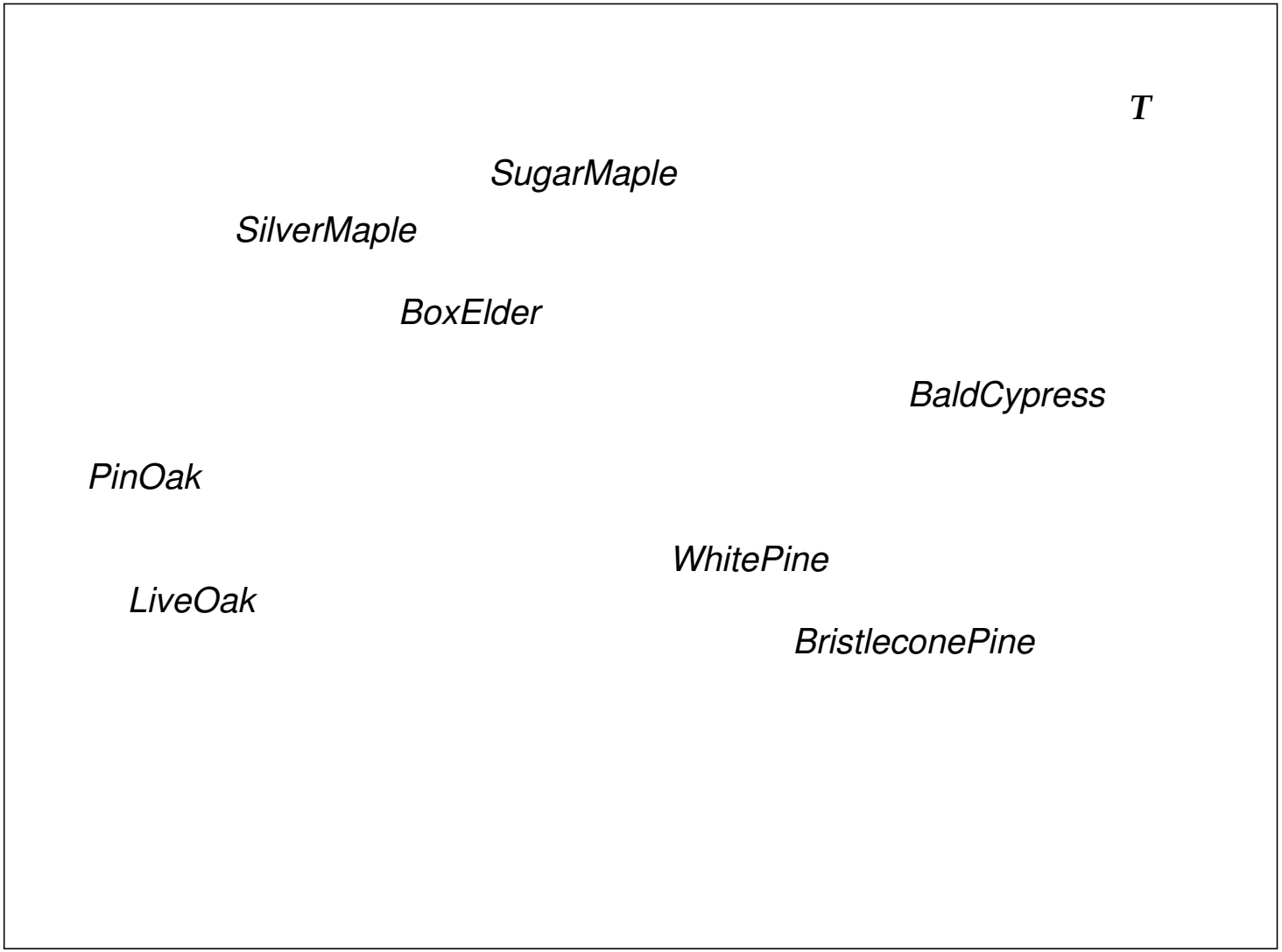
Miscellaneous Set Concepts

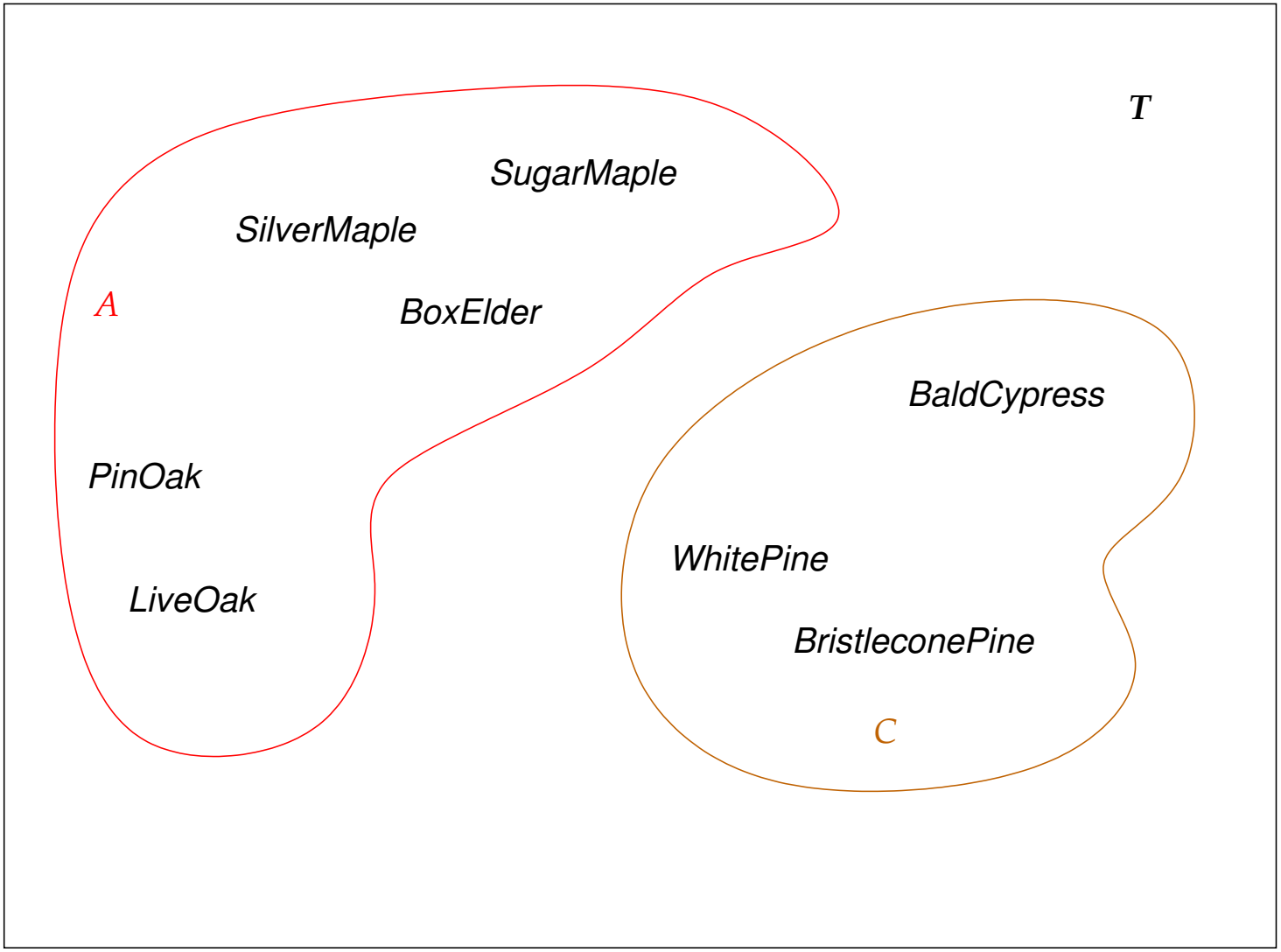
Slides to accompany Sections 1.(8 & 9) of *Discrete Mathematics and Functional Programming*

