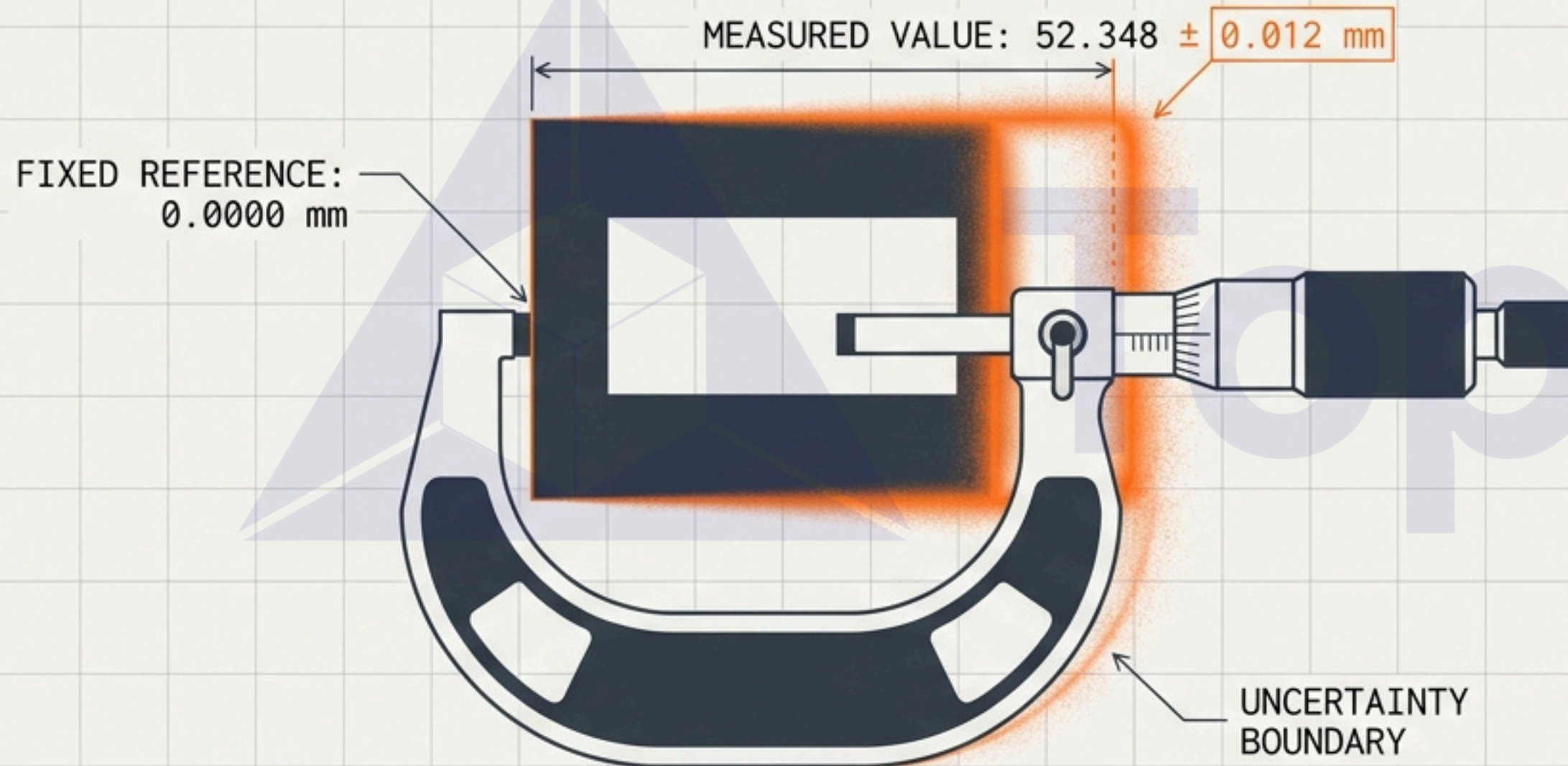


Uncertainty: The Hidden Part of Measurement

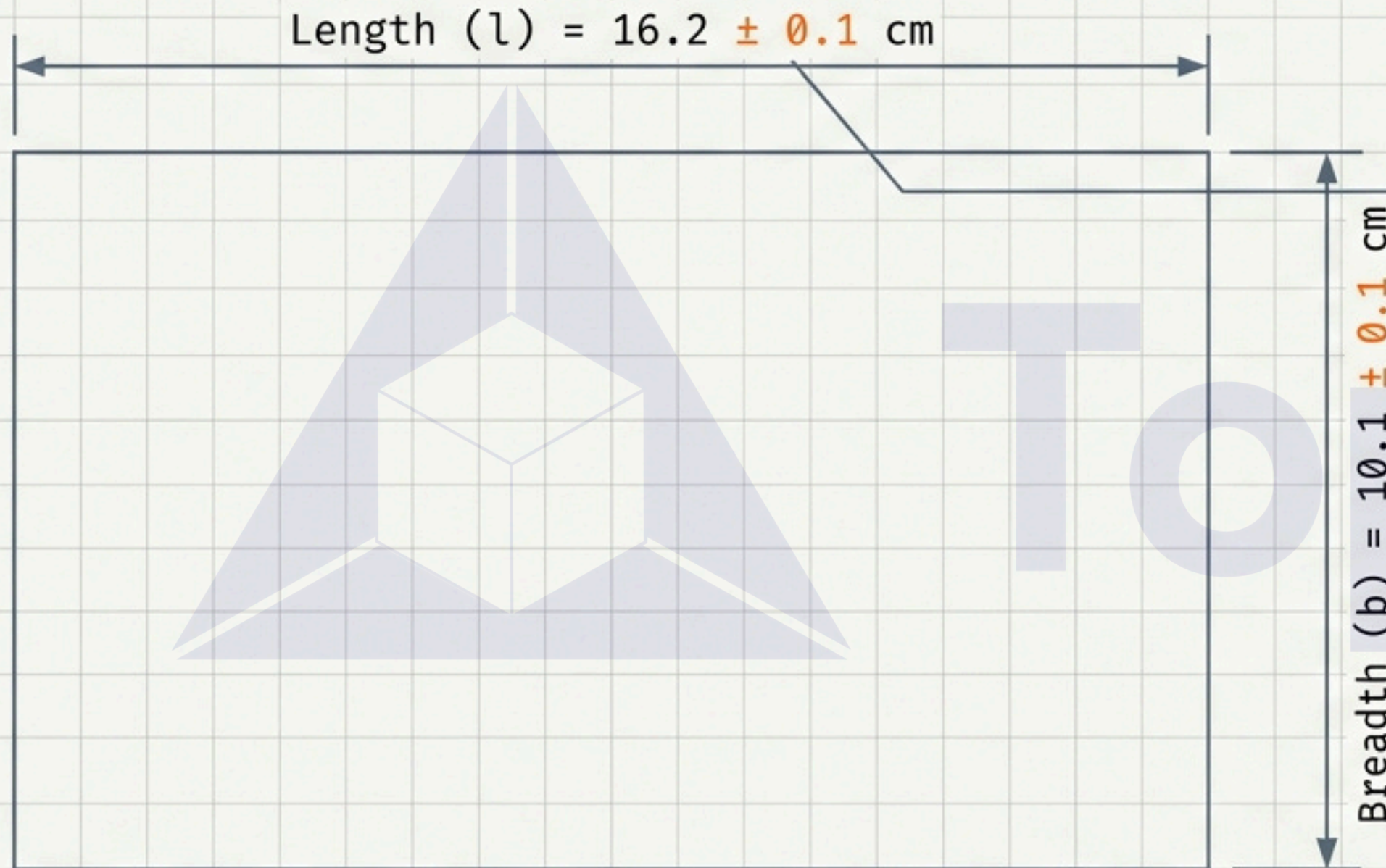


RELATIVE UNCERTAINTY

$$(U_{\text{rel}}) = \frac{0.012}{52.348} \times 100 = 0.023\%$$

Visually represents the range of possible true values due to measurement limitations, precision errors, and environmental factors. No measurement is absolute.

The Anatomy of a Measurement



Absolute Error

This represents the physical limit of the measuring instrument (e.g., a standard metre scale).

Both measurements possess exactly three significant figures.



