```
function [t,y ] = EulerForward(fun, tspan, N, y0 )
h=(tspan(end)-tspan(1))/N;
t=tspan(1):h:tspan(end);
y=y0; %Must be a column vector
for i=1:N
y(:,i+1)=y(:,i)+h*fun(t(i),y(:,i));
end

end
```

```
Not enough input arguments.

Error in EulerForward (line 2)
h=(tspan(end)-tspan(1))/N;
```

Published with MATLAB® R2016b

```
function [t,y] = RK4(fun, tspan, N, y0 )
h=(tspan(end)-tspan(1))/N;
t=tspan(1):h:tspan(end);
y=y0; %Must be a column vector
for i=1:N
    f1=fun(t(i),y(:,i));
    f2=fun(t(i)+h/2,y(:,i)+h/2*f1);
    f3=fun(t(i)+h/2,y(:,i)+h/2*f2);
    f4=fun(t(i)+h,y(:,i)+h*f3);
    y(:,i+1)=y(:,i)+h/6*(f1+2*f2+2*f3+f4);


end



end
```

```
Not enough input arguments.

Error in RK4 (line 2)
h=(tspan(end)-tspan(1))/N;
```

Published with MATLAB® R2016b

```
f=@(t,y) 1+t-y;
val_vec=[];
N=4;
for i=0:3
h=0.8/N;
t=0:h:0.8;
y=1;
for k=1:N
y=y+h*f(t(k),y);
end
val_vec=[val_vec; y];
N=2*N;
end
y_real=exp(-0.8)+0.8;
fel=abs(val_vec-y_real)
```

```
fel =

    0.0397
    0.0189
    0.0092
    0.0045
```

```
%--------------Uppgift fr?n extenta-----------------

clear all; close all;

f=@(t,u) [u(2); 3+3*sin(u(2))-cos(u(1))];
% Runge-Kutta:
tspan=[0 0.1];
N=1;
[tRK,yRK]=RK4(f, tspan, N, [pi; 0]);
% Euler fram?t:
[tE,yE ] = EulerForward(f, tspan, N, [pi; 0]);
[tODE45,yODE45] = ode45(f,tspan,[pi; 0])

disp(['Value calculated with ODE45 is :' num2str(yODE45(end,2))])
disp(['Value calculated with RK4 is :' num2str(yRK(end,2))])
disp(['Value calculated with Euler is :' num2str(yE(end,2))])
```

```
tODE45 =

         0
    0.0000
    0.0000
    0.0000
    0.0001
    0.0001
    0.0002
```

