EGR 103L - Fall 2016

Laboratory 7 - Linear Algebra

CEMAL YAGCIOGLU (cy111)
Lab Section 5D, Wednesday 11.45AM - 2.35PM
30 OCTOBER, 2016

I understand and have adhered to all the tenets of the Duke Community Standard in completing every part of this assignment. I understand that a violation of any part of the Standard on any part of this assignment can result in failure of this assignment, failure of this course, and/or suspension from Duke University.

Contents

List of Figures

1 Palm Problem 8.1

Part	x	y	z
a	2.4762e+00	2.4762e+00	N/A
b	-1.1818e+00	1.0909e+00	N/A
c	3.0000e+00	5.0000e+00	-2.0000e+00
d	2.0035e+00	-2.6848e+00	5.2312e+00

2 Based on Chapra Problem 8.3

$$\left[\mathbf{A}\right]\left\{\mathbf{x}\right\} = \left\{\mathbf{b}\right\}$$

$$\begin{bmatrix} 0 & -6 & 5 \\ 0 & 2 & 7 \\ -4 & 3 & -7 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \\ x_3 \end{Bmatrix} = \begin{Bmatrix} 50 \\ -30 \\ 50 \end{Bmatrix}$$

Solution is:

$$\begin{Bmatrix} -1.7019e+01 \\ -9.6154e+00 \\ 1.5385e+00 \end{Bmatrix}$$

Transpose of the matrix A:

$$\begin{bmatrix} 0 & 0 & -4 \\ -6 & 2 & 3 \\ 5 & 7 & -7 \end{bmatrix}$$

Inverse of the matrix A:

$$\begin{bmatrix} -1.6827e-01 & -1.2981e-01 & -2.5000e-01 \\ -1.3462e-01 & 9.6154e-02 & 0 \\ 3.8462e-02 & 1.1538e-01 & 0 \end{bmatrix}$$

Condition number for 1 norm is 19. Condition number for 2 norm is 1.2062e+01. Condition number for Frobenius norm is 1.3711e+01. Condition number for infinity norm is 14. They show the relative error. Thus higher level norms can be said to give more reliable answers.

3 Based on Chapra Problem 8.10

$$\begin{bmatrix} -cos(30) & 0 & cos(60) & 0 & 0 & 0 \\ -sin(30) & 0 & -sin(60) & 0 & 0 & 0 \\ cos(30) & 1 & 0 & 2 & 0 & 0 \\ sin(30) & 0 & 0 & 0 & 2 & 0 \\ 0 & -1 & cos(60) & 0 & 0 & 0 \\ 0 & 0 & sin(60) & 0 & 0 & 2 \end{bmatrix} \begin{Bmatrix} F_1 \\ F_2 \\ F_3 \\ H_2 \\ V_2 \\ V_3 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 2000 \\ 0 \\ 0 \\ 0 \\ 0 \end{Bmatrix}$$

Answers of the Matrix:

F_1:	`-1.000e+03 N`
F_2:	`-8.660e+02 N`
F_3:	`-1.732e+03 N`
H_2:	`8.660e+02 N`
V_2:	`2.500e+02 N`
V_3:	`7.500e+02 N`

4 Palm 8.5(b)

When c is equal to zero, none of the other x,y,z variables has coefficients leading to x=y=z=0. This point can also be seen on the graph. As we are including both ends of the limits, taking 201 points gives us less rounded points and it also gives us the answer for when c variable is zero. If 200 was used, the c=0 would not be tested.

5 Based on Palm 8.9

$$\begin{bmatrix} 3 & -1 & -1 & 0 \\ -1 & 2 & 0 & -1 \\ -1 & 0 & 2 & -1 \\ 0 & -1 & -1 & 3 \end{bmatrix} \begin{Bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \end{Bmatrix} = \begin{Bmatrix} T_a \\ 0 \\ 0 \\ T_b \end{Bmatrix}$$

Temperature data for T_a=120 degree Celcius and T_b=20 degree Celcius:

T1: 1.067e+02 C
T2: 8.500e+01 C
T3: 8.500e+01 C
T4: 6.333e+01 C

6 Based on Palm 8.16(a)

The a,b,c values for the first part of the question are respectively 6,-7,5.Calculated coefficients of for the set of points are in the table below.

