Assignment 1

Shridhar Sharma — IMT2020065
Mayank Chadha — IMT2020045

Instructor: Prof. G.Srinivasaraghavan *Date:* March 31, 2022

1 Description

Generating digits of π up to any given precision (number of decimal digits after the decimal point) using Borwein's Algorithm.

*We could get **1000** correct digits in **9** iterations with the code running for **2.08 seconds** on our laptop.*

NOTE: Our code works correctly only upto Base 2^{13}. For Base $\geq 2^{14}$ integer overflow occurs, which is a hardware limitation.

For the Internal sub-parts of the assignment, we are comparing Correct Digits of π and Correct Digits of $\sqrt{2}$ which are stored in tester.hpp to test them with our final output to ease the process of assignment checking.

We are using C++ because of its unique STL features such as Vector and its properties.

Algorithm used for:

Addition - Addition Algorithm as taught in class.

Subtraction - Subtraction Algorithm as taught in class.

Multiplication - Both Karatsuba's Algorithm and Simple MUL algorithm as taught in class

Division - Division Algorithm as taught in class.

Square Root - Newton-Raphson Iterative method.

2 I/O and Commands

Inputs:

A Menu-driven interface is provided.

The internal Base used can be changed for rigorous code testing by modifying the "BASE" and "BASE_BITS" macros defined in pi.hpp. We are currently using Base 2^6 for best performance.

Outputs:

The digits of π or $\sqrt{2}$ are displayed on the screen with the precision and the correct number of digits. Also, the execution time is displayed.

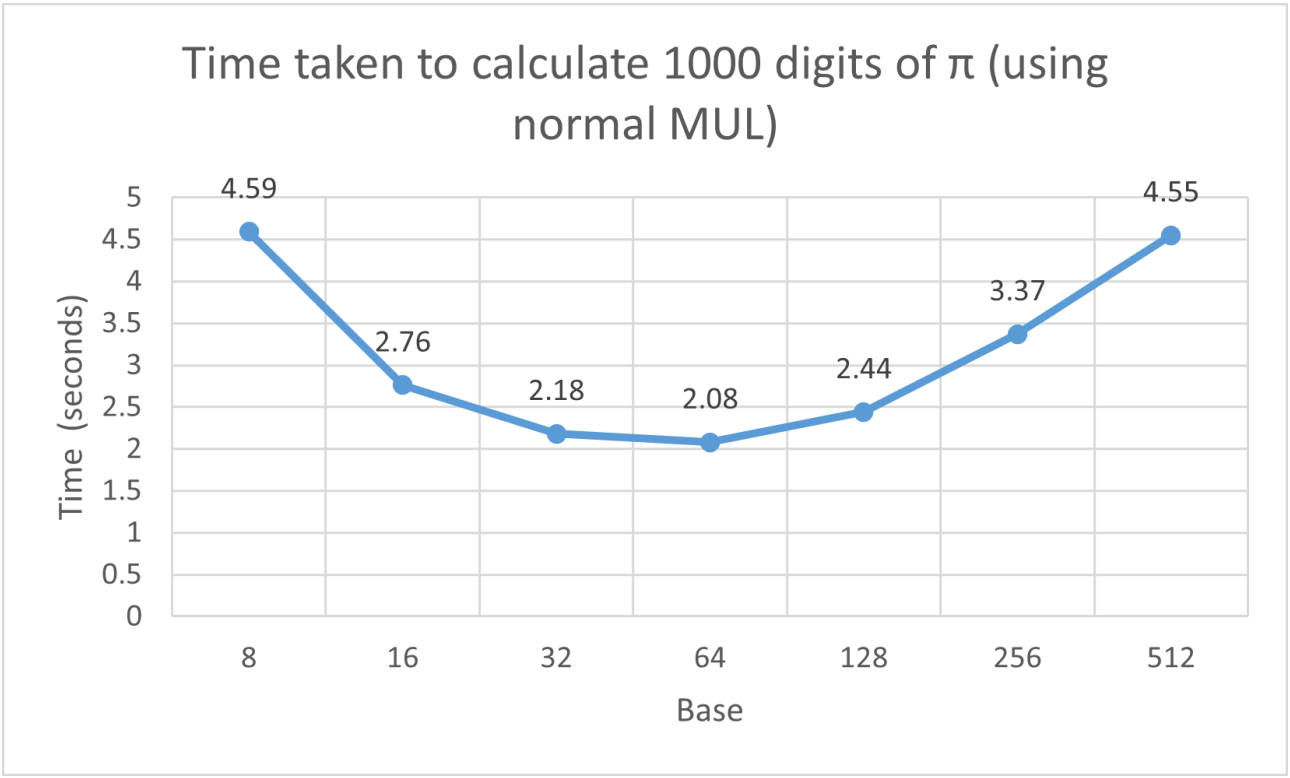
Execution time varies according to the System Specifications.

