# Homework Assignment 3
# CSc 301 Scientific Computing

1. Splines can be used to approximate a "parametric curve" $\big(x(t), y(t)\big)$ by using a spline for each of the functions separately and then plotting the resulting function $y$ vs. $x$. Draw a script letter on a graph paper, place a few points on the letter and take down the coordinates of the points (it doesn't have to be many points: 5 to 12 points is enough, depending on the chosen letter, if chosen wisely). Create two arrays with these data and find the spline approximations $S_y(t)$ and $S_x(t)$ for each of the functions $y(t)$ and $x(t)$ with parameter $t$ representing the array index. Plot the resulting $S_y$ vs. $S_x$. Despite only using a few points for each letter, the resulting plot should be nice and smooth. Experiment with different "end conditions". Explain your choice.

2. The first U.S. postage stamp was issued in 1885, with the cost to mail a letter set at 2 cents. In 1917, the cost was raised to 3 cents but then was returned to 2 cents in 1919. In 1932, it was upped to 3 cents again, where it remained for 26 years. Then a series of increases took place as follows: 1958 = 4 cents, 1963 = 5 cents, 1968 = 6 cents, 1971 = 8 cents, 1974 = 10 cents, 1978 = 15 cents, 1981 = 18 cents in March and 20 cents in October, 1985 = 22 cents, 1988 = 25 cents, 1991 = 29 cents, 1995 = 32 cents, 1999 = 33 cents, 2001 = 34 cents, 2002 = 37 cents, 2006 = 39 cents, 2007 = 41 cents, 2008 = 42 cents, 2009=44 cents, 2012=45 cents, 2013=46 cents, 2014=49 cents, 2015=49 cents, 2016=47 cents (if you want to consider the prices prior to 1885, you can find them on Wikipedia: https://en.wikipedia.org/wiki/History_of_United_States_postage_rates).
   (a) Determine the Newton interpolation polynomial for these data;
   (b) Determine the not-a-knot cubic spline for these data;
   (c) Using both results, to answer the questions: when will it cost 50 cents to mail a letter? Currently, the cost is 47 cents. What would each of these two types of interpolation predict using the data prior to 2016?

3. Take the US census data from wiki: https://en.wikipedia.org/wiki/United_States_Census.
   (a) Find the natural cubic spline function to interpolate the data. Plot.
   (b) Write a script that first discarded one of the data-entry from the given table at a time and then using the spline to estimate it. Draw the plot of errors for each year. What (if anything) you can conclude from these estimates?