QUESTION 1

November 17, 2015 1:31 AM

(a) $[p(\theta)\,d\theta][p(\phi)\,d\phi] = \frac{\sin\theta}{2}\,d\theta \cdot \frac{1}{2\pi}\,d\phi$

Ranges of θ & ϕ: $\boxed{\begin{array}{c} 0 \leq \phi \leq 2\pi \\ 0 \leq \theta \leq \pi \end{array}}$

Normalisation:

$d\phi = \frac{1}{2\pi} \cdot \quad d\phi = \frac{1}{2\pi} \cdot 2\pi = 1$ ✓

$\sin\theta\,d\theta = -\frac{1}{2}\cos\theta \quad = -\frac{1}{2}\left(\underbrace{\cos(\pi)}_{-1} - \underbrace{\cos(0)}_{1}\right) = \left(\frac{-1}{2}\right)(-2) = 1$ ✓

(b) (*) $\int_0^{\phi(u)} p(\phi')\,d\phi' = \int_0^u du' = u$

$\int_0^{\phi(u)} \frac{1}{2\pi}\,d\phi' = u$

$\Rightarrow \boxed{\phi(u) = 2\pi u}$

(*) $\int_0^{\theta(v)} p(\theta')\,d\theta' = \int_0^v dv' = v$

$\frac{1}{2}\int_0^{\theta(v)} \sin(\theta')\,d\theta' = v$

$-\frac{1}{2}\cos(\theta(v)) = v + \text{constant}$

$\theta(v) = \cos^{-1}(-2v + \text{constant})$

Choose constant $= 1$

$\Rightarrow \boxed{\theta(v) = \cos^{-1}(1 - 2v)}$

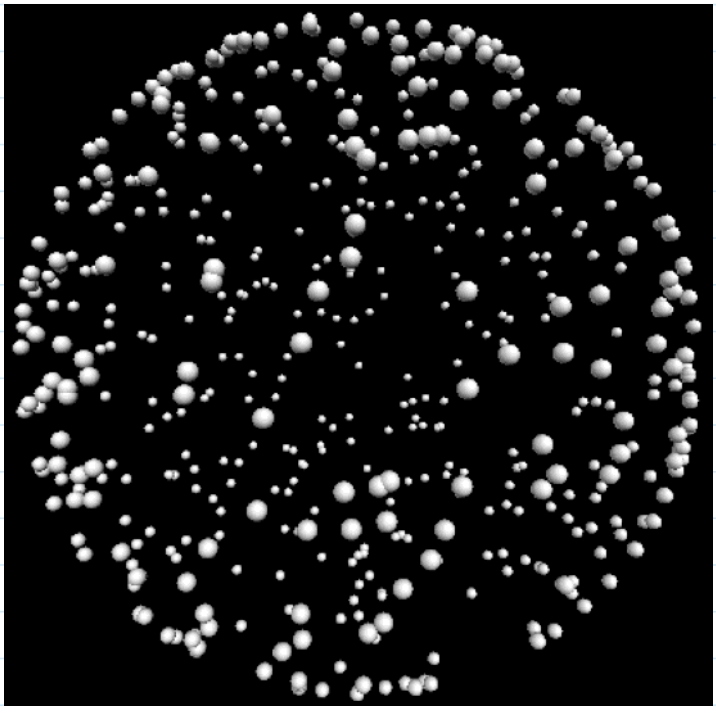
So:

$\theta = \cos^{-1}(1-2v)$

$\phi = 2\pi u$

where u and v are random

c + d



A screen shot showing the result of my Python program.

