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% CMSC/AMSC 460  Fall 2007
% Homework 5
%
% Purpose: Practice in solving linear systems
%          of equations and systems of ODEs.
% We want to use ode45 to solve the differential equation:
%                  y' = J\y-y
%
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% Modified by Sima Taheri, 15 Oct. 2007
%
% Parameters:
%   [tout,yout,te,ye] = ode45(@hmwk5f, tspan, y0, options);
%
%   hmwk5f:  A function handle that evaluates the
%            right side of the differential equations.
%   tspam:   A vector specifying the interval of integration, [0,10].
%   y0:      A vector of initial conditions, y0 = [1,3,4]'.
%   options: Structure of optional parameters that change
%            the default integration properties.
%   hmwk5e:  A function handle for event.
%
% Outputs:
%   tout:  Column vector of time points.
%   ypout: Solution array. Each row in yout corresponds to the
%          solution at a time returned in the corresponding row of tout
%   te:    The time when event, y3(t) = 1, occurs.
%   ye:    The solution at the time of the event
%   Plot of the three components of y.

global maxcond

% maxcond records the maximum condition number of the J
% matrix over the course of the integration.

maxcond = 1;

options=odeset('Events',@hmwk5e);
[tout,yout,te,ye] = ode45(@hmwk5f, [0 10], [1 3 4]',options);

plot(tout,yout(:,1),'r-',tout,yout(:,2),'b:',tout,yout(:,3),'g-.')
grid on
xlabel('t')
ylabel('y')
legend('y(1)','y(2)','y(3)')
title('The solution to the differential equation in Hmwk 5')

disp(sprintf('The maximum condition number of J was %f.',maxcond))
disp(sprintf('y(3)=1 at t=%f',te))

%%%%%%%%%%%%%%%%%%%%%%%%%%
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```
% Function that evaluates the right side of the differential equation.
function yprime = hmwk5f(t,y)

global maxcond

J = [1+t       t^2*y(2)  t*y(3)
    t*y(1)     1+t       t^2*y(3)
    t^2*y(1)   t*y(2)    1+t];

yprime =  J\y - y;

maxcond = max(maxcond,cond(J));


%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%


% Event function
function [value,isterminal,direction] = hmwk5e(t,y)

% value:       The value of the function
% isterminal = 1, if the integration is to terminate
%                 at a zero of this event function and 0 otherwise.
% direction  = 0 if all zeros are to be computed
%             +1 if only the zeros where the event function increases,
%             -1 if only the zeros where the event function decreases.

value = y(3)-1;
isterminal = 0;
direction = 0;
```

Output:

```
The maximum condition number of J was 491.116941.

y(3)=1 at t=2.238698
```

Plot: