

# Monte Carlo, Exercise Session 3

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## 1 Exercise 1

Code: Ex1.cpp. Answer: Figure 1.

```
Exercise 1
N: 1, Volgyimi: 2+-0
N: 2, Volgyimi: 3.14168+-0.00107932
N: 3, Volgyimi: 4.18902+-0.00248752
N: 4, Volgyimi: 4.93425+-0.00575504
N: 5, Volgyimi: 5.2643+-0.00500032
N: 6, Volgyimi: 5.1679+-0.00612608
N: 7, Volgyimi: 4.72715+-0.0160602
N: 8, Volgyimi: 4.05555+-0.0121037
N: 9, Volgyimi: 3.29869+-0.0191181
N: 10, Volgyimi: 2.55503+-0.038656
N: 11, Volgyimi: 1.87685+-0.0285286
N: 12, Volgyimi: 1.32288+-0.0400179
N: 13, Volgyimi: 0.896286+-0.0566067
N: 14, Volgyimi: 0.591626+-0.0440729
N: 15, Volgyimi: 0.383058+-0.0527565
End!

Process returned 0 (0x0)   execution time : 937.251 s
Press ENTER to continue.
█
```

Figure 1: Ex1 answer.

Result makes sense, since the correct answers are  $2$ ,  $\pi$ ,  $4\pi/3$  ...

## 2 Exercise 2

Answer presented in Figure 2.

```
Exercise 2
N: 1, Volyymi: 1.96099+-0.058554
N: 2, Volyymi: 3.09459+-0.0454919
N: 3, Volyymi: 4.11248+-0.0966952
N: 4, Volyymi: 4.81752+-0.149956
N: 5, Volyymi: 5.10814+-0.196707
□
```

Figure 2: Ex2 answer.

Result in Exercise 1 and Exercise 2 are pretty similar. However the sampling method requires significantly more time, so had to increase binning, which increased the uncertainty.

### 3 Exercise 3

Answer presented in Figure 3.

```
Exercise 3
HM
N=10^2, delta I: 0.003002910 ,Time: 0.000200000 sec
N=10^3, delta I: -0.041997090 ,Time: 0.001041000 sec
N=10^4, delta I: 0.026502910 ,Time: 0.008813000 sec
N=10^5, delta I: 0.000302910 ,Time: 0.067871000 sec
N=10^6, delta I: -0.000047090 ,Time: 0.679489000 sec
DS
N=10^2, delta I: 0.026515182 ,Time: 0.000067000 sec
N=10^3, delta I: 0.047064267 ,Time: 0.000653000 sec
N=10^4, delta I: 0.003453047 ,Time: 0.006505000 sec
N=10^5, delta I: -0.005294656 ,Time: 0.065005000 sec
N=10^6, delta I: -0.001357247 ,Time: 0.648338000 sec
SS
N=10^2, delta I: 0.103002910 ,Time: 0.000098000 sec
N=10^3, delta I: 0.015541932 ,Time: 0.000773000 sec
N=10^4, delta I: 0.001002910 ,Time: 0.007859000 sec
N=10^5, delta I: 0.000166826 ,Time: 0.076617000 sec
N=10^6, delta I: -0.000007090 ,Time: 0.761908000 sec
PSS
N=10^2, delta I: 0.053002910 ,Time: 0.000086000 sec
N=10^3, delta I: -0.006997090 ,Time: 0.000606000 sec
N=10^4, delta I: 0.006502910 ,Time: 0.005838000 sec
N=10^5, delta I: 0.009652910 ,Time: 0.059029000 sec
N=10^6, delta I: 0.000437910 ,Time: 0.583344000 sec
End!

Process returned 0 (0x0)   execution time : 2.982 s
Press ENTER to continue.
□
```

Figure 3: Ex3 answer.

The increase of N looks like increasing the precision of the result.

The strange peak is observed in PSS at  $N=10^5$ , which suggests that the N is not big enough.

Time increase is as predictable, N multiplication by 10 increases time nearly 10 times.

## 4 Exercise 4

### 4.1 a)

Figure 4.

```
Exercise 4
n: 501, value base 7: 0.6009996, value base 11: 0.5567243
n: 502, value base 7: 0.7438567, value base 11: 0.6476334
n: 503, value base 7: 0.8867139, value base 11: 0.7385424
n: 504, value base 7: 0.04997918, value base 11: 0.8294515
n: 505, value base 7: 0.1928363, value base 11: 0.9203606
n: 506, value base 7: 0.3356935, value base 11: 0.01953418
n: 507, value base 7: 0.4785506, value base 11: 0.1104433
n: 508, value base 7: 0.6214077, value base 11: 0.2013524
n: 509, value base 7: 0.7642649, value base 11: 0.2922615
n: 510, value base 7: 0.907122, value base 11: 0.3831705
End!

Process returned 0 (0x0)   execution time : 0.004 s
Press ENTER to continue.
□
```

Figure 4: Ex3 answer.