Points	a	b	c
(1,4), (4, 73), (5, 120)	6.00e+00	-7.00e+00	5.00e+00
(1,4), (4, -73), (5, 120)	5.47e+01	-2.99e+02	2.48e+02
(1,4), (4, 73), (4, 120)	**N/A**	**N/A**	**N/A**
(1,4), (4, 73), (5, -120)	-5.40e+01	2.93e+02	-2.35e+02

A Codes and Output

A.1 Problem Palm 8.1, p. 357

```
%[Problem1.m]
%[Cemal Yagcioglu]
%[October 30,2016]
% I have adhered to all the tenets of the
% Duke Community Standard in creating this code.
% Signed: [cy111]
clear
format short e
a1=[2,1;3,-9];
b1=[5;7];
A1=a1\b1

a2=[-8,-5;-2,7];
b2=[4;10];
A2=a2\b2

a3=[12,-5,0;-3,4,7;6,2,3];
b3=[11;-3;22];
A3=a3\b3

a4=[6,-3,4;12,5,-7;-5,2,6];
b4=[41;-26;16];
A4=a4\b4
```

A.2 Problem Based on Chapra Problem 8.3, p. 226

```
%[Problem2.m]
%[Cemal Yagcioglu]
%[October 30,2016]
% I have adhered to all the tenets of the
% Duke Community Standard in creating this code.
% Signed: [cy111]
clear
format short e

a=[0,-6,5;0,2,7;-4,3,7]
b=[50;-30;50]
InvA=inv(a)
UnknownAns=InvA*b
TransPosA=a'
Norm1=norm(a,1)
Norm2=norm(a)
NormFro=norm(a, 'fro')
NormInf=norm(a,Inf)
```

A.3 Problem Chapra 8.10, pp. 226-227

```
%[Problem3.m]
%[Cemal Yagcioglu]
%[October 30,2016]
% I have adhered to all the tenets of the
% Duke Community Standard in creating this code.
```

```
% Signed: [cy111]

a = [-cosd(30),0,cosd(60),0,0,0;...
    -sind(30),0,-sind(60),0,0,0;...
    cosd(30),1,0,2,0,0;...
    sind(30),0,0,0,2,0;...
    0,-1,cosd(60),0,0,0;...
    0,0,sind(60),0,0,2]

b=[0;2000;0;0;0;0]

Answers=a\b

TrussData = fopen(’TrussData.txt’, ’w’)
fprintf(TrussData, ’\n\\begin{tabular}{|c c|}\\hline\n’);
fprintf(TrussData, ’$F_1$: & %0.3e N\\\\\n’, Answers(1))
fprintf(TrussData, ’$F_2$: & %0.3e N\\\\\n’, Answers(2))
fprintf(TrussData, ’$F_3$: & %0.3e N\\\\\n’, Answers(3))
fprintf(TrussData, ’$H_2$: & %0.3e N\\\\\n’, Answers(4))
fprintf(TrussData, ’$V_2$: & %0.3e N\\\\\n’, Answers(5))
fprintf(TrussData, ’$V_3$: & %0.3e N\\\\\\hline\n’, Answers(6))
fprintf(TrussData, ’\\end{tabular}\n’)

fclose(TrussData)

```

A.4 Problem Palm 8.5(b), p. 359

```
A = [1,-5,-2;6,3,1;7,3,-5]

c=linspace(-10,10,201)

for k=1:length(c)
    b=[11.*c(k);13.*c(k);10.*c(k)]
    MyVals=A\b
    x(k)=MyVals(1)
    y(k)=MyVals(2)
    z(k)=MyVals(3)

end
figure(1);clf
plot(c,x,’b-’,c,y,’r-’,c,z,’k-’)
title(’The Solution for Palm Problem 8.5(b), p.359(cy111)’)
xlabel(’values of c’)
ylabel(’x,y,z answers’)
legend(’x’,’y’,’z’,’Location’,’northwest’)

print -depsc Problem4
```

