Assignment MPI: Circuit Satisability

Parallel and Grid Computing Lecture

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Exercise 1. Pi computation using trapezium rule

1. $f''(x) = \dfrac{8(3x^2-1)}{(1+x^2)^3}$

   global maximum M is 2, when $x = \pm 1$

Global maxima:

$$\max\left\{\frac{8\left(3x^2-1\right)}{\left(x^2+1\right)^3}\right\} = 2 \text{ at } x = -1$$

$$\max\left\{\frac{8\left(3x^2-1\right)}{\left(x^2+1\right)^3}\right\} = 2 \text{ at } x = 1$$

Plot:

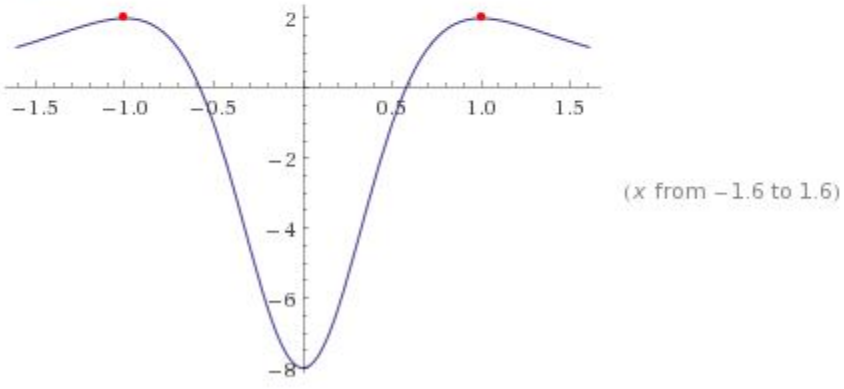
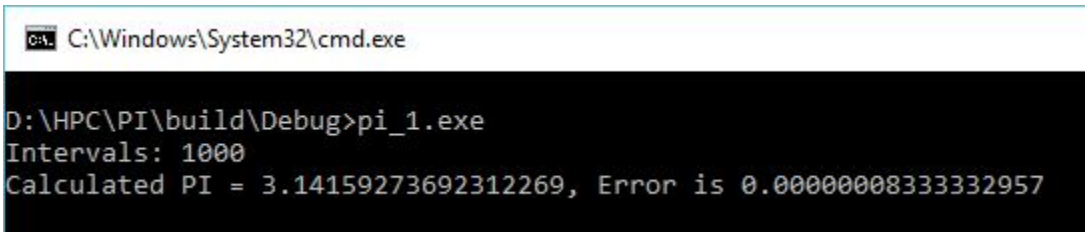


