Name: BLG202E
Number: **Homework 1** February 28, 2020

- **Prepare a report for this homework in PDF format using Word or Latex. The handwritten parts of the solutions must be present on white paper legibly and put in the appropriate places in the report after scanned clearly.**
- **Only one page should be used for each answer.**
- **Write your name and number at the top of the each page.**
- **No late submissions will be accepted.**
- **In Case of Cheating and Plagiarism Strong disciplinary action will be taken.**
- **For any questions about the homework, contact Rusen Halepmollasi via mail (halepmollasi@itu.edu.tr).**

Submissions: Please submit your report through Ninova e-Learning System. Another way of submission will not be accepted.

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1. (20 pt.) What is the rounding unit for base $\beta = 2$ and $t = 52$ digits?

2. (20 pt.) : Let $x = 0,85317$ and $y = 0,85301$. Use four-digit arithmetic to approximate x - y and determine the absolute and relative errors using

   (a) rounding

   (b) chopping.

3. (30 pt.) Consider the linear system

$$\begin{pmatrix} a & b \\ b & a \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

   with $a, b > 0$.

   (a) Suggest a numerically stable formula for computing $z = x + y$ given a and b.

   (b) Determine whether the following statement is true or false, and explain why: "When $a \approx b$, the problem of solving the linear system is *ill-conditioned* but the problem of computing $x + y$ is *not ill-conditioned*."

4. (30 pt.) Suppose a machine with a floating point system $(\beta, t, L, U) = (10, 8, -50, 50)$ is used to calculate the roots of the quadratic equation

$$ax^2 + bx + c = 0,$$

   where a, b, and c are given, real coefficients.

   (a)Explain with two sentences the meaning and importance of β, t, L, and U by which a general floating point system is characterized.

   (b) For each of the following, state the numerical difficulties that arise if one uses the standard formula for computing the roots. Explain how to overcome these difficulties (when possible).

   (i) $a = 1; b = -10^5; c = 1$.

   (ii) $a = 6 \cdot 10^{30}; b = 5 \cdot 10^{30}; c = -4 \cdot 10^{30}$.