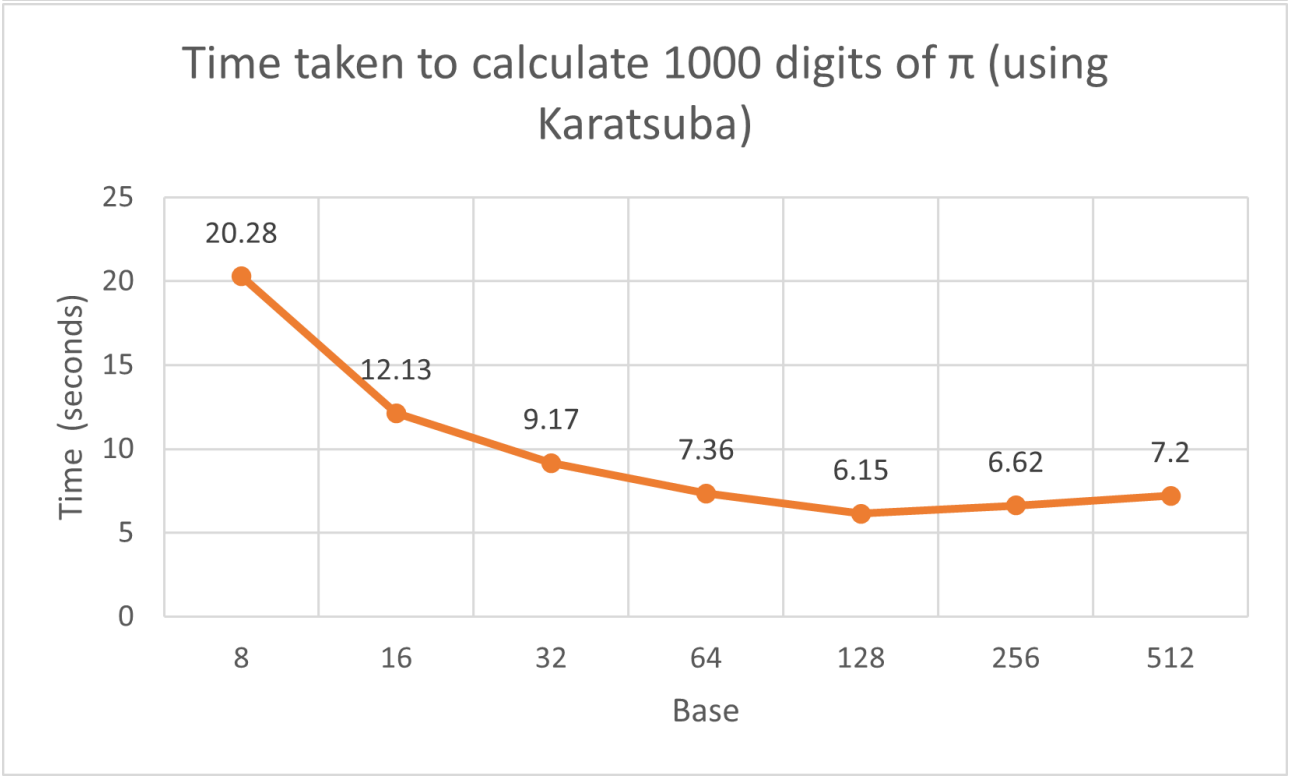
Commands to Compile and Run our Code:

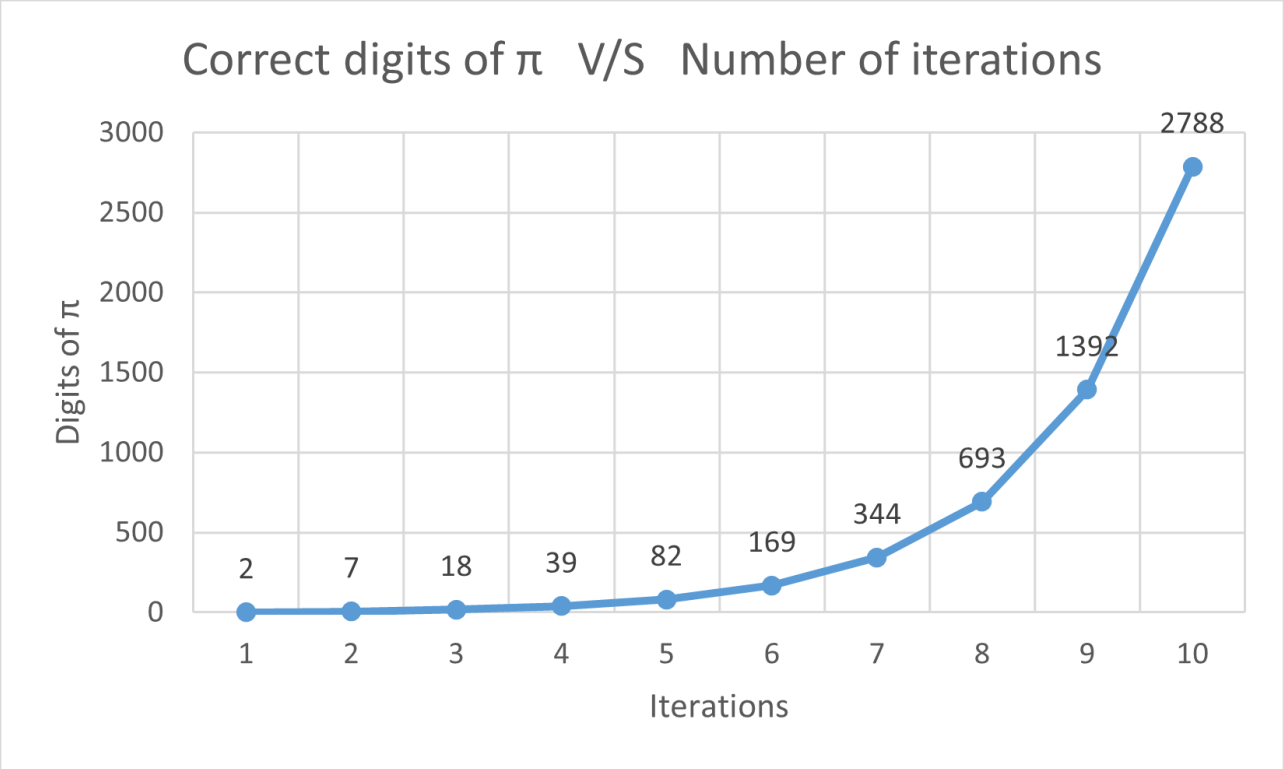
```
make
./pi
```

3 Observations

Some Graphs to help you interpret how some of the critical parameters vary with the execution of our code.


Time taken to calculate 1000 digits of π (using normal MUL)
Time (seconds)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4.59
2.76
2.18
2.08
2.44
3.37
4.55
8
16
32
64
128
256
512
Base


Time taken to calculate 1000 digits of π (using Karatsuba)
Time (seconds)
25
20
15
10
5
0
20.28
12.13
9.17
7.36
6.15
6.62
7.2
8
16
32
64
128
256
512
Base



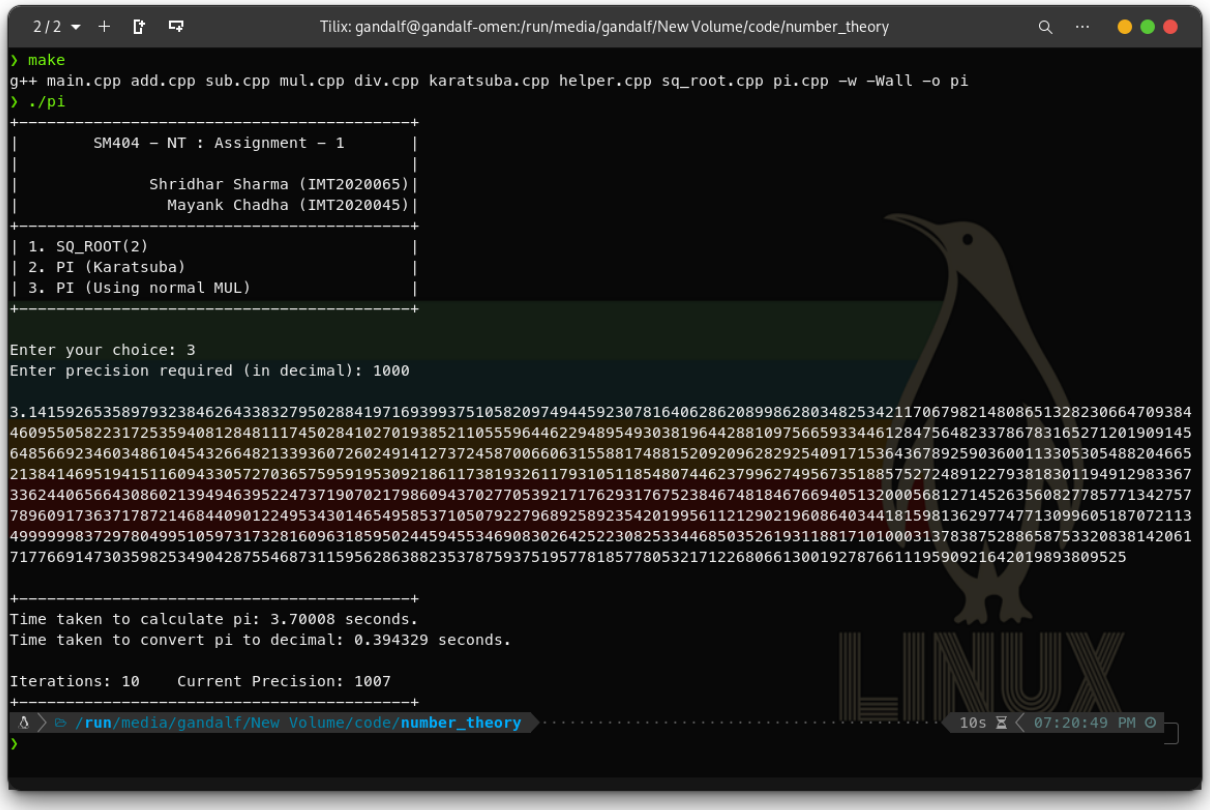


Figure 1: Sample I/O