Assignment 1 Design Document

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1 Description of Program

The program, plot.sh, is a bash script that produces plots of the C program "monte_carlo.c". plot.sh will produce two plots similar to the figure 2 and 3 on the assignment 1 pdf, as well as two additional plots to show the low and high iterations of the error estimatinos. monte_carlo.c prints the Monte Carlo estimation for pi after each random point it tests.

2 Files to be included in directory "asgn1":

1. plot.sh

   - This bash script produces the Monte Carlo method plots used in my report. This script should produce plots similar to Figures 2, 3 in the asgn1.pdf.

2. monte_carlo.c

   - This C program contains the implementation of the Monte Carlo program.

3. Makefile

   - This file directs the compilation process of the Monte Carlo program.

4. README.md

   - This file is in Markdown format and describes how to use my script and Makefile. It also lists and explains the different command-line options that my program accepts.

5. DESIGN.pdf

   - This file is a PDF version of this design document for assignment 1. It describes my design and design process for my program with pseudocode and images.

6. WRITEUP.pdf

   - This file is a PDF version of my writeup for assignment 1. It includes the plots that I produced using my bash script, as well as discussion on which UNIX commands I used to produce each plot and why I chose to use them.

3 Pseudocode

plot.sh:

Figure 2

The following image is Figure 2 from the assignment 1 pdf which my bash script will try to produce:
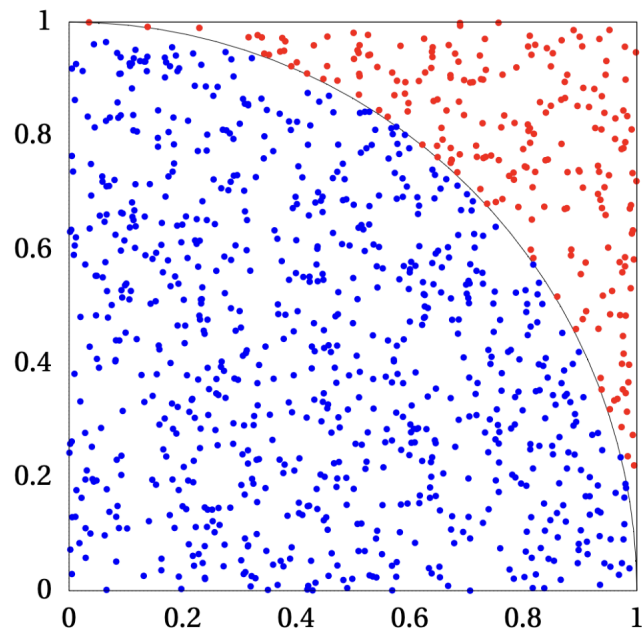

Figure 2: Blue points have distance less than or equal to 1, and hence belong both in the square and the circle, red points are a part of the square but not the circle.

Pipe monte_carlo using 1000 iterations, print the third and fourth column if the fifth column is a 1, and put the output into one data file.

Pipe monte_carlo using 1000 iterations, print the third and fourth column if the fifth column is a 0, and put the output into another data file.

Plot figure 2 using gnuplot
    Set terminal to pdf
    Set output name to figure2
    Set size of the plot to a square shape
    Set range of x axis to 0 to 1
    Set range of y axis to 0 to 1

Set each tic of the x axis to 0.2

Set each tic of the y axis to 0.2

Define f(x) to the equation of a circle

Plot f(x) with lines that are half width and black, the data file containing the points inside the circle with blue, circular, 0,25 sized points, and the data file containing the points outside the circle with red, circular, 0.25 sized points

Empty data files

Figure 3

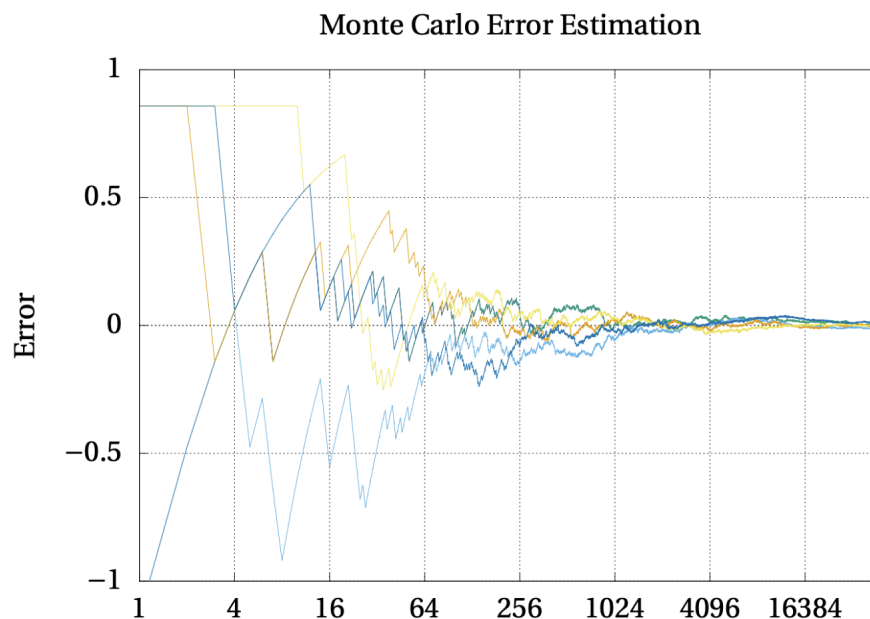The following image is Figure 3 from the assignment 1 pdf which my bash script will try to produce:

Figure 3: The value of the difference between the estimated π and pi gets closer to zero as we increase iterations. The different colors represent different seeds for the random number generator.

Define a variable "PI" and set equal to first ten digits of pi

Loop through the random seeds with iterations 1-5

Pipe monte_carlo using 32000 iterations and loop through the random seeds, print the first and second column - PI, and put the output into different data files using the loop

Plot figure 3 using gnuplot
    Set terminal to pdf
    Set output name to figure3
    Set title of plot to "Monte Carlo Error Estimation"
    Set label of y axis to "Error"
    Set range of x axis to 0 to 25000
    Set range of y axis to -1 to 1
    Set each tic of the x axis from iterations 0-7 in a loop to $(0, 4^i)$
    Set logscale 4^x
    Set each tic of the y axis to 0.5
    Plot each data file with lines

Empty data files

Extra Plot of Low Iterations

Loop through the random seeds with iterations 1-5
    Pipe monte_carlo using 32000 iterations and loop through the random seeds, print the first and second column - PI, and put the output into different data files using the loop

Plot extra plot of low iterations using gnuplot
    Set terminal to pdf
    Set output name to low_iterations
    Set title of plot to "Monte Carlo Error Estimation of Low Iterations"
    Set label of x axis to "Iterations"
    Set label of y axis to "Error"
    Set range of x axis to 1 to 64
    Set range of y axis to -1 to 1
    Set each tic of the x axis to 8
    Set each tic of the y axis to 0.5
    Plot each data file with lines

Empty data files

Extra Plot of High Iterations

Loop through the random seeds with iterations 1-5
    Pipe monte_carlo using 32000 iterations and loop through the random seeds, print the first and second column - PI, and put the output into different data files using the loop

Plot extra plot of high iterations using gnuplot
    Set terminal to pdf

Set output name to high_iterations
Set title of plot to "Monte Carlo Error Estimation of High Iterations"
Set label of x axis to "Iterations"
Set label of y axis to "Error"
Set range of x axis to 1024 to 25000
Set range of y axis to -0.5 to 0.5
Set each tic of the x axis to log base 4
Set each tic of the y axis to 0.25
Plot each data file with lines

Empty data files