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%Intro. to Numerical Methods for Differential Equations
%This is the script file that goes with problem 2.3 in HW 4.

clear all
close all
clc

e = 0.1; %value of epsilon
b = 1/(exp(1/e) - 1); %value of beta
N = 10;
%N = 20;
%N = 40;
x = 0:1/(N+1):1;
h = 1/(N+1);

%compute the exact solution at every point
y_exact = 1 + x + b*(exp(x/e) - 1);

%Compute the approximate solution using backwards difference for the first
%derivative at every point.
A = zeros(N,N);

a = -(2+h/e);
b = 1+h/e;
c = 1;

%Constructing the matrix:
for i = 1:N-1
    A(i,i) = a;
    A(i+1,i) = b;
    A(i,i+1) = c;
end
    A(N,N) = a;

%Constructing the vector for z:
z = zeros(1,N);
z(1) = h^2/e - b;
z(N) = h^2/e - 3;
for i = 2:N-1
    z(i) = h^2/e;
end

y_back = tridiag(A,z,N);
y_back(2:11) = y_back(1:10);
y_back(1) = 1;
y_back(12) = 3;

figure(1)
plot(x,y_exact,'-k+',x,y_back,'-bd')
title('Solutions to \in*y`` - y` = -1')
xlabel('x')
ylabel('y')
legend('Exact Solution','Approximate Solution with backward difference')
```