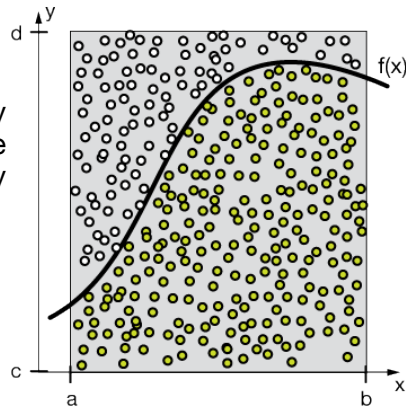
ASTR 119 Final Project Option #4
Monte Carlo Integration

Consider the diagram on the right, which shows an illustration of Monte Carlo integration. Given any integrable function (the line is one example) we can compute the area between f(x) and f=0 over the range x=[a,b] by filling the space with randomly drawn points over the domain x=[a,b], y=[c,d], computing the fraction of points below f(x), and then multiplying that fraction by (d-c)*(b-a).



Final Project #4 Requirements

1) Write a scheme to compute a Monte Carlo integral for any specified function. The integration scheme should take a defined function as a parameter, along with the domain limits x=[a,b]. The domain y=[c,d] should be determined for the function considered automatically.

2) Engineer a method for specifying a tolerance for the Monte Carlo integration. Note this tolerance can refer to the absolute difference between two numerical estimates of the integral.

3) Have the Monte Carlo integrator produce a plot of f(x) over the domain x=[a,b] and y=[c,d], and overplot the samples (as small colored dots, with points above and below the line f(x) as distinctive colors. Have the plot contain the answer to the integral as "F(a,b) = XXX" where XXX is the floating point answer. Make a legend for f(x), and the dots above and below f(x).
4) Test your model on cos(x) over the domain x = [0,1.75]

5) Extra Credit:

Produce an animation of the Monte Carlo integration where each from adds more points to the panel discussed in 3). Add another panel that shows the estimated error of the integral as a function of the number of points.