PHY407H1 Lab10

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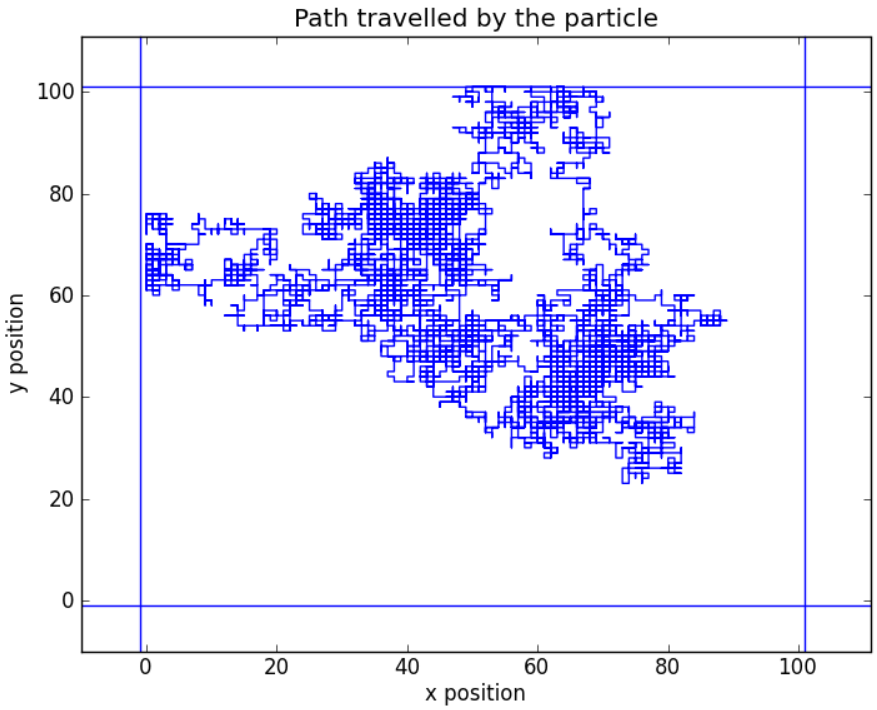
QUESTION 1

a) b) See the document (Question 1.pdf) attached by Chi.
c) d) See Lab10_q1a.py by Chi. The screen shot is also in the attached document.

QUESTION 2

a) See Lab10_q2a.py by Chi.



b) Didn't need to hand in anything for this.
c) See Lab10_q2c.py by Chi.

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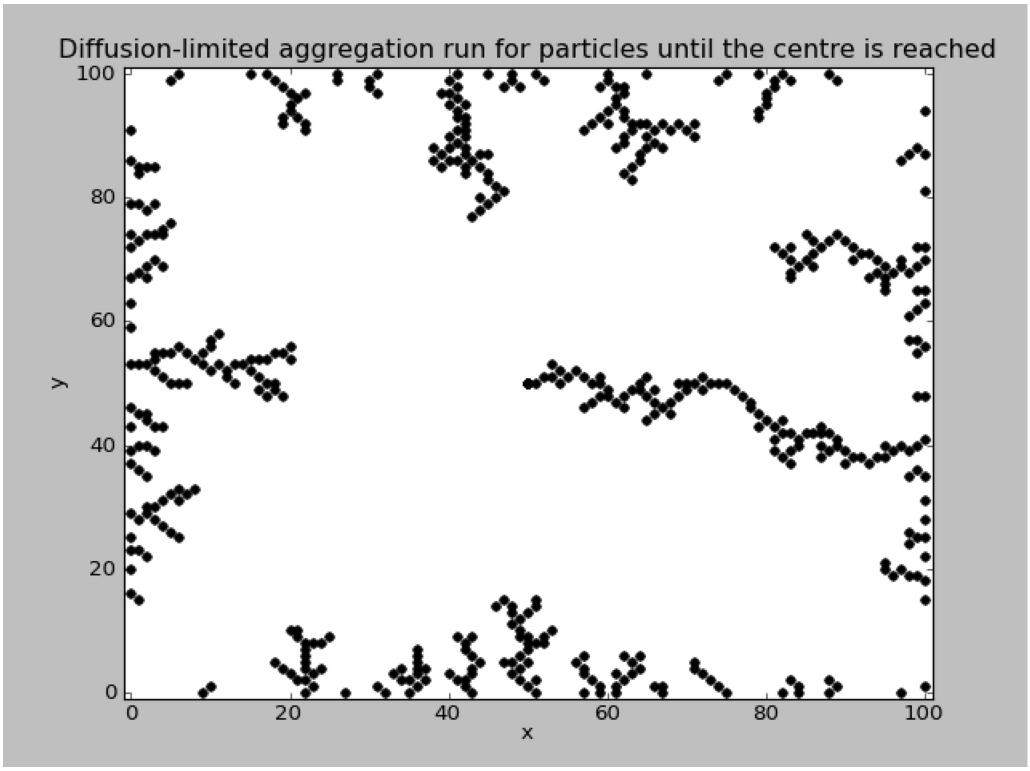
Diffusion-limited aggregation run for particles until the centre is reached
y
x
0
20
40
60
80
100

