Homework 4: Optimization

Due May 24

1. Write a program to find the minimum of a function of one variable using the Golden Search method.

   Write your code in a flexible manner so that you can use it later for other problems, and choose your stopping criteria carefully.

2. Test your implementation on the following problem:

   The rotation curves (that is, rotation velocity vs. distance from the center) for galaxies are observed to rise linearly close to the center, and to be constant far from the center. A possible (but dynamically, not well motivated) function which can be fit to such a rotation curve is;

   $$v_{model}(r) = v_{inf}(1 - e^{-r/r_0}),$$

   where v_{inf} is the assympotic velocity and r_0 is a characteristic radius.

   Using the Golden Search method, and assuming that v_{inf} is 100 km/s, find the r_0 that gives the best fit of the above formula to the following "data":

r_{obs} (kiloparsecs)	v_{obs}(km/s)
1.0	12.09
2.0	47.53
3.0	51.80
4.0	63.28
5.0	90.33
6.0	84.32
7.0	92.23
8.0	94.84
9.0	99.37
10.0	94.42

   This data is available at

   `http://faculty.washington.edu/trq/astr427/rot.dat`. As a criteria for goodness of fit, use the standard least squares formulae:

   $$E = \sum_{i=1}^{N_{data}} (v_{obs} - v_{model}(r_{obs}))^2.$$

   That is, the observational error is the same for each data point.