ASSIGNMENT I

COMPUTING THE AREA OF THE MANDELBROT SET

DEADLINE: November 11, 2015

In this exercise you will explore some properties of the Mandelbrot set. There is plenty of information available on that in the internet.

1. Study the problem, implement the iteration and maybe create colourful pictures of the fractal.

The task is to investigate the area A_M of the Mandelbrot set by Monte Carlo integration methods, yielding an estimate $A_{i,s}$ of the area A_M, where i refers to the number of iterations and s to the number of samples drawn, respectively. In particular, we are interested in the convergence behaviour of $A_{i,s} \rightarrow A_M$ for $i \rightarrow \infty$ and $s \rightarrow \infty$. For large i computation of $A_{i,s}$ with reasonably good statistics can become expensive.

2. Investigate the convergence of $A_{i,s} \rightarrow A_M$ to an extent feasible by the computing power available. In doing that, always balance i and s so that the errors caused by the finiteness of i and s are comparable (consider computing all $A_{j,s}$ $\forall$ $j < i$ then study ($A_{j,s}$ - $A_{i,s}$) as a function of j).

3. You may want to compare the quality of the results obtained using
   - Pure random sampling,
   - Latin hypercube sampling,
   - Orthogonal sampling

   The latter two sampling techniques are described, albeit briefly, in http://en.wikipedia.org/wiki/Latin_hypercube_sampling. For every method used, provide an estimate the accuracy of your computation.

4. Is there any optimization you can do by using the properties of the system to improve your estimate?