Øving 1 - Signalbehandling og kommunikasjon

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Problem 1 - Vectors and matrices

a)

```
A = [1 2; 3 4]
B = [2 -1; 0 1]
v = [0 0 1]
C = A*B
```

```
        A =

             1      2
             3      4


        B =

             2     -1
             0      1


        v =
```

```
        0       0       1


    C =

        2       1
        6       1
```

Multiplisere matrisene komponentvis:

```
D = A.*B


    D =

        2      -2
        0       4
```

Transponerer matrise v

```
vT = transpose(v)


    vT =

        0
        0
        1
```

b) Replacing indexes

```
y = zeros(1,10)


    y =

        0       0       0       0       0       0       0       0       0       0
```

Even indexed elements = Pi

Solution 1:

```
for i=2:2:10
    y(i) = pi;
end
```

Solution 2:

```
y([2:2:end]) = pi
```

```
y =

    Columns 1 through 7

         0    3.1416         0    3.1416         0    3.1416         0

    Columns 8 through 10

      3.1416         0    3.1416
```

Problem 2 Complex numbers

```
z1 = 2*exp((pi/6)*j);
z2 = j-1;
```

a) Imaginary and real parts:

Z1:

```
imag(z1)
real(z1)
```

```
    ans =

        1.0000


    ans =

        1.7321
```

Z2^*:

```
imag(conj(z2))
real(conj(z1))
```

```
    ans =

        -1


    ans =

        1.7321
```

Z1*Z2:

```
imag(z1*z2)
real(z1*z2)
```

```
ans =

    0.7321
```

```
ans =

    -2.7321
```

Z1/Z2:

```
imag(z1/z2)
real(z1/z2)
```

```
ans =

    -1.3660
```

```
ans =

    -0.3660
```

b) Absolute value and argument:

Z1^*:

```
abs(conj(z1))
angle(conj(z1))
```

```
ans =

    2
```

```
ans =

    -0.5236
```

Z2:

```
abs(z2)
angle(conj(z2))
```

```
ans =

    1.4142


ans =

   -2.3562
```

Z1*Z2:

```
abs(z1*z2)
angle(z1*z2)
```

```
    ans =

        2.8284


    ans =

        2.8798
```

Z1/Z2:

```
abs(z1/z2)
angle(z1/z2)
```

```
    ans =

        1.4142


    ans =

       -1.8326
```
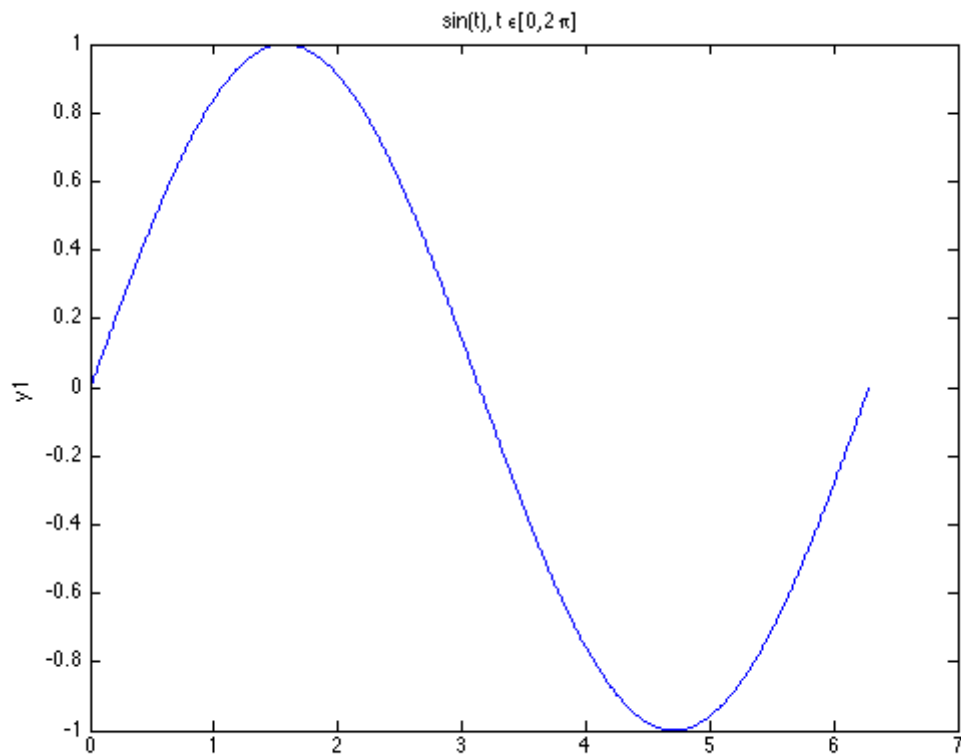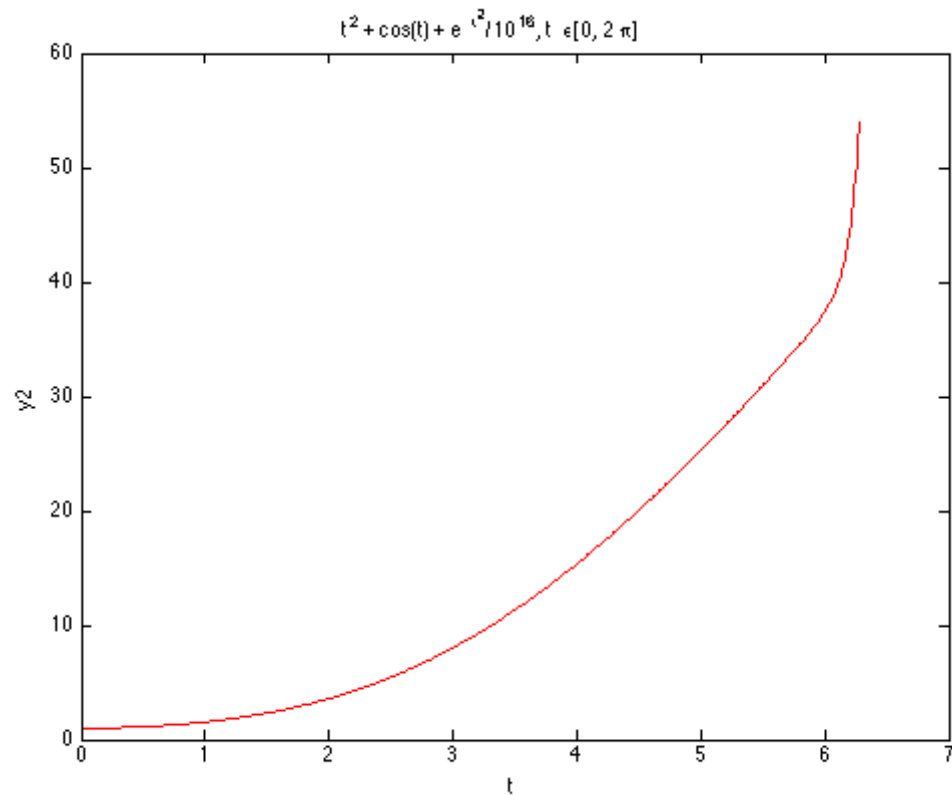
Problem 3 Plotting functions