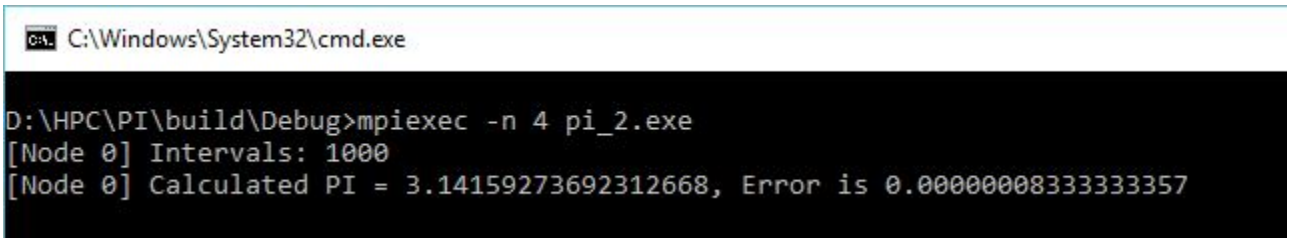
Figure 1: Global maximum

Thus the error $\epsilon \leq \dfrac{11}{66n^2}$

2. please find the solution **pi_1.c**



3. please find the solution **pi_2.c**



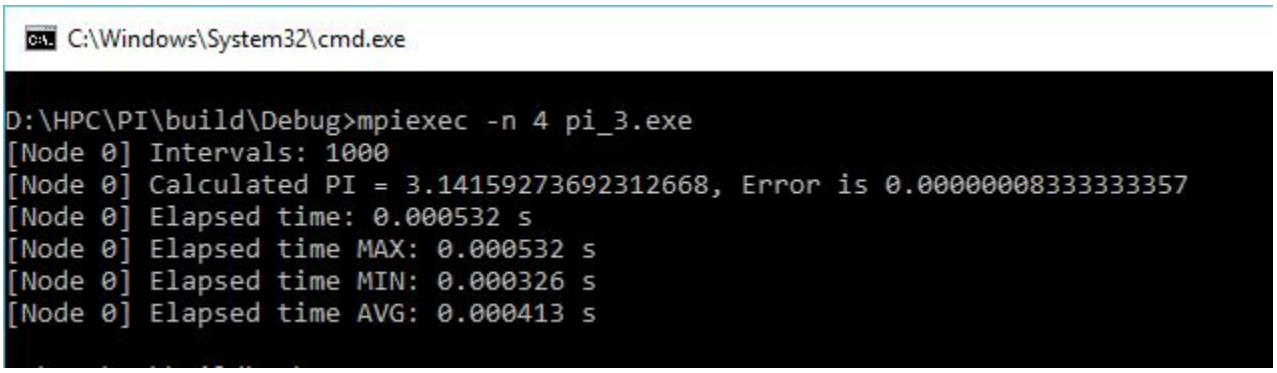