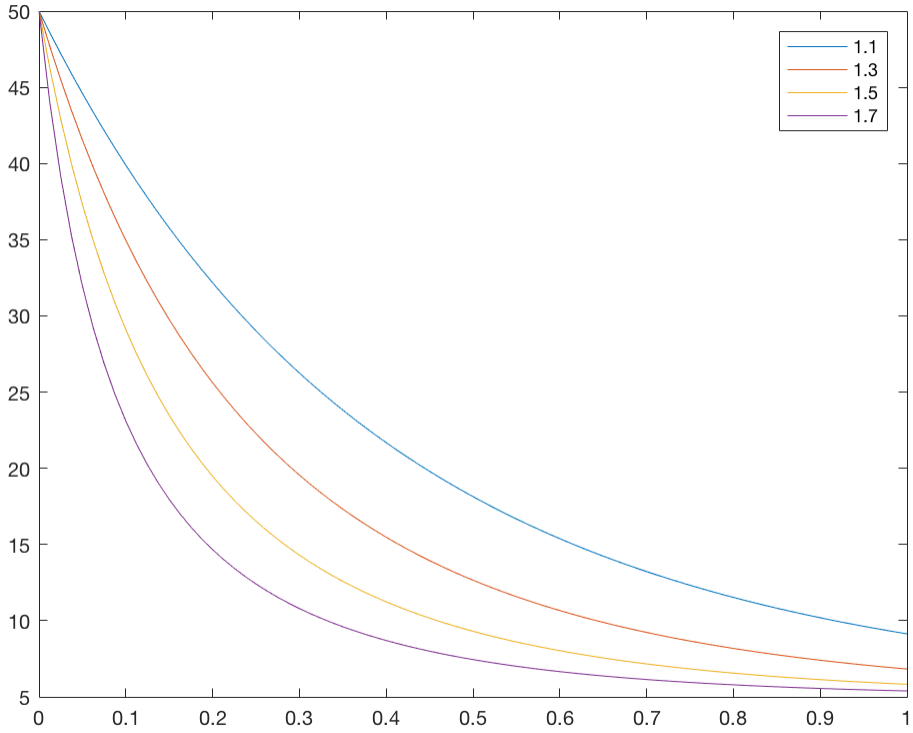
```
    0.0002
    0.0003
    0.0006
    0.0009
    0.0012
    0.0016
    0.0031
    0.0047
    0.0063
    0.0078
    0.0103
    0.0128
    0.0153
    0.0178
    0.0203
    0.0228
    0.0253
    0.0278
    0.0303
    0.0328
    0.0353
    0.0378
    0.0403
    0.0428
    0.0453
    0.0478
    0.0503
    0.0528
    0.0553
    0.0578
    0.0603
    0.0628
    0.0653
    0.0678
    0.0703
    0.0728
    0.0753
    0.0778
    0.0803
    0.0828
    0.0853
    0.0878
    0.0903
    0.0928
    0.0953
    0.0978
    0.0984
    0.0989
    0.0995
    0.1000


yODE45 =
```

```
3.1416         0
3.1416    0.0001
3.1416    0.0001
3.1416    0.0002
3.1416    0.0002
3.1416    0.0005
3.1416    0.0007
3.1416    0.0010
3.1416    0.0012
3.1416    0.0025
3.1416    0.0037
3.1416    0.0050
3.1416    0.0062
3.1416    0.0126
3.1416    0.0189
3.1417    0.0253
3.1417    0.0317
3.1418    0.0420
3.1419    0.0523
3.1421    0.0628
3.1422    0.0733
3.1424    0.0839
3.1427    0.0945
3.1429    0.1053
3.1432    0.1161
3.1435    0.1270
3.1438    0.1380
3.1442    0.1491
3.1446    0.1603
3.1450    0.1715
3.1454    0.1828
3.1459    0.1942
3.1464    0.2057
3.1469    0.2173
3.1475    0.2289
3.1481    0.2407
3.1487    0.2525
3.1493    0.2644
3.1500    0.2764
3.1507    0.2885
3.1515    0.3007
3.1522    0.3130
3.1530    0.3253
3.1538    0.3378
3.1547    0.3503
3.1556    0.3629
3.1565    0.3756
3.1575    0.3884
3.1585    0.4013
3.1595    0.4143
3.1605    0.4273
3.1616    0.4405
3.1627    0.4537
3.1630    0.4566
```

```
    3.1632    0.4595
    3.1635    0.4624
    3.1637    0.4653

Value calculated with ODE45 is :0.46526
Value calculated with RK4 is :0.46521
Value calculated with Euler is :0.4
```

```
%-------Uppgift 7.3------------
clear all; close all
alpha=1.1; g=9.81;
dvdt=@(t,v) g*(1-(v/5)^alpha);

v0=50;
N=1/0.05;

[tE,yE ] = EulerForward(dvdt, [0 1], N, v0);
plot(tE,yE)
disp(['End velocity is: ' num2str(yE(end))])

[tE,yE2 ] = EulerForward(dvdt, [0 1], N*2, v0);
[tE,yE3 ] = EulerForward(dvdt, [0 1], N*4, v0);
err=abs(yE2(end)-yE3(end));

disp('*****************')
disp(['End velocity is: ' num2str(yE2(end)) ' with error: '
 num2str(err)])

alpha_vec=[1.1; 1.3; 1.5; 1.7];
close all
for i=1:length(alpha_vec)
alpha=alpha_vec(i);
dvdt=@(t,v) g*(1-(v/5)^alpha);
v0=50;
N=1/0.05;

[tE,yE ] = EulerForward(dvdt, [0 1], N*4, v0);
plot(tE,yE)
hold on
disp(['End velocity is: ' num2str(yE(end))])

end
legend('1.1', '1.3','1.5','1.7')
```

```
End velocity is: 8.6894
*****************
End velocity is: 8.9888 with error: 0.14894
End velocity is: 9.1377
End velocity is: 6.8284
End velocity is: 5.8273
End velocity is: 5.3899
```



Published with MATLAB® R2016b