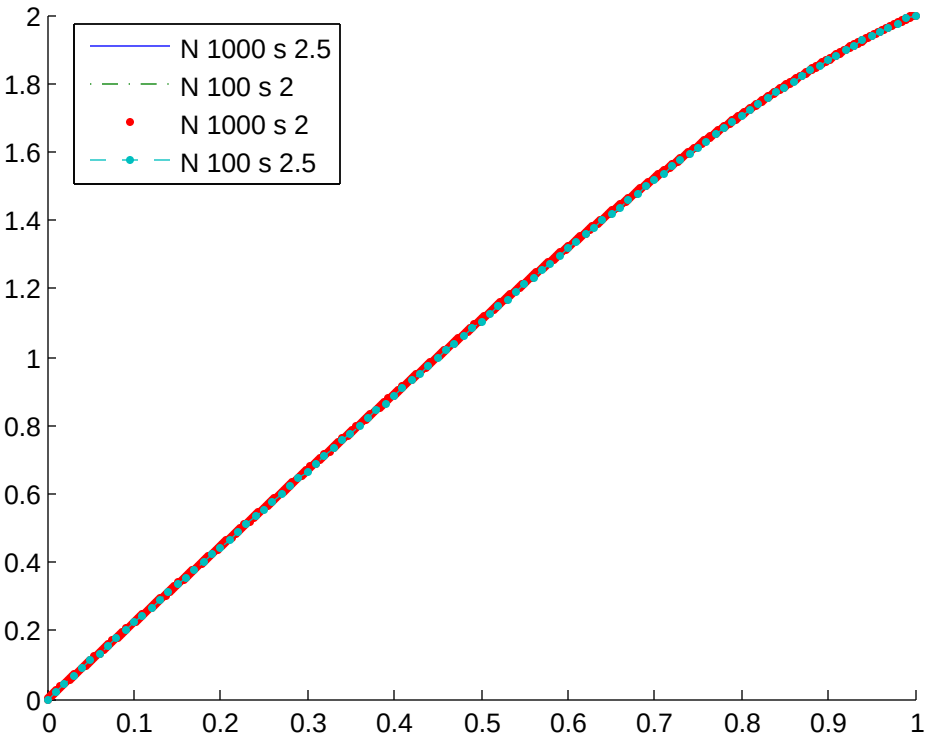
```
clc;
clear;
syms x y;
%% test for tutorial question
d2f = -y; d3f=-1; xa=0; xb=1; f0=0; N=1000; s=1.1; delta=0.001; Nmax=100;yb=1;
[y1_test, iter_test, s_test]=shoot(d2f, d3f, xa, xb, f0, N, s, delta, Nmax, yb);
% run problem 4
% 1
d2f = -y^2 * x; d3f = -x*2*y; xa = 0; xb = 1; f0 = 0; N = 1000;
s = 2.5; delta = 0.001; Nmax = 100;yb = 2;
[y1, iter1, s1, x1]=shoot(d2f, d3f, xa, xb, f0, N, s, delta, Nmax, yb);

N = 100;
s = 2;
[y2, iter2, s2, x2]=shoot(d2f, d3f, xa, xb, f0, N, s, delta, Nmax, yb);

N = 1000;
s = 2;
[y3, iter3, s3, x3]=shoot(d2f, d3f, xa, xb, f0, N, s, delta, Nmax, yb);

N = 100;
s = 2.5;
[y4, iter4, s4, x4]=shoot(d2f, d3f, xa, xb, f0, N, s, delta, Nmax, yb);

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
```

```
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
        %% under a given s, get y1
        %  get y1 n+1
        y1(i+1) = y1(i) + y2(i)*step;
        %  get y2 n+1
        %         yp = y2(i) + eval(subs(subs(d2f,'x',x(i)),'y',y2(i)))*step;
        %         left = eval(subs(subs(d2f,'x',x(i)),'y',y2(i)));
        %         right = eval(subs(subs(d2f,'x',x(i+1)),'y',yp));
        %         y2(i+1) = y2(i) + 1/2*(left+right)*step;
        y2(i+1) = y2(i) + eval(subs(subs(d2f,'x',x(i)),'y',y1(i)))*step;
        %% get F to update s
        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
    iter = iter + 1;
%     disp(y1(N+1));
    s = s - (y1(N+1)-yb) / Y1(N+1);
%     disp(s);
%     fprintf('%20.6f\n', abs(y1(N+1)-yb) / Y1(N+1));
    if abs(y1(N+1)-yb) / Y1(N+1) < delta
        break;
    end
end

end
```


N 1000 s 2.5
N 100 s 2
N 1000 s 2
N 100 s 2.5
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1