   (a) Partitioning – compute the chunk based on processes ID

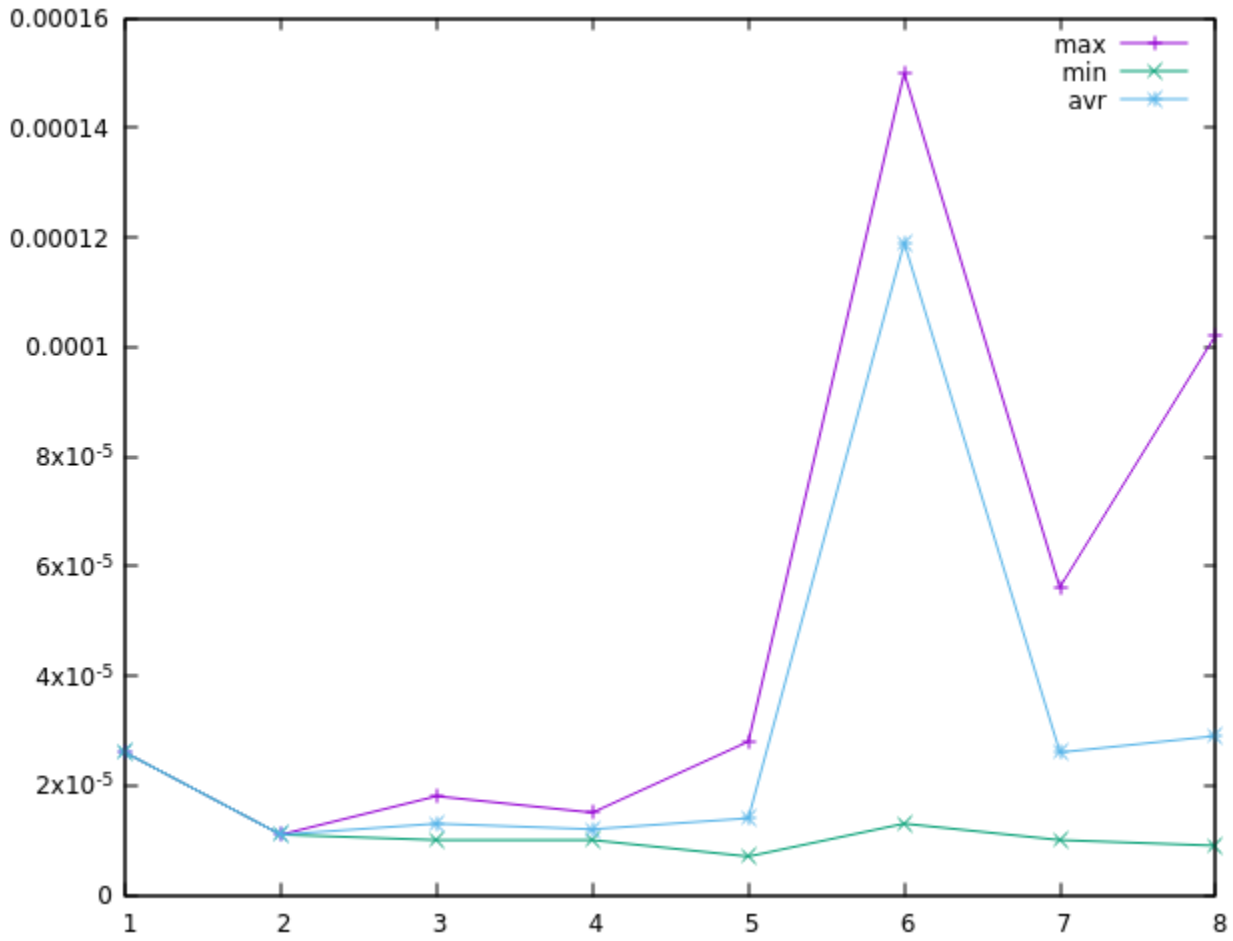
   (b) Communication – process 0 broadcasts the number of intervals to the others, the value of pi itself is reduced at the end

