If you are using a jupyter notebook (recommended), then keep all your programs in a single notebook. A good programming style is to define a function for one task with clearly defined input (arguments) and output. For plots you may use matplotlib (if you are using python) or gnuplot (if you are using c or fortran) or LsqFit module if you are using Julia.

If you are planning to submit separate programs, then please follow the guideline below:

- Keep all files of a worksheet in a single folder.
- Follow a systematic naming convention. You may name the program files as `Q1.py` or `Q1a.py`, `Q1b.py` for question 1 (if you have created multiple files for a single question). The data file should be named as `Q1-data-a.dat` and so on.
- Finally compress the entire folder as a single `.zip` or `.tgz` (using `tar cvfz archive.tgz folder-name/`, and submit the file in WeLearn.

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1. (10 points) Calculate the integral
$$\int_0^1 w(x)\,dx, = \int_0^1 \frac{x^3}{e^x - 1}$$
using *importance sampling* method. You may proceed as follows:
   (a) (3 points) Choose a trial function of the form
   $$\frac{1}{b + (x - x_\circ)^2}$$
   . Choose b and x_{circ} (intuitively).
   (b) (7 points) Calculate the integral using the importance sampling method.

2. (10 points) In this problem, we shall generate a set of random numbers whose distribution (not normalized) is given as
$$w(x) = \frac{1}{1 + (x - 1)^2}\ \forall x \in \mathbb{R}.$$
To achieve this we shall use the Metropolis algorithm in the following way:
   (a) (1 point) Plot the distribution as a function of x to get an idea about its behavior.
   (b) (6 points) Start a random walk of steps $1e6$ steps from $x_0 \sim 0.5$. We are choosing a starting point which is close to the maximum of this distribution.
      1 Take a step δx by choosing a floating point random number between -1 and 1 (corresponds to a maximum step size 1).
      2 Find
      $$a = \min\left[1, \frac{w(x_i + \delta x)}{w(x_i)}\right].$$
      2 Accept the step with a probability a.
      1 Store the result and take the next step.
   (c) (2 points) Generate the histogram data and normalize it.
   (d) (1 point) Plot the normalized distribution. On the same plot, draw normalized $w(x)$.