d) See Lab10_q2d.py by me.

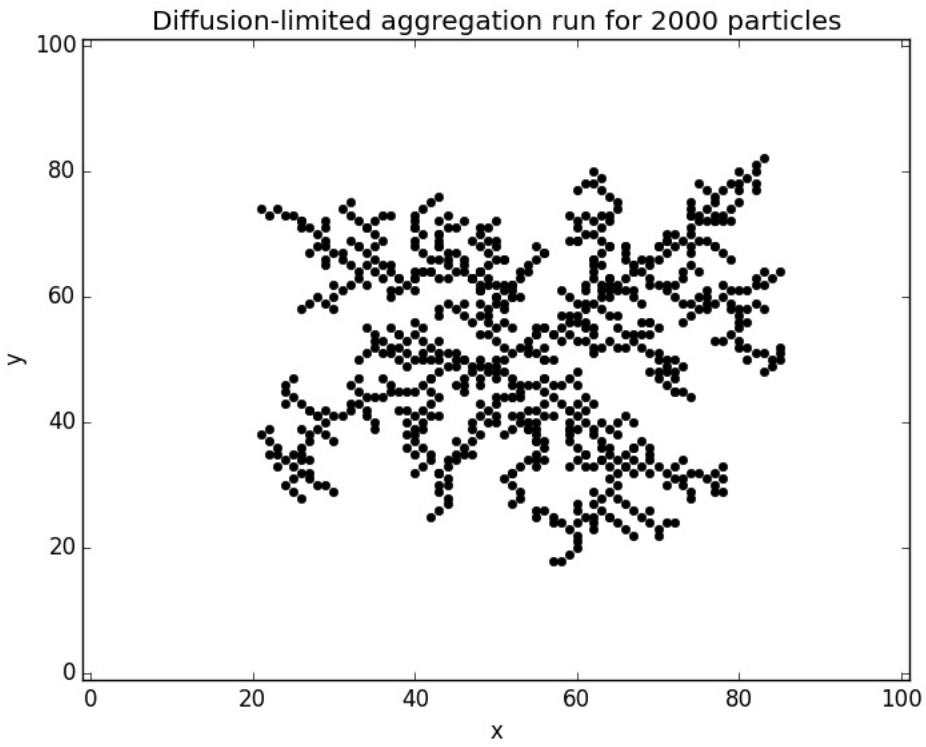

FIG. 1: N = 2000, Domain is 100

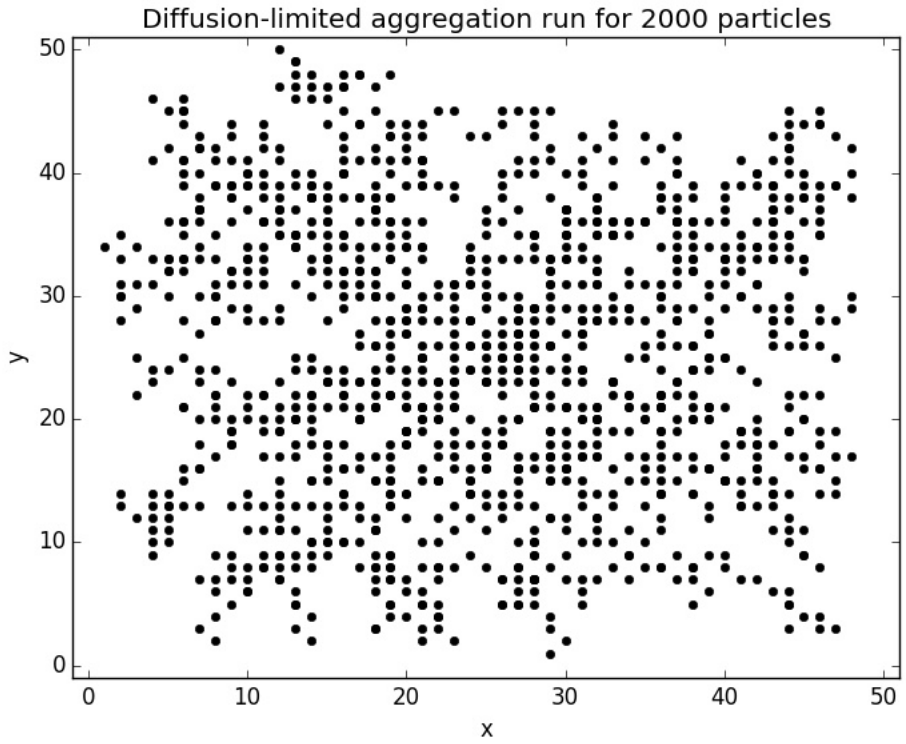

FIG. 2: N = 2000, Domain is 50, tried decreasing domain

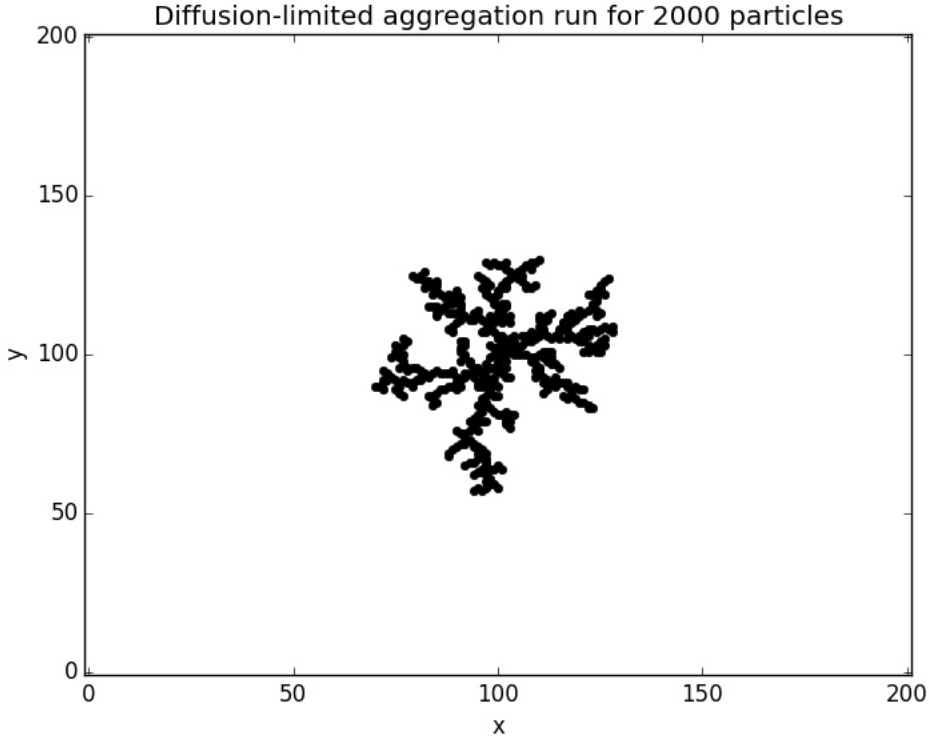

FIG. 3: N = 2000, Domain is 200, tried increasing domain

The centre is not more filled in because the chance for a particle to be anchored to another particle is higher than being anchored to the domain.