   (c) Agglomeration – the algorithm has a parallel nature

   (d) Mapping – try to map the tasks proportionally to cores computing abilities.

4. please find the solution **pi_3.c**
   The time estimates and a graph are also attached.



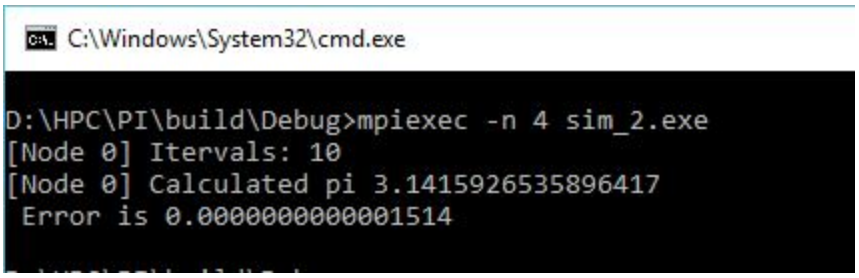


Exercise 2. Pi computation using Simpson's rule

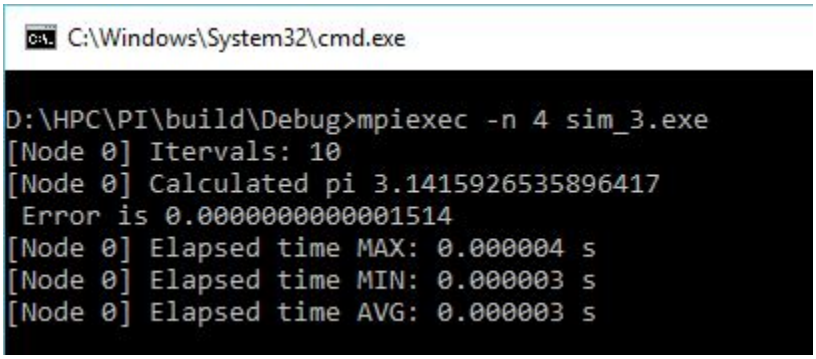
1. please find the solution **sim_1.c**

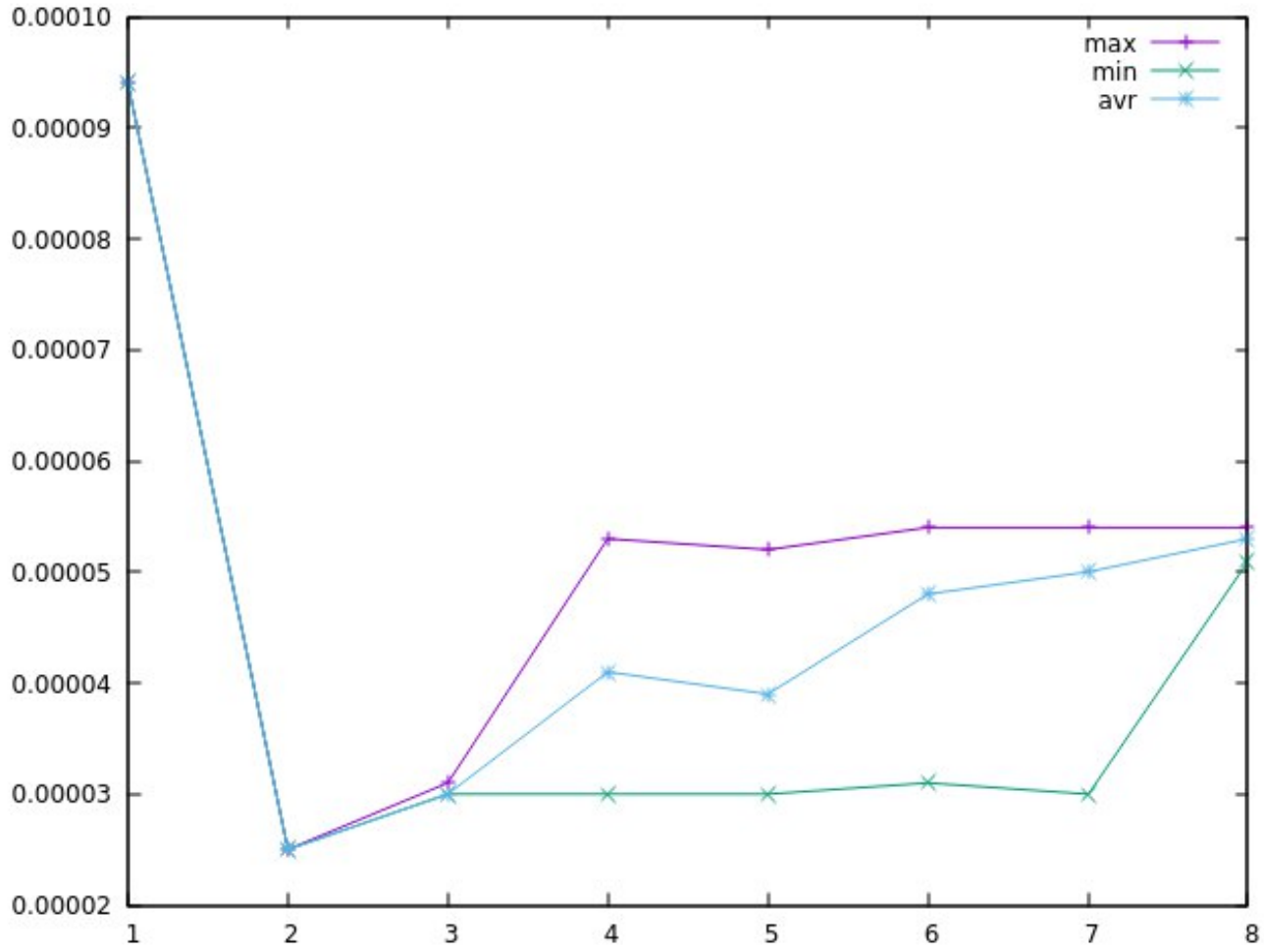
```
C:\Windows\System32\cmd.exe

D:\HPC\PI\build\Debug>sim_1.exe
Intervals: 100
Calculated PI = 3.14159265358979489, Error is 0.00000000000000178
```

2. please find the solution **sim_2.c**
   The methodology is identical to the previous problem



3. please find the solution **sim_3.c**
   The time estimates and a graph are also attached





