

CEE 451 Coding problem

Xiaowen Lin

The main subroutine:

```
clc;
clear;
syms x y;
%% test for tutorial question
d2f = -y; d3f=-1; xa=0; xb=1; f0=0; N=1000; s=1.1; delta=0.001;
Nmax=100; yb=1;
[y1_test, iter_test, s_test, x_test]=shoot(d2f, d3f, xa, xb, f0, N, s, delta,
Nmax, yb);
figure('name', 't1');
plot(x_test, y1_test);
title('y-x for test, s=1.1, N=1000, delta=0.001');
xlabel('x'); ylabel('y');
ylim([0, 1.1]);
fprintf('For N=1000, initial s=1.1, delta=0.001, s is %f.\n',s_test);

N=100; s=2;
[y1_test, iter_test, s_test, x_test]=shoot(d2f, d3f, xa, xb, f0, N, s, delta,
Nmax, yb);
figure('name', 't2');
plot(x_test, y1_test);
title('y-x for test, s=2, N=100, delta=0.001');
xlabel('x'); ylabel('y');
ylim([0, 1.1]);
fprintf('For N=100, initial s=2, delta=0.001, s is %f.\n',s_test);

N=100; s=1.1;
[y1_test, iter_test, s_test, x_test]=shoot(d2f, d3f, xa, xb, f0, N, s, delta,
Nmax, yb);
figure('name', 't3');
plot(x_test, y1_test);
title('y-x for test, s=1.1, N=100, delta=0.001');
xlabel('x'); ylabel('y');
ylim([0, 1.1]);
fprintf('For N=100, initial s=1.1, delta=0.001, s is %f.\n',s_test);
% run problem 4
% 1
d2f = -y^2 * x; d3f = -x*2*y; xa = 0; xb = 1; f0 = 0; N = 1000;
s = 2.5; delta = 0.001; Nmax = 100; yb = 2;
[y1, iter1, s1, x1]=shoot(d2f, d3f, xa, xb, f0, N, s, delta, Nmax, yb);
figure(2);
plot(x1, y1);
title('y-x for s=2.5 and N=1000');
xlabel('x'); ylabel('y');
% 2
N = 100;
s = 2;
[y2, iter2, s2, x2]=shoot(d2f, d3f, xa, xb, f0, N, s, delta, Nmax, yb);
figure(3);
plot(x2, y2);
title('y-x for s=2 and N=100');
```

```

xlabel('x'); ylabel('y');
% 3
N = 1000;
s = 2;
[y3, iter3, s3, x3]=shoot(d2f, d3f, xa, xb, f0, N, s, delta, Nmax, yb);
figure(4);
plot(x3, y3);
title('y-x for s=2 and N=1000');
xlabel('x'); ylabel('y');
% 4
N = 100;
s = 2.5;
[y4, iter4, s4, x4]=shoot(d2f, d3f, xa, xb, f0, N, s, delta, Nmax, yb);
figure(5);
plot(x4, y4);
title('y-x for s=2.5 and N=100');
xlabel('x'); ylabel('y');

hold all;
plot(x1, y1, '-');
plot(x2, y2, '-.');
plot(x3, y3, '.');
plot(x4, y4, '--.');
legend('N 1000 s 2.5', 'N 100 s 2', 'N 1000 s 2', 'N 100 s 2.5');
hold off;
disp('final s for each conditions:');
fprintf('s1 = %f\n', s1);
fprintf('s2 = %f\n', s2);
fprintf('s3 = %f\n', s3);
fprintf('s4 = %f\n', s4);

```

shooting subroutine

```

function [y1 , iter, s, x] = shoot(d2f, d3f, xa, xb, f0, N, s, delta, Nmax,
yb)
% d2f: right hand side expression, e.g. -f^2*x
% d3f: e.g. -x*2f
step = (xb-xa) / N;
x = linspace(xa, xb, N+1);
y1 = linspace(0, 0, N+1);
y2 = linspace(0, 0, N+1);
Y1 = linspace(0, 0, N+1);
Y2 = linspace(0, 0, N+1);
iter = 0;
while iter < Nmax
    y1(1) = f0;
    y2(1) = s;
    Y1(1) = 0;
    Y2(1) = 1;
    for i = 1:N
        y1(i+1) = y1(i) + y2(i)*step;
        y2(i+1) = y2(i) + eval(subs(d2f, 'x', x(i)), 'y', y1(i)))*step;
        Y1(i+1) = Y1(i) + Y2(i)*step;
        Y2(i+1) = Y2(i) +
        eval(subs(subs(d3f, 'x', x(i)), 'y', y1(i)))*Y1(i)*step;
    end
end

```

```

end
iter = iter + 1;
s = s - (y1(N+1)-yb) / Y1(N+1);
if abs(y1(N+1)-yb) / Y1(N+1) < delta
    break;
end
end
end
end

```

Console result

For test:

For N=1000, initial s=1.1, delta=0.001, s is 1.187801.