Thomas VanDrunen

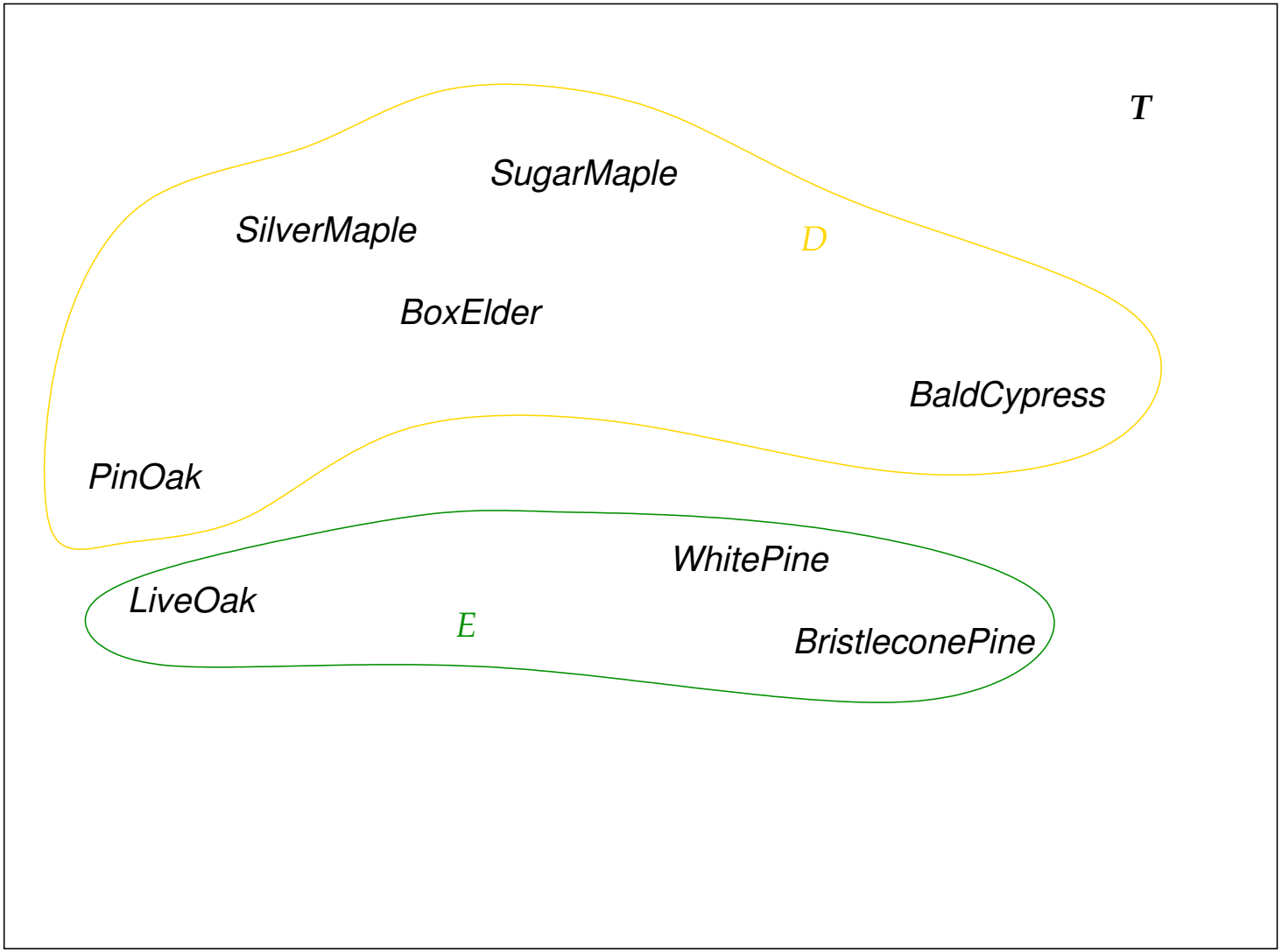
Tree example



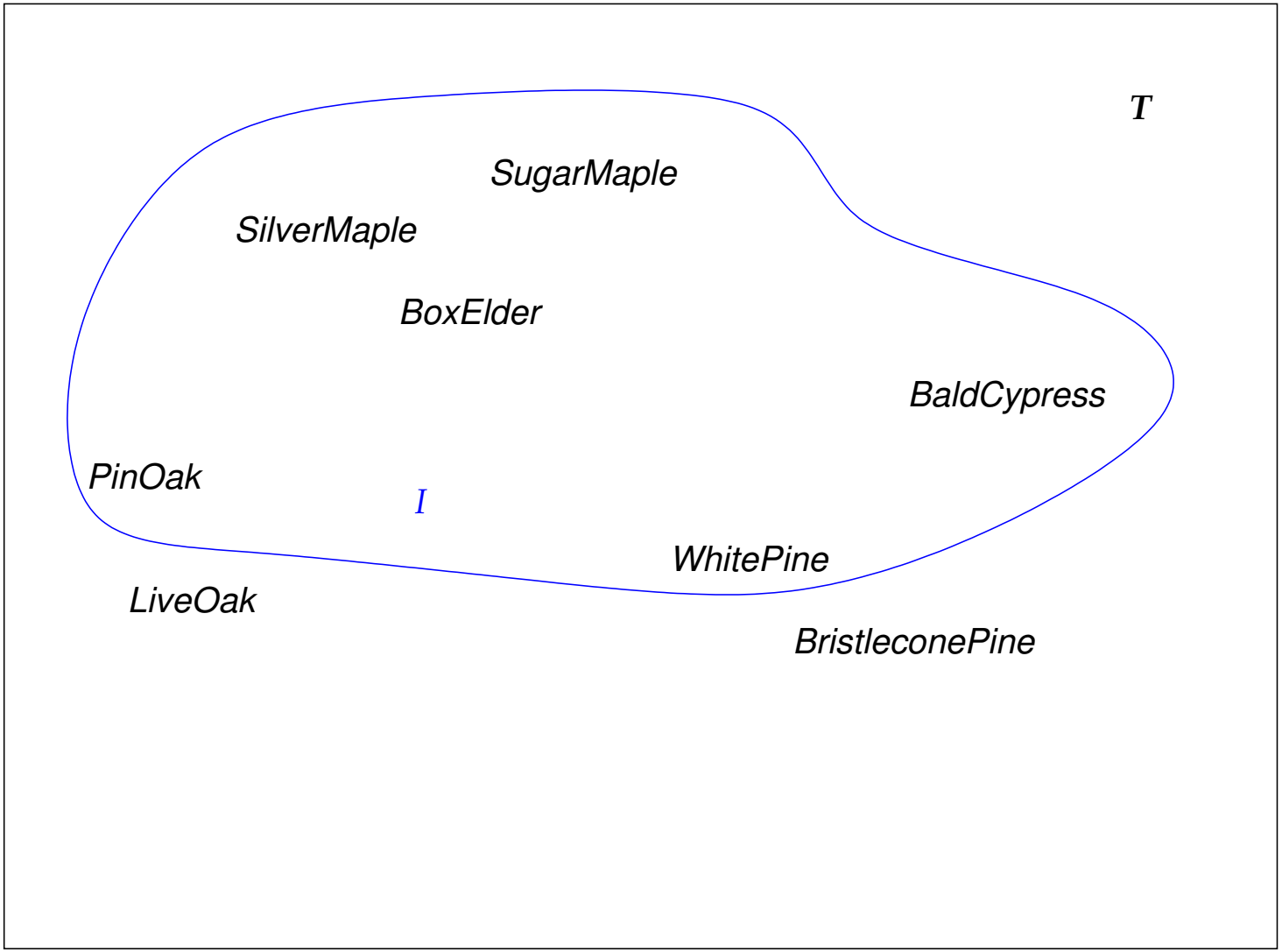
Tree example



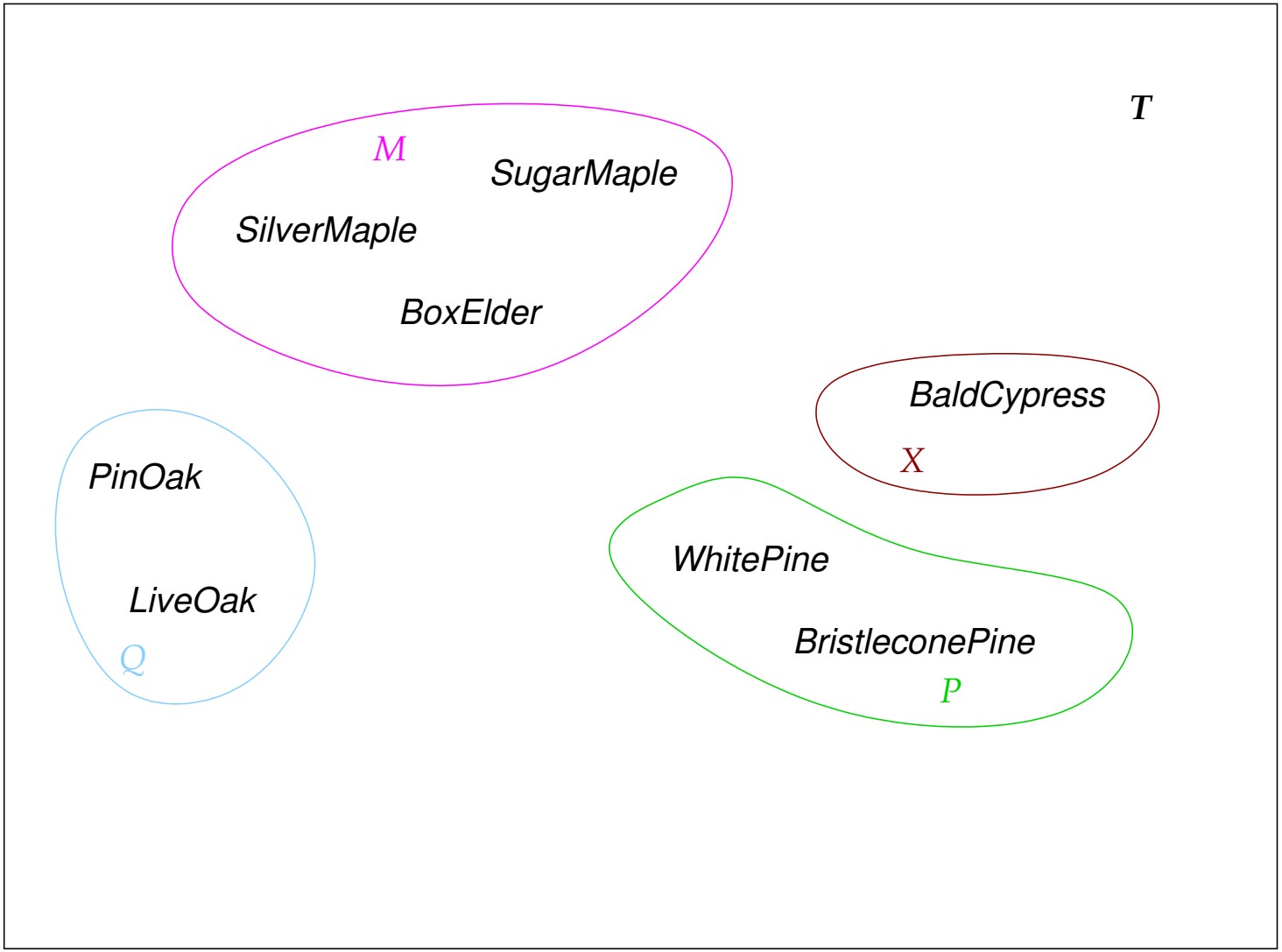
Tree example



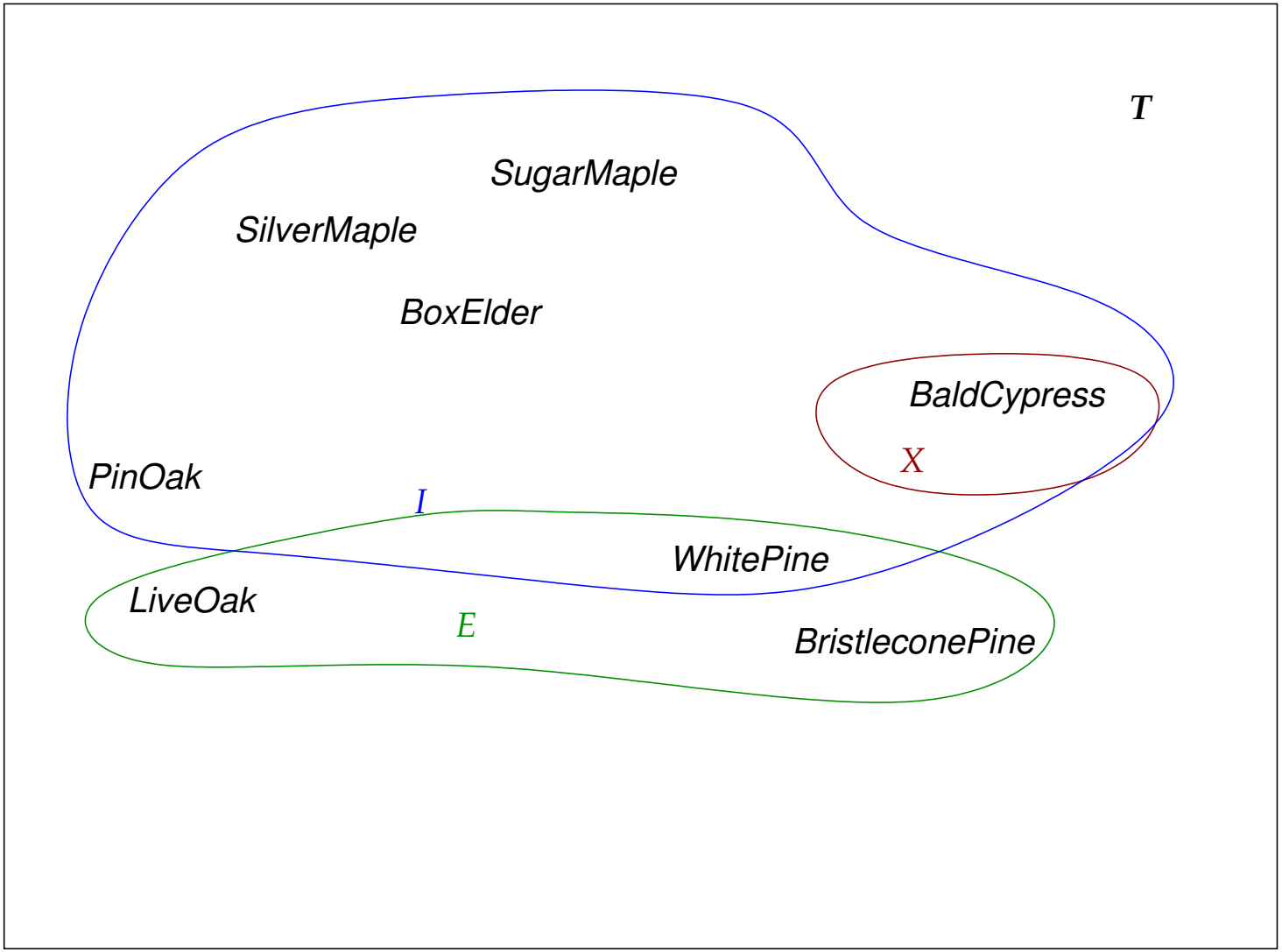
Tree example



Tree example

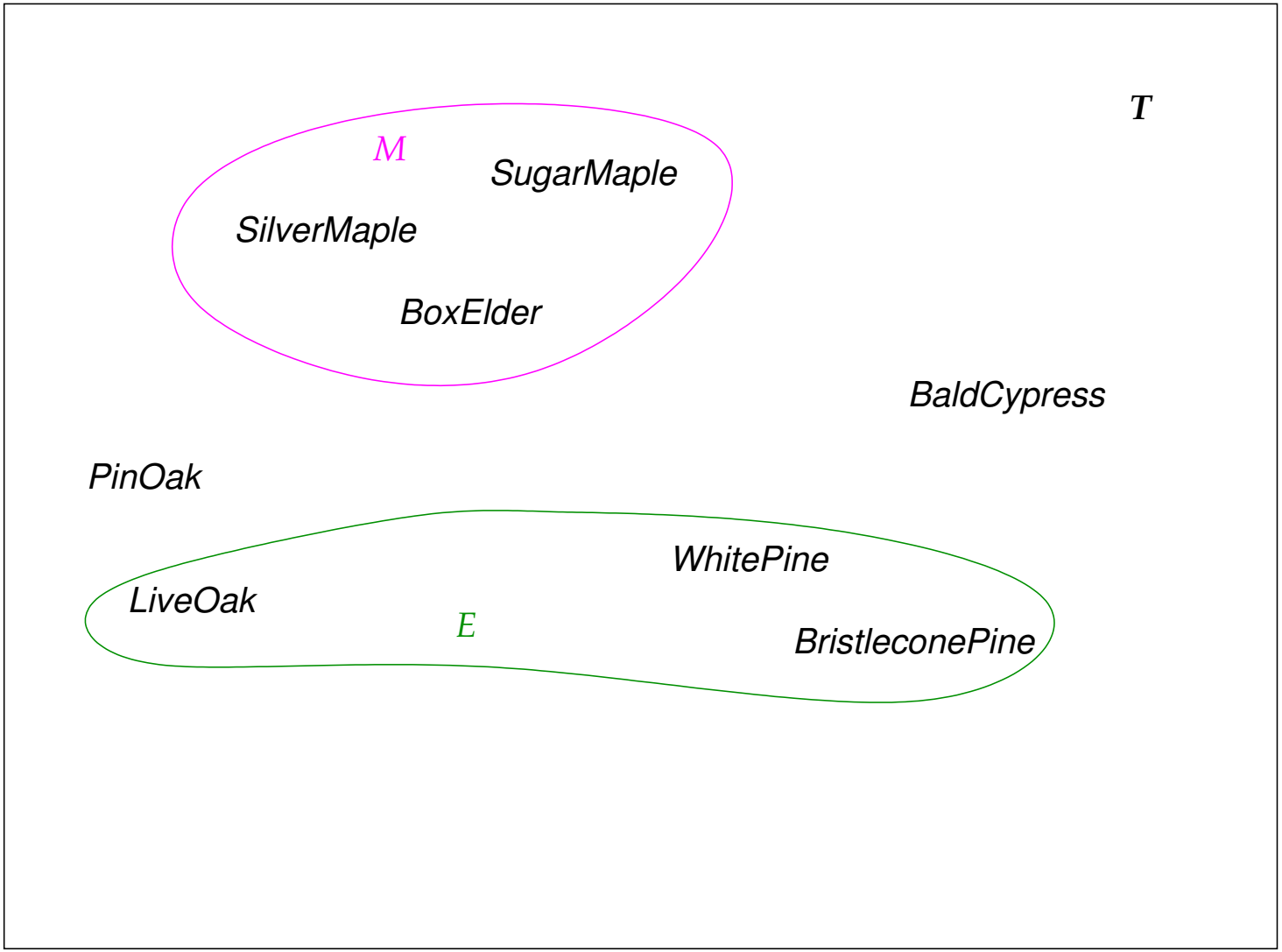


Cardinality



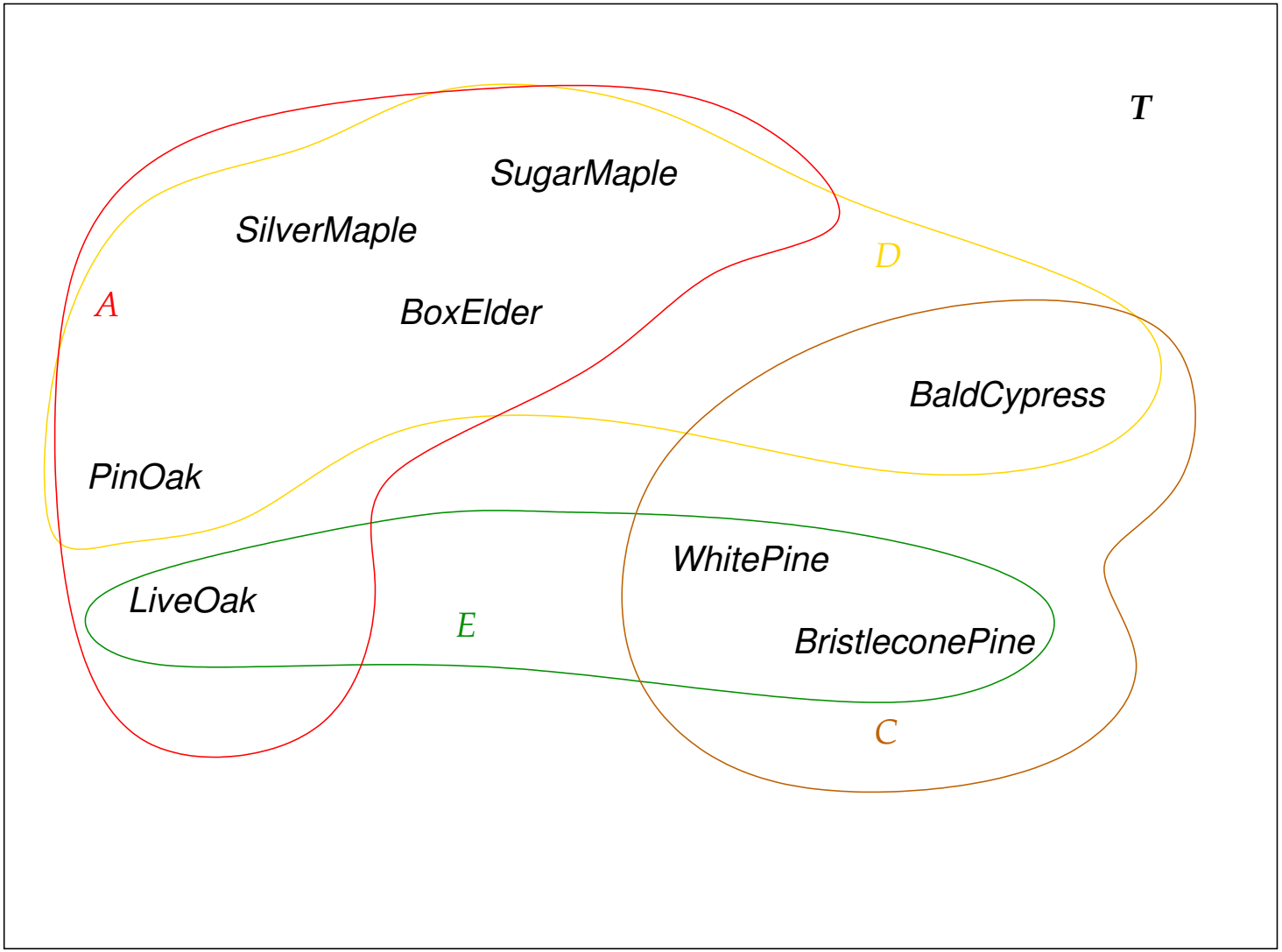
$|I| = 6.$ $|X| = 1.$ $|E| = 3.$ $|I - E| = 5.$ $|X - I| = 0.$

Disjoint



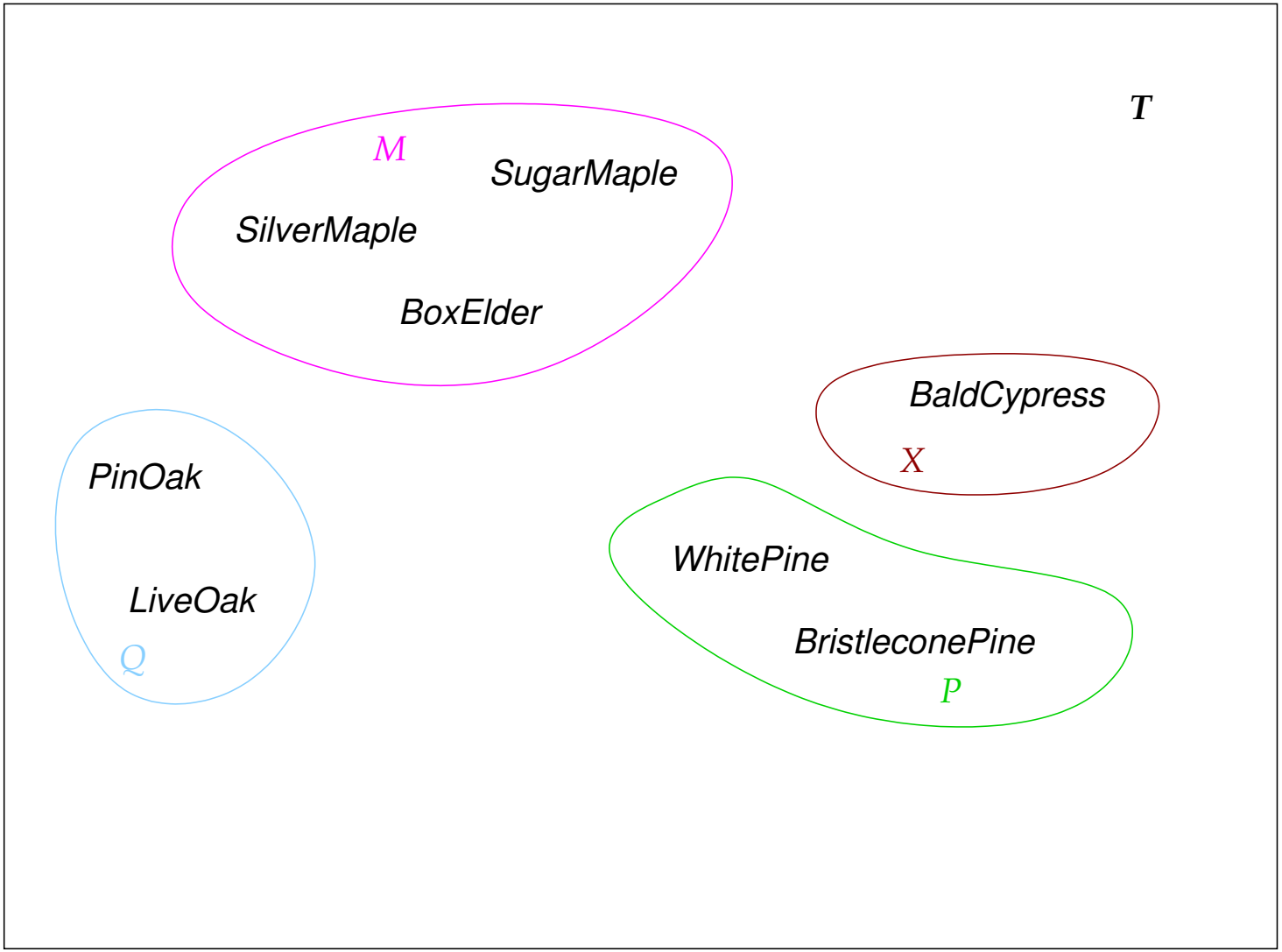
$M \cap E = \emptyset.$ $\quad |M \cap E| = 0.$

Not Disjoint



$A \cap E = \{LiveOak\} \neq \emptyset.$ $C \cap D = \{BaldCypress\} \neq \emptyset.$

Pairwise disjoint



Questions

$$
\begin{aligned}
&(E - C) \cap (C - E) \\
&\quad = \quad (\{\mathit{LiveOak}, \mathit{WhitePine}, \mathit{BristleconePine}\} \\
&\qquad\qquad -\{\mathit{WhitePine}, \mathit{BristleconePineBaldCypress}\}) \\