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$$E=mc^2$$



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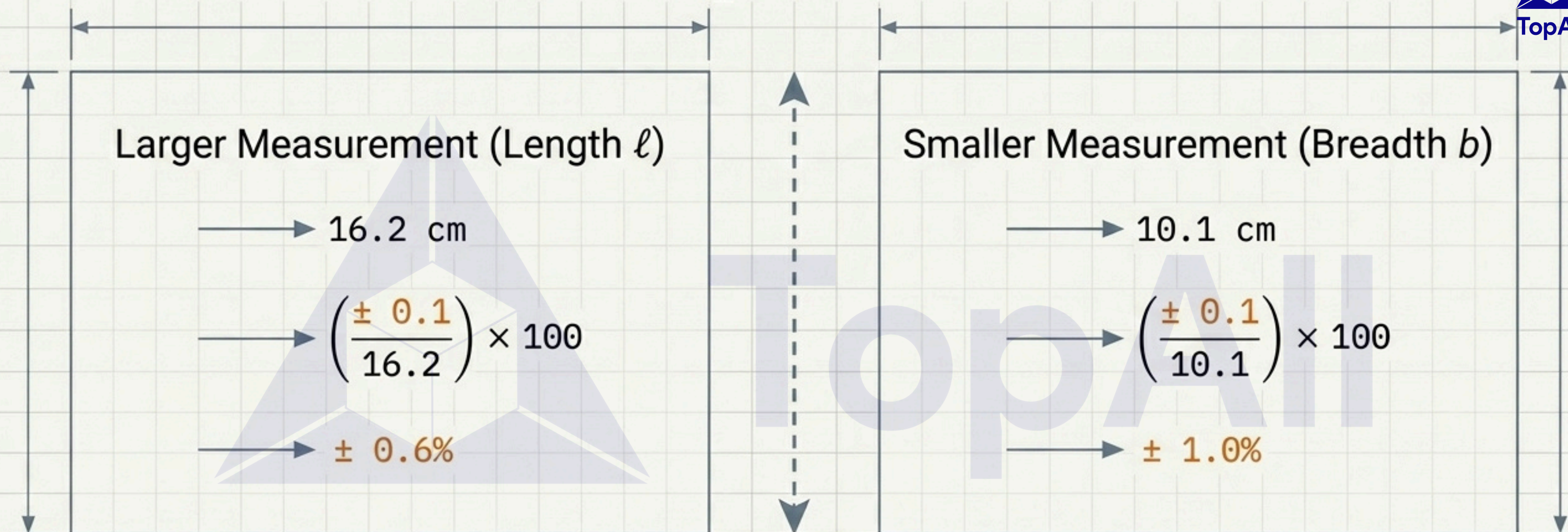
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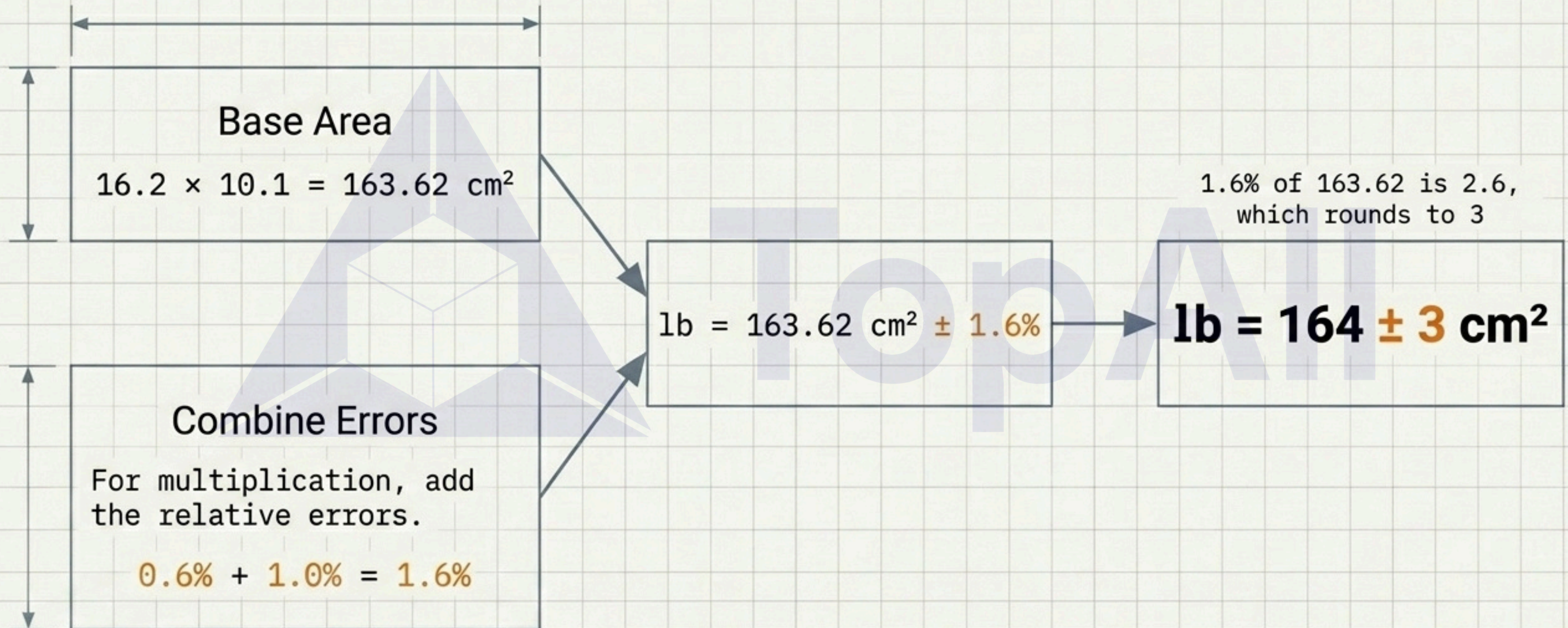


