

Lab Assignment 9: PDEs Pt. II

Q1. Brownian motion and diffusion limited aggregation

a) Full trajectory of random walk

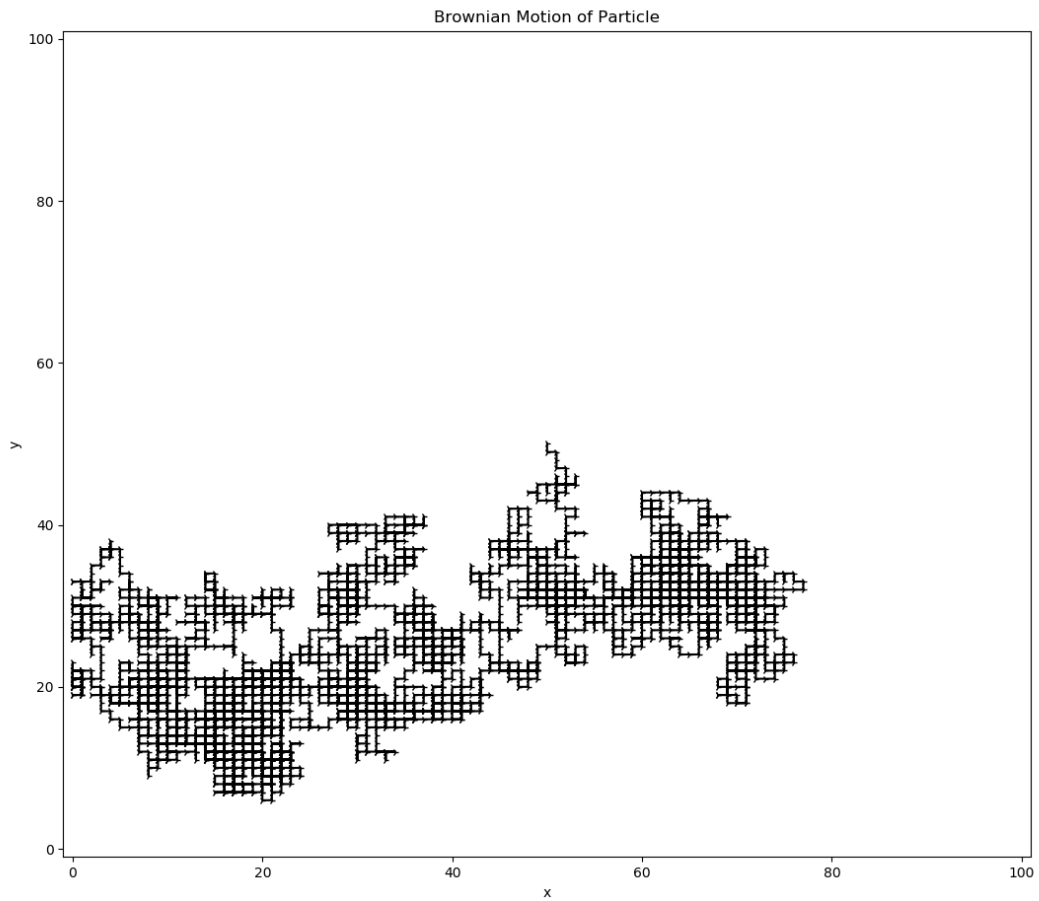


Figure 1. The full trajectory of a particle undergoing Brownian motion for 5000 time steps.

