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% Liam Fruzyna
% MATH 4540
% Assignment 3

format long

% 6.2 1c) Apply the explicit trapezoid method on a grid of step size h=0.1
% from 0 to 1 to the initial value problem  $y' = 2(t + 1)y$ . Print a table of
% the t values, approximations, and global truncation error at each step.

f = @(t, w) 2 * (t + 1) * w;

euler(f, 0, 1, 0.1, 1);

function [t, w] = euler(f, a, b, h, y0)
    n = (b - a) / h;
    t = zeros(1, n+1);
    w = zeros(1, n+1);
    t(1) = a;
    w(1) = y0;
    for i=1:n
        t(i+1) = t(i) + h;
        w(i+1) = w(i) + (h / 2) * (f(t(i),w(i)) + f(t(i)+h,w(i)+h*f(t(i),w(i))));

        syms y(s)
        ySol(s) = dsolve(diff(y,s) == 2 * (s + 1) * y, y(0) == 1);
        error(i) = abs(double(ySol(t(i+1))) - w(i+1));
    end
    t
    w
    error
    plot(t,w);
end

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Results

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t = 0 0.100000000000000 0.200000000000000 0.300000000000000 0.400000000000000
0.500000000000000 0.600000000000000 0.700000000000000 0.800000000000000 0.900000000000000
1.000000000000000

w = 1.000000000000000 1.232000000000000 1.547884800000000 1.983150005760000 2.590787167524864
3.450928507143119 4.686360912700357 6.487798047542373 9.155580604691798 13.169387141788681
19.306321549862204

error = 0.001678059956743 0.004822418511336 0.010565527483082 0.020909305898253
0.039414450318722 0.072460332437497 0.131570633500704 0.237750682750985 0.429663710042245
0.779215373325463

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