The Conversion Engine: Absolute to Relative



Notice the proportional impact: Even though the absolute error (± 0.1 cm) is identical for both, the relative uncertainty is nearly twice as large on the smaller measurement.

Calculating Area: The Combination of Errors



The Edge Case: Precision in Subtraction



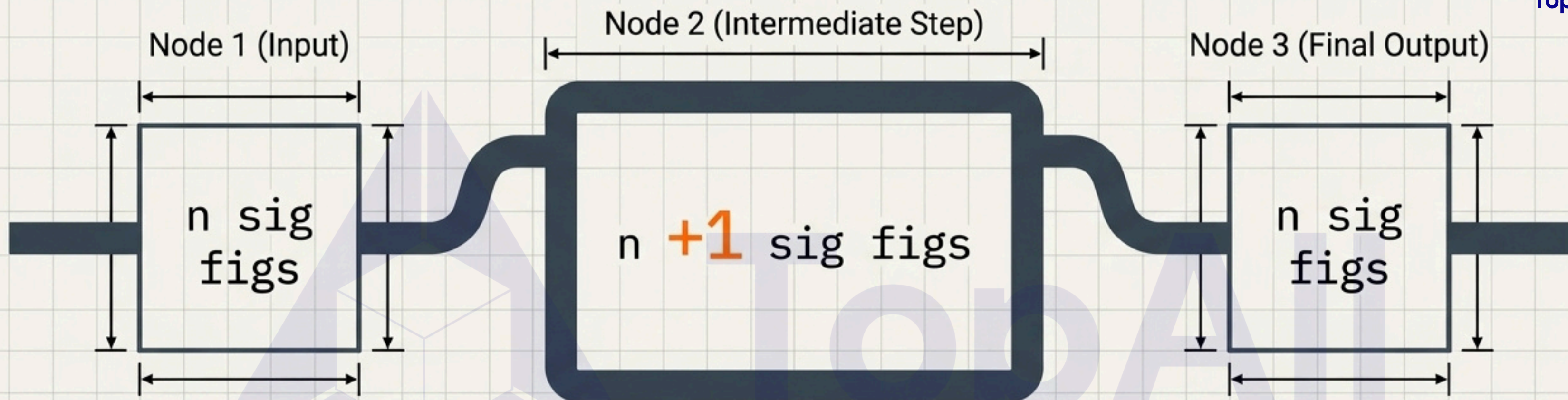
$$\begin{array}{r} 12.9[?] \text{ g} \\ - 7.06 \text{ g} \\ \hline = 5.84 \text{ g} \end{array} \rightarrow 5.8 \text{ g}$$

The uncertainty in 12.9 g dominates this column.

Uncertainties in addition/subtraction combine by decimal places, not significant figures.

12.9 g and 7.06 g both start with three significant figures, but the valid result (5.8 g) only retains two.

The Golden Rule of Multi-Step Math



In multi-step calculations, always keep **one extra significant figure** in your intermediate steps.

Rounding too early builds compounding errors. Retaining an extra digit acts as a buffer against structural uncertainty, ensuring your final answer reflects the true precision of your initial measurements.



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