- b) Cf. code
- c) Final DLA distribution

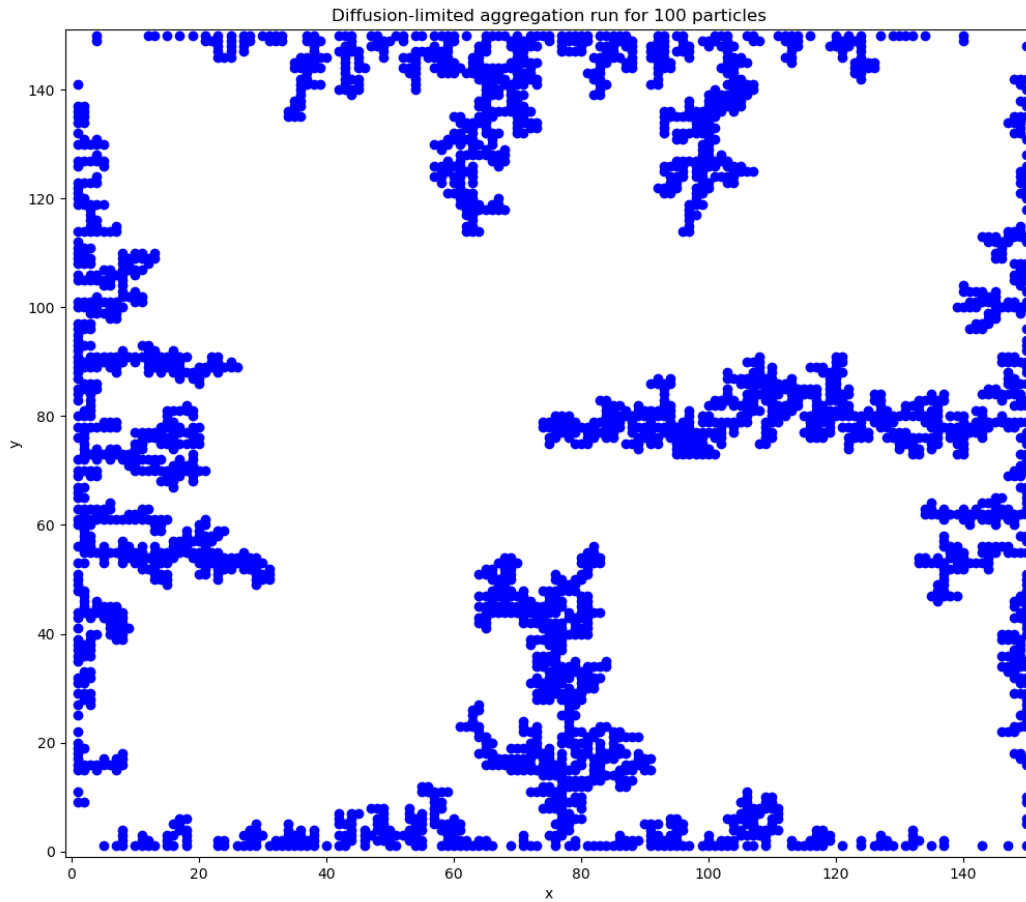


Figure 2. The final DLA distribution, which is composed of 2821 particles undergoing random walk.

Q2. Volume of a 10-D Hypersphere

Using mean value monte carlo integration:

The value of the integral was 2.518016 units¹⁰.

The value of the error associated with this value was 9.90345038055e-05 units¹⁰

This error was calculated by $\sigma = (b - a) \sqrt{\frac{\sum_{i=1}^N [f(r_i)]^2 - [\sum_{i=1}^N f(r_i)]^2}{N}}$

Q3. Importance sampling

- a) Using importance sampling to evaluate a divergent integral, the following plots were outputted:

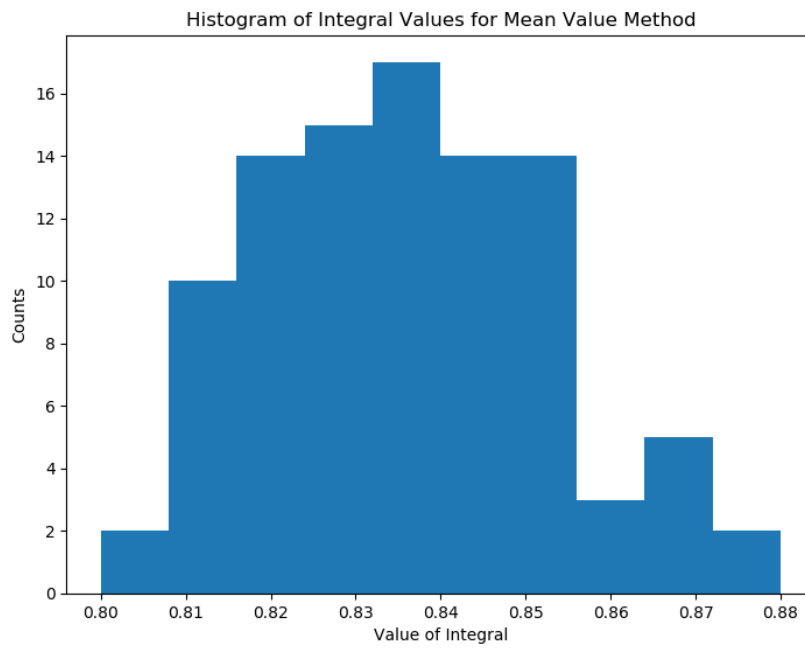


Figure 3. Histogram of the outputted integral values using the mean value method.

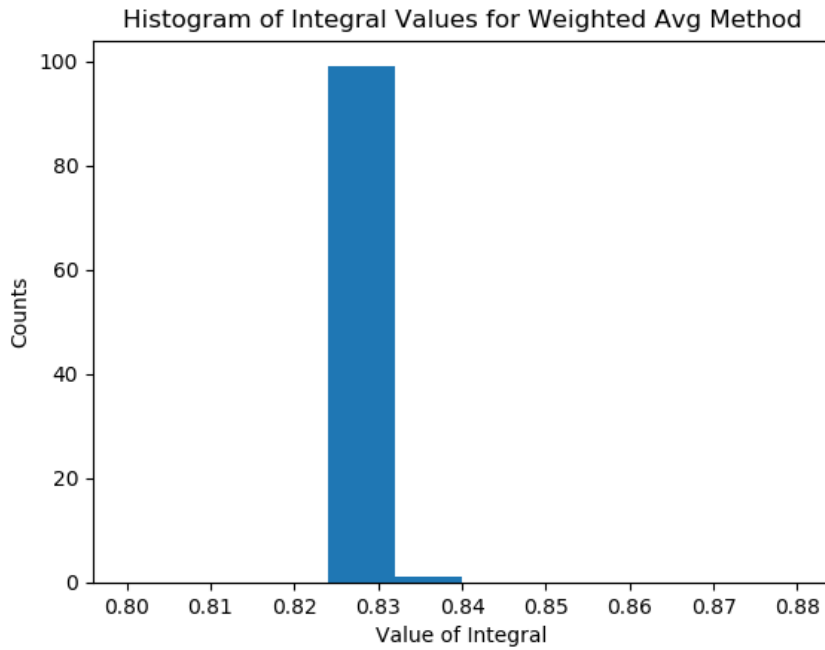


Figure 4. Histogram of the outputted integral values using the weighted average method.

