Computational Physics Homework # 206.

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When you hand in the homework, you should gather all your files into a single tarball file as follows.

- Use an unix command `tar -czf <file name>.tar.gz <file 1> <file 2> ···`.
- For undergraduate students, put a copy of a tarball <file name>.tar.gz into a directory:

  `/physics/upload/comp2023/<user-ID>`.
- For graduate students, put a copy of a tarball <file name>.tar.gz into a directory:

  `/physics/upload/acomp2023/<user-ID>`.
- You must use the GNU `make` command and `Makefile` to compile the code starting from the homework `hw101`.

Monte Carlo Method

1. Let us consider the following integral

$$I_1 = \int_0^\infty dx \ \sin(x\sin(x))\frac{x^2}{x^2+1}\exp(-x^2)$$

   (a) Using the quadrature method, calculate the interal.

(b) Using the Metropolis algorithm with $w(x) = \exp(-x^2)$, calculate the intergal.

(c) Using the Metropolis algorithm with

$$w(x) = \frac{1}{x^2+1}\exp(-x^2)\,, \tag{1}$$

calculate the intergal.

(d) Using the Metropolis algorithm with

$$w(x) = \frac{x^2}{x^2+1}\exp(-x^2)\,, \tag{2}$$

calculate the intergal.

(e) Discuss the precision of your results and their efficiency.