

Math 104A: Homework 4

Raghav Thirumulu, Perm 3499720
rrajuthirumulu@umail.ucsb.edu

July 24, 2018

1.

```
function [a,b,c,d] = cubic_spline_coefficients(x,y)
% Computer code for evaluating coefficients of cubic spline
% Input:  x      --- vector of x points
%         y      --- vector of y points
% Output a,b,c,d --- coefficients of cubic spline
% Author: Raghav Thirumulu, Perm 3499720
% Date:   07/23/2018

% Find length of our dataset
n=length(x);

% Find interval lengths and store in h
for i=1:n-1
    h(i)=x(i+1)-x(i);
end

% Create vectors/matrices for storing values
A=zeros(n,n);
f=zeros(n,1);
A(1,1)=1;
A(n,n)=1;

% Iterate through, replacing points
for i=2:n-1
    A(i,i)=2*(h(i)+h(i-1));
    f(i)=6*((y(i+1)-y(i))/h(i)-(y(i)-y(i-1))/h(i-1)));
end
for i=2:n-2
    A(i,i+1)=h(i+1);
end
for i=3:n-1
    A(i,i-1)=h(i);
end

s=A\f;

for i=1:n-1
    a(i)=(s(i+1)-s(i))/(6*h(i));
    b(i)=s(i)/2;
    c(i)=(y(i+1)-y(i))/h(i)-(2*h(i)*s(i)+h(i)*s(i+1))/6;
    d(i)=y(i);
end
```

```
function ybar = cubic_spline_eval(s0,s1,s2,s3,xbar,x)
% Computer code for evaluating cubic spline at certain point
% Input: s0,s1,s2,s3 --- coefficients we solved for earlier
%        xbar      --- x value we are interpolating at
%        x         --- data points for interpolation
% Output ybar      --- evaluation of cubic spline
% Author: Raghav Thirumulu, Perm 3499720
% Date:   07/23/2018

n=length(x);
i=1;

while (xbar>x(i+1) && i<=n-1)
    i=i+1;
end
```

```
% Multiply coefficients with degree for evaluation
ybar=s0(i)*(xbar-x(i))^3+s1(i)*(xbar-x(i))^2+s2(i)*(xbar-x(i))+s3(i);
```

2.

S0(t,x)	S1(t,x)	S2(t,x)	S3(t,x)	S0(t,y)	S1(t,y)	S2(t,y)	S3(t,y)
0.0157	0	-0.9769	1.5000	0.2829	0	0.1347	0.7500
0.0320	0.0291	-0.9588	0.9000	-3.0574	0.5245	0.4564	0.9000
1.0594	0.0596	-0.9088	0.6000	2.6103	-2.3831	-0.1297	1.0000
-2.1432	1.0766	-0.4928	0.3500	-0.5798	0.1229	-0.8813	0.8000
6.3975	-1.3731	-0.4653	0.2000	2.5834	-0.5398	-0.9711	0.4500
-3.9670	3.7897	0.0829	0.1000	-0.9674	1.5449	-0.7150	0.2000
0.9217	-1.1136	1.3086	0.5000	-0.3785	0.3493	0.1164	0.1000
-0.1966	0.2967	0.8946	1.0000	0.1523	-0.2299	0.1765	0.2000

```
function plot_cubic_spline(t,s0,s1,s2,s3,s4,s5,s6,s7)
% Computer code for plotting parametric spline function
% Input: t --- vector of t values for interpolation
% s0,s1,s2,s3 --- evaluation of coefficients from
% cubic_spline_coefficients(t,x)
% s4,s5,s6,s7 --- evaluation of coefficients from
% cubic_spline_coefficients(t,y)
% Output: Plot of parametric curve of x(t) vs y(t)
% Author: Raghav Thirumulu, Perm 3499720
% Date: 07/23/2018
n = length(t);

for i=1:n-1
    xx(i) = cubic_spline_eval(s0,s1,s2,s3,t(i),t);
    yy(i) = cubic_spline_eval(s4,s5,s6,s7,t(i),t);
end
plot(xx,yy,'b');
title('Parametric representation of curve');
xlabel('x(t)');
ylabel('y(t)');
```

