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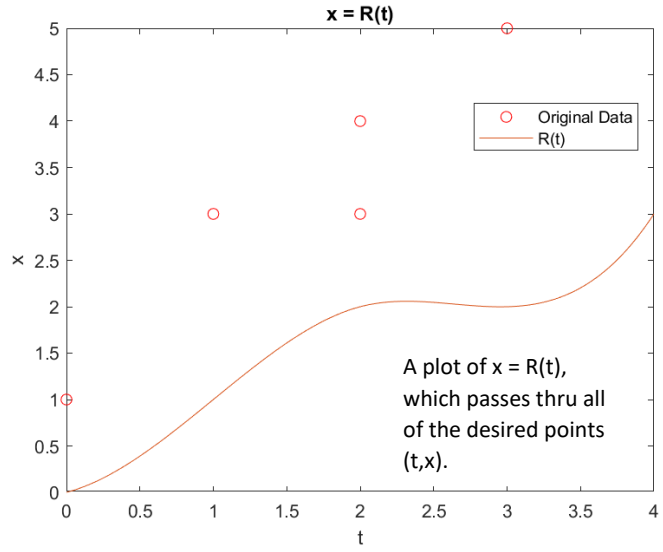
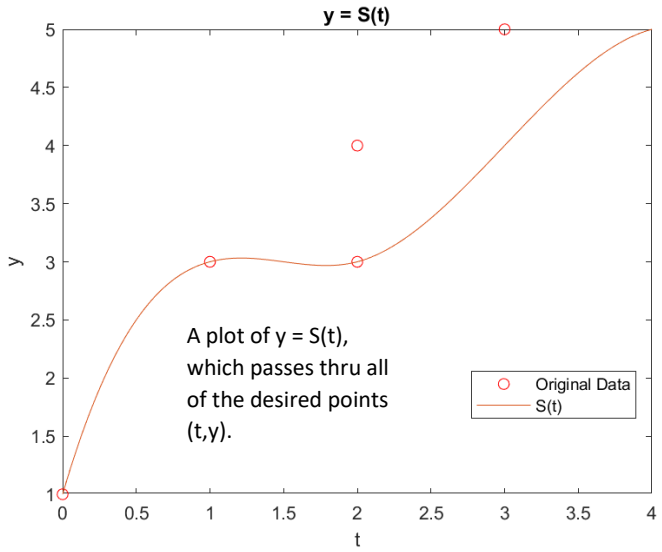
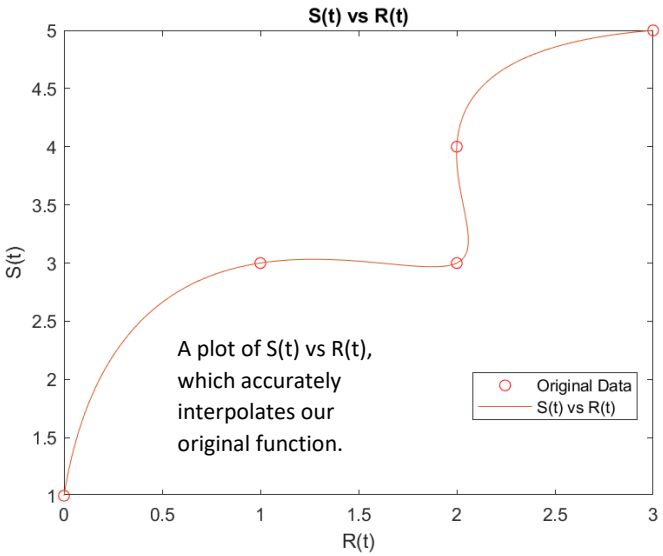
MACM 316 – Assignment 7

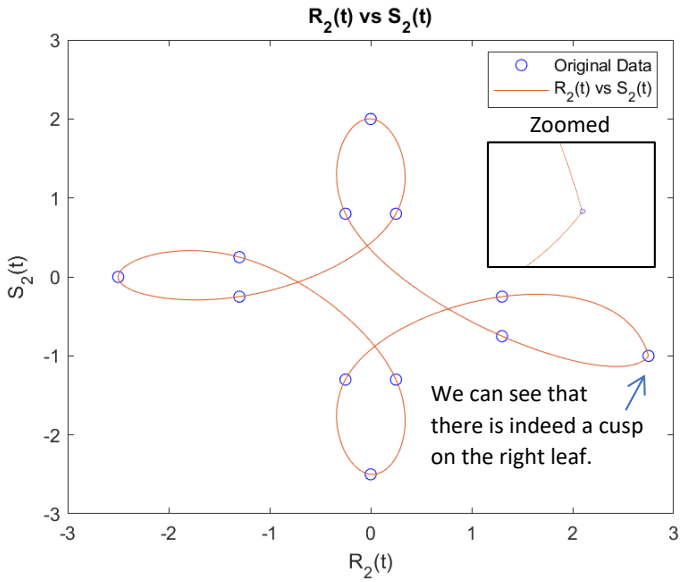
a)



