Programming Task: Relationship Between Lines

We consider lines in the plane in general form:

$$l_i: \ A_i x + B_i y + C_i = 0, \qquad A_i, B_i, C_i \in \mathbb{R}.$$

Input format

When the program is executed:

1. The user is prompted to enter an integer $n \geq 2$, the number of lines. Inputs $n = 0$ or $n = 1$ are invalid and must be rejected with a clear message and a new prompt.

2. Next, for each $i = 1, \ldots, n$, the user is prompted to enter the three coefficients
$$A_i, \ B_i, \ C_i,$$
which define the line $l_i : A_i x + B_i y + C_i = 0$.

3. All coefficients are then stored (for example in a list or array) so that the program can analyze all pairs of lines.

Example run

```
Enter number of lines n: 3
Enter coefficients A1 B1 C1: 1 1 -2
Enter coefficients A2 B2 C2: 1 -1 0
Enter coefficients A3 B3 C3: 2 -3 5
```

Task

Write a Python program that:

1. For each **ordered** pair (l_i, l_j) with $i \neq j$:

   - Decide whether the lines **intersect**, are **parallel but distinct**, or are **coincident**.
   - If they intersect, compute the intersection point (x, y).

- If they intersect and they are not perpendicular, compute the *angle from l_i to l_j* in degrees using the slope formula

$$\tan\theta \;=\; \frac{m_j - m_i}{1 + m_i m_j},$$

where m_k is the slope of l_k (vertical lines must be treated carefully). The angle should be the smallest positive angle.

With this convention, $\theta(l_j \to l_i) = 180^\circ - \theta(l_i \to l_j)$.

Implementation Notes

- The slope of $Ax + By + C = 0$ is $m = -A/B$ when $B \neq 0$. Treat vertical lines ($B = 0$) carefully.
- Distinguish parallel vs. coincident via proportionality: (A_i, B_i, C_i) proportional to (A_j, B_j, C_j) implies coincidence.
- Validate that each line is well-defined: $(A_i, B_i) \neq (0, 0)$. Reject or re-prompt otherwise.