Homework #4

Computational Physics: Fall 2023
Professor Coan & Olness

Due Wednesday 13 September 11:59pm in Canvas upload

0) PROGRAM SUBMISSION:
For problems where you submit code please use the following format so I can EASILY run your code.

1. Make a new sub-directory with your name and homework #
2. Copy the source code ONLY (not the big executable) into this directory
3. Make a 'doit' file that will compile the code; be sure to use debugging flag '-g'
4. Move up to the upper level directory (where 'olness2' directory is located)
5. Zip this into a zip file: **`zip olness2.zip ./olness2/*`**
6. Upload the zip file to canvas.

1) [20 points] Using the Monte Carlo method estimate Pi using $n=10^2, 10^3, 10^{4 ...}$, points.
[Note: On ManeFrame, see how many points you can run, BUT don't run this for more than 30 seconds; we don't want to swamp the CPU. If you are running on a different machine, then go wild :]
a) show a plot of the points in the range x,y=[-1,1].
b) compute Pi for the 3 cases and estimate the error.
c) how does the error depend on n???
d) Double precision is about 16 digits. What n would be necessary to achieve this precision.

2) [20 points] Using the Monte Carlo method compute the volume of an N-sphere.
Use a reasonable number of points, and estimate the error. Compare with the analytic value.
https://en.wikipedia.org/wiki/N-sphere
Do this for: 3, 4 & 5 dimensions

3) [20 points] Using the Monte Carlo method compute the Gaussian integral:
Int[Exp[-x2], {x,0,xmax}] where xmax = {1,3,10}.
For each case:

a) compute the integral
b) estimate the efficiency (number of points inside vs outside)
c) estimate the error and compare with analytic value.
I suggest Mathemtica for the analytic value.

4) [20 points] Repeat for the below function: Exp[-(x/5)^2] Sin[x]