A.5 Problem Based on Palm 8.9, p. 363-364

```
%[Temperatures.m]
%[Cemal Yagcioglu]
%[October 30,2016]
% I have adhered to all the tenets of the
% Duke Community Standard in creating this code.
```

```
% Signed: [cy111]
clear
TemperatureMatrix = [3,-1,-1,0;...
                -1,2,0,-1;...
                -1,0,2,-1;...
                0,-1,-1,3]
Ta=150;
Tb=20;
Outputs = [Ta;0;0;Tb]
UnknownMat=inv(TemperatureMatrix)*Outputs
TempData = fopen('TempData.txt','w')
fprintf(TempData, '\n\\begin{tabular}{|c|}\\hline \n')
for i=1:4
    fprintf(TempData,'T%0.0f:  %0.3e C\\\\\n', i, UnknownMat(i))
end
fprint(TempData,'\\hline\n')
fprintf(TempData, '\\end{tabular}\n')
fclose(TempData)

```

A.6 Problem Based on Palm 8.16(a), pp. 367 a,b,c solver

```
%[ABCSolver.m]
%[Cemal Yagcioglu]
%[October 30,2016]
% I have adhered to all the tenets of the
% Duke Community Standard in creating this code.
% Signed: [cy111]
%First Part of the Palm 8.16(a) - Calculating a b c

clear
Coeff = [1,1,1;16,4,1;25,5,1]
Output = [4;73;120]
unknowns = inv(Coeff)*Output
```

A.7 Problem Based on Palm 8.16(a), pp. 367 Function

```
%[findquad.m]
%[Cemal Yagcioglu]
%[October 30,2016]
% I have adhered to all the tenets of the
% Duke Community Standard in creating this code.
% Signed: [cy111]

%PART 1 : Calculating
%clear
%Coeff = [1,1,1;16,4,1;25,5,1]
%Output = [4;73;120]
%unknowns = inv(Coeff)*Output

function [a,b,c] = findquad(x,y,flag)
hold off
if nargin<2
    error('Not enough input arguments!')
elseif nargin==2
    flag=0
```

```
end
for i=1:3
CoeffMat(i,:) = [x(i).^2,x(i),1];
end
if cond(CoeffMat)>10^5
    error('Matrix is ill conditioned!')
else
    vectorY=y';
    abc=inv(CoeffMat)*vectorY;
    a=abc(1);
    b=abc(2);
    c=abc(3);
    fprintf('a:%0.2e, b:%0.2e, c:%0.2e', a,b,c)
    if flag==1
         ExtRange=(max(x)-min(x)).*0.1;
         X = linspace(min(x)-ExtRange,max(x)+ExtRange,100);
         Y=a.*X.^2+b.*X+c;
         plot(X,Y)
         grid on
         title(sprintf('Graph of y=%0.2ex^2%+0.2ex%+0.2e(cy111)', a , b , c ))
         hold on
         plot(x,y,'s','MarkerSize',12,'LineWidth',3,...
             'MarkerFaceColor','g','MarkerEdgeColor','b')
         xlabel('x')
         ylabel('y')
         %print -depsc findquad1
         %print -depsc findquad2
         print -depsc findquad3
    end

end
end
```