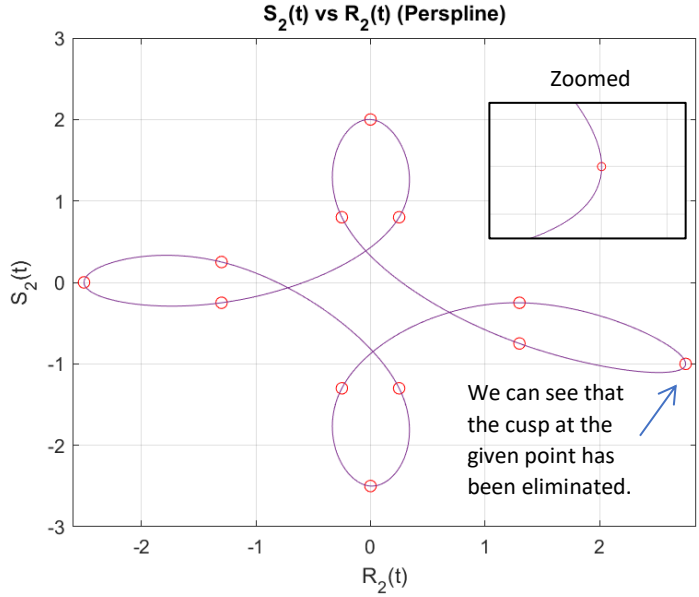




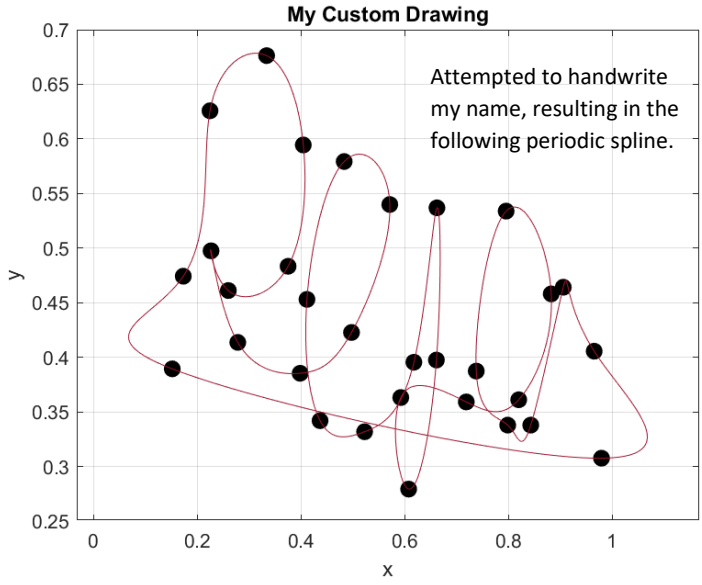
b)



c)



d)



