1. Download the Matlab functions *feuler_modified.m*, *fun3a.m* and *fun3b.m* from the course website. Then follow the commands in the next page to solve the example we did not finish in class.

2. Use the Matlab function *feuler_modified.m* to solve the boundary value problem

$$y'' = -\frac{4}{x}y' - \frac{2}{x^2}y + \frac{2\ln x}{x^2}, \quad 1 \le x \le 2$$
$$y(1) = 1/2, \quad y(2) = \ln 2.$$

Try different step size (e.g. $n = 10$, 20, 40, etc). Compare the results to the exact solution

$$y(x) = \frac{4}{x} - \frac{2}{x^2} + \ln x - \frac{3}{2},$$

and plot the error versus h.

MATLAB 7.12.0 (R2011a)

File Edit Debug Parallel Desktop Window Help

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Shortcuts How to Add What's New

```
>> c2=1/70*(8-12*sin(log(2))-4*cos(log(2))); c1=11/10-c2;
>> yexact=inline('varargin(1)*x+varargin(2)./(x.^2)-3/10*sin(log(x))-1/10*cos(log(x))','x','varargin');
>>
>> tspan=[1,2]; n=10;
>> [t, y1]=feuler_modified(@fun3a,tspan,[1,0]', n);
>> % y1 is the solution to the 1st initial value problem;
>> % note that y1 is a vector consisting of y (the 1st column of y1)
>> % and its derivative y' or u (the second column)
>>
>> [t, y2]=feuler_modified(@fun3b,tspan,[0,1]', n);
>> % y2 is the solution to the 2nd initial value problem.
>>
>> y=y1(:,1)+(2-y1(end,1))/y2(end,1)*y2(:,1);
>> % y is the solution to the boundary value problem.
>>
>> yy=feval(yexact, t, [c1, c2]);
>> % yy is the exact solution
>>
>> plot(t, y,'o'); hold; plot(t, yy,'r')
Current plot held
>>
>> error = max(abs(y-yy'))

error =

   3.9208e-05

>>
```

Start