

```
% Euler's Method
```

```
m=@(x,y) y-3.*x;
```

```
yexact=@(x) 7*exp(x)+3*x+3;
```

```
y0=10
```

```
y0 =  
10
```

```
x0=0
```

```
x0 =  
0
```

```
xf=3
```

```
xf =  
3
```

```
h=1
```

```
h =  
1
```

```
x=x0:h:xf
```

```
x = 1×4  
    0    1    2    3
```

```
y=zeros(size(x))
```

```
y = 1×4  
    0    0    0    0
```

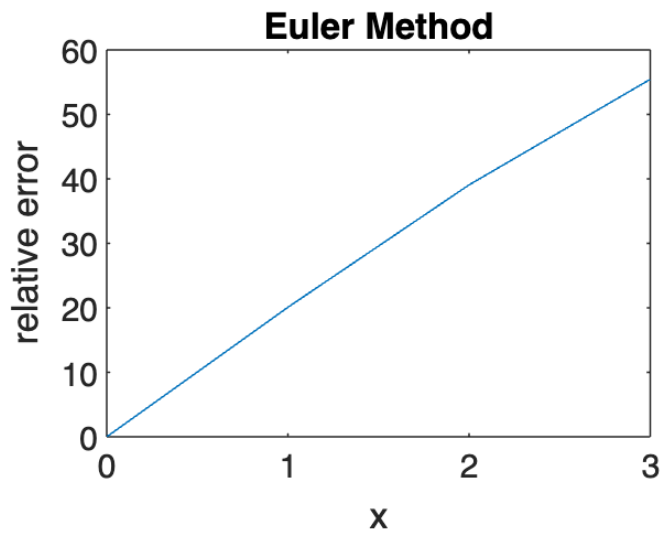
```
y(1)=y0
```

```
y = 1×4  
   10    0    0    0
```

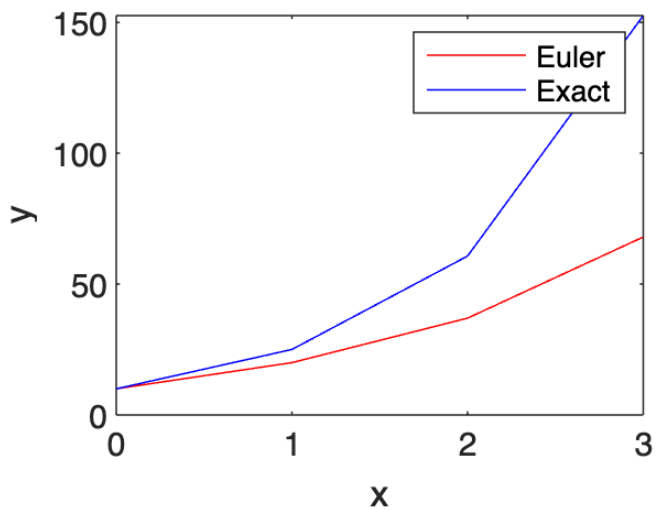
```
err=zeros(size(x))
```

```
err = 1×4  
    0    0    0    0
```

```
for i=1:length(x)-1  
    y(i+1)=y(i)+h*m(x(i),y(i));  
    err(i+1)=abs((yexact(x(i+1))-y(i+1))/yexact(x(i+1)))*100;  
end  
y_euler = y; % <-- Guarda el resultado de Euler aquí  
  
plot(x,err)  
title("Euler Method")  
xlabel("x")  
ylabel("relative error")
```



```
plot(x,y,'r')
hold on
plot(x,yexact(x),'b')
hold off
xlabel("x")
ylabel("y")
legend("Euler","Exact")
```



```
y1st=y;
```

```
% 1st improvement over Euler's Method
m=@(x,y) y-3.*x;
yexact=@(x) 7*exp(x)+3*x+3;

y0=10
```

```
y0 =
```

10

```
x0=0
```

```
x0 =  
0
```

```
xf=3
```

```
xf =  
3
```

```
h=1
```

```
h =  
1
```

```
x=x0:h:xf
```

```
x = 1×4  
    0    1    2    3
```

```
y=zeros(size(x))
```

```
y = 1×4  
    0    0    0    0
```

```
y(1)=y0
```

