DELFT UNIVERSITY OF TECHNOLOGY September 2006
Faculty of Electrical Engineering, Mathematics and Computer Science

ANSWERS

Exercise: Matlab introduction exercise

PART I: BASIC MATLAB

1. 1.5954 e+01.

2. 2.3298 e+00.

3. $z_1 z_2 = -1 + 3i$, $|z_1 z_2^2| = 7.0711$.

4. B_{23} = - 567.

$$vw = \begin{bmatrix} -50 & 25 & -15 \\ 100 & -50 & 30 \\ -10 & 5 & -3 \end{bmatrix}$$

wv= -103.

5. Matlab commands to determine C and the determinant of C read:

C = A.^3;
determinant = ***det***(*C*);

det(C) = -7912250.

6. *norm(v,1)*

7. The Matlab command used is:

x = A\b;

$$x = \begin{bmatrix} -3.0714e-01 \\ -2.2143e-01 \\ 3.2143e-01 \end{bmatrix}$$

8. The Matlab commands used are:

```
x = zeros(250,1);          % preallocation
x(1)=0.1;
for j=1:249
        x(j+1)=3.5*x(j)*(1-x(j));
end;
```

The values asked for are:

x_{241} = 8.2694e-01	x_{242} = 5.0088e-01
x_{245} = 8.2694e-01	x_{246} = 5.0088e-01
x_{249} = 8.2694e-01	x_{250} = 5.0088e-01

9. It is not possible to solve the system using multiple right-hand sides. However, it is profitable to perform the decomposition of A only once.

$$x_{10} = \begin{bmatrix} -1.6505e-03 \\ 5.3230e-06 \\ 5.5066e-03 \end{bmatrix}$$

Matlab commands:

```
x(:,1)=b;
[L,U]=lu(A);          % chol also possible
for j=2:10
b=x(:,j-1);
y=L\b; x(:,j)=U\y;
end;
```

10. Matlab commands:

```
v1 = ones (1,10);
v2 = 5 * ones (1,10);
y= [v1  v2 ];
z= [v1'; v2'];
```

11. The Matlab commands are:

```
k = [0:10]';
x = pi*k/10;
y = sin(x);
disp('     x      y(x)');
format short
disp([x y])
```

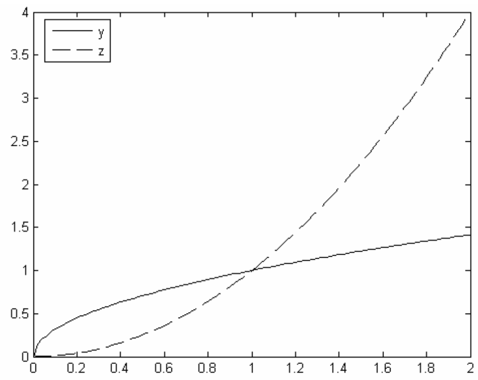
The table should look like this:

x	y (x)
0	0
0.3142	0.3090
0.6283	0.5878
0.9425	0.8090
1.2566	0.9511
1.5708	1.0000
1.8850	0.9511
2.1991	0.8090
2.5133	0.5878
2.8274	0.3090
3.1416	0.0000

12. Matlab commands:

a. *x = [0:N]*h;* or *x=linspace(0,2,N+1);*
b. *y = sqrt (x);*
z = x.^2;

c. The plot is:



13. The script file is:

y = sin(x)/x;

For x = 0.1, this gives y = 0.9983.