&\qquad \cap \{\mathit{WhitePine}, \mathit{BristleconePineBaldCypress}\} \\
&\qquad\qquad -(\{\mathit{LiveOak}, \mathit{WhitePine}, \mathit{BristleconePine}\}) \\
&\quad = \quad \{\mathit{LiveOak}\} \cap \{\mathit{BaldCypress}\} \\
&\quad = \quad \emptyset
\end{aligned}
$$

Is it true that for any two sets A and B, $(A - B) \cap (B - A) = \emptyset$?

Questions

$$
\begin{aligned}
|M \cup Q| &= |\{SugarMaple, SilverMaple, BoxElder\} \\
&\qquad \cup \{PinOak, LiveOak\}| \\
&= |\{SugarMaple, SilverMaple, BoxElder, \\
&\qquad PinOak, LiveOak\}| \\
&= 5 \\
&= 3 + 2 \\
&= |\{SugarMaple, SilverMaple, BoxElder\}| \\
&\qquad + |\{PinOak, LiveOak\}| \\
&= |M| + |Q|
\end{aligned}
$$

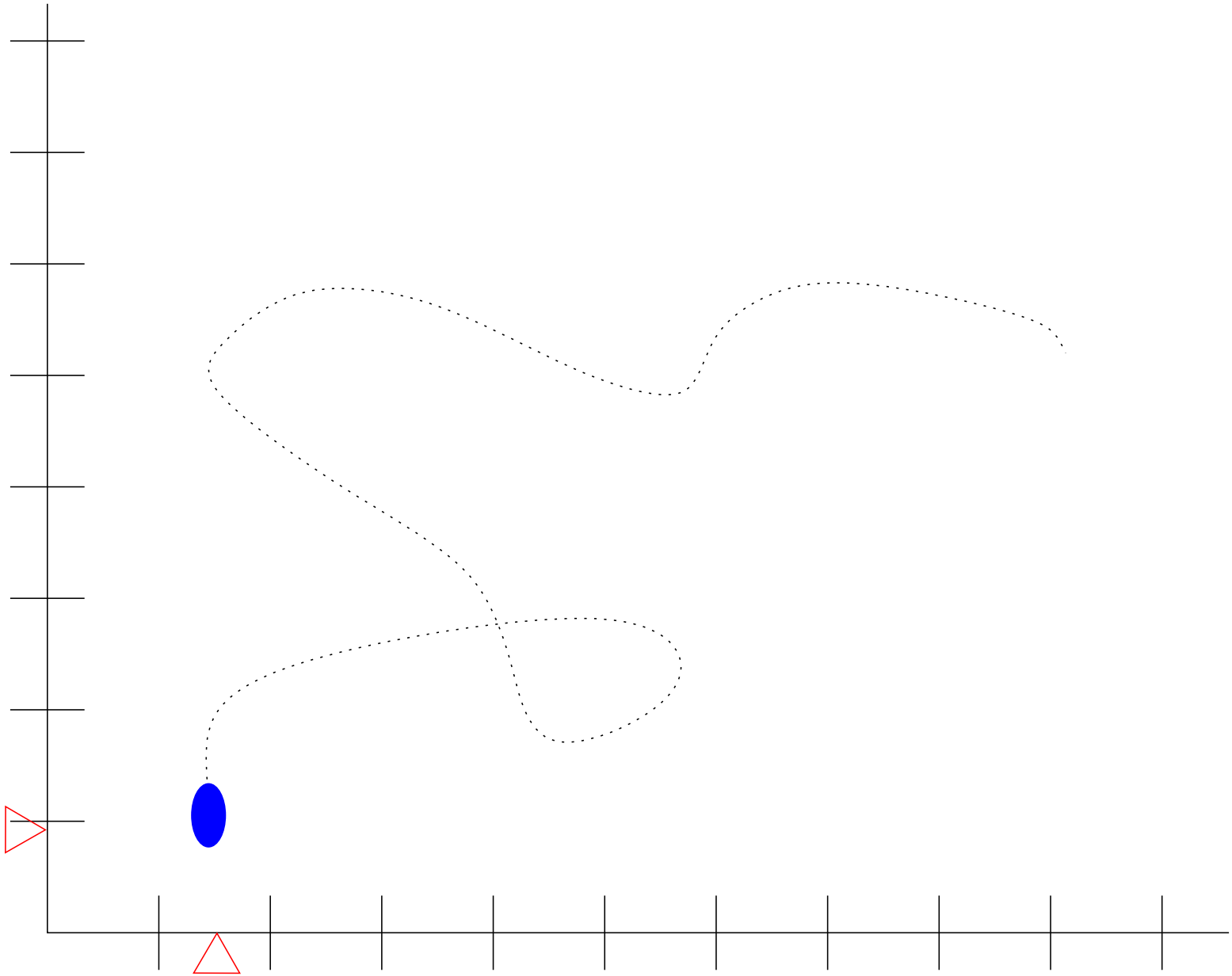
Is it true that for any two sets A and B, $|A \cup B| = |A| + |B|$?

Questions

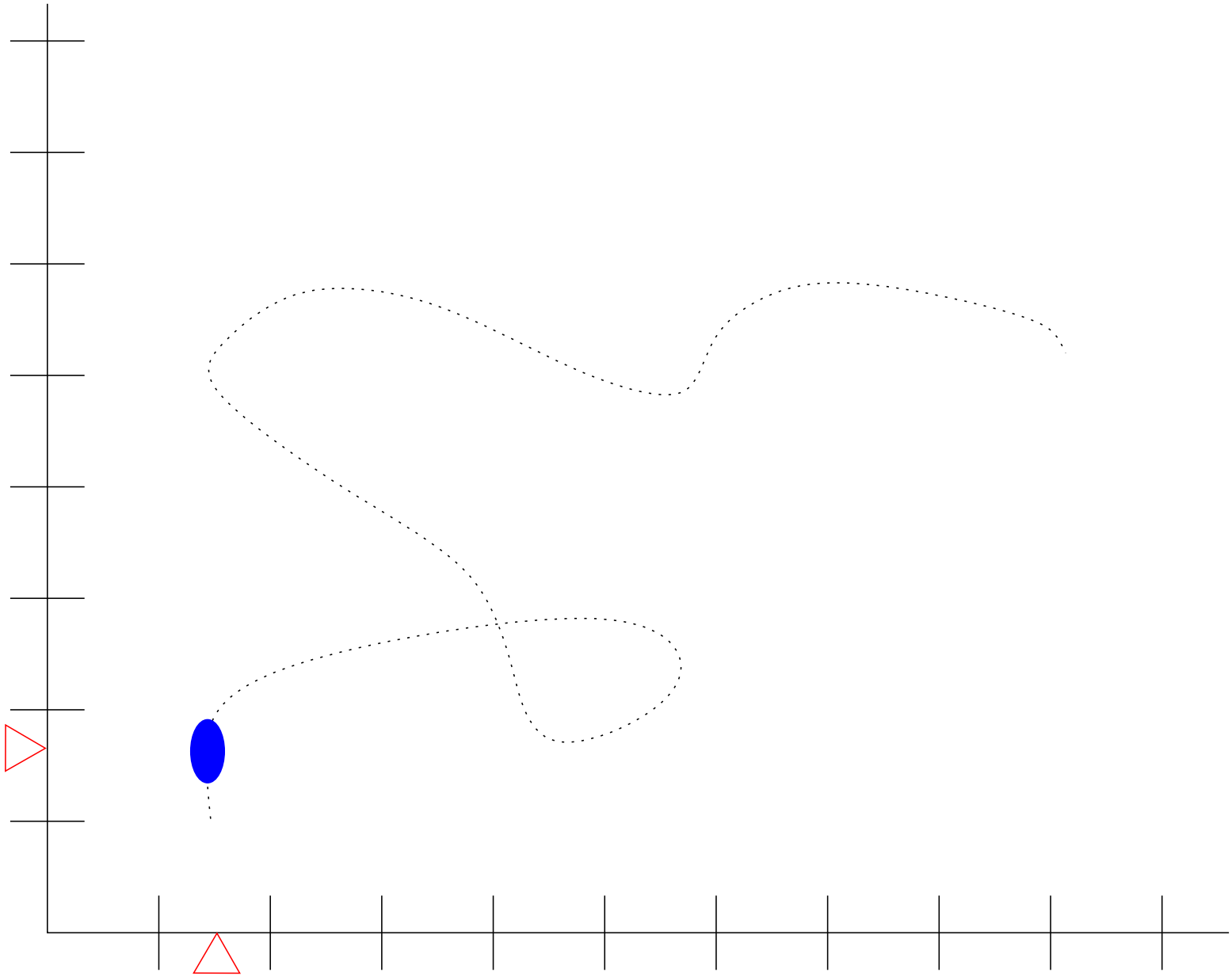
$$
\begin{aligned}
|C - X| &= |\{WhitePine, BristleconePine, BaldCypress\} \\
&\qquad -\{BaldCypress\}| \\
&= |\{WhitePine, BristleconePine\}| \\
&= 2 \\
&= 3 - 1 \\
&= |\{WhitePine, BristleconePine, BaldCypress\}| \\
&\qquad -|\{BaldCypress\}| \\
&= |C| - |X|
\end{aligned}
$$

Is it true that for any two sets A and B, $|A - B| = |A| - |B|$?

Cartesian Plane



Cartesian Plane



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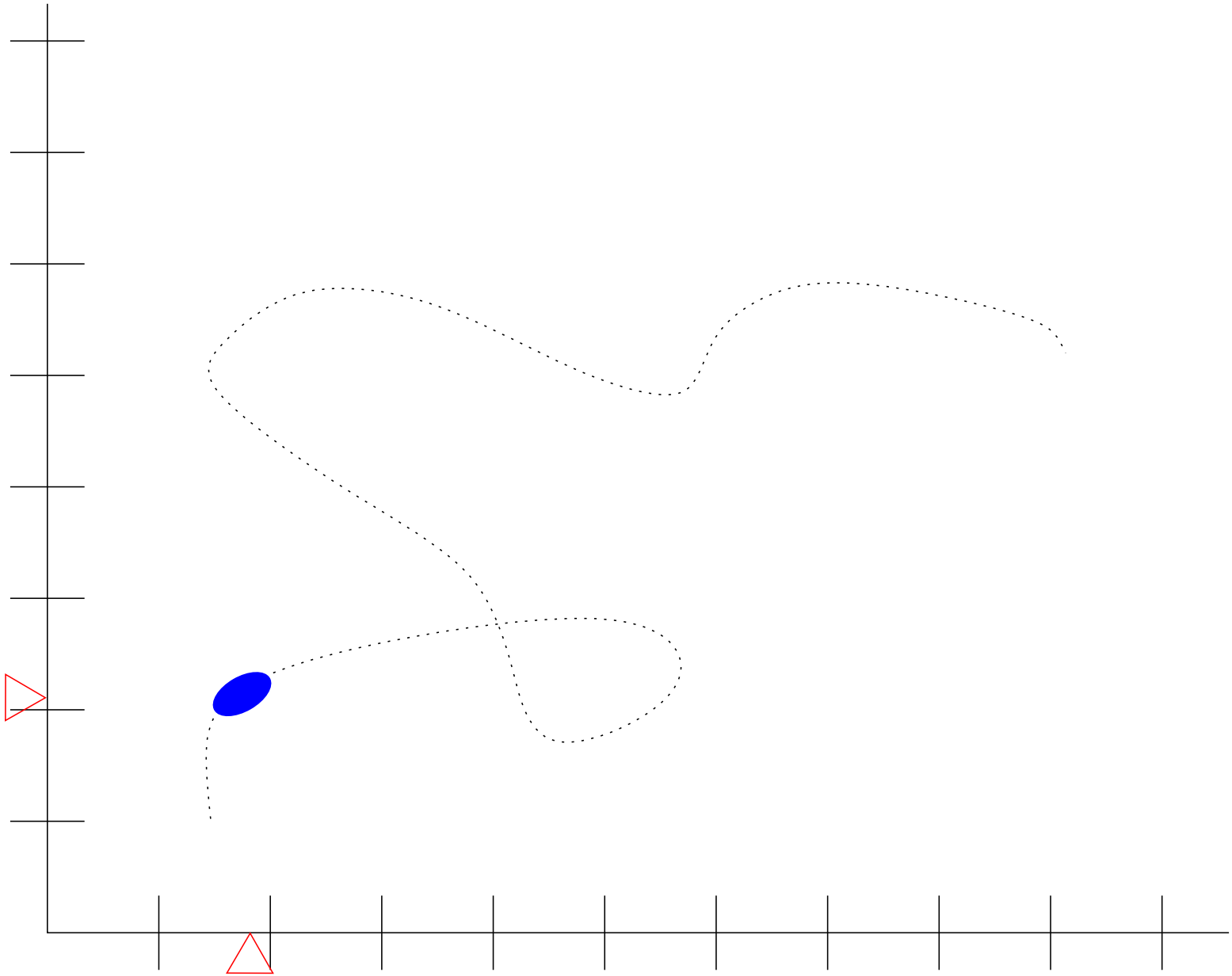

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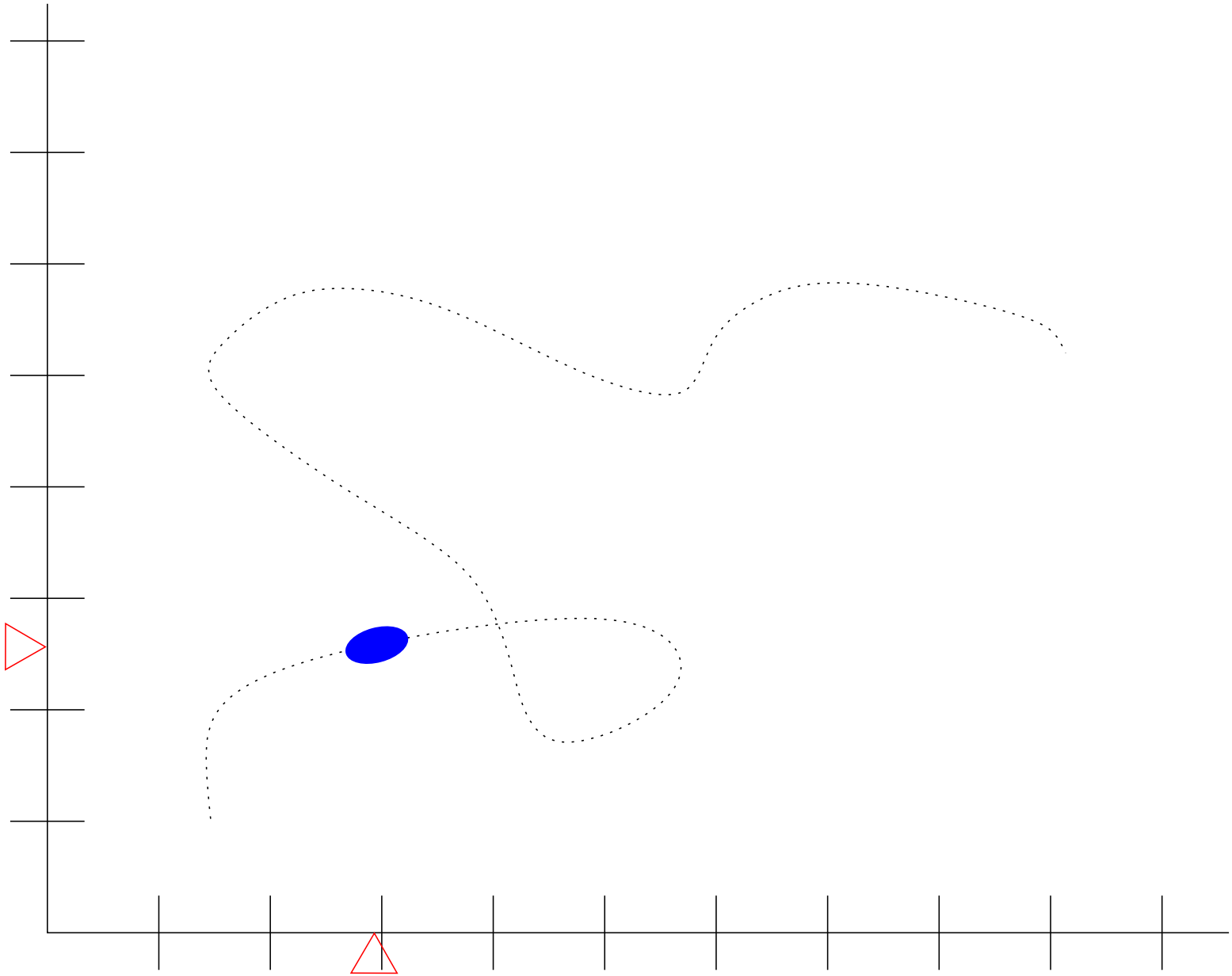

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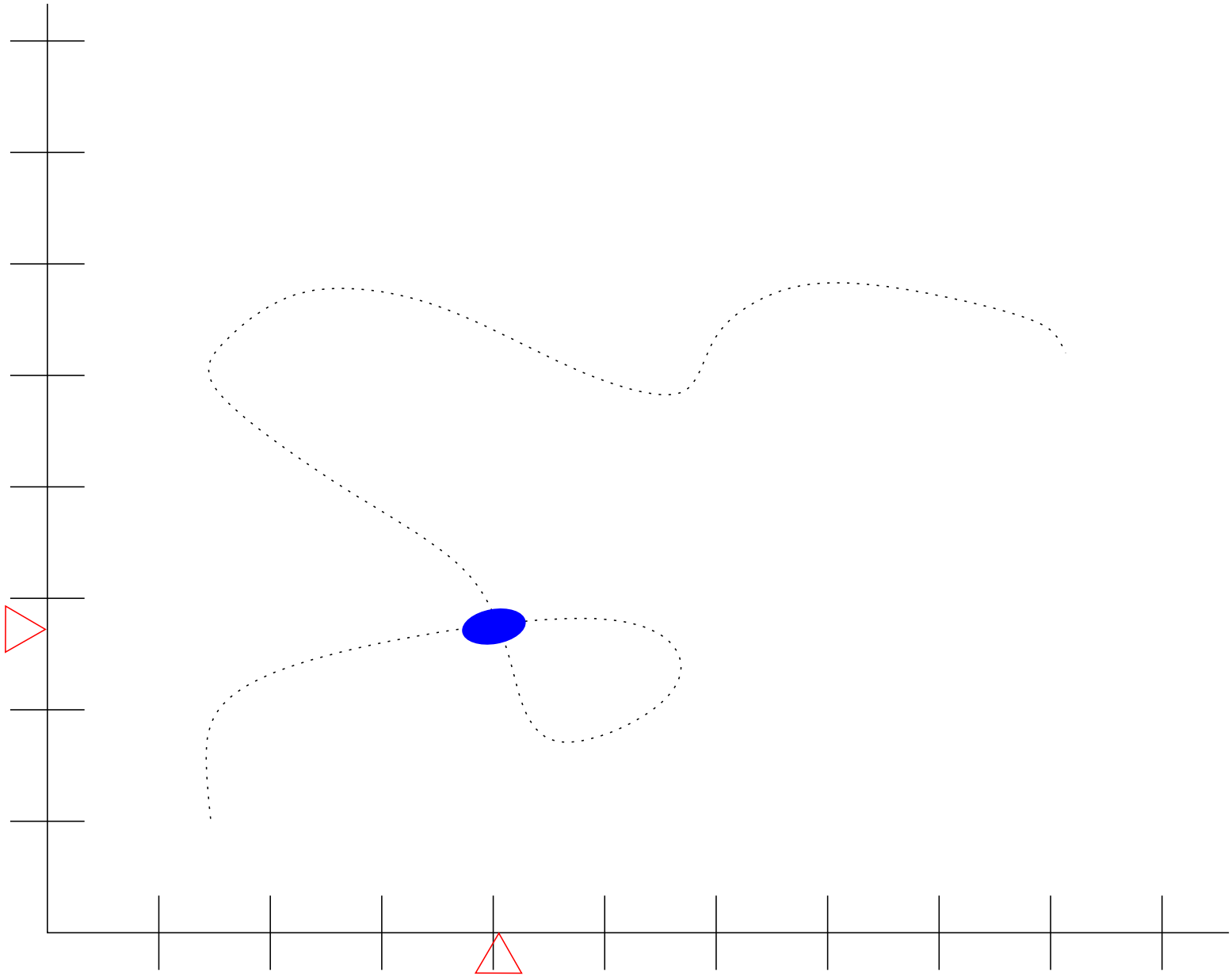

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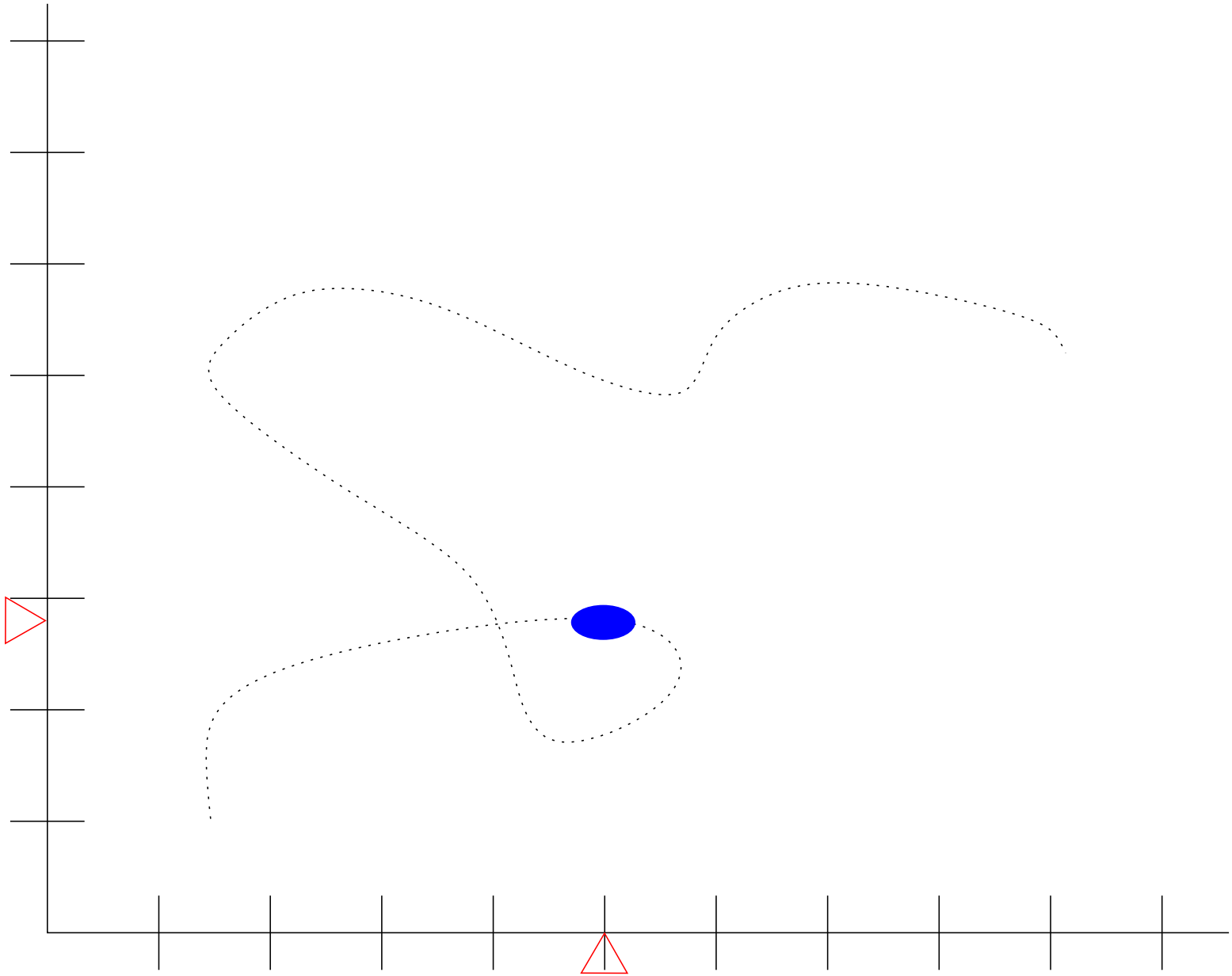

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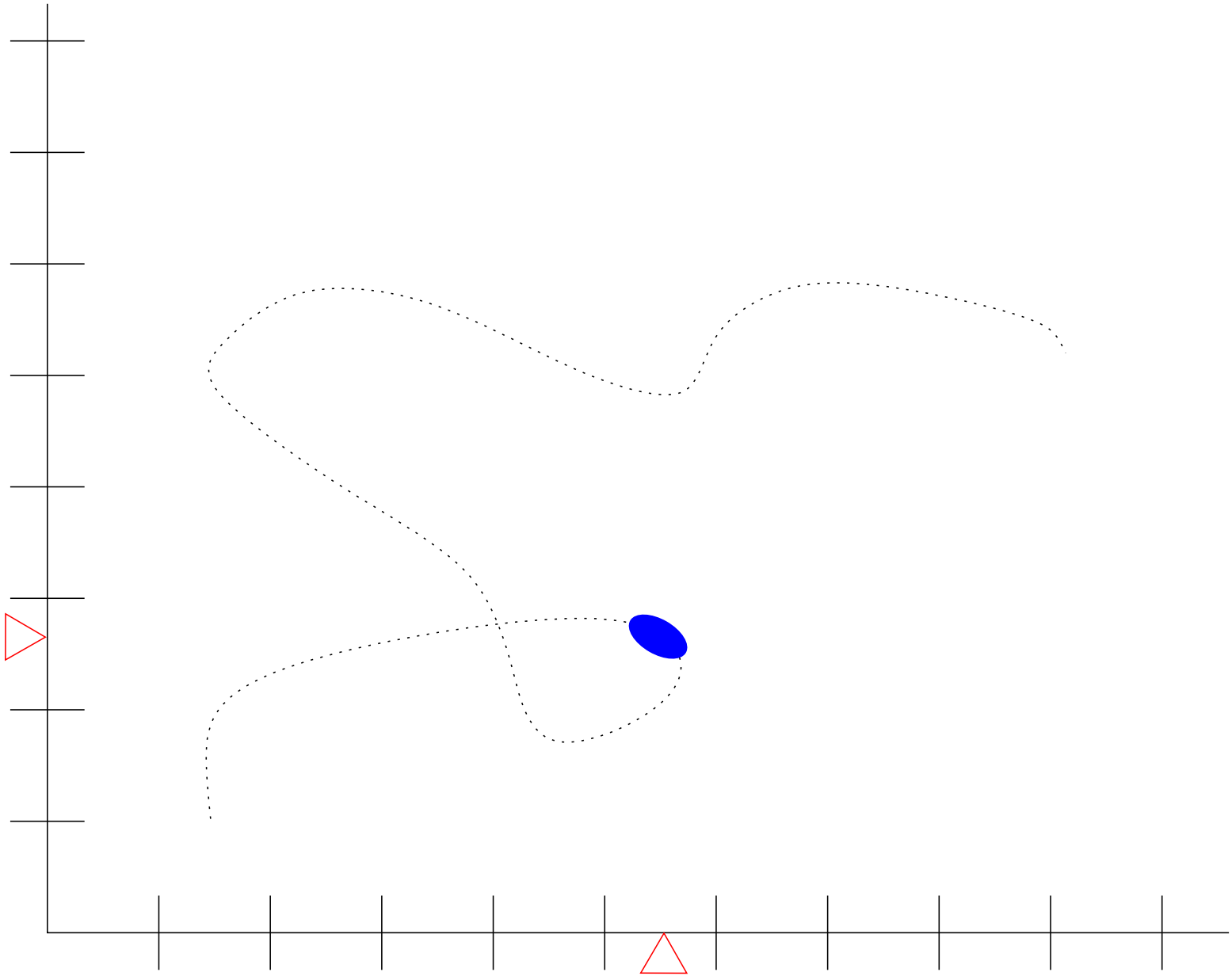

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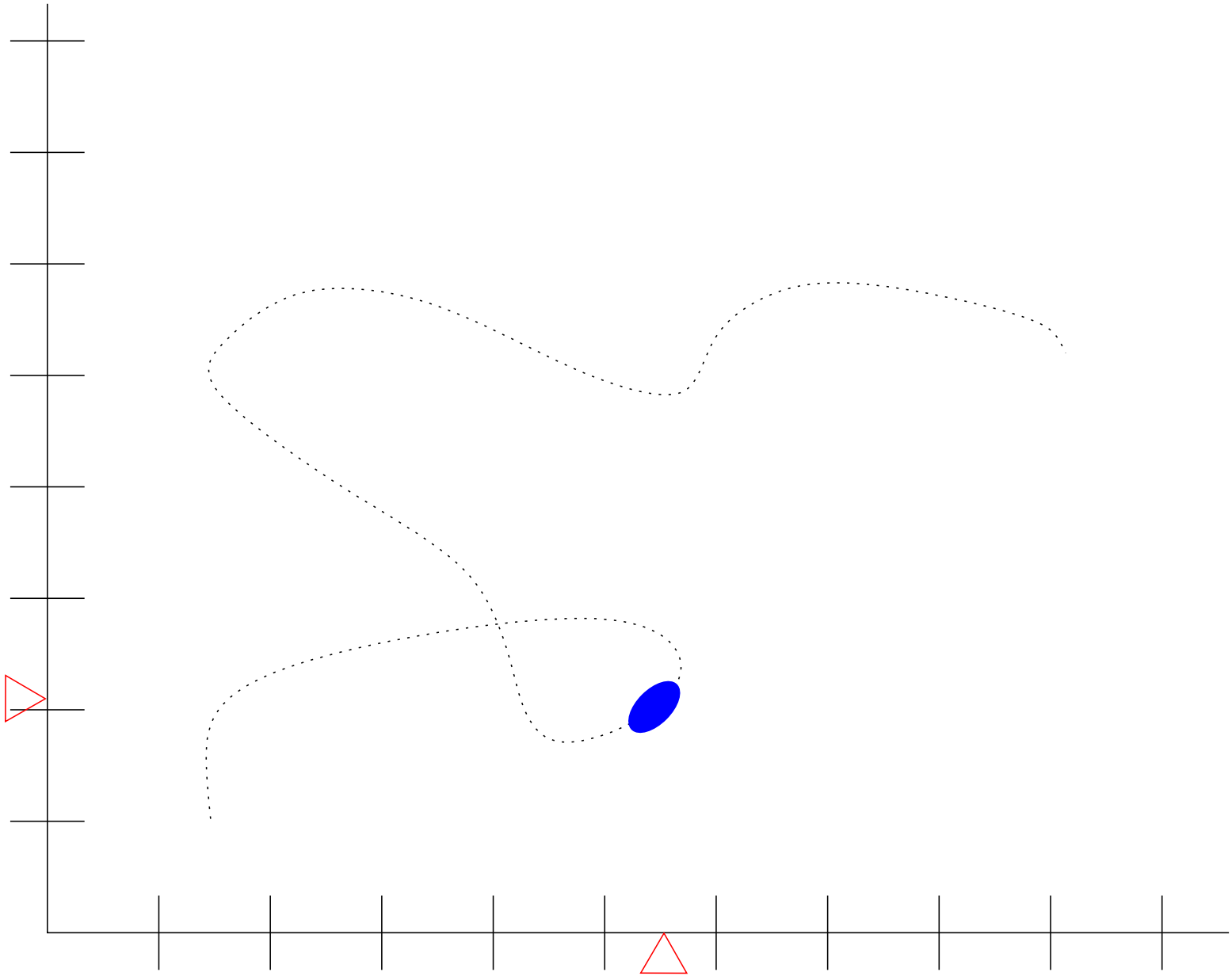

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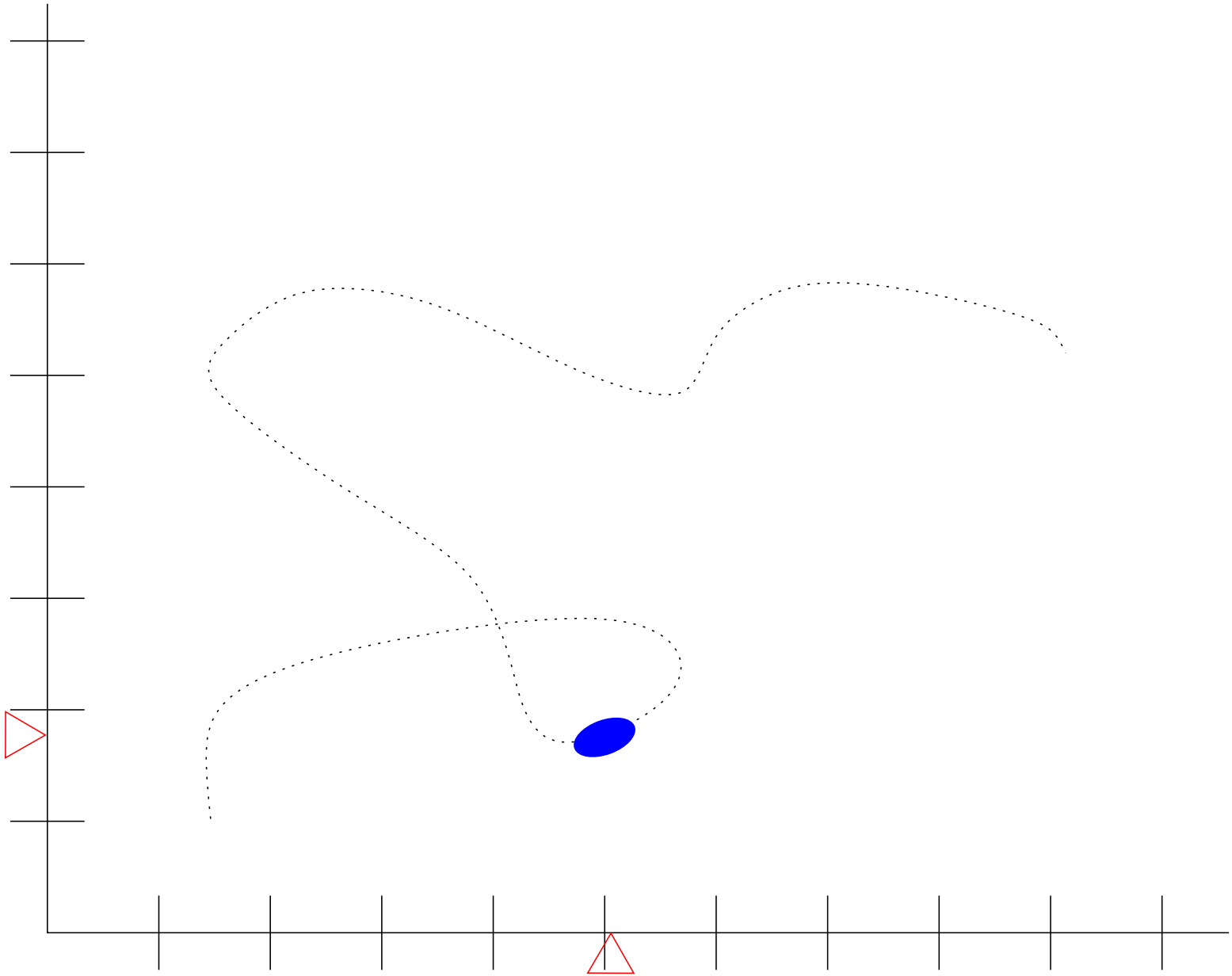

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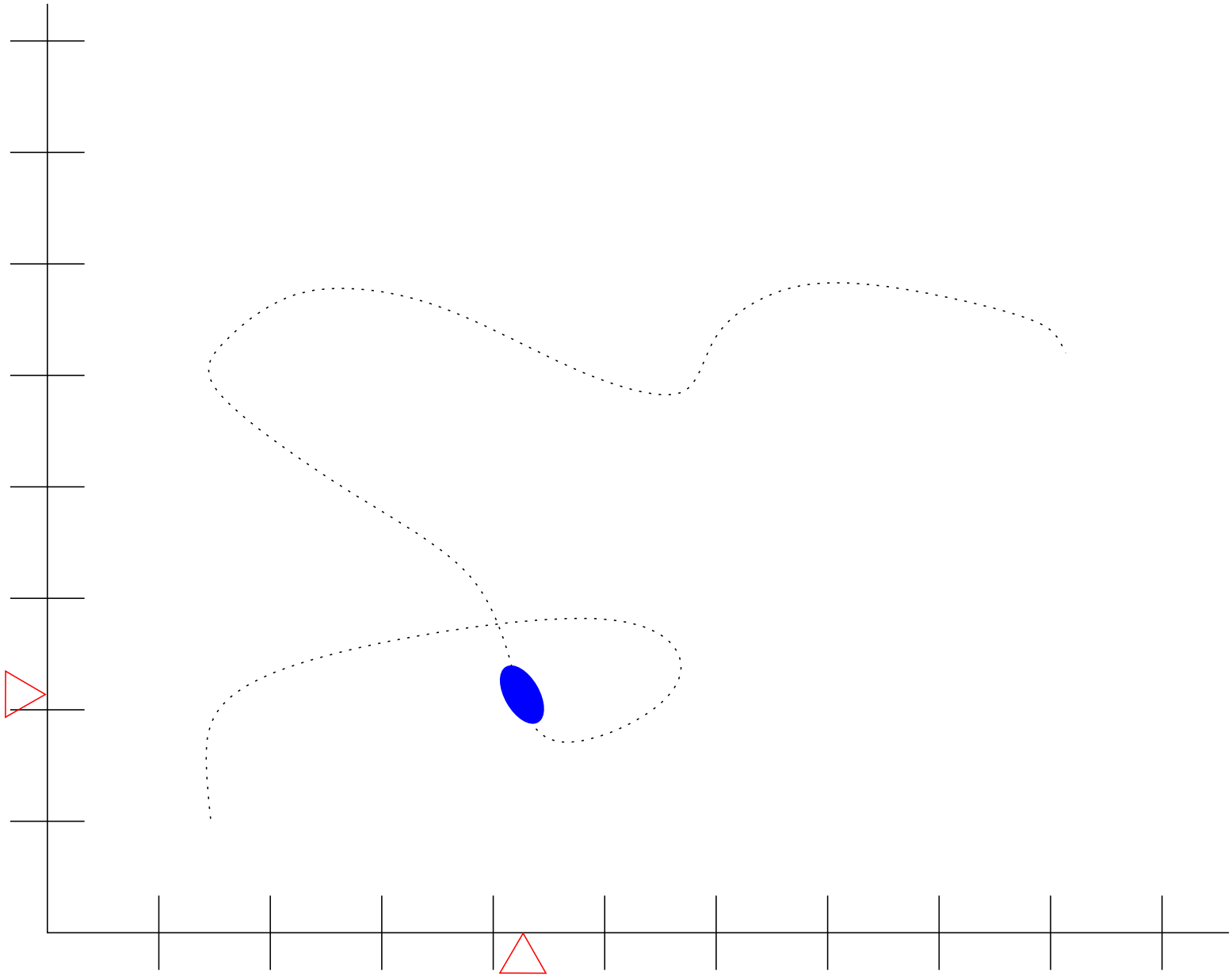

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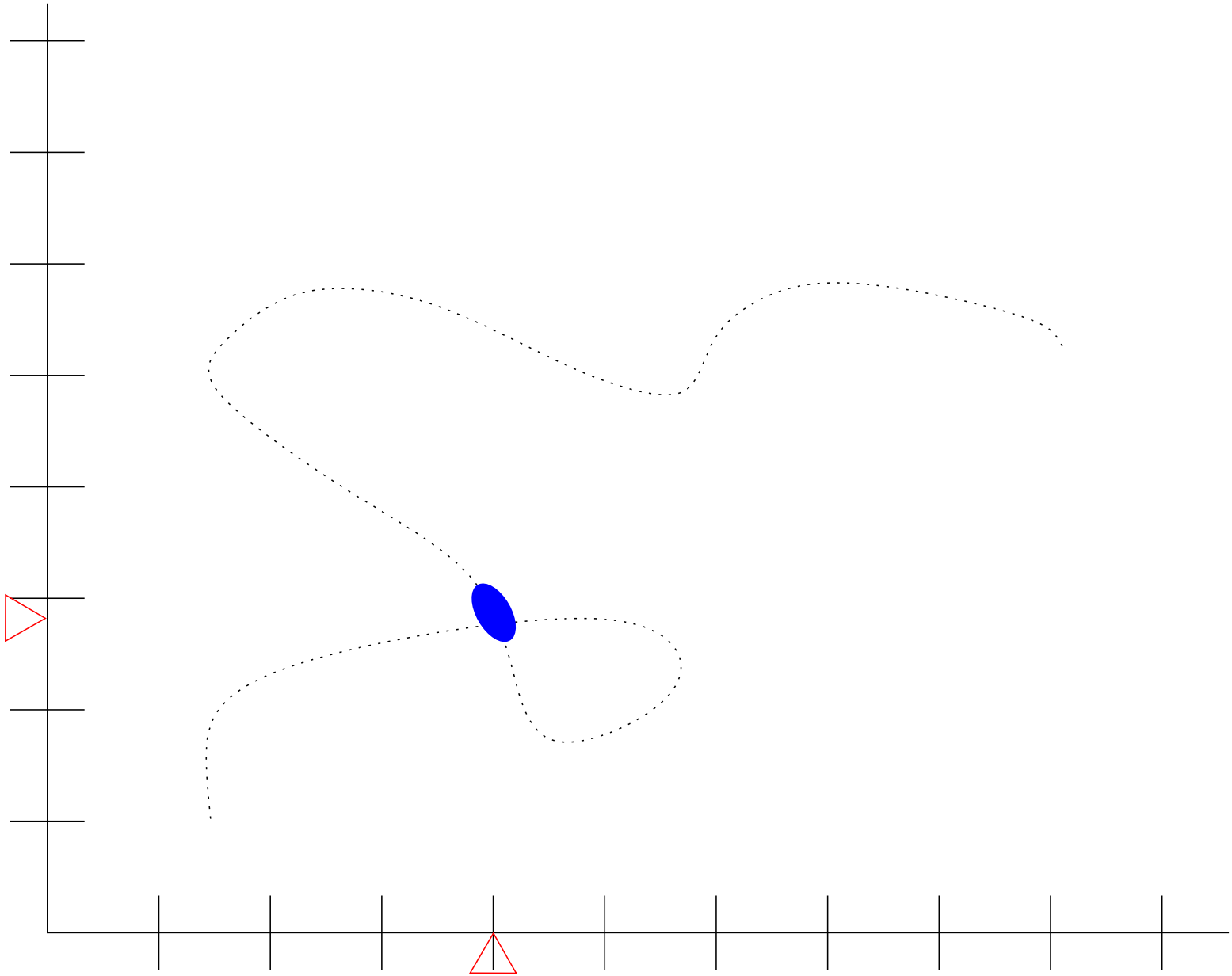

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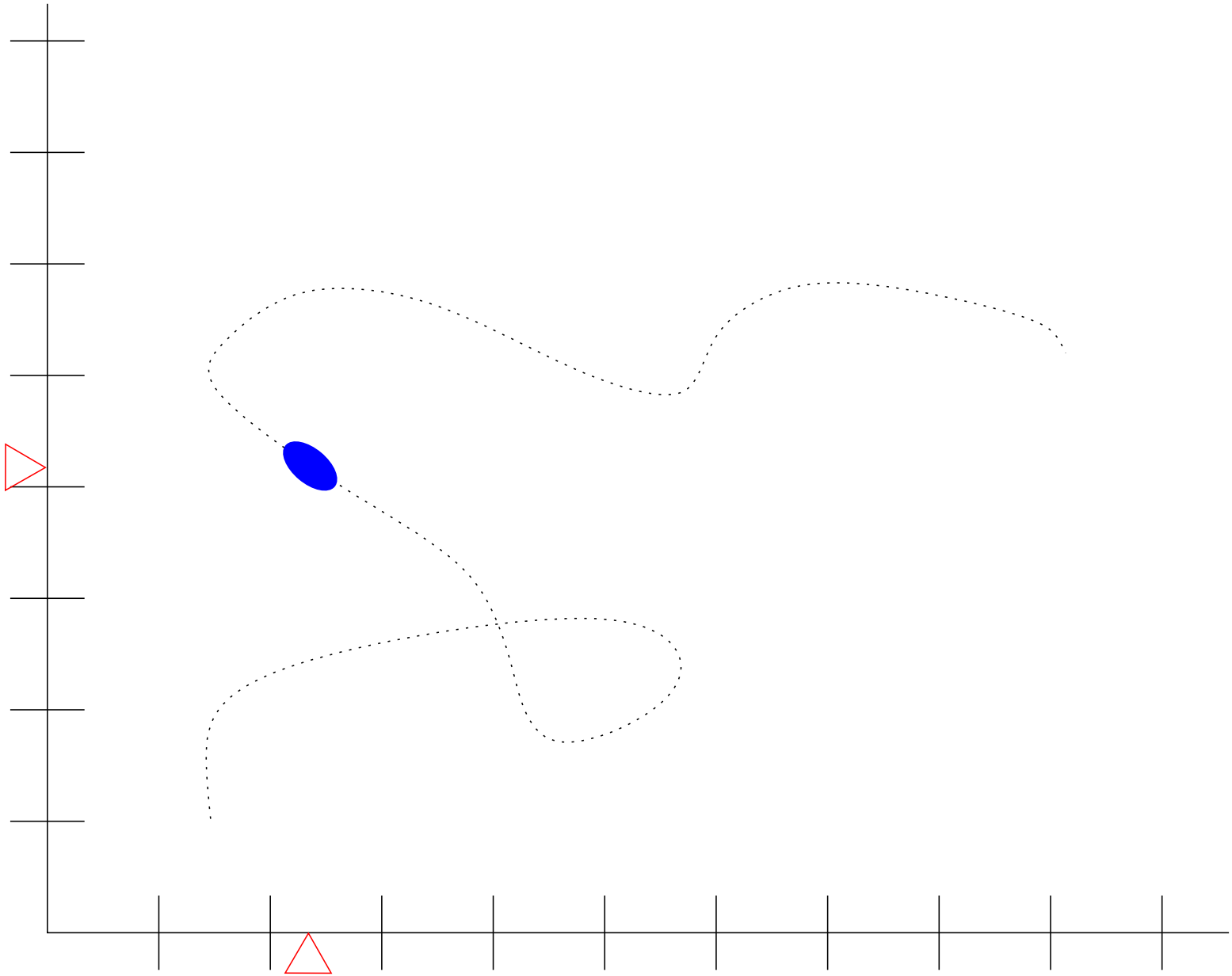

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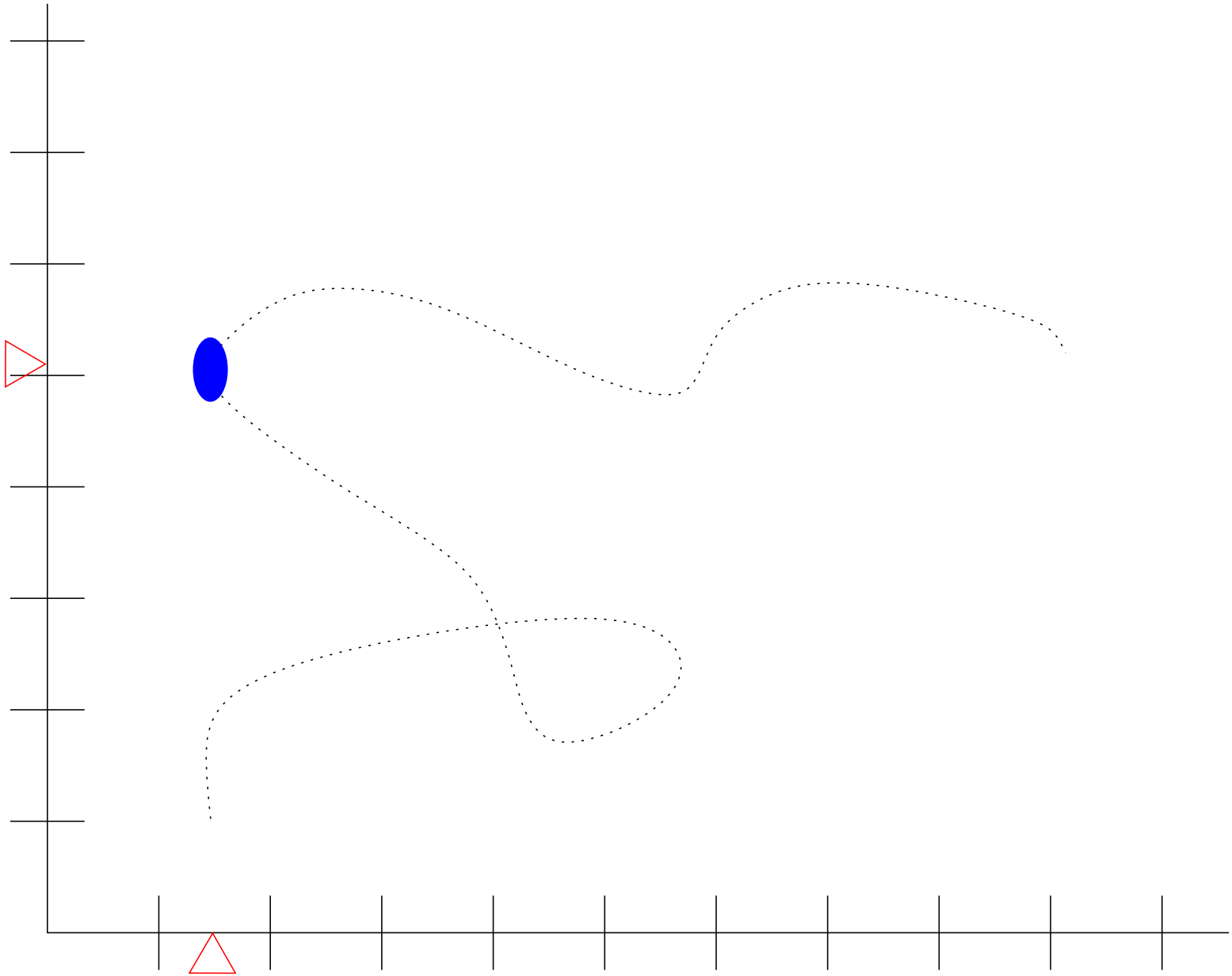

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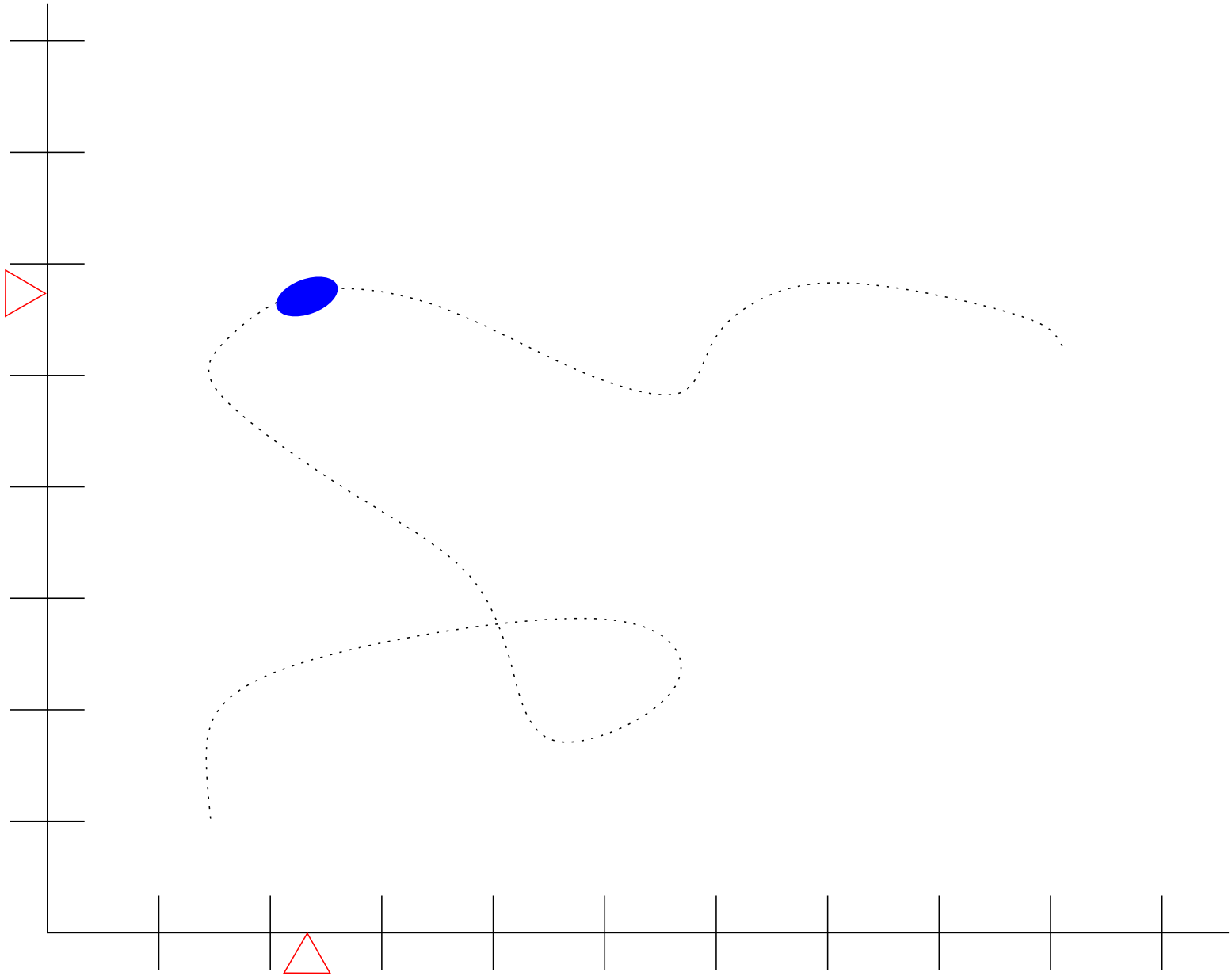

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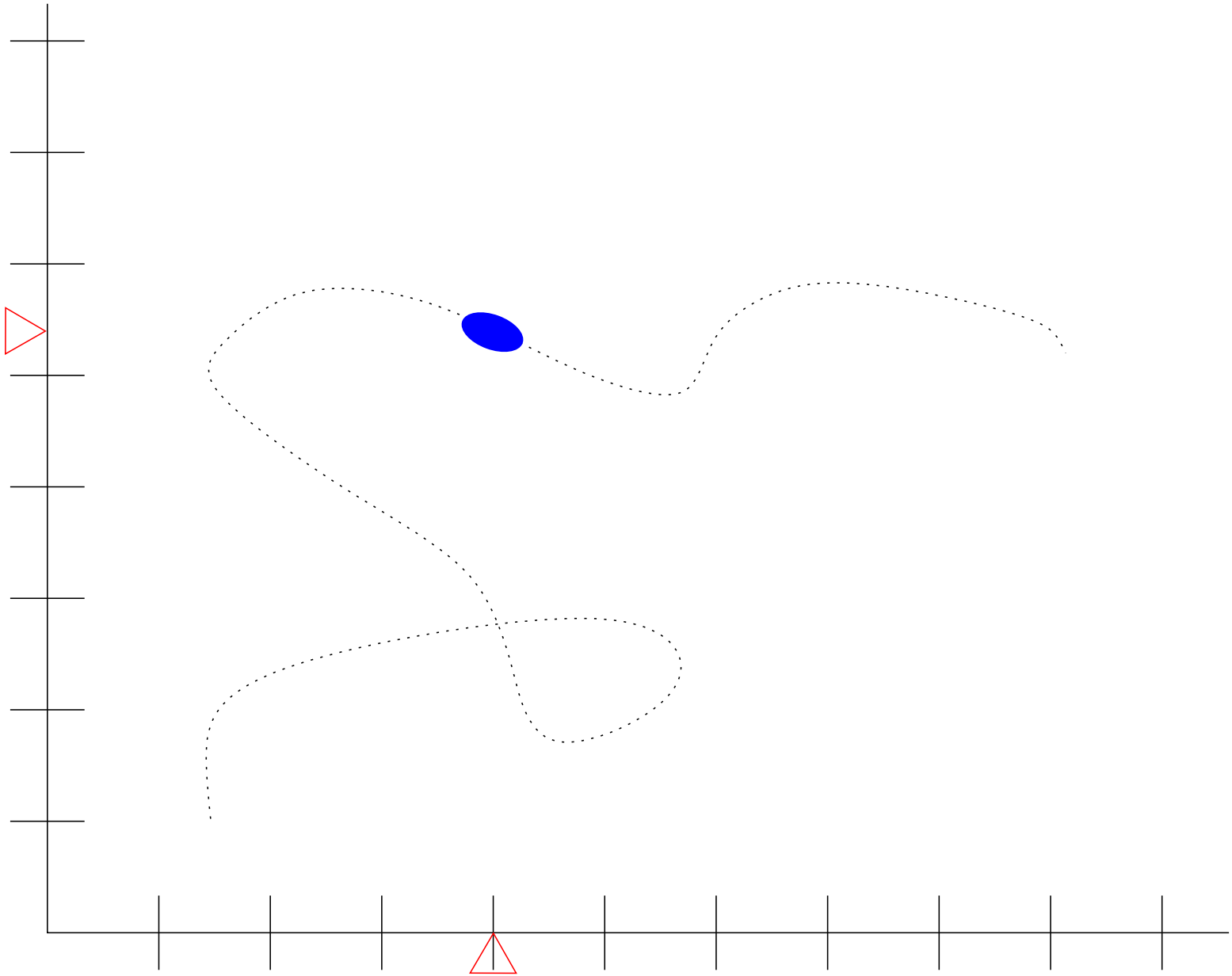

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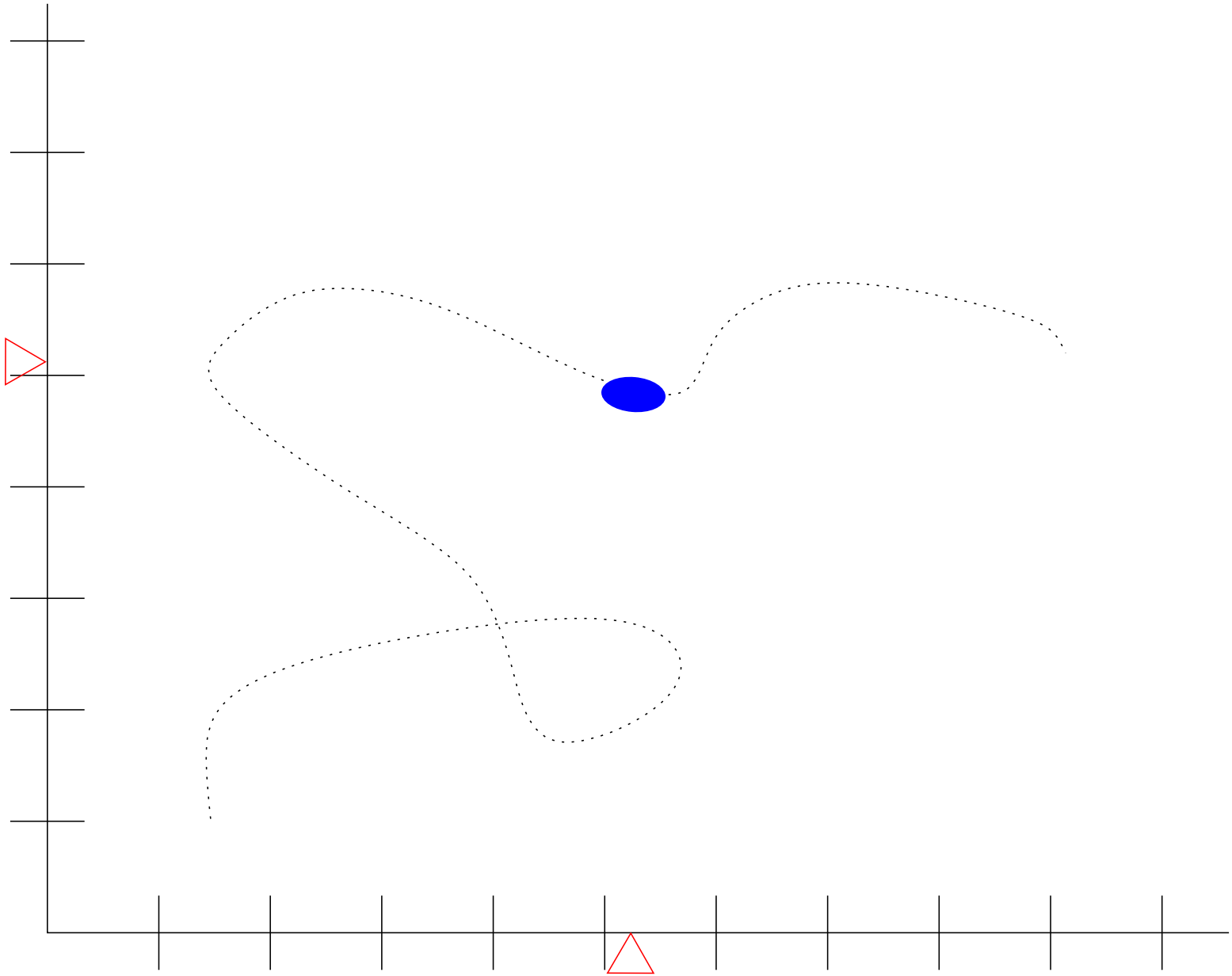

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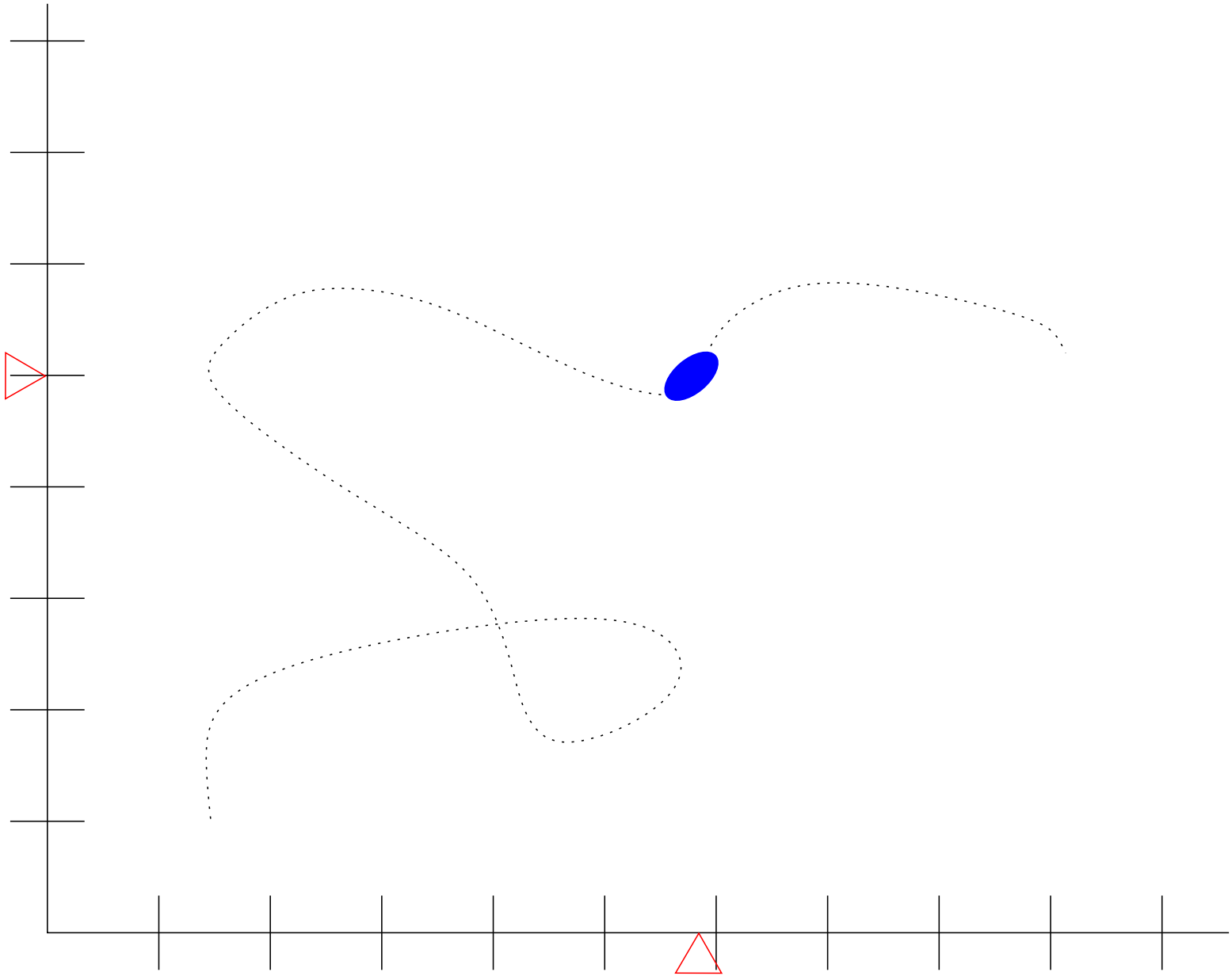

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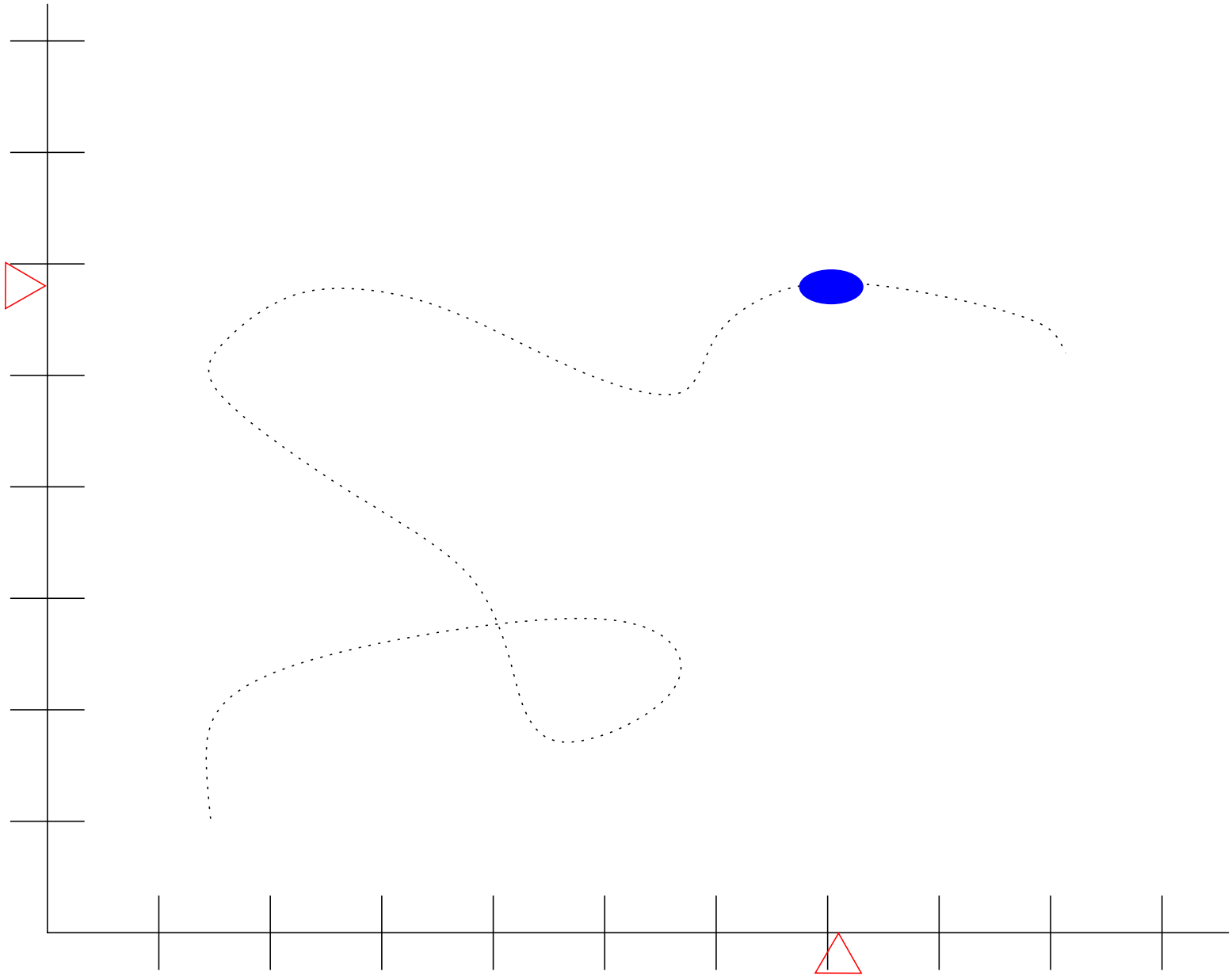

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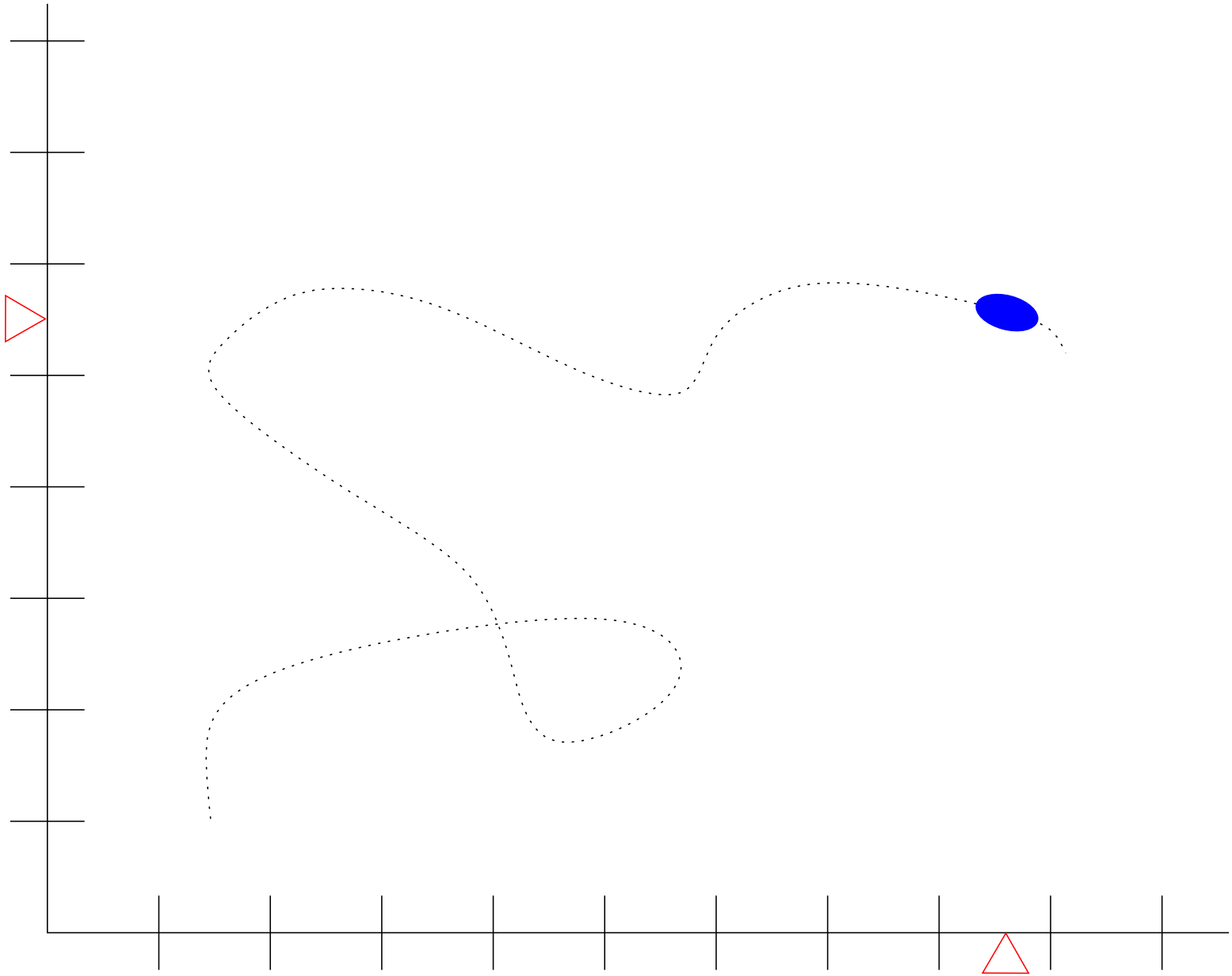

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