y1 = sin(t)

y2 = t^2 + cos(t) + e^(t^2)/(10^16)

a)Continuous signals

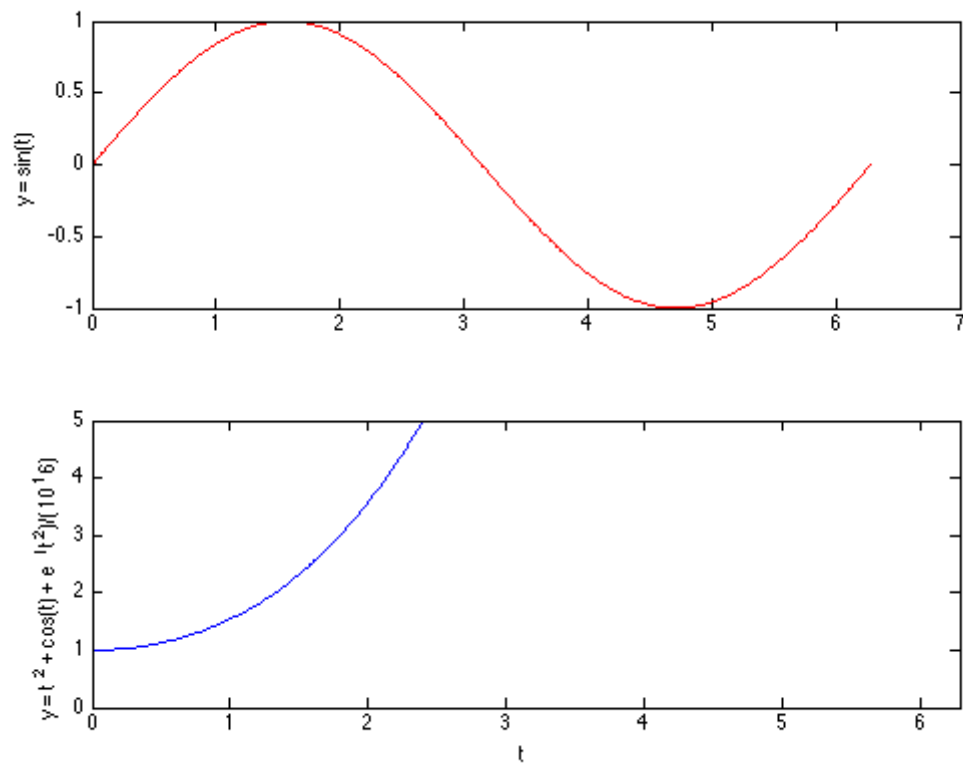```
t = 0:0.01:2*pi;
y1 = sin(t);
```

```
y2 = t.^2 + cos(t) + exp(t.^2)/(10.^16);
plot(t, sin(t))
title('sin(t), t\in [0,2\pi]')
ylabel('y1')
figure
plot(t, y2, 'r')
xlabel('t')
ylabel('y2')
title('t^2 + cos(t) + e^{t^2}/10^{16}, t \in [0, 2\pi]')
xlabel('t')
```

$t^2 + \cos(t) + e^{t^2}/10^{16}, t \in [0, 2\pi]$
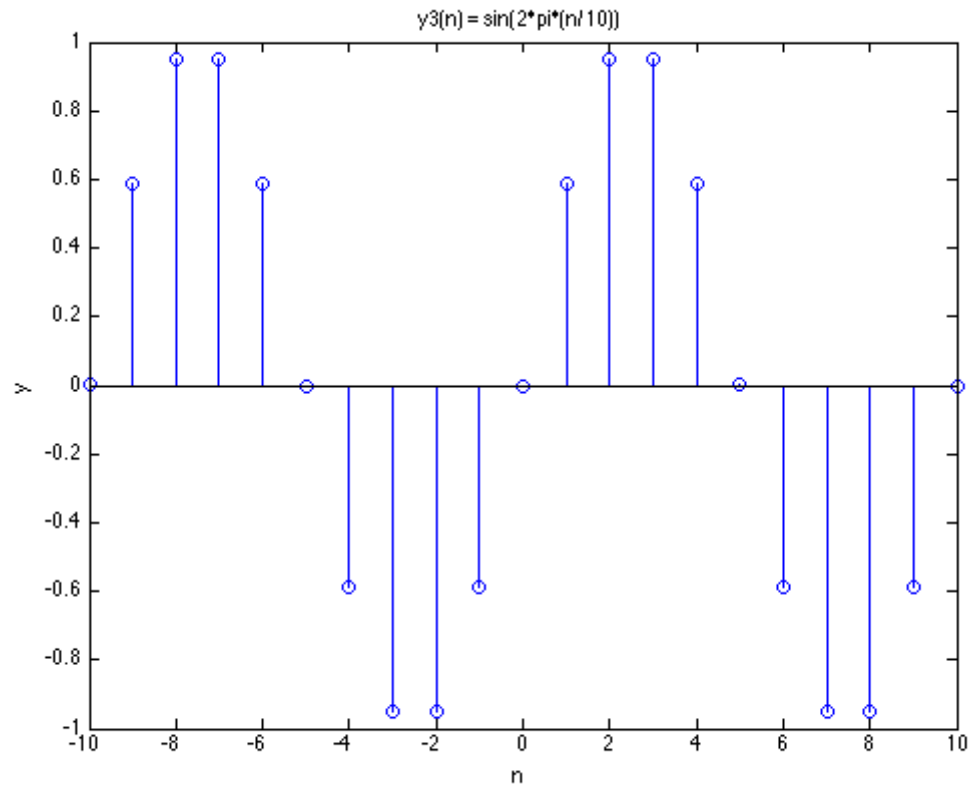

Subplots av funksjonene Y1 og Y2:

```
subplot(2,1,1);
plot(t,sin(t),'r');
ylabel('y = sin(t)');
subplot(2,1,2);
plot(t,t.^2 + cos(t) + exp(t.^2)/(10.^16));
axis([0,2*pi,0,5]);
xlabel('t'); ylabel('y = t^2 + cos(t) + e^(t^2)/(10^16)');
subplot(111)
```

b) Plot av diskret signal

```
n = -10:10;
stem(n, sin(2*pi*(n/10)));
title('y3(n) = sin(2*pi*(n/10))');
xlabel('n');
ylabel('y');
```

Problem 4

a) Lese inn Dolly.wav og høre på den:

```
[y,Fs] = audioread('Dolly.wav');
soundsc(y,Fs)
```

b) Changing of sampling frequencies

Samplingfrekvens på 16kHz:

```
[y] = audioread('Dolly.wav');
soundsc(y,16000)
```

Ved 16kHz blir sangstemmen mørkere og sangen tregere.

Samplingfrekvens på 32kHz:

```
[y] = audioread('Dolly.wav');
soundsc(y,32000)
```

Ved 32kHz blir sangstemmen lysere og sangen går fortere.

c) Load and display Lena

Lena.jpg:

```
A = imread('Lena.jpg');
image(A), axis image, axis off
```


d)

The negative image:

```
IM2 = imcomplement(A);
image(IM2), axis image, axis off
```

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