For N=100, initial s=2, delta=0.001, s is 1.182494.

For N=100, initial s=1.1, delta=0.001, s is 1.182494.

For N=1000, initial s=2, delta=0.001, s is 1.187801.

For problem 4

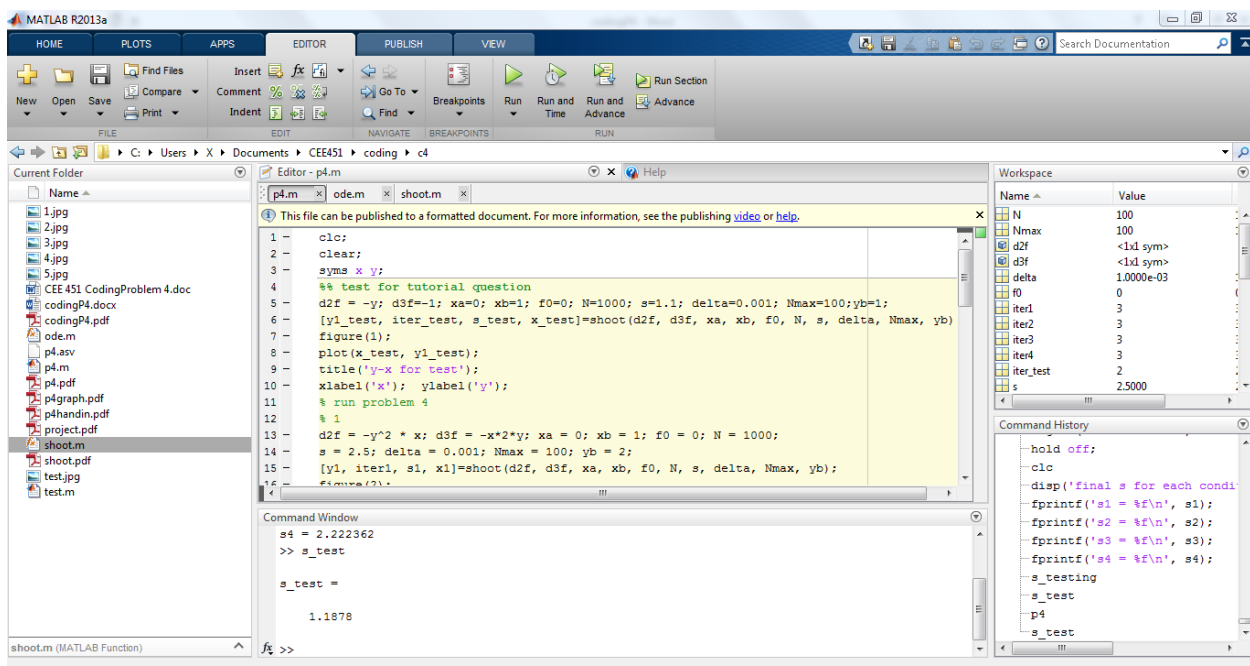
final s for each conditions:

