Calculating pi

Ayush Bhardwaj

March 31, 2020

1 Introduction

I am making this document to put down all the methods I know for calculating pi. As you can guess, its pure tinkering

2 Calculation by computer

Calculating pi with a computer isn't a tough task actually, its all about calculating an integral. As you increase the number of steps or number of partitions, you get closer and closer to the result. Lets start it.

Pi is defined as the ratio of circumference to diameter of circle. It is equivalently defined as the ratio of area of a circle to the square of its radius. For simplicity, we take a unit circle centered at origin.

$$I = \int_0^1 \sqrt{1 - x^2}\, \mathrm{d}x \tag{1}$$

This integral essentially gives pi, if the number of partitions of the interval 0 to 1 is sufficiently high. This is the link for the code.

3 Calculating by hand

There are a number of methods, and I will use my favourite one.

$$x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \ldots = tan^{-1}x \tag{2}$$

Put x = 1 on both sides of the equation and you will get

$$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \ldots = \frac{\pi}{4} \tag{3}$$

Okay, we got one methods of each kind and we can get a number of such methods. For example, for calculating pi by hand we can similarly put $\frac{1}{\sqrt{3}}$ on both sides of equation (2) and get

$$\frac{1}{\sqrt{3}} - \frac{1}{9\sqrt{3}} + \frac{1}{45\sqrt{3}} + \ldots = \frac{\pi}{6} \tag{4}$$

Similarly, we can use taylor's expansion for other inverse trigonometric functions and put the right values.

To be continued