hw3

January 29, 2019

In [1]: %hi

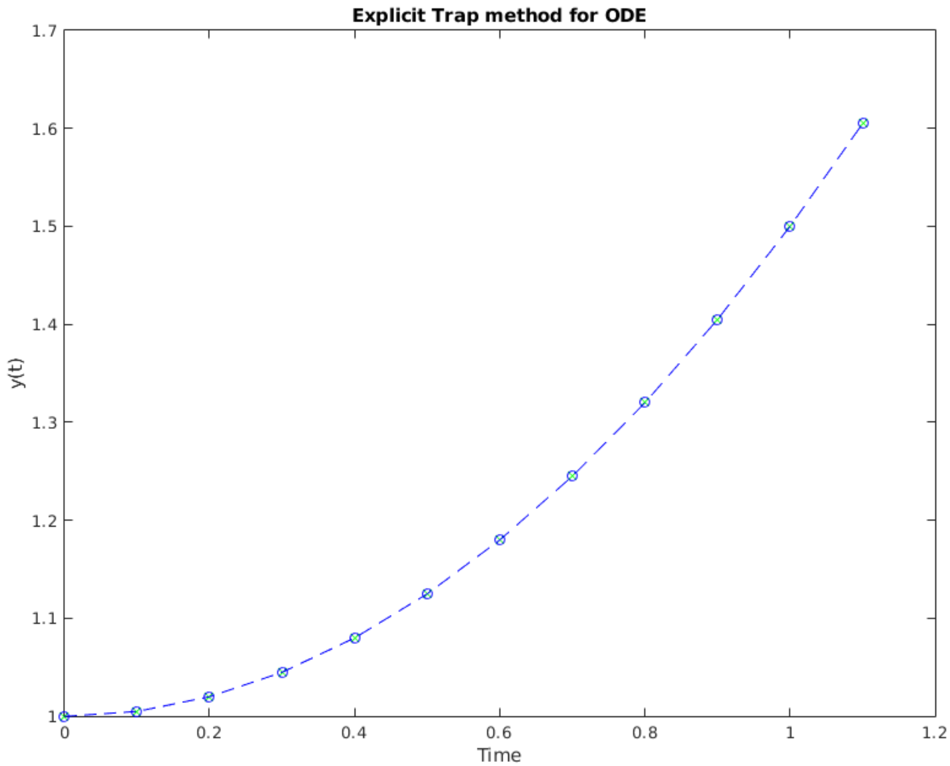
In [2]: !cat a.m

```
%Explicit trapezoidal method for integrating first order ODE
% t(1) = initial time
% w(1) = initial condition
% h = time step size
% n = number of time steps
t(1)=0.;
h=0.1;
n=10;
w(1)=1.;
ye(1)=1.;
e(1)=0.;
% Print output title lines
fprintf(1,'Explicit Trap method\n');
fprintf(1,'  t(I)        w(I)          y(I)          e(I)\n');
for i=1:n+1
t(i+1)=t(i)+h;
% Change right hand side f(i) as needed.
%f(i)=(w(i)*t(i)+t(i)^3);
%f(i+1)=((w(i)+h*f(i))*t(i+1)+t(i+1)^3);
%(a)
f(i)=t(i);
f(i+1)=t(i+1);
%(b)
w(i+1)=w(i)+(f(i)+f(i+1))*h/2;
% Change exact solution as needed.
ye(i+1)=(t(i+1)*t(i+1))/2+1;
%
e(i+1)=w(i+1)-ye(i+1);
% Print output
fprintf(1,'%6.3f  %15.7e %15.7e %10.7f \n',t(i),w(i),ye(i),e(i));
end
%
% Plot results
%subplot(1,2,1)
```

```
plot(t,w,'g--x',t,ye,'b--o')
title('Explicit Trap method for ODE')
xlabel('Time')
ylabel(' y(t) ')
%ylabel('Approximate y(t)')
%
%subplot(1,2,2)
%plot(t,ye)
%title('Euler method for ODE')
%xlabel('Time')
%ylabel('Exact y(t)')
```

```
In [3]: a
```

```
Explicit Trap method
  t(I)        w(I)          y(I)          e(I)
 0.000    1.0000000e+00   1.0000000e+00  0.0000000
 0.100    1.0050000e+00   1.0050000e+00  0.0000000
 0.200    1.0200000e+00   1.0200000e+00 -0.0000000
 0.300    1.0450000e+00   1.0450000e+00 -0.0000000
 0.400    1.0800000e+00   1.0800000e+00 -0.0000000
 0.500    1.1250000e+00   1.1250000e+00 -0.0000000
 0.600    1.1800000e+00   1.1800000e+00 -0.0000000
 0.700    1.2450000e+00   1.2450000e+00 -0.0000000
 0.800    1.3200000e+00   1.3200000e+00 -0.0000000
 0.900    1.4050000e+00   1.4050000e+00 -0.0000000
 1.000    1.5000000e+00   1.5000000e+00 -0.0000000
```



