**Class 13** – **Optimization (Chp 7)**

ChE310\_Sec1\_F2019 / 10.8.19

<http://www.reuelgroup.org/numerical-methods-che-310.html>

Announcements:

* Test grades released today, discussion on performance
* Office hours: Wed in 1126

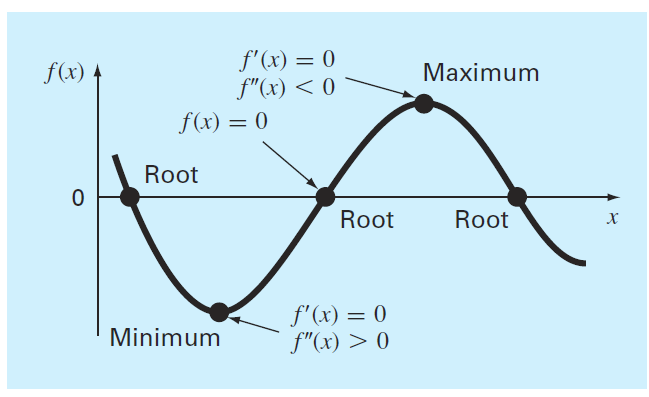
**Warm Up Group Activity:** submit to SLACK by 2:25pm.

For the function f(x) = 2x2+4x+6x3-7, find the single, real root using the following methods:

* Newton Raphson
* **roots** function
* **fzero** function

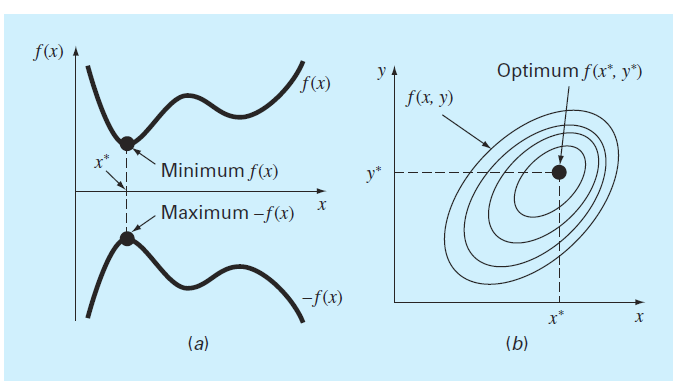
**Outline for Class 13 Lecture**

1. Engineering = Optimization
   1. ‘Well it depends’ answer…
   2. Balance of cost and functionality
   3. Competing variables (Temp, P., Time)
   4. Balance of your time
2. Optimization ≈ Root finding



* Very similar to root finding, in that if the first and second derivative can be found, the max or min can be solved for as a root.
* However, in real life functions do not have simple derivatives, hence numerical methods.

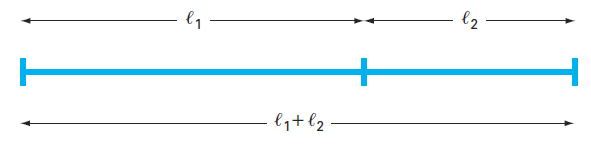
1. Optimization features
   1. One or multiple variables

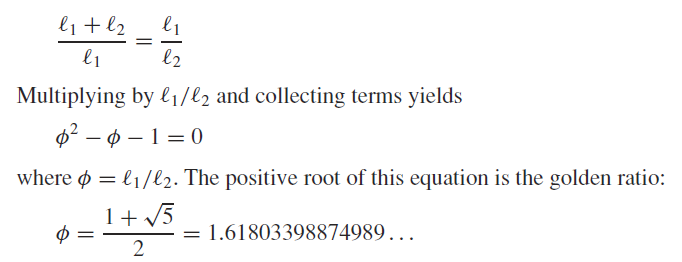


* 1. Global vs. local [hiking picture]

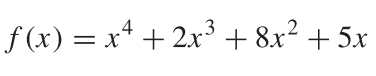
1. 1D: Bracketed: Golden Search





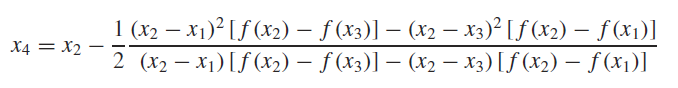


* 1. Example problem 7.9 in text (w/ code)





1. 1D: Bracketed: Parabolic Interpolation

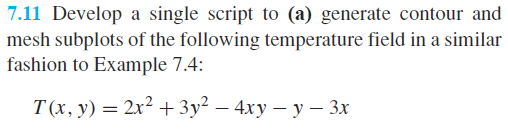


1. 1D: Bracketed: **fminbnd**
   1. find minimum of single variable on defined search interval
   2. Also invented by Richard Brent
   3. Combines slow golden search w/ parabola fit, once in tight window

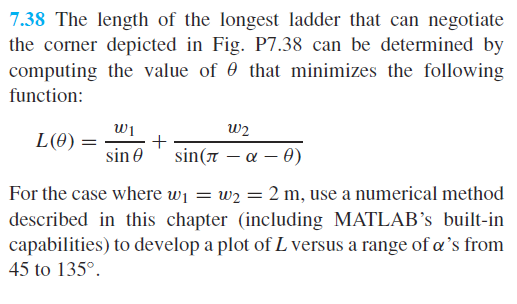
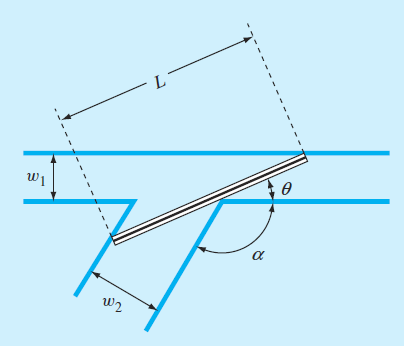


1. 1D or nD: Open: **fminsearch**
   1. Nelder-Mead method, direct search with function values (no analytical derivatives.)
   2. Handles non-smooth objective functions
   3. Multiple variables must be inserted as array





* 1. Passing parameters



1. 1D or nD: Open: **fmincon**
   1. Ultimate Swiss Army Knife to find min!
   2. Included in ‘Optimization Tool Box’
   3. find minimum of constrained nonlinear multivariable functions
   4. *Example 1 –* Himmelblau’s function



* 1. *Example 2 –* Rosenbrock’s function



1. Remind: How do you find a maximum?