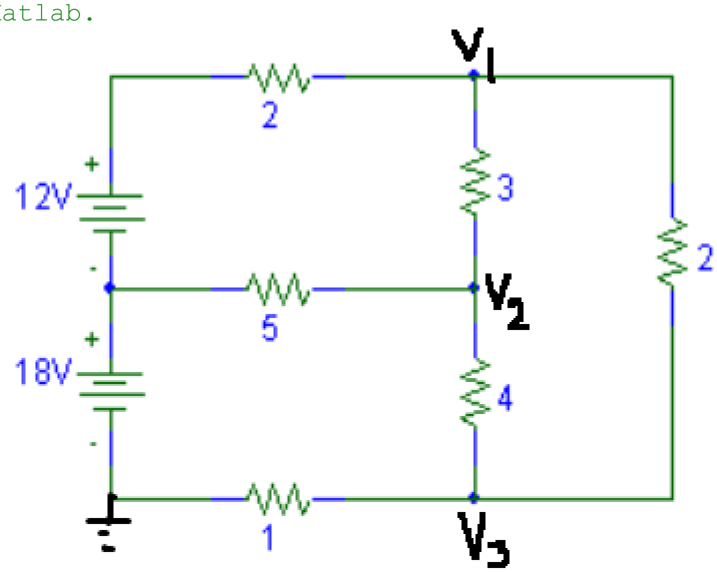
```
    30    31    32    33    34    35    36    37    38    39
    40    41    42    43    44    45    46    47    48    49
    50    51    52    53    54    55    56    57    58    59
    60    61    62    63    64    65    66    67    68    69
    70    71    72    73    74    75    76    77    78    79
    80    81    82    83    84    85    86    87    88    89
    90    91    92    93    94    95    96    97    98    99
sum =
   450   460   470   480   490   500   510   520   530   540
prod =
   8.6840e+26
```

Problem Set 5

Problem Set 5-1:
For the circuit below, label the bottom left node as "ground"; then

```
% a. label the unknown nodal voltages
% b. determine (by inspection) the conductance matrix, G;
% c. determine (by inspection) the effective source current vector, is;
% d. use MATLAB to solve the equation: Gv= is for the unknown nodal voltages
in vector v. find the downward current through the right-most 2W resistor.
Ans: 5.2131 A


% Program Name: nodalAnalysis.m
% Author: Juan Silva Last Modified: Feb. 14, 2018
% Description: This program will find the voltages at specified nodes using
inspection and Matlab.
```




```
clear, clc, close all
format short, format compact

% Define variables

Vs1 = 12    %volts
```

```
Vs2 = 18    %volts

R1 = 2;     %Ohms
R2 = 3;     %Ohms
R3 = 2;     %Ohms
R4 = 5;     %Ohms
R5 = 4;     %Ohms
R6 = 1;     %Ohms

G1 = (R1)^-1;
G2 = (R2)^-1;
G3 = (R3)^-1;
G4 = (R4)^-1;
G5 = (R5)^-1;
G6 = (R6)^-1;

% Start Code

% Develop the conductance matrix using inspection
a11 = G1 + G2 + G3;
a12 = -G2;
a13 = -G3;
a21 = -G2;
a22 = G2 + G4 + G5;
a23 = -G5;
a31 = -G3;
a32 = -G5;
a33 = G3 + G5 + G6;

% Create the matrix and current source vector.
G = [a11,a12,a13;a21,a22,a23;a31,a32,a33]
Is = [(Vs1 + Vs2) * G1; Vs2 * G4; 0 * G6]

% Solve for voltage vector
v = inv(G) * Is
display('            Volts');

% Use Ohm's Law to solve the current at resistance
downCurrent = (v(1) - v(3)) / R3
```

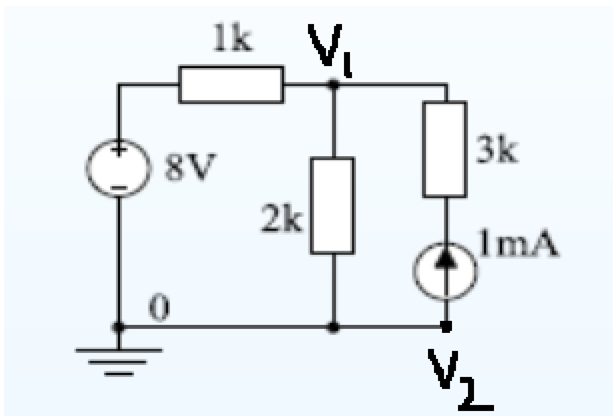
Results

```
G =
    1.3333   -0.3333   -0.5000
   -0.3333    0.7833   -0.2500
   -0.5000   -0.2500    1.7500
Is =
   15.0000
    3.6000
         0
v =
   17.4492
   14.2623
    7.0230
            Volts
downCurrent =
    5.2131
```

Problem Set 5-2:
Notation: In the sketch below, the boxes represent resistors; note that the ground is already labeled.

```
% a. label the unknownnodal voltages;
% b. determine (by inspection) the conductance matrix, G;
% c. determine (by inspection) the effective source current vector, is;
% d. use MATLAB to solve the equation: Gv= isfor the unknown nodal voltages
% in vector v;
% Ans:  v = [6; 9]e. find the downward current through the 2 KW resistor.
% Ans:  3 mA

% Program Name: nodalAnalysis2.m
% Author: Juan Silva Last Modified: Feb. 14, 2018
% Description: This program will find the voltages at specified nodes using
inspection and Matlab.
```




```
% Define variables
Vs1 = 8;        %volts
Is = 1e-3;      %amps

R1 = 1e3;       %Ohms
R2 = 2e3;       %Ohms
R3 = 3e3;       %Ohms

G1 = (R1)^-1;
G2 = (R2)^-1;
G3 = (R3)^-1;

% Start Code

% Develop the conductance matrix using inspection
a11 = G1+G2+G3;
a12 = -(G3);
a21 = -(G3);
a22 = G3;
G = [a11,a12;a21,a22]

% Effective current source by inspection
I = [G1 * Vs1; 1e-3];
```

```
% Solve for voltage vector
v = inv(G) * I

display('            Volts');

% Use Ohm's Law to solve the current at resistance
downCurrent2 = (v(1) - 0) / R2
```

Results

```
G =
    0.0018   -0.0003
   -0.0003    0.0003
w =
    6.0000
    9.0000
            Volts

downCurrent2 =
    0.0030
```