B Figures

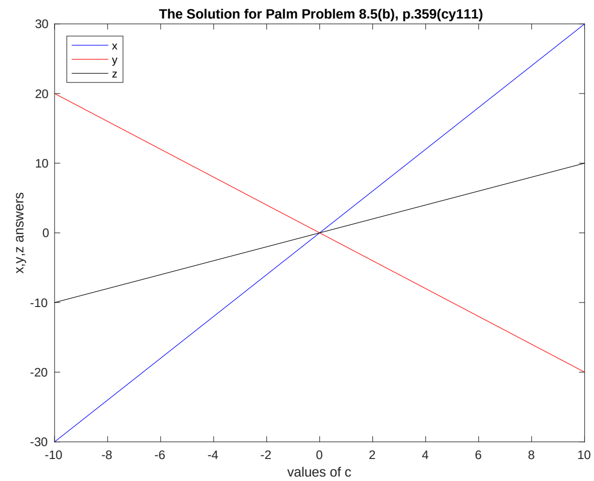

Figure 1: Palm Problem 8.5(b), p.359

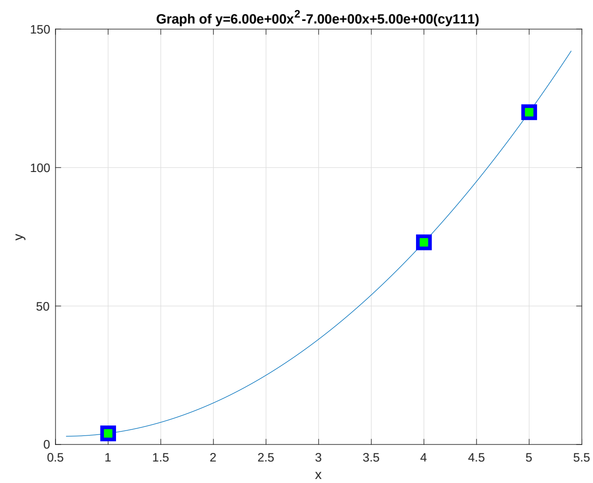

Figure 2: Graph 1 for Palm 8.16(a), pp. 367

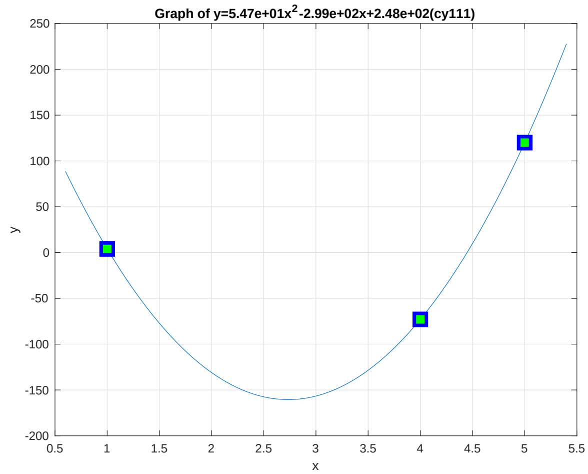

Figure 3: Graph 2 for Palm 8.16(a), pp. 367

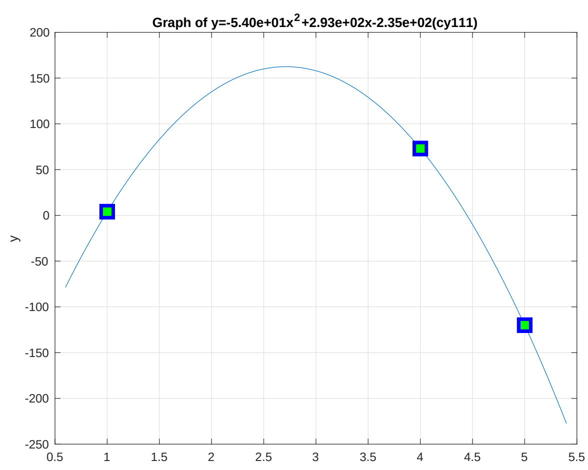

Figure 4: Graph 3 for Palm 8.16(a), pp. 367

References

[1] Chapra, Steven C., *Applied Numerical Methods with MATLAB for Engineering and Scientists*. McGraw-Hill, New York, 3rd Edition, 2012.

[2] Palm, William J., *Introduction to MATLAB for Engineers*. McGraw-Hill, New York, 3rd Edition, 2011.