CSCI181AF: Advanced Data Structures
09/07/2022

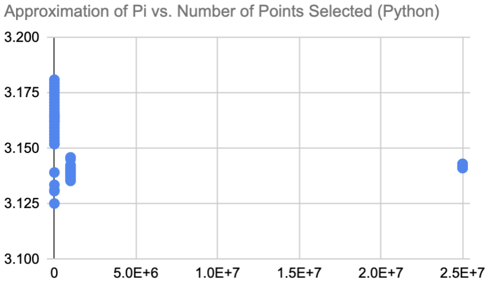
# Writeup HW #1

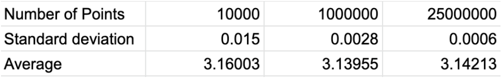
## 0.1 Introduction

In this writeup, we will be evaluating two different algorithms written in two different programming languages ability to approximate $\pi$. The first Python algorithm calculates $\pi$ by simulating the inscribing of a circle in a square by selecting random points in the square and checking if they are in said circle giving us $\approx \frac{\pi}{4}$. In comparison, the C++ algorithm uses the average value of the function $f(x) = \sqrt{1-x^2}$ on the interval $[0, 1]$ to approximate $\frac{\pi}{4}$. Both algorithms used $n$ points.

## 0.2 Python Approximation

From the Python approximation, we were able to generate the following approximations of $\pi$ for $n = 10000, 1000000, 25000000$ points.

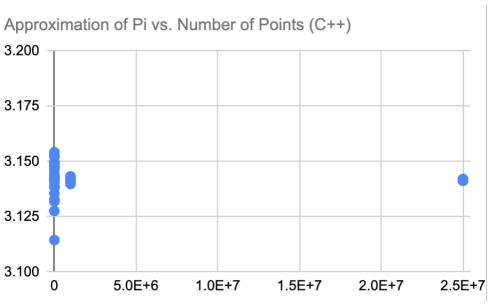


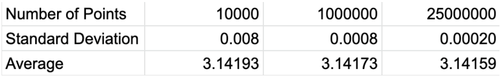


| Number of Points | 10000 | 1000000 | 25000000 |
|---|---|---|---|
| Standard deviation | 0.015 | 0.0028 | 0.0006 |
| Average | 3.16003 | 3.13955 | 3.14213 |

## 0.3 C++ Approximation

From the C++ approximation, we were able to generate the following approximations of $\pi$ for $n = 10000, 1000000, 25000000$ points.





| Number of Points | 10000 | 1000000 | 25000000 |
|---|---|---|---|
| Standard Deviation | 0.008 | 0.0008 | 0.00020 |
| Average | 3.14193 | 3.14173 | 3.14159 |

## 0.4 Conclusion

One thing to note when comparing the two algorithms, is that the C++ algorithm was able to approximate $\pi$ more quickly (timewise) and with a higher degree of accuracy for a lower value of $n$, as indicated by the lesser standard deviation for $n = 10000$ and an average that is closer to $\pi$. Similarly, for larger values of $n$, the C++ algorithm was able to obtain an average value closer to $\pi$, with a lesser spread as seen by the case where $n = 25000000$ where the standard deviation of C++ Approx $<$ standard deviation of Python Approx, all while $|\pi - approx|$ was minimized under the C++ algorithm for each of our $n$ point experiments.