Comparing both distributions, it is obvious that the weighted average method outputs integral values with a higher degree of accuracy. While the integral values outputted using the mean value method exhibit much variance, the integral values outputted by the weighted average method are confined to a single histogram bin. This implies that it is better to use the weighted average method when evaluating divergent integrals.

- b) Using importance sampling to evaluate a convergent integral, the following plots were outputted:

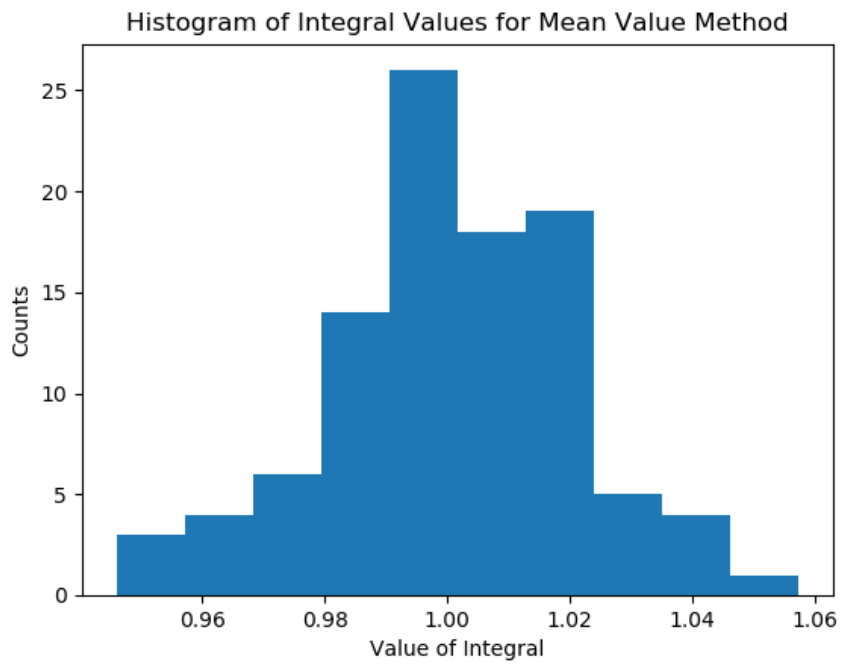


Figure 5. Histogram of outputted integral values using the mean value method.

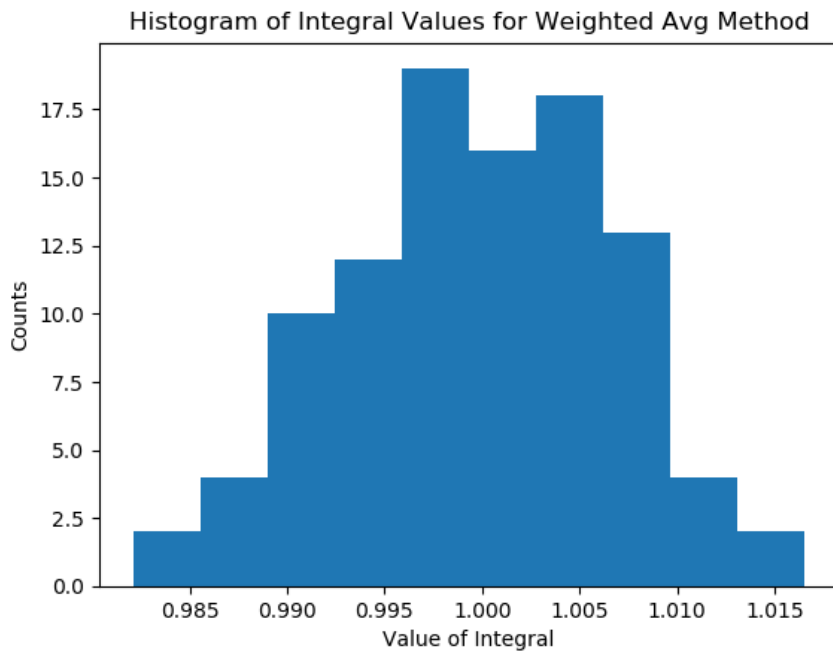


Figure 6. Histogram of the outputted integral values using the weighted average method.

In contrast to what we observed in part a), there is so significant difference between the distribution of integral values outputted using the mean value method and the weighted average

method. This implies that, for evaluated convergent integrals, both methods are comparable in terms of accuracy.