SAMPLE

BOLT Monte Carlo PI estimator

1 Overview

1.1 Location

$<*APPSDKSamplesInstallPath*>\samples\bolt\

1.2 How to Run

See the *Getting Started* guide for how to build samples. You first must compile the sample.

Use the command line to change to the directory where the executable is located. The pre-compiled sample executable is at $<*APPSDKSamplesInstallPath*>\samples\bolt\bin\x86\ for 32-bit builds and at $<*APPSDKSamplesInstallPath*>\samples\bolt\bin\x86_64\ for 64-bit builds.

Type the following command(s).

1. `MonteCarloPI`
   This command runs the program with the default options.
2. `MonteCarloPI -h`
   This command prints the help file.
3. `MonteCarloPI_TBB -h`
   This command generates a build with the multiCoreCpu path (the Thread Building Block library), enabled.

1.3 Command Line Options

Table 1 lists, and briefly describes, the command line options.

Table 1 Command Line Options

Short Form	Long Form	Description
-h	--help	Shows all command options and their respective meanings.
	--device	Explicit device selection for Bolt [auto/openCL/multiCoreCpu/SerialCpu].
-q	--quiet	Quiet mode. Suppress most text output.
-e	--verify	Verify results against reference implementation.
-t	--timing	Print timing-related statistics.
-v	--version	BOLT and run-time version string.
-x	--samples	Number of sample input values.
-i	--iterations	Number of iterations.
-g	--gui	Show the GUI.

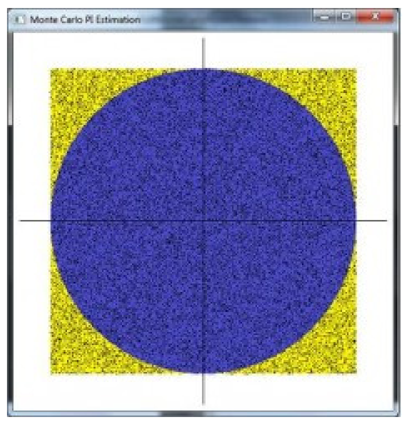
Note: The `--device multiCoreCpu` option becomes available when the sample is compiled with `ENABLE_TBB` defined. Microsoft Visual Studio build configurations `Debug_TBB` and

`Release_TBB` are created for this purpose. These configurations have `ENABLE_TBB` defined to enable the TBB path (multiCoreCpu) for all the AMD BOLT functions used in the sample.

2 Introduction

This sample implements an estimator of *pi* using the Monte Carlo method. Monte Carlo methods solve computation problems by observing the outcome of a large number of random samples in a system. It is common knowledge that the value of *pi*/4 is equal to the probability of a "dot" falling inside a circle bounded by a circumscribing square. This factor can be arrived at by simply dividing the area of the circle by the area of the square. This sample uses a Monte Carlo simulation to find the probability of a point falling inside the circle and uses that probability to compute the value of *pi*.

The following figure shows an example of the simulation performed by the sample. A circle is shown in its bounding square, with random points uniformly scattered over its area.



3 Implementation details

The implementation is broken down into 2 steps:

1. For all the given points (numbering `totalPoints`), check whether or not the point falls inside the circle. A point is inside the circle, if the distance between the point and center of circle is less than the radius of the circle.

2. Count all the points that fall inside the circle (say `numPointsInCircle`)

The value of *pi* is then computed as `(4*numPointsInCircle)/totalPoints`.

This algorithm can be implemented in three different ways using different Bolt APIs.

1. Using the `transform()` and `reduce()` BOLT APIs.
   This implementation uses the two Bolt APIs, Transform and Reduce.

An intermediate device_vector, `insideCircle`, of type `int`, is created. This array indicates whether or not the point exists within the circle.

i. Apply `bolt::cl::transform()` on the input points and store the result in `insideCircle`.

ii. Count the number of 1s in `insideCircle` using `bolt::cl::reduce()`.

2. Using the `transform_reduce()` BOLT API.

This method uses the `transform_reduce()` API. Instead of creating a temporary array to store intermediate results, using the `bolt::cl::transform_reduce()` API allows fusing the operations used in the previous method and reducing some memory overhead.

3. Using the `count_if()` BOLT API.

The algorithm can also be implemented using the `count_if()` API. `count_if()` counts the number of elements in the specified range for which the specified predicate is *true*. Here the elements are the input points and the predicate is `insideCircle`.

4 References

1. http://developer.amd.com/community/blog/monte-carlo-sample-in-bolt/

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