Instructions for preparing the solution script:

- Write your name, ID#, and Section number clearly in the very front page.
- Please use A4 paper and write all answers sequentially.
- Start answering a question (not the part of the question) from the top of a new page.
- Write legibly and in orderly fashion maintaining all mathematical norms and rules. Prepare a single solution file.
- Start working right away. There is no late submission form. If you miss the deadline, you need to use the make-up assignment to cover up the marks.

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1. In the classes, we discussed three forms of floating number representations as shown below,

$$\text{Standard Form} \quad : \quad F = \pm(0.d_1d_2d_3\cdots d_m)_\beta\,\beta^e\,, \quad (d_1 \neq 0) \tag{1}$$

$$\text{IEEE Normalized Form} \quad : \quad F = \pm(0.1d_1d_2d_3\cdots d_m)_\beta\,\beta^e\,, \tag{2}$$

$$\text{IEEE Denormalized Form} \quad : \quad F = \pm(1.d_1d_2d_3\cdots d_m)_\beta\,\beta^e\,, \tag{3}$$

   where $d_i, \beta, e \in \mathbb{Z}$, $0 \leq d_i \leq \beta - 1$ and $e_{\min} \leq e \leq e_{\max}$. Now, let's take, $\beta = 2$, $m = 5$ and $-2 \leq e \leq 5$. Based on these, answer the following:

   (a) (6 marks) What are the maximum numbers that can be stored in the system by these three forms defined above (express your answer in decimal values)?

   (b) (6 marks) What are the non-negative minimum numbers that can be stored in the system by the three forms defined above (express your answer in decimal values)?

   (c) (6 marks) Including negative numbers, what range of the floating numbers in these three representations are considered as ZERO and $\pm\infty$ because of the underflow and overflow respectively.

2. Consider the quadratic equation, $x^2 - 60x + 1 = 0$. Below calculate up to 6 significant figures.

   (a) (4 marks) **Find out** where the loss of significance occur when you calculate the roots?

   (b) (4 marks) **Show that** the roots evaluated in the previous part do not satisfy the fundamental properties of a polynomial.

   (c) (4 marks) **Evaluate** the correct roots such that loss of significance does not occur.