14. f = 0.9983

The function file f14.m reads:

function y = f14(x);
y = sin(x)/x;

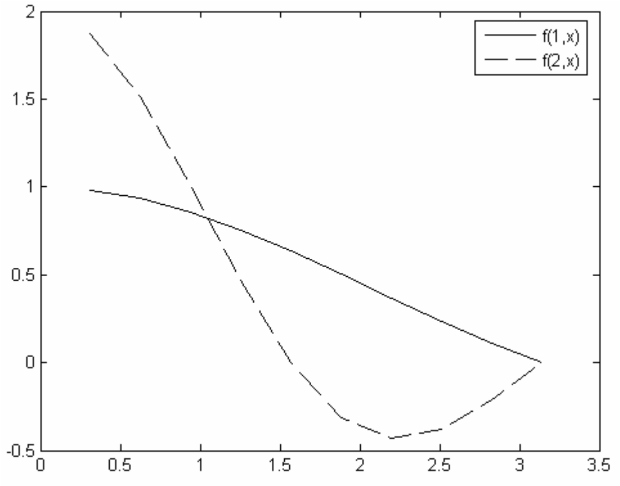
15. f = 0.9983 0.9933 0.9851 0.9735 0.9589

Modification: *y = sin(x)./x;*

16. The function file f16.m reads:

function f = f16(j,x);
*f = sin(j*x)./x;*

The plot is:

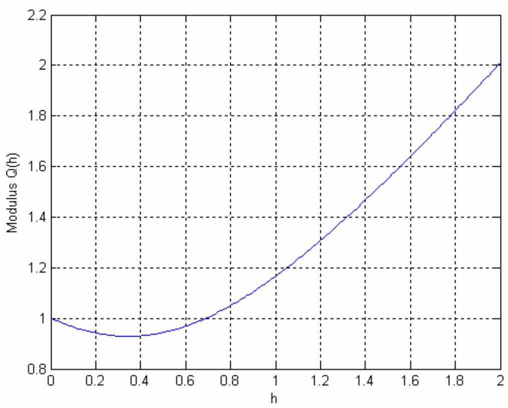


17. h_{max} = 0.69

The Matlab commands to make the plot are:

```
labda=-0.4+i;
h=0:0.01:2;
Q=1+labda*h;
MQ=abs(Q);
plot(h,MQ); grid;
```

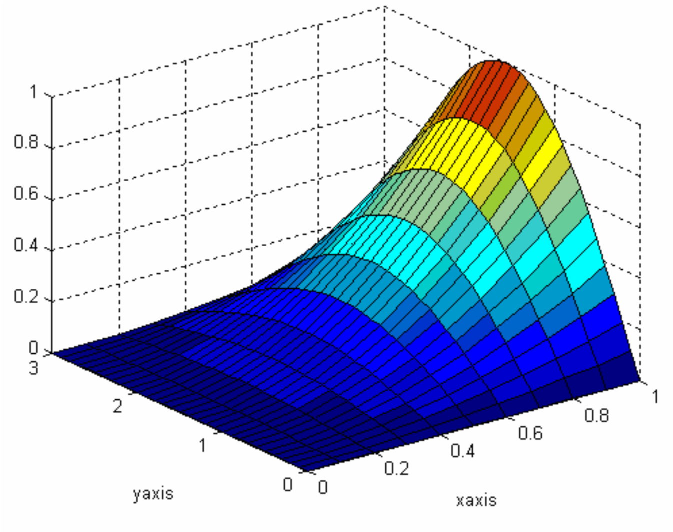
And the resulting plot is:



18. Matlab commands to build f are:

x=0:0.1:1; y=0:0.1:3;
[X,Y]=meshgrid(x,y);
*f=sin(Y).*X.^2;*

The plot is:



PART II: SYMBOLIC COMPUTING

Exercise 1:

a. f'(0.2)=-1.8466

b. $y = \frac{2653370841572301}{2251799813685248} - \frac{8316265243705949}{4503599627370496} * x = 1.1783 - 1.8466 * x$

c. Plot:

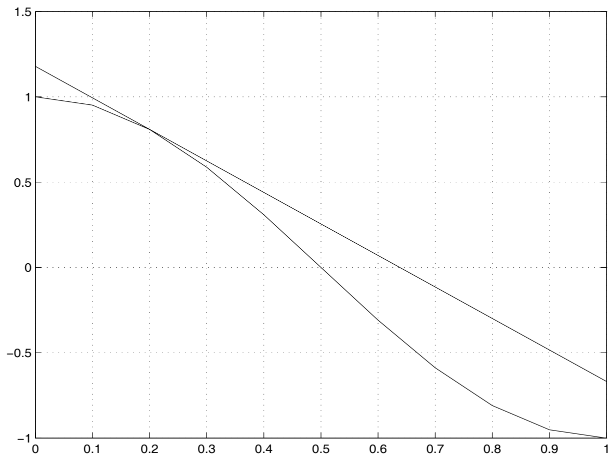


Figure 1: Function f and tangent line in Exercise 1

Matlab commands used:

```
syms x;
f = cos(pi*x);
facc = diff(f);
a=0.2;
facca = subs(facc,x,a)
fa = subs(f,x,a);
y = fa-facca*a + facca*x;
fprintf('y = %7.4f  %7.4f*x\n',fa-facca*a,facca);
xvec = subs(x,x,[0:10]/10);
yvec = subs(y,x,[0:10]/10);
fvec = subs(f,x,[0:10]/10);
plot(xvec,yvec,xvec,fvec); grid;
```

Exercise 2:

a. $f_x = -1/567*21^{1/2} = -0.0081$
$f_y = -44/567*21^{1/2} = -0.3556$

b. $z = 241/1134*21^{1/2}-1/567*21^{1/2}*x-44/567*21^{1/2}*y$

Matlab commands used

```
syms x y;
f = sqrt(1+4*x^2+4*y^2)/(1+x^4+y^4);
fx = diff(f,x); fy = diff(f,y);
x0=sym(1); y0=sym(2);
fx12= subs(fx,{x,y},{x0,y0}),
disp(double(fx12))
fy12= subs(fy,{x,y},{x0,y0});
disp(double(fy12));
f12 = subs(f,{x,y},{x0,y0});
z = f12 + fx12*(x-1) + fy12*(y-2);
z = simplify(z)
```

<u>*Exercise 3:*</u>

a. y(t) =-1/49*exp(8*t)+1/7*t*exp(8*t)+C1*exp(t)+C2*exp(8*t)

b. y(t) =-1/49*exp(8*t)+1/7*t*exp(8*t)+50/49*exp(t)

c. (2 decimals suffice) t_{int} =0.36

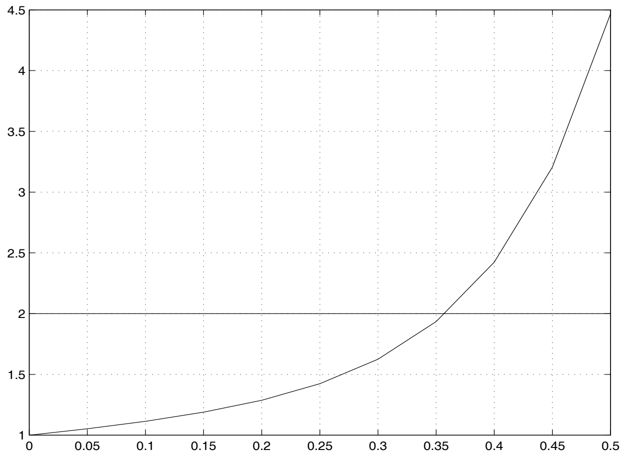


Figure 2: Solution y in Exercise 3

Matlab commands used

```
syms y t
yg = dsolve('D2y-9*Dy+8*y=exp(8*t)')
yp = dsolve('D2y-9*Dy+8*y=exp(8*t)','y(0)=1','Dy(0)=1');
yp = simplify(yp)
tvec=[0:10]/20;
ypvec=subs(yp,t,tvec);
plot(tvec,ypvec,tvec,2*ones(1,11)); grid
tint=ginput(1)
```