# Homework 6: Optimization

CS 205A: Mathematical Methods for Robotics, Vision, and Graphics (Spring 2017)
Stanford University
Due Friday, May 26, 11:59pm

**Textbook problems:** 9.1 (10 points), 9.3 (20 points), 9.5 (30 points)

**Julia Programming:** This question uses the following two functions,

$$f(x) = 1 + x + x^2 + x^3 + x^4 \qquad \text{(easy)}$$

$$h(x) = exp\left(-\frac{1}{x^2}\right) \qquad \text{(hard)}$$

(which you should plot for your own information).

Do the following:

- Implement a function to perform **Newton's method for minimization** on a scalar function of one variable, that takes a function as input, and an initial guess $x_0$. Use `ForwardDiff` to compute any derivatives you need (see `https://github.com/JuliaDiff/ForwardDiff.jl`). (8 points)
  - Apply it to $f$, starting at $x = 1$, and report the first 20 values at each step. (3 points)
  - Apply it to $h$, starting at $x = 1$, and report the first 20 values at each step. (3 points)
  - How close to the true minima can you get in each case? (4 points)
  - Why is the $h$ function so hard to optimize? (2 points)
- Implement a function to perform **golden section search** that takes a function as input, and an initial search interval. (8 points)
  - Apply it to $f$, starting on the interval [-1,1], and report the first 20 values at each step. (3 points)
  - Apply it to $h$, starting on the interval [-1,1], and report the first 20 values at each step. (3 points)
  - How close to the true minima can you get in each case? (4 points)
  - Is golden section search more reliable than Newton's method for $h$? Why? (2 points)