e) See Lab10_q2e.py by Chi. The number of anchored points

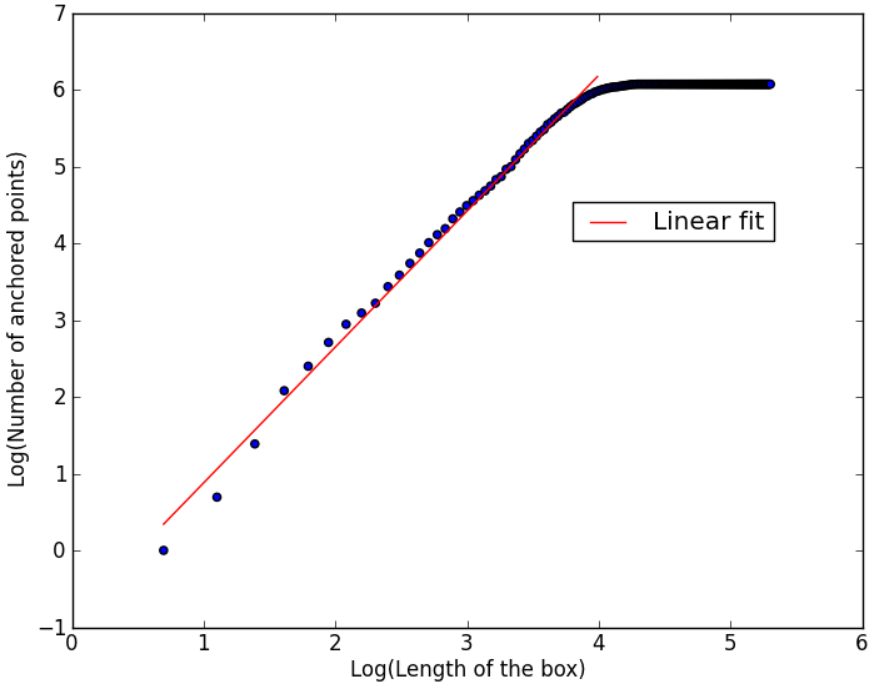

FIG. 4: Non Log scale

With the parameters L = 201, and N = 2000, the estimated Fractal dimension k = 1.76825112433±0.0190041937053

