Problem Set 6
Due on December 9ᵗʰ, 2011

Problem 1

You will study 1D spline interpolation in this problem:

a) Write a function that finds the 2nd derivatives (y_j'') of a given data set. The prototype of the function should look like this:

```
void spline(double *x, double *y, int n, double *y2)
```

where x and y are containing n data points given as input. y2 should return the 2nd derivatives (y_j''). Assume that, the 2nd derivatives at end points of the whole data set are zero; $y_1'' = y_n'' = 0$.

b) Write a function that finds the interpolated value for a given data set and 2nd derivatives. The prototype of the function should look like this:

```
double splineval(double *x, double *y, double *y2, int n, double xx)
```

where x, y, and y2 are containing n data points with their derivatives as their names suggest. This function will return, as a **double** type, the interpolated value for a given xx.

c) Consider the following table to test your code:

x	y
0	0.00000
1	0.67744
2	0.15969
3	0.00740
4	-0.01386
5	-0.00646

Find interpolated values between 0 and 5 with steps of 0.01 using cubic splines. Make a plot of your interpolated *curve* superimposed on top of the data using "o" markers.

Problem 2

Consider the following table:

	x=-3	-1.5	0.0	1.5	3.0
y=-3.0	0.0000	-0.0320	-0.2999	-0.0312	0.0000
-1.5	-0.0005	0.0000	-7.9966	-0.4784	0.0031
0.0	-0.0365	-2.7736	0.0000	2.7736	0.0365
1.5	-0.0031	0.4784	7.9966	0.0000	0.0005
3.0	0.0000	0.0312	0.2999	0.0320	0.0000

Write a code that finds interpolated values of this data for all $x = [-3, 3]$ and $y = [-3, 3]$ pairs in steps of 0.025 for each axis using 2D cubic splines. There will be total of $241 \times 241 = 58081$ points. Make a contour plot of these interpolated data with 19 levels, from -9 to 9. (Hint: You can call `contourf(x,y,z,-9:9)` to do this in Matlab.)