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```
% a)
t = [0 1 2 3 4];
x = [0.0 1.0 2.0 2.0 3.0];
y = [1.0 3.0 3.0 4.0 5.0];
xx = linspace(0, 4, 1000);
grid on
pp1 = spline(t, y);
St = ppval(pp1, xx);
pp2 = spline(t, x);
Rt = ppval(pp2, xx);
plot(x, y, 'ro', xx, Rt)
title 'x = R(t)'
xlabel('t')
ylabel('x')
legend ('Original Data','R(t)', 'location', 'best')
plot(x, y, 'ro', xx, St)
title 'y = S(t)'
xlabel('t')
ylabel('y')
legend ('Original Data','S(t)', 'location', 'best')
plot(x, y, 'ro', Rt, St)
title  'S(t) vs R(t)'
xlabel('R(t)')
ylabel('S(t)')
legend ('Original Data','S(t) vs R(t)', 'location',
'best')
% b)
x2 = [2.75 1.3 -0.25 0.0 0.25 -1.3 -2.5 -1.3 0.25
0.0 -0.25 1.3 2.75];
y2 = [-1.0 -0.75 0.8 2.0 0.8 -0.25 0.0 0.25 -1.3 -
2.5 -1.3 -0.25 -1.0];
t2 = [-3 -2.5 -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 2.5 3];
xx2 = linspace(-3, 3, 1000);
pp3 = spline(t2, x2);
Rt2 = ppval(pp3, xx2)
pp4 = spline(t2, y2);
St2 = ppval(pp4, xx2)
plot(x2, y2, 'bo', xx, Rt2)
title  'x = R_2(t)'
xlabel('t')
ylabel('x')
legend ('Original Data','R_2(t)', 'location',
'best')
plot(x2, y2, 'bo', xx, St2)
title  'y = S_2(t)'
xlabel('t')
ylabel('y')
legend ('Original Data','S_2(t)', 'location',
'best')
plot(x2, y2, 'bo', Rt2, St2)
title  'R_2(t) vs S_2(t)'
xlabel('R_2(t)')
ylabel('S_2(t)')
legend ('Original Data','R_2(t) vs S_2(t)',
'location', 'best')
% c)
[ylist1] = perspline(t2, x2, 1);
[ylist2] = perspline(t2, y2, 1);
[ylist3] = perspline(ylist1, ylist2, 0);
% d)
%figure('position', get(0,'screensize')) % biggest
window possible
%axes('position', [0 0 1 1]) % domain [0,1] x [0,1]
%axis square % x,y axes equal
%[x,y] = ginput; % record mouse clicks
%close % get rid of huge window
%save mydatafile.mat x y % save the data points
% I renamed the variables x and y to xd and yd in
the variable editor
td = linspace(0, 1, length(xd))
[ylist1] = perspline(td, xd', 1);
[ylist2] = perspline(td, yd', 1);
[ylist3] = perspline(ylist1, ylist2, 0);
```

```
% PERSPLINE: Perform cubic spline interpolation on a given set
%            of data points, using periodic end-point conditions.

% NOTE: Must have y(1)=y(end)!!  So this is a modified version
% of the data used for the other spline examples.
function [ylist] = perspline(x,y, dots)
x = x';
y = y';
n = length(x) - 1;
ylist = [];
x2 = [];
y2 = [];
% Set up the matrix
h = diff(x);
diag0 = [1; 2*(h(1:end-1)+h(2:end)); 2*h(end)];
A = spdiags([[h;0], diag0, [0;h]], [-1, 0, 1], n+1, n+1);
% Then do a little surgery on the first/last rows ...
A(1,2)   = 0;
A(1,end) = -1;
A(end,1) = 2*h(1);
A(end,2) = h(1);
dy = diff(y);
% ... and the RHS vector
rhs = 6*[0; diff(dy./h); dy(1)/h(1)-dy(end)/h(end)];
m = A \ rhs;     % Solve for slopes, m_i=S''(x_i)

% Compute the cubic polynomial coefficients
a = y;
b = dy./h - h.*m(1:end-1)/2 - h.*diff(m)/6;
c = m(1:end-1)/2;
d = diff(m)./h/6;

% Plot each spline along with the data
for i = 1 : n
  xx = linspace(x(i), x(i+1), 100);
  yy = a(i) + b(i)*(xx-x(i)) + c(i)*(xx-x(i)).^2 ...
       + d(i)*(xx-x(i)).^3;
  ylist = [ylist, yy];
  plot(xx, yy, 'r-')
  hold on
end
if dots == 1
    plot(x,y,'k.', 'MarkerSize', 30)
    hold off
    set(gca, 'XLim', [min(x)-0.1, max(x)+0.1])
    xlabel('t'), ylabel('R(t)')
    title 'x = R(t)'
    grid on, shg
    print -djpeg 'perspline.jpg'
elseif dots == 0
    for i = 1:100:n
        x2 = [x2, x(i)];
        y2 = [y2, y(i)];
    end
    plot(x2,y2,'k.', 'MarkerSize', 30)
    plot(x,y)
    hold on
    set(gca, 'XLim', [min(x)-0.1, max(x)+0.1])
    xlabel('x'), ylabel('y')
    title 'My Custom Drawing'
    grid on, shg
    print -djpeg 'perspline.jpg'
end
```