Math 128A, Fall 2016.

Programming assignment 1, due Oct 26th.

1. Consider the cubic equation

$$ax^3 + bx^2 + cx + d = 0$$

where a, b, c and d are real input coefficients. Write a MATLAB function `cubic.m` of the form

```
function [largestRoot] = cubic(a, b, c, d)
%           a: Coefficient of x^3
%           d: Coefficient of x^2
%           c: Coefficient of x
%           d: Coefficient of 1
% largestRoot: The largest real root of the cubic
```

to find the largest real root of this equation accurate to within a relative error 10^{-6} using any methods discussed in class. Your program should not use the MATLAB functions `fzero`, `roots` or `eig`.

Before submitting, verify that your code works using `testCubic.m`.

2. 'Complexify' the equation $z^2 + 1 = 0$, i.e., reformulate it as a system $f = 0$ where $f : \mathbb{R}^2 \to \mathbb{R}^2$, and write a MATLAB function `imaginaryUnits.m` of the form

```
function [limit] = imaginaryUnits(x0, y0)
%    x0: Real part of starting value z0
%    y0: Imaginary part of starting value z0
% limit: The limit of the sequence starting at z0
```

that implements Newton's method for this bivariate problem starting with an initial input $z_0 = x_0 + iy_0$. In your commentary, discuss what stopping criterion you are using and why. If any starting values don't lead to convergence, then the `limit` returned should be `NaN`.

Use the MATLAB function `makePlot.m` to generate a phase portrait of Problem 2 by running your `imaginaryUnits.m` function starting from 1000 uniformly spaced initial points from the disk $|z| \le 10$; color-code the initial points according to whether Newton's method converges to i, converges to $-i$, or diverges.