Introduction to CUDA Parallel Programming

Homework Assignment 6

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1 README

This file is `report.pdf`. `src/` folder contains the source code. `result/` folder contains the result.

In `src/` folder, executing `make` to compile the program.

To execute the program, run `./monte_carlo` and follow the instructions to enter the corresponding parameters.

2 Result

- N = 64
  Simple sampling: 0.2385625668 +/- 0.0070036985
  Importance sampling: 0.2518644072 +/- 0.0213739423
  Importance sampling (GPU): 0.2518643856 +/- 0.0213739424
- N = 128
  Simple sampling: 0.2385351064 +/- 0.0050680023
  Importance sampling: 0.2514901202 +/- 0.0157394652
  Importance sampling (GPU): 0.2514900986 +/- 0.0157394648
- N = 256
  Simple sampling: 0.2385673115 +/- 0.0034410813
  Importance sampling: 0.2501277925 +/- 0.0115069909
  Importance sampling (GPU): 0.2501277681 +/- 0.0115069905
- N = 512
  Simple sampling: 0.2429491577 +/- 0.0027659887
  Importance sampling: 0.2478900043 +/- 0.0092405719
  Importance sampling (GPU): 0.2478899800 +/- 0.0092405707

- N = 1024
  Simple sampling: 0.2428134730 +/- 0.0018965395
  Importance sampling: 0.2449582952 +/- 0.0061309250
  Importance sampling (GPU): 0.2449582720 +/- 0.0061309243

- N = 2048
  Simple sampling: 0.2428249057 +/- 0.0012923626
  Importance sampling: 0.2413184387 +/- 0.0043216870
  Importance sampling (GPU): 0.2413184150 +/- 0.0043216865

- N = 4096
  Simple sampling: 0.2419261684 +/- 0.0009097175
  Importance sampling: 0.2441979956 +/- 0.0030401059
  Importance sampling (GPU): 0.2441979703 +/- 0.0030401055

- N = 8192
  Simple sampling: 0.2427989300 +/- 0.0006514979
  Importance sampling: 0.2427237392 +/- 0.0021378133
  Importance sampling (GPU): 0.2427237138 +/- 0.0021378131

- N = 16384
  Simple sampling: 0.2433008997 +/- 0.0004637446
  Importance sampling: 0.2426799453 +/- 0.0015278602
  Importance sampling (GPU): 0.2426799192 +/- 0.0015278600

- N = 32768
  Simple sampling: 0.2433333976 +/- 0.0003246500
  Importance sampling: 0.2416005221 +/- 0.0010691695
  Importance sampling (GPU): 0.2416004963 +/- 0.0010691693

- N = 65536
  Simple sampling: 0.2434060574 +/- 0.0002295169
  Importance sampling: 0.2417996817 +/- 0.0007599454
  Importance sampling (GPU): 0.2417996561 +/- 0.0007599453

3 Discussion

I choose $a = 1$ and $C = 1.5819767068693265$ such that $\int_0^1 w(x_i) = 1$.

The Monte Carlo simulation result computed by CPU and GPU are very close. The result of one GPU and two GPU are the same. The standard deviation is somewhat larger in Monte Carlo simulation. As the number of samplings increases, the standard deviation and the difference between simple sampling and importance sampling decreases.