In [4]: !cat b.m

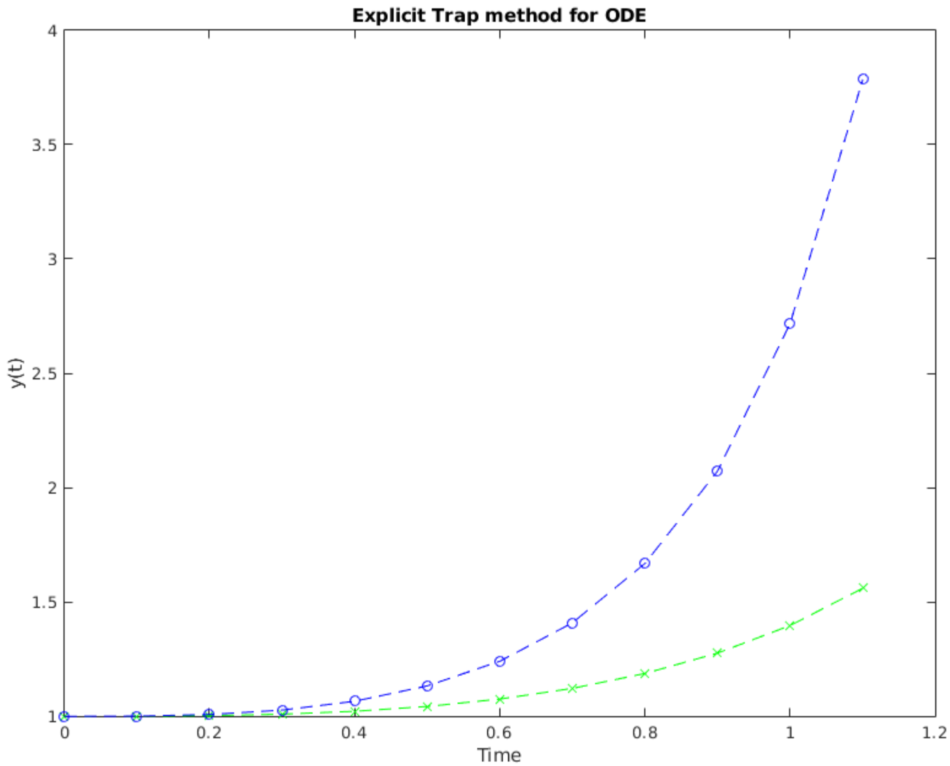
```
%Explicit trapezoidal method for integrating first order ODE
% t(1) = initial time
% w(1) = initial condition
% h = time step size
% n = number of time steps
t(1)=0.;
h=0.1;
n=10;
w(1)=1.;
ye(1)=1.;
e(1)=0.;
% Print output title lines
fprintf(1,'Explicit Trap method\n');
fprintf(1,'  t(I)        w(I)          y(I)          e(I)\n');
for i=1:n+1
t(i+1)=t(i)+h;
% Change right hand side f(i) as needed.
%f(i)=(w(i)*t(i)+t(i)^3);
%f(i+1)=((w(i)+h*f(i))*t(i+1)+t(i+1)^3);
```

```
%(a)
%f(i)=t(i);
%f(i+1)=1;
%(b)
f(i)=w(i)*t(i)^2;
y_eul=w(i)+h*f(i);
f(i+1)=y_eul*t(i+1)^2;
%don't change this one
w(i+1)=w(i)+(f(i)+f(i+1))*h/2;
% Change exact solution as needed.
ye(i+1)=exp(t(i+1)^3);
%
e(i+1)=w(i+1)-ye(i+1);
% Print outputye(i+1)=3*exp(((t(i+1))^2)/2)-t(i+1)^2-2;

fprintf(1,'%6.3f  %15.7e %15.7e %10.7f \n',t(i),w(i),ye(i),e(i));
end
%
% Plot results
%subplot(1,2,1)
plot(t,w,'g--x',t,ye,'b--o')
title('Explicit Trap method for ODE')
xlabel('Time')
ylabel(' y(t) ')
%ylabel('Approximate y(t)')
%
%subplot(1,2,2)
%plot(t,ye)
%title('Euler method for ODE')
%xlabel('Time')
%ylabel('Exact y(t)')
```

```
In [5]: b
```

```
Explicit Trap method
  t(I)        w(I)           y(I)          e(I)
 0.000    1.0000000e+00   1.0000000e+00  0.0000000
 0.100    1.0005000e+00   1.0010005e+00 -0.0005005
 0.200    1.0030033e+00   1.0080321e+00 -0.0050288
 0.300    1.0095408e+00   1.0273678e+00 -0.0178270
 0.400    1.0222328e+00   1.0660924e+00 -0.0438596
 0.500    1.0433930e+00   1.1331485e+00 -0.0897555
 0.600    1.0756860e+00   1.2411024e+00 -0.1654164
 0.700    1.1223514e+00   1.4091688e+00 -0.2868173
 0.800    1.1875241e+00   1.6686251e+00 -0.4811010
 0.900    1.2766977e+00   2.0730066e+00 -0.7963089
 1.000    1.3974094e+00   2.7182818e+00 -1.3208724
```