N=1000, initial s=2.5, s1 = 2.233780

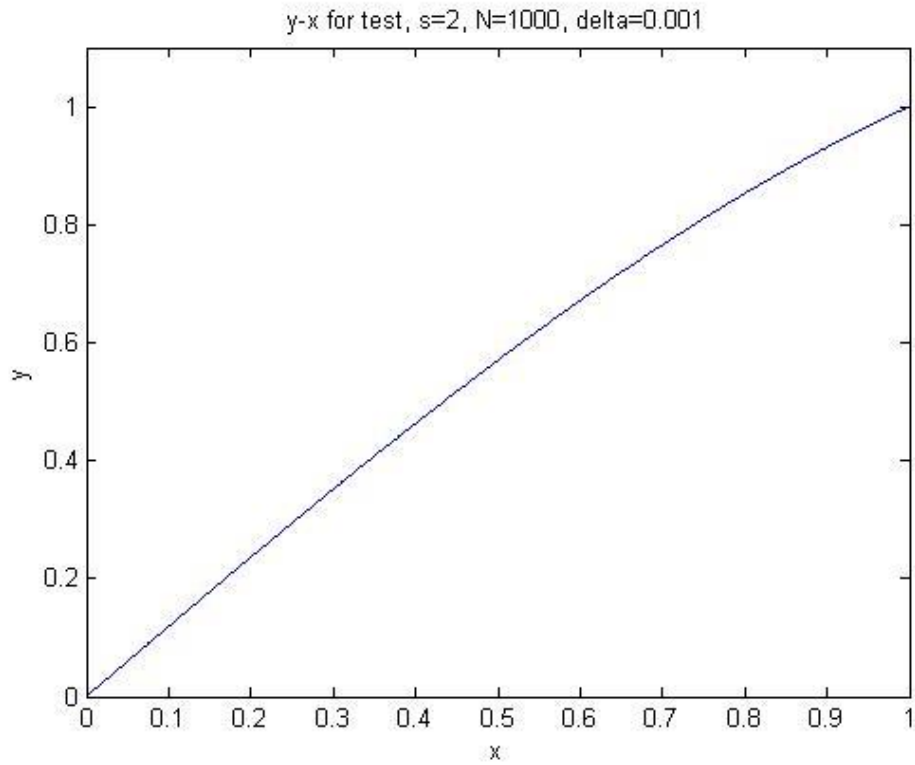
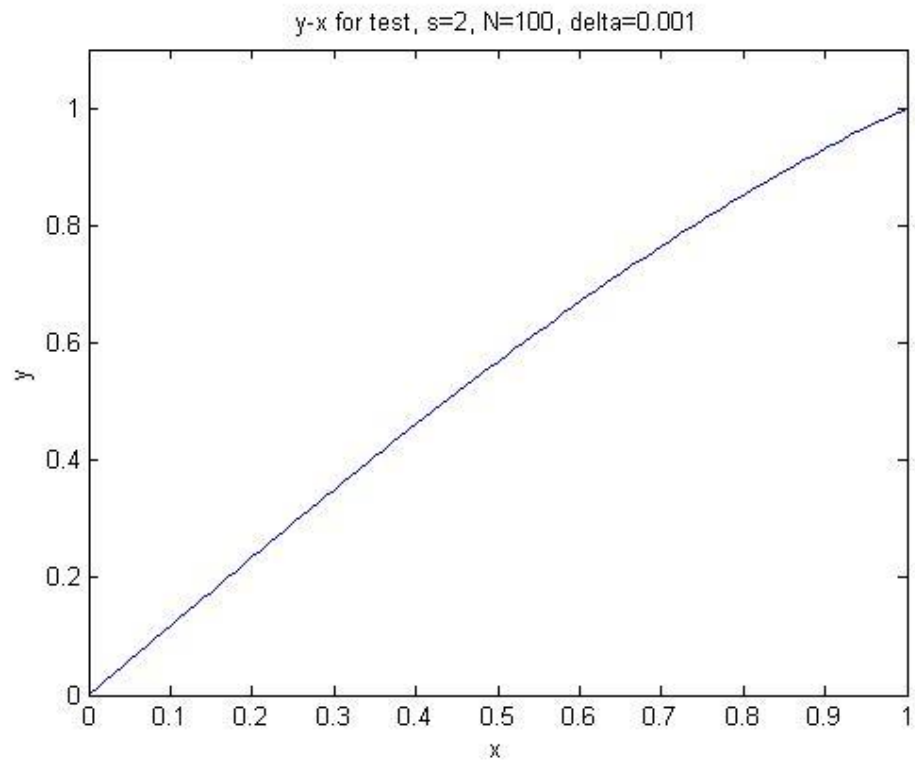
N=100, initial s=2, s2 = 2.222362

