MACM 316 – Computing Assignment 1

- Read the *Guidelines for Assignments* first.
- Write a one-page PDF report summarizing your finding. This report must also include all your figures.
- Submit the one-page PDF report using Crowdmark and add your Matlab code to it (as extra pages). You must use the link sent by Crowdmark to your SFU email address. Follow the instructions on the Crowdmark to upload your file. If the report is hand-written then use the CamScanner app with your cellphone to scan the report and every page of the code. You will lose marks for poor quality pictures.
- You must acknowledge any collaborations/assistance from fellow students, discussion forums, TAs, instructors, etc.

Floating Point Arithmetic

It is well known that the number $\mathrm{e} = \exp(1)$ can be written as the limit

$$\mathrm{e} = \lim_{n\to\infty} (1 + 1/n)^n.$$

Your objective in this assignment is to investigate the robustness of the approximation

$$\mathrm{e} \approx \mathrm{e}_n = (1 + 1/n)^n, \qquad (\star)$$

for large values of n.

Write a Matlab code that computes e_n and the resulting approximation error for n in equal increments up to a maximum value of around 10^9. Plot your results in a figure, choosing the scales for your axes in a suitable way.

Next, suppose that n is restricted to being a power of 2, i.e. $n = 2^k$ for $k = 1, 2, \ldots$. Modify your code to use these values of n only and re-run the experiment up to a maximum value of n around 10^{30}. Plot your results in a figure, again choosing the scales for your axes in a suitable way.

Write up your findings in a one-page report. Your report should include the following:

(a) Appropriately-formatted figures showing your results.

(b) A discussion of behaviour seen in each case in terms of the robustness of algorithms.

(c) An explanation of the phenomena observed using the concepts of floating point numbers and floating point arithmetic.

(d) An explanation of the expected results if e was replaced by e^c for some positive number c (which could be integer, rational or irrational) and $(\star)$ was replaced by $\mathrm{e}_n^c = (1 + c/n)^n$. Note: you a not required to submit any additional numerical results for this part. But it is recommended you test this experimentally.