```
%% Exercise 1.3

clear
clc

% Define A matrix
A = sym([ ...
   754     0  -377; ...
     0   754   377; ...
   377  -377     0; ...
]);
```

```
% (a) Compute the eigenvalues of A
lambda = eig(A)
```

lambda =

$$\begin{pmatrix} 754 \\ 377 - 377\,\mathrm{i} \\ 377 + 377\,\mathrm{i} \end{pmatrix}$$

```
% (b) Compute the diagonalization of A
[Q,D] = eig(A)
```

Q =

$$\begin{pmatrix} 1 & \frac{1}{2} - \frac{1}{2}\,\mathrm{i} & \frac{1}{2} + \frac{1}{2}\,\mathrm{i} \\ 1 & -\frac{1}{2} + \frac{1}{2}\,\mathrm{i} & -\frac{1}{2} - \frac{1}{2}\,\mathrm{i} \\ 0 & 1 & 1 \end{pmatrix}$$

D =

$$\begin{pmatrix} 754 & 0 & 0 \\ 0 & 377 - 377\,\mathrm{i} & 0 \\ 0 & 0 & 377 + 377\,\mathrm{i} \end{pmatrix}$$

```
Qinv = Q^-1
```

Qinv =

$$\begin{pmatrix} \frac{1}{2} & \frac{1}{2} & 0 \\ \frac{1}{2}\,\mathrm{i} & -\frac{1}{2}\,\mathrm{i} & \frac{1}{2} - \frac{1}{2}\,\mathrm{i} \\ -\frac{1}{2}\,\mathrm{i} & \frac{1}{2}\,\mathrm{i} & \frac{1}{2} + \frac{1}{2}\,\mathrm{i} \end{pmatrix}$$

```
% Define t
syms t
```

```
% Define x_0
x_0 = [0; 0; 1];

% (d) Compute x(t) with equilibrium initial condition
x = Q*[exp(D(1,1)*t) 0 0; 0 exp(D(2,2)*t) 0; 0 0 exp(D(3,3)*t)]*Qinv*x_0
```

x =

$$\begin{pmatrix} -\sigma_1 + \sigma_2 \\ \sigma_1 - \sigma_2 \\ e^{t\,(377-377\,i)}\left(\frac{1}{2}-\frac{1}{2}\,i\right) + e^{t\,(377+377\,i)}\left(\frac{1}{2}+\frac{1}{2}\,i\right) \end{pmatrix}$$

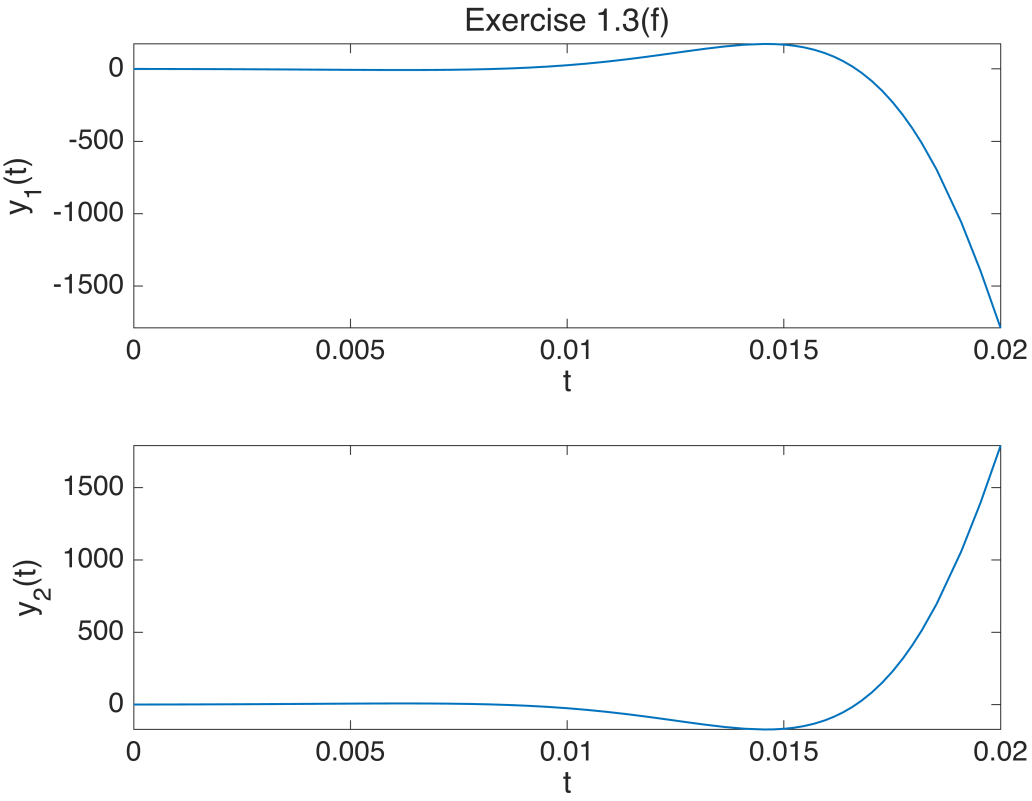
where

$$\sigma_1 = \frac{e^{t\,(377-377\,i)}\,i}{2}$$

$$\sigma_2 = \frac{e^{t\,(377+377\,i)}\,i}{2}$$

```
% (f) Plot output y
y1 = -exp(377*t)*sin(377*t);
y2 = exp(377*t)*sin(377*t);

myplot = tiledlayout(2,1);
title(myplot,"Exercise 1.3(f)","FontSize",16)
nexttile
fplot(y1,[0,0.02],"LineWidth",1)
xlabel("t")
ylabel("y_1(t)")
set(gca,"FontSize",14)
nexttile
fplot(y2,[0,0.02],"LineWidth",1)
xlabel("t")
ylabel("y_2(t)")
set(gca,"FontSize",14)
```


Exercise 1.3(f)
0
-500
-1000
-1500
y1(t)
0
0.005
0.01
0.015
0.02
t
1500
1000
500
0
y2(t)
0
0.005
0.01
0.015
0.02
t