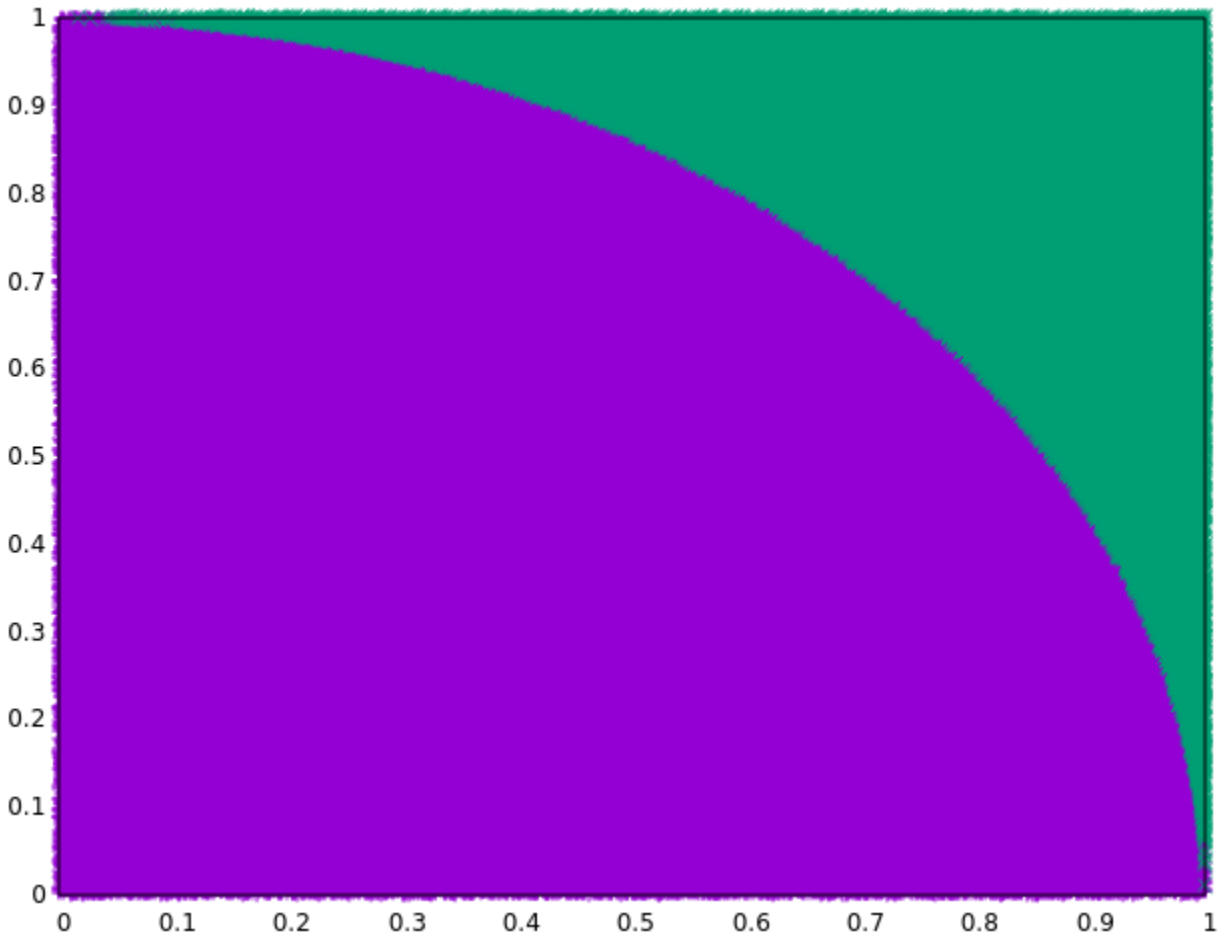
Exercise 3. Pi computation using Monte-Carlo rule

1. please find the solution **mc_1.c**

```
C:\Windows\System32\cmd.exe

D:\HPC\PI\build\Debug>mc_1.exe
Calculated PI = 3.14342400000000000, Error is 0.00183134641020688
```

2. please find the solution **mc_2.c**
   The image of PI Approximation with two classes of points.

```
C:\Windows\System32\cmd.exe

D:\HPC\PI\build\Debug>mc_2.exe
Calculated PI = 3.14342400000000000, Error is 0.00183134641020688
```