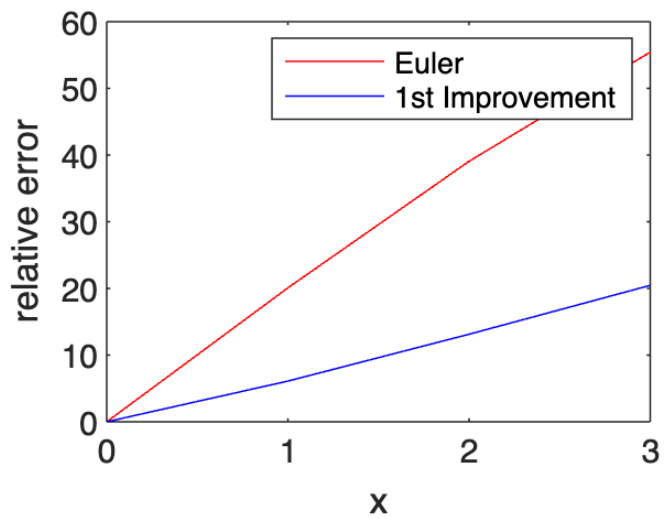
```
y = 1×4  
   10    0    0    0
```

```
err2=zeros(size(x))
```

```
err2 = 1×4  
    0    0    0    0
```

```
for i=1:length(x)-1  
    mi=m(x(i),y(i));  
    ypred=y(i)+h*mi;  
    mf=m(x(i+1),ypred);  
    m_avg=(mi+mf)/2;  
    y(i+1)=y(i)+h*m_avg;  
    err2(i+1)=abs((yexact(x(i+1))-y(i+1))/yexact(x(i+1)))*100;  
end
```

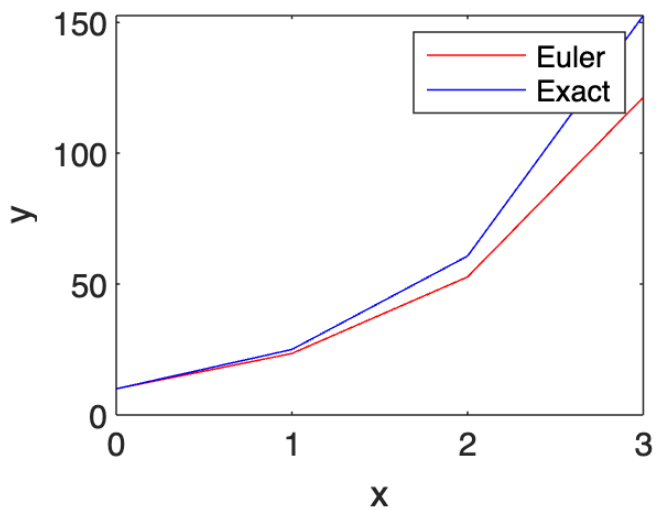
```
plot(x,err,'r')  
hold on  
plot(x,err2,'b')  
hold off  
legend("Euler","1st Improvement")  
xlabel("x")  
ylabel("relative error")
```



```

plot(x,y,'r')
hold on
plot(x,yexact(x),'b')
hold off
xlabel("x")
ylabel("y")
legend("Euler","Exact")

```



```
y1st=y;
```

```
% 2nd improvement over Euler's Method
```

```
m=@(x,y) y-3.*x;
yexact=@(x) 7*exp(x)+3*x+3;
```

```
y0=10
```

```
y0 =
```

10

```
x0=0
```

```
x0 =  
0
```

```
xf=3
```

```
xf =  
3
```

```
h=1
```

```
h =  
1
```

```
x=x0:h:xf
```

```
x = 1×4  
    0    1    2    3
```

```
y=zeros(size(x))
```

```
y = 1×4  
    0    0    0    0
```

```
y(1)=y0
```