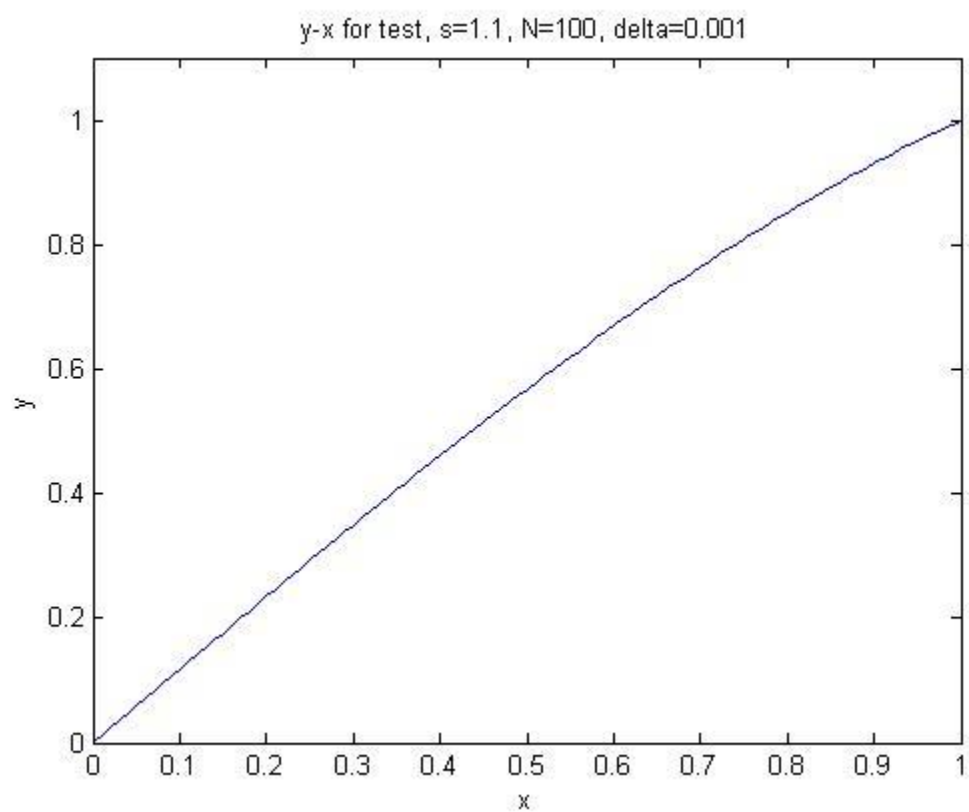
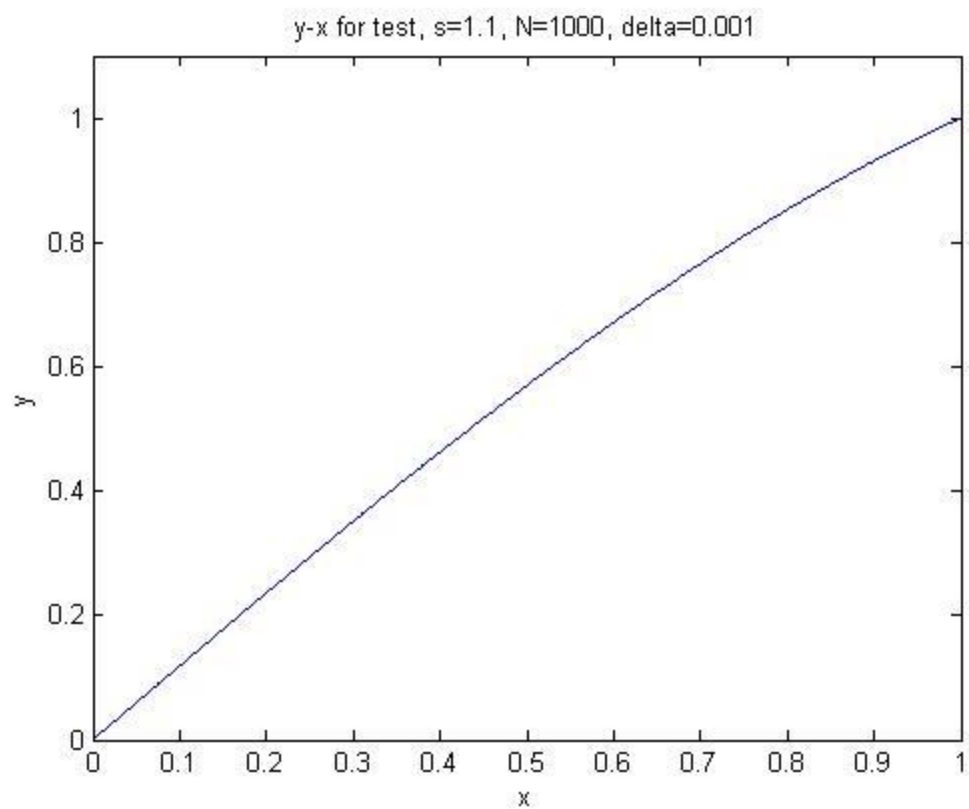
N=1000, initial s=2, s3 = 2.233780

N=100, initial s=2.5, s4 = 2.222362



Plotting





Coding problem itself