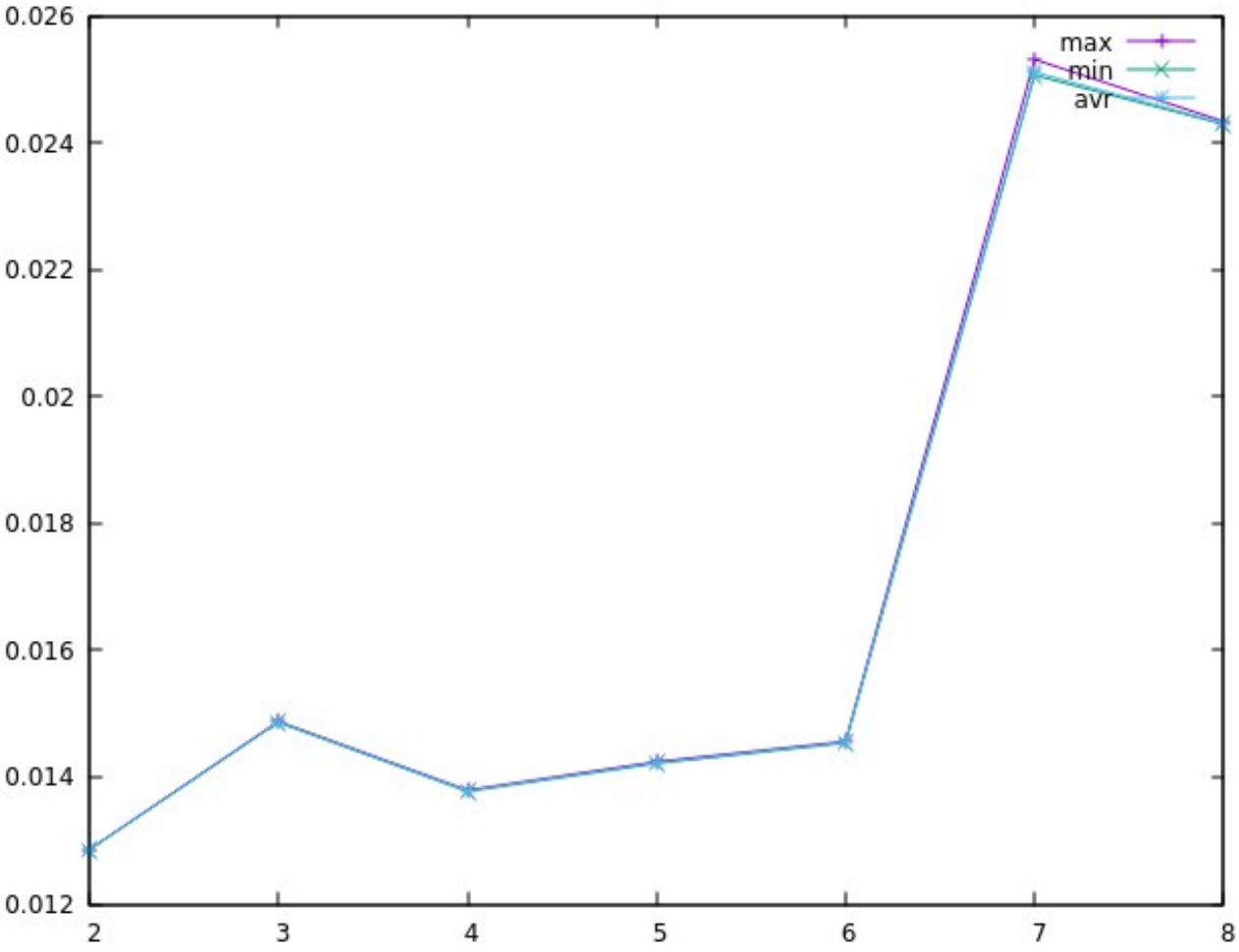
3. please find the solution **mc_3.c**

4. please find the solution **mc_3.c**

```
C:\Windows\System32\cmd.exe

D:\HPC\PI\build\Debug>mpiexec -n 4 mc_3.exe
Calculated PI = 3.13786826347305370, Error is 0.00372439011673942
```

5. please find the solution **mc_4.c**
   Time graphs are:

```
C:\Windows\System32\cmd.exe

D:\HPC\PI\build\Debug>mpiexec -n 4 mc_4.exe
Calculated PI = 3.15161676646706601, Error is 0.01002411287727289
[Node 0] Elapsed time MAX: 2.709514 s
[Node 0] Elapsed time MIN: 2.709354 s
[Node 0] Elapsed time AVG: 2.709463 s
```



References

[1] Sbastien Varrette. *The Lecture slides.*