Small Group Activity - How to "round" error terms to a single digit

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Activity Kind

Small group activity

Purpose

The purpose of this activity is to get to the heart of the purpose of expressing an error term and then leverage that to deal with the issue of rounding after doing a computation.

Pre-requisite

Students must have participated in the Small Group Activity - Handling operands with and without error terms.

Tasking

The first part of this task is to consider a situation where you must compute the product of two values, each with an error term as shown here:

$$3145.62 \pm 0.01 \times 2.5 \pm 0.1 \tag{1}$$

If we convert this typical engineering notation to ranges, we have the following equation. (The smallest element of the first range times the smallest element of the second range will be the smallest possible value. Similarly, the largest possible element of the first range times the largest possible value of the second will produce the largest possible value.):

$$[3145.61 \times 2.4, \ 3145.63 \times 2.6] \tag{2}$$

Performing the two multiplications, we end up with the following result range:

$$[7549.464, \ 8178.638] \tag{3}$$

The average of these two values is the mid-point of the result, and that is: 7864.051 Subtracting this value from the two extreme values of the range gives us the following:

$$[7864.051 - 314.587, \ 7864.051 + 314.587] \tag{4}$$

Given this form, it is trivial to convert the result back into the usual engineering form:

$$7864.051 \pm 314.587 \tag{5}$$

Now it gets interesting. We want the error term to be expressed with a single significant digit. Should we round "up", should we do the "usual rounding", or should we round "down" (truncate)? If the goal is to ensure that the two endpoints of the range in equation 3 are within the range expressed by the result after "rounding", which rounding should we use and explain why. Be sure to capture this in your ENB.

The second task is to write a short Java program that uses the console to read in a measured value and an error term, computes the "rounded" error term, and writes it out. Again, be sure to capture the console output, explain what we see and why it is correct.

Deliverable

Capture notes from this activity, in your ENB, as evidence that you actually did the work.

Submission

Each student must produce and submit an ENB for this day's work.