

Improved Euler Method via m-files

Improved Euler Method for
 $y' = t y^{1/2}$ and $y(0) = 4$

```
clear;
y(1) = 4.;
yexact(1) = 4;
T = 2;
KK = 4
h = T/KK;
t(1)= 0.;
for k = 1:KK
    t(k+1) = t(k) + h;
    yexact(k+1) = (.25*t(k+1)^2+2)^2.;
    y(k+1) = y(k) + h*(t(k)*y(k)^.5);
    left    = t(k)*y(k)^.5;
    right   = t(k+1)*y(k+1)^.5;
    y(k+1) = y(k) + h*.5*(left+right);
end
error = abs(yexact(KK+1) - y(KK+1))
plot(t,y,'b',t,yexact,'r')
```

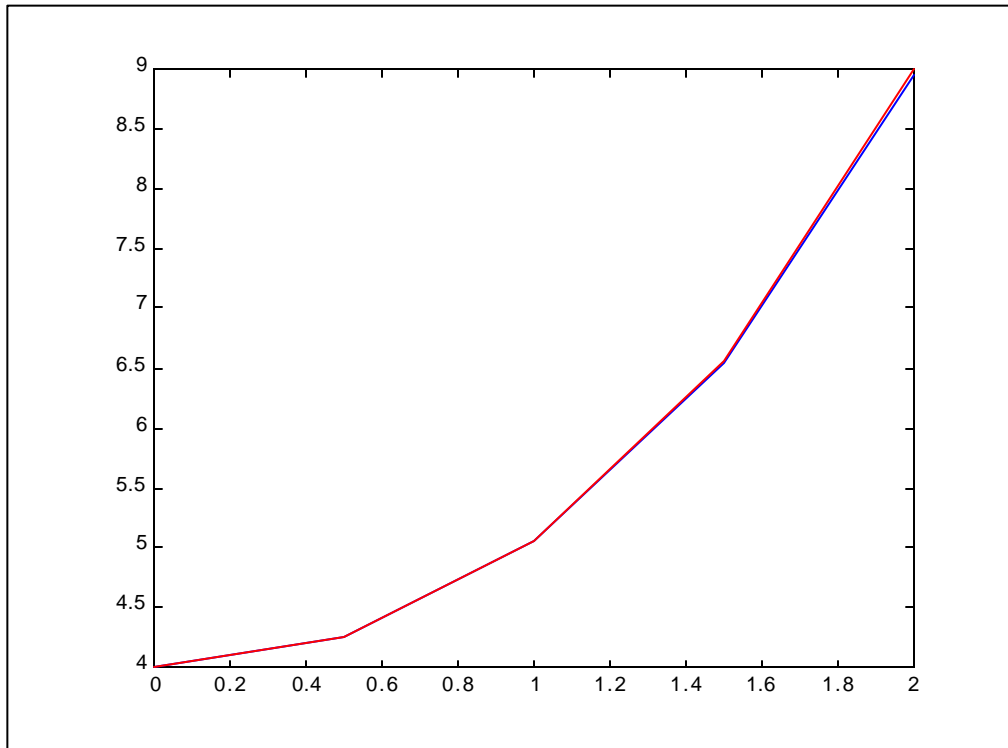
EDU» imeulerc2

KK =

4

error =

0.0381



EDU» imeulerc2

KK =

4

error =

0.0381

EDU» imeulerc2

KK =

8

error =

0.0082

EDU» imeulerc2

KK =

16

error =

0.0019

EDU» imeulerc2

KK =

32

error =

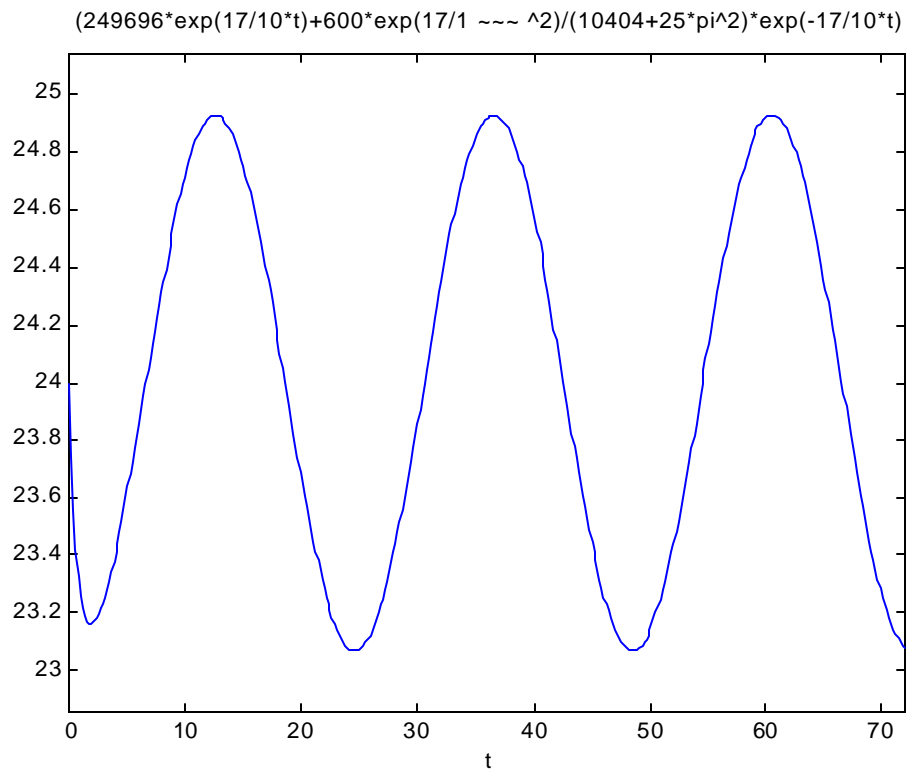
4.4535e-004

Error =? $y_{\text{exact}}(KK+1) - y(KK+1)$?? $C ? t^2$

Improved Euler Method for

$$y' = .2(24 - \cos(t/12) - y) + 1.5(24 - y)$$

and $y(0) = 24$



```

%clear;
y(1) = 24.;
T = 72;
KK = 256
h = T/KK;
t(1)= 0.;
for k = 1:KK
    t(k+1) = t(k) + h;
    y(k+1) = y(k) + h*
        (.2*(24-8*cos(pi/12*t(k))
        -y(k))+ 1.5*(24-y(k)));
    left    = .2*(24-8*cos(pi/12*t(k))
        -y(k))+ 1.5*(24-y(k));
