

**CSE/Mathematics 451**  
**Homework Five—Part I**  
**Due 7 November 2007**

You will write part of a simple cubic spline program in MATLAB. The data will be based upon your student number. Suppose your student number is 9 2648 8703. You will then use the interpolation data

x	y
1	9
2	-2
3	6
4	-4
5	8
6	-8
7	7
8	0
9	3

That is  $f(j) = (-1)^{j-1}s_j$  where  $s_j$  is the  $j$ th digit of your student number. You will compute the complete cubic spline that interpolates this data for your student number. Use the endpoint conditions

$$S''(1) = S''(9) = 0.$$

Use the notes as a guide. Note that since the data points are the first 9 positive integers,  $h_j = 1$  for all  $j$ . Thus in the tridiagonal system in the notes,  $t_{jj} = 4, t_{j,j+1} = t_{j,j-1} = 1$ .

I suggest that you write two functions with the following calling sequences.

```
function [a,b,c,d]=spline_parm(x,y)
```

The vectors  $a$ ,  $b$ ,  $c$ , and  $d$  contain the coefficients such that spline for the interval  $[x_k, x_{k+1}]$  is

$$S_k(x) = a_k + b_k(x - x_k) + c_k(x - x_k)^2 + d_k(x - x_k)^3.$$

The second function you should write is

```
function yy=spline_eval(a,b,c,d,xx)
```

which evaluates the spline at the point (or points)  $xx$  and outputs the value in  $yy$ . Since the knots are known to be the integers 1 through 9, you can give out an error for any value less than 1 or greater than 9 and then compute

$$diff = xx - floor(xx), \quad i = floor(xx)$$

to get the distance between  $xx$  and the knot below it. Your routine should accept vector input and give vector output. The function

```
n=length(xx)
```

determines the length of a vector.

To verify that you have the right spline do the following computation

```
pp=csape(x,y,'variational'); (x and y are your data)
xx=1:0.1:9;
yy=spline_eval(a,b,c,d,xx);
yyc=ppval(pp,xx);
err=yy-yyc;
plot(xx,err)
title('Plot of Error in My Personal Spline')
```

Print out the plot of  $err$ . It should be very small. Please also produce a plot of your spline. That may be done by typing

```
plot(xx,yy)
title('Personal spline of Alan Turing')
```

Please substitute your name for Alan Turing's.