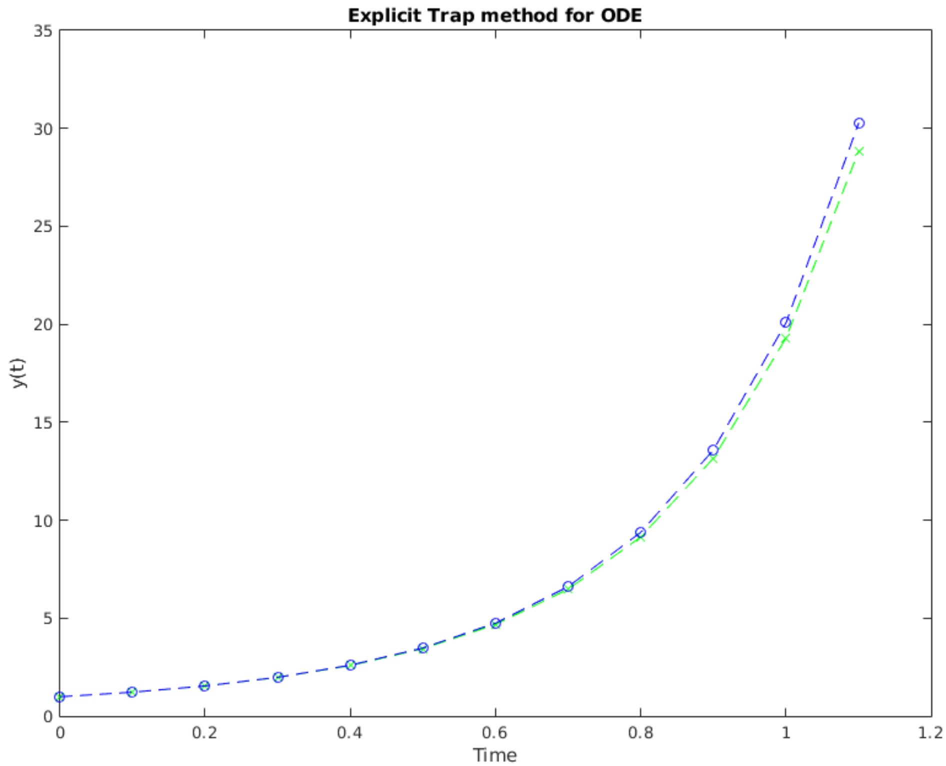
In [6]: !cat c.m

```
%Explicit trapezoidal method for integrating first order ODE
% t(1) = initial time
% w(1) = initial condition
% h = time step size
% n = number of time steps
t(1)=0.;
h=0.1;
n=10;
w(1)=1.;
ye(1)=1.;
e(1)=0.;
% Print output title lines
fprintf(1,'Explicit Trap method\n');
fprintf(1,'  t(I)        w(I)          y(I)          e(I)\n');
for i=1:n+1
t(i+1)=t(i)+h;
% Change right hand side f(i) as needed.
%(default)
%f(i)=(w(i)*t(i)+t(i)^3);
```

```
%f(i+1)=((w(i)+h*f(i))*t(i+1)+t(i+1)^3);
%(a)
%f(i)=t(i);
%f(i+1)=1;
%(b)
%(c)
f(i)=2*w(i)*(t(i)+1);
f(i+1)=2*(w(i)+h*f(i))*(t(i+1)+1);
%est w
w(i+1)=w(i)+(f(i)+f(i+1))*h/2;
% Change exact solution as needed.
ye(i+1)=exp(t(i+1)^2+2*t(i+1));
%
e(i+1)=w(i+1)-ye(i+1);
% Print output
fprintf(1,'%6.3f  %15.7e %15.7e %10.7f \n',t(i),w(i),ye(i),e(i));
end
%
% Plot results
%subplot(1,2,1)
plot(t,w,'g--x',t,ye,'b--o')
title('Explicit Trap method for ODE')
xlabel('Time')
ylabel(' y(t) ')
%ylabel('Approximate y(t)')
%
%subplot(1,2,2)
%plot(t,ye)
%title('Euler method for ODE')
%xlabel('Time')
%ylabel('Exact y(t)')
```

```
In [7]: c
```

```
Explicit Trap method
  t(I)        w(I)           y(I)          e(I)
 0.000    1.0000000e+00   1.0000000e+00  0.0000000
 0.100    1.2320000e+00   1.2336781e+00 -0.0016781
 0.200    1.5478848e+00   1.5527072e+00 -0.0048224
 0.300    1.9831500e+00   1.9937155e+00 -0.0105655
 0.400    2.5907872e+00   2.6116965e+00 -0.0209093
 0.500    3.4509285e+00   3.4903430e+00 -0.0394145
 0.600    4.6863609e+00   4.7588212e+00 -0.0724603
 0.700    6.4877980e+00   6.6193687e+00 -0.1315706
 0.800    9.1555806e+00   9.3933313e+00 -0.2377507
 0.900    1.3169387e+01   1.3599051e+01 -0.4296637
 1.000    1.9306322e+01   2.0085537e+01 -0.7792154
```