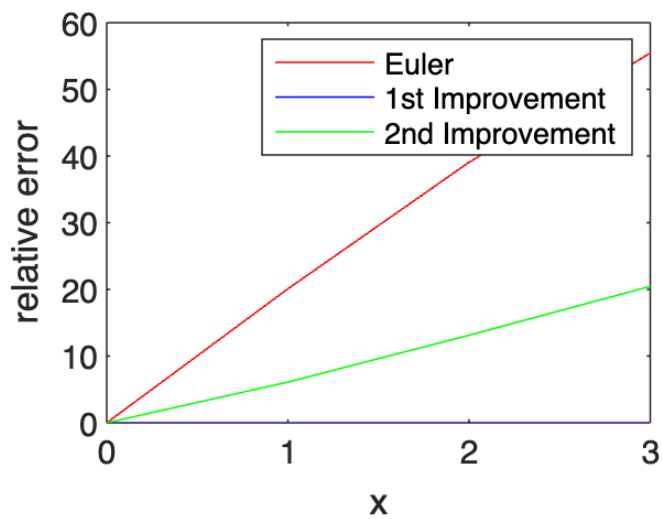
```
y = 1×4  
   10    0    0    0
```

```
err2=zeros(size(x))
```

```
err2 = 1×4  
    0    0    0    0
```

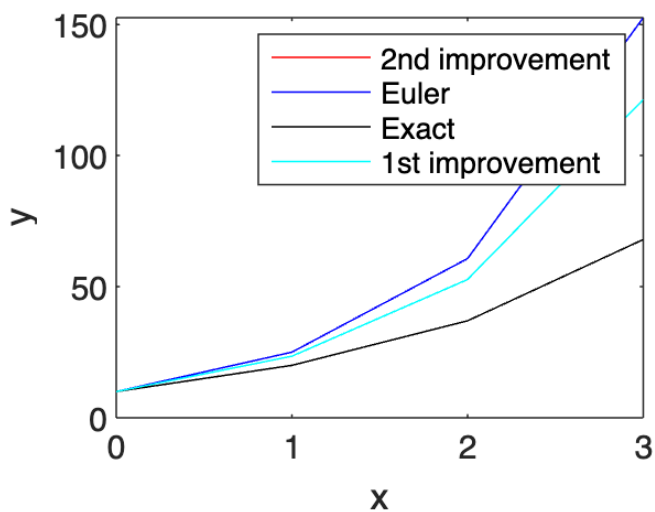
```
for i=1:length(x)-1  
    mi=m(x(i),y(i));  
    ypred=y(i)+h/2*mi;  
    m_mid=m(x(i)+h/2,ypred);  
  
    y(i+1)=y(i)+h*m_mid;  
    err3(i+1)=abs((yexact(x(i+1))-y(i+1))/yexact(x(i+1)))*100;  
end  
  
clf  
plot(x,err,'r')  
hold on  
plot(x,err2,'b')  
plot(x,err3,'g')  
hold off  
legend("Euler","1st Improvement", "2nd Improvement")  
xlabel("x")
```

```
ylabel("relative error")
```



```
plot(x,y,'r')
hold on
plot(x,yexact(x),'b')
plot(x,y_euler,'k')
plot(x,y1st,'c')

hold off
xlabel("x")
ylabel("y")
legend("2nd improvement","Euler","Exact","1st improvement")
```



```
y2nd = y;
```

```
m=@(x,y) y-3.*x;
yexact=@(x) 7*exp(x)+3*x+3;
```

```
y0=10
```

```
y0 =  
10
```

```
x0=0
```

```
x0 =  
0
```

```
xf=3
```

```
xf =  
3
```

```
h=1
```

```
h =  
1
```

```
x=x0:h:xf
```

```
x = 1×4  
    0    1    2    3
```

```
y=zeros(size(x))
```

```
y = 1×4  
    0    0    0    0
```

```
y(1)=y0
```

```
y = 1×4  
   10    0    0    0
```

```
err4=zeros(size(x))
```

```
err4 = 1×4  
    0    0    0    0
```

```
% Vegeta 777 Method
```

```
a2 = 777;
```

```
a1=1-a2;
```

```
q=1/(2*a2)
```

```
q =  
6.4350e-04
```

```
for i=1:length(x)-1  
    k1=m(x(i),y(i));  
    k2=m(x(i)+q*h,y(i)+q*k1*h);  
  
    y(i+1)=y(i)+(a1*k1+a2*k2);  
    err4(i+1)=abs((yexact(x(i+1))-y(i+1))/yexact(x(i+1)))*100;
```

```
end
```

```
clf  
plot(x,y,'r')  
hold on  
plot(x,y2nd,'c')  
hold off  
legend("Runge-Kutta", "2nd method")  
xlabel("x")  
ylabel("y")
```