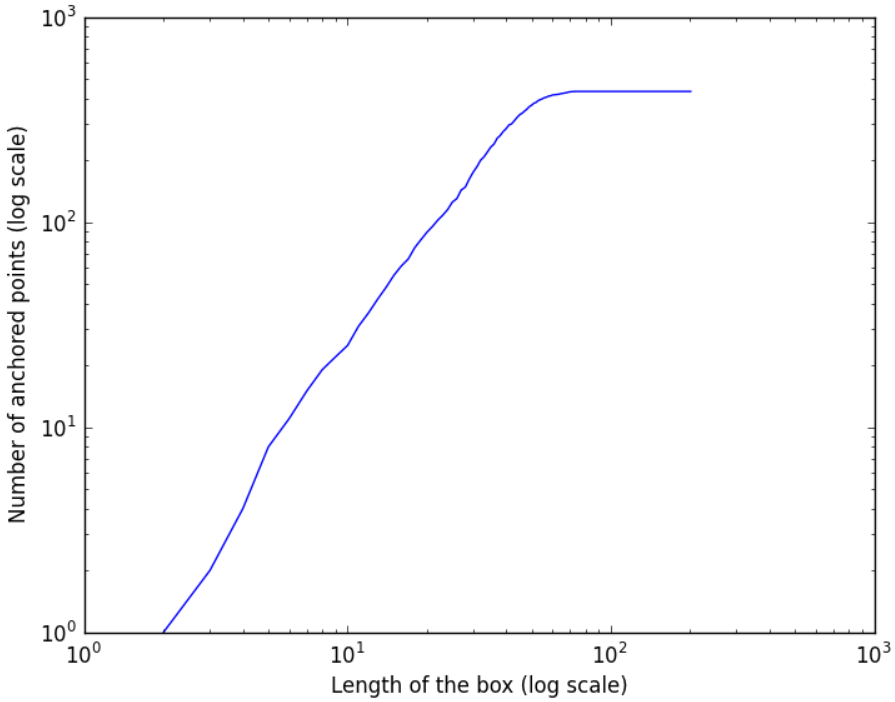

FIG. 5: Log scale

QUESTION 3

a) See Lab10_q3a.py by me.
b) See Lab10_q3b.py by me.
c) See Lab10_q3c.py by me.
The x values were found from the probability distribution shown below

$$P(x) = \frac{1}{2\sqrt{x}}$$

$$\int_0^{x(z)} \frac{dx}{2\sqrt{x}} = \int_0^z dz = z$$

$$\sqrt{x(z)} = z$$

$$\Rightarrow \boxed{x(z) = z^2}$$

A comparison between b) and c) was plotted below.

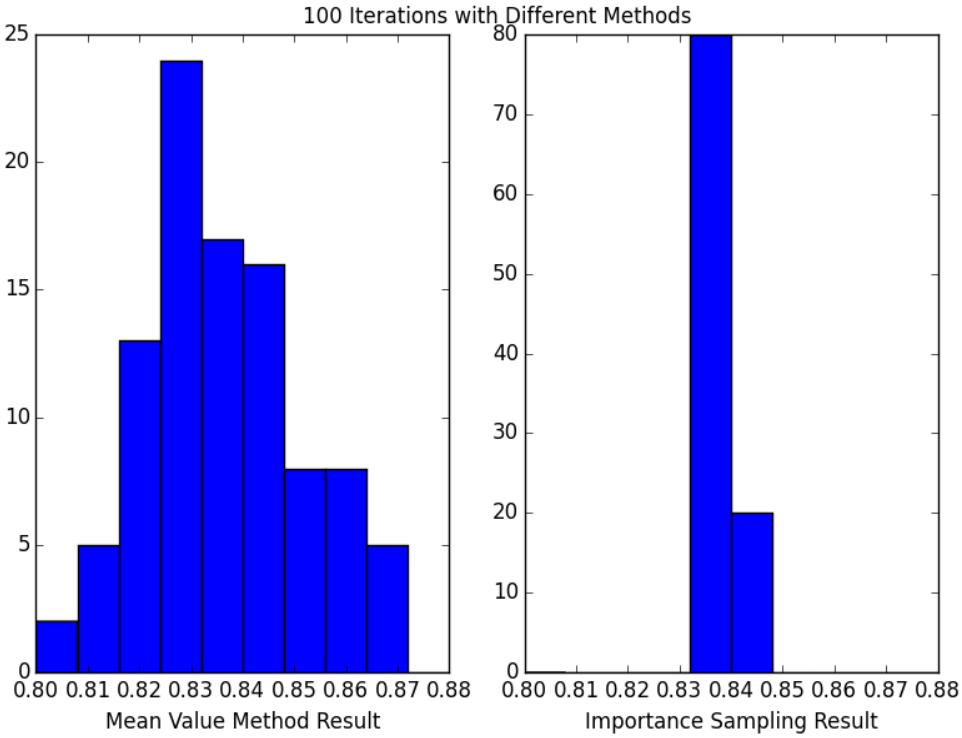

FIG. 6: Plotted using Lab10_q3subplot.py