In [8]: !cat d.m

```
%Explicit trapezoidal method for integrating first order ODE
% t(1) = initial time
% w(1) = initial condition
% h = time step size
% n = number of time steps
t(1)=0.;
h=0.1;
n=10;
w(1)=1.;
ye(1)=1.;
e(1)=0.;
% Print output title lines
fprintf(1,'Explicit Trap method\n');
fprintf(1,'  t(I)        w(I)          y(I)          e(I)\n');
for i=1:n+1
t(i+1)=t(i)+h;
% Change right hand side f(i) as needed.
%(default)
%f(i)=(w(i)*t(i)+t(i)^3);
```

```
%f(i+1)=((w(i)+h*f(i))*t(i+1)+t(i+1)^3);
%(a)
%f(i)=t(i);
%f(i+1)=1;
%(b)
%(c)
f(i)=5*t(i)^4*w(i);
w(i+1)=w(i)+h*f(i);% first estimate
f(i+1)=5*t(i+1)^4*w(i+1); % use first estimate to get dest slope
%est w
w(i+1)=w(i)+(f(i)+f(i+1))*h/2;
% Change exact solution as needed.
ye(i+1)=exp(t(i+1)^5);
%
e(i+1)=w(i+1)-ye(i+1);
% Print output
fprintf(1,'%6.3f  %15.7e %15.7e %10.7f \n',t(i),w(i),ye(i),e(i));
end
%
% Plot results
%subplot(1,2,1)
plot(t,w,'g--x',t,ye,'b--o')
title('Explicit Trap method for ODE')
xlabel('Time')
ylabel(' y(t) ')
%ylabel('Approximate y(t)')
%
%subplot(1,2,2)
%plot(t,ye)
%title('Euler method for ODE')
%xlabel('Time')
%ylabel('Exact y(t)')
```

In [9]: d

```
Explicit Trap method
  t(I)        w(I)           y(I)          e(I)
 0.000    1.0000000e+00   1.0000000e+00  0.0000000
 0.100    1.0000250e+00   1.0000100e+00  0.0000150
 0.200    1.0004500e+00   1.0003201e+00  0.0001300
 0.300    1.0028777e+00   1.0024330e+00  0.0004448
 0.400    1.0113530e+00   1.0102926e+00  0.0010604
 0.500    1.0338303e+00   1.0317434e+00  0.0020869
 0.600    1.0845268e+00   1.0808632e+00  0.0036635
 0.700    1.1889825e+00   1.1830194e+00  0.0059631
 0.800    1.3967193e+00   1.3877448e+00  0.0089745
 0.900    1.8157593e+00   1.8048726e+00  0.0108867
```

```
1.000     2.7164440e+00   2.7182818e+00 -0.0018378
```