    right   = .2*(24-8*cos(pi/12*t(k+1))
        -y(k+1))+1.5*(24-y(k+1));
    y(k+1) = y(k) + h*.5*(left+right);
end
plot(t,y)

```

```
EDU» imeulerc3
KK =
    32
```

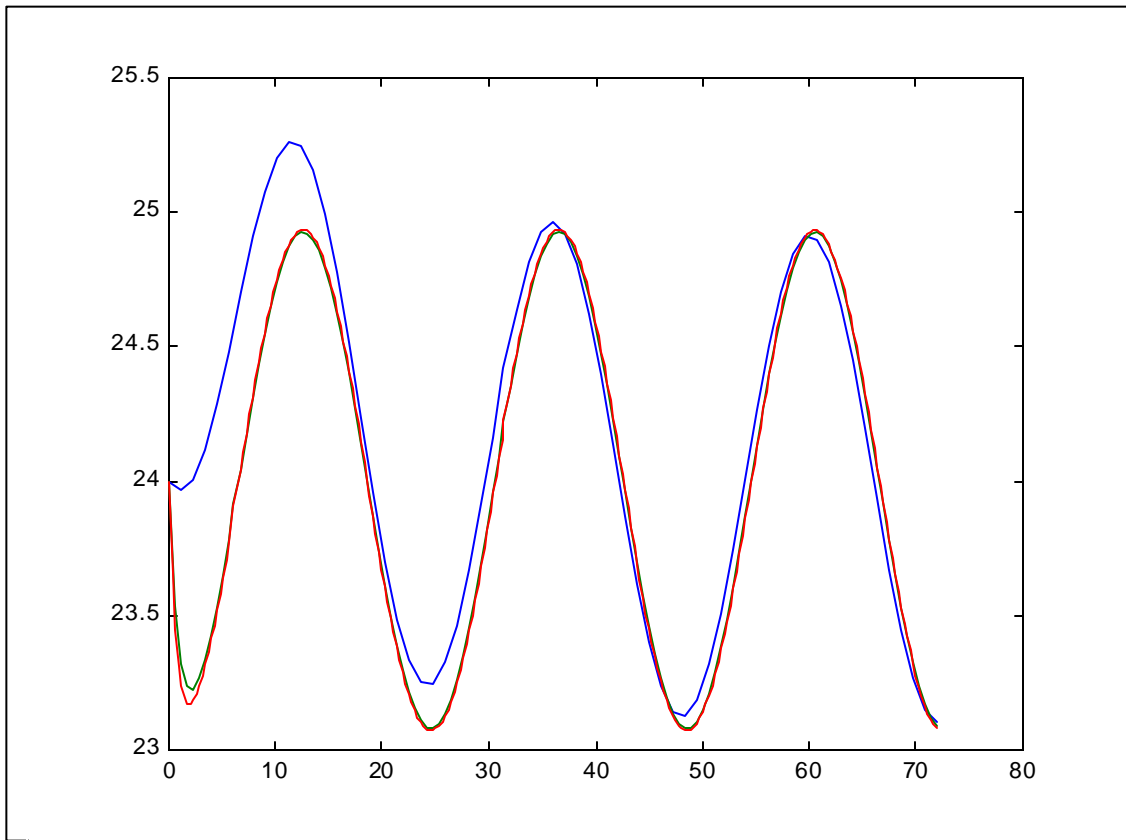
Blows Up!!
Time Step is Too Large

```
EDU» imeulerc3
KK =
    64
EDU» t64 =t;
EDU» y64 =y;
```

```
EDU» imeulerc3
KK =
    128
EDU» t128 = t;
EDU» y128 = y;
```

```
EDU» imeulerc3
KK =
    256
EDU» t256 = t;
EDU» y256 = y;
```

```
EDU>plot(t64,y64,t128,y128,t256,y256)
```



ON-OFF Heating and Cooling

```
%clear;
y(1) = 24.;
T = 72;
KK = 512
h = T/KK;
t(1)= 0.;
for k = 1:KK
    t(k+1) = t(k) + h;
    y(k+1) = y(k) + h*(.2*(24-
        8*cos(pi/12*t(k))-y(k))
        + 1.*(23.5>y(k))
        - 1.*(24.5<y(k)));
    left = .2*(24
        -8*cos(pi/12*t(k))-y(k))
        + 1.*(23.5>y(k))
        - 1.*(24.5<y(k));
    right = .2*(24-
        8*cos(pi/12*t(k+1))-(k+1))
        + 1.*(23.5>y(k+1))
        - 1.*(24.5<y(k+1));
    y(k+1) = y(k) + h*.5*(left+right);
end
plot(t,y)
```

```
EDU» clear
EDU» imeulerc4
KK =
    256
EDU» t256 = t;
EDU» y256 = y;
```

```
EDU» imeulerc4
KK =
    512
EDU» t512 = t;
EDU» y512 = y;
EDU» plot(t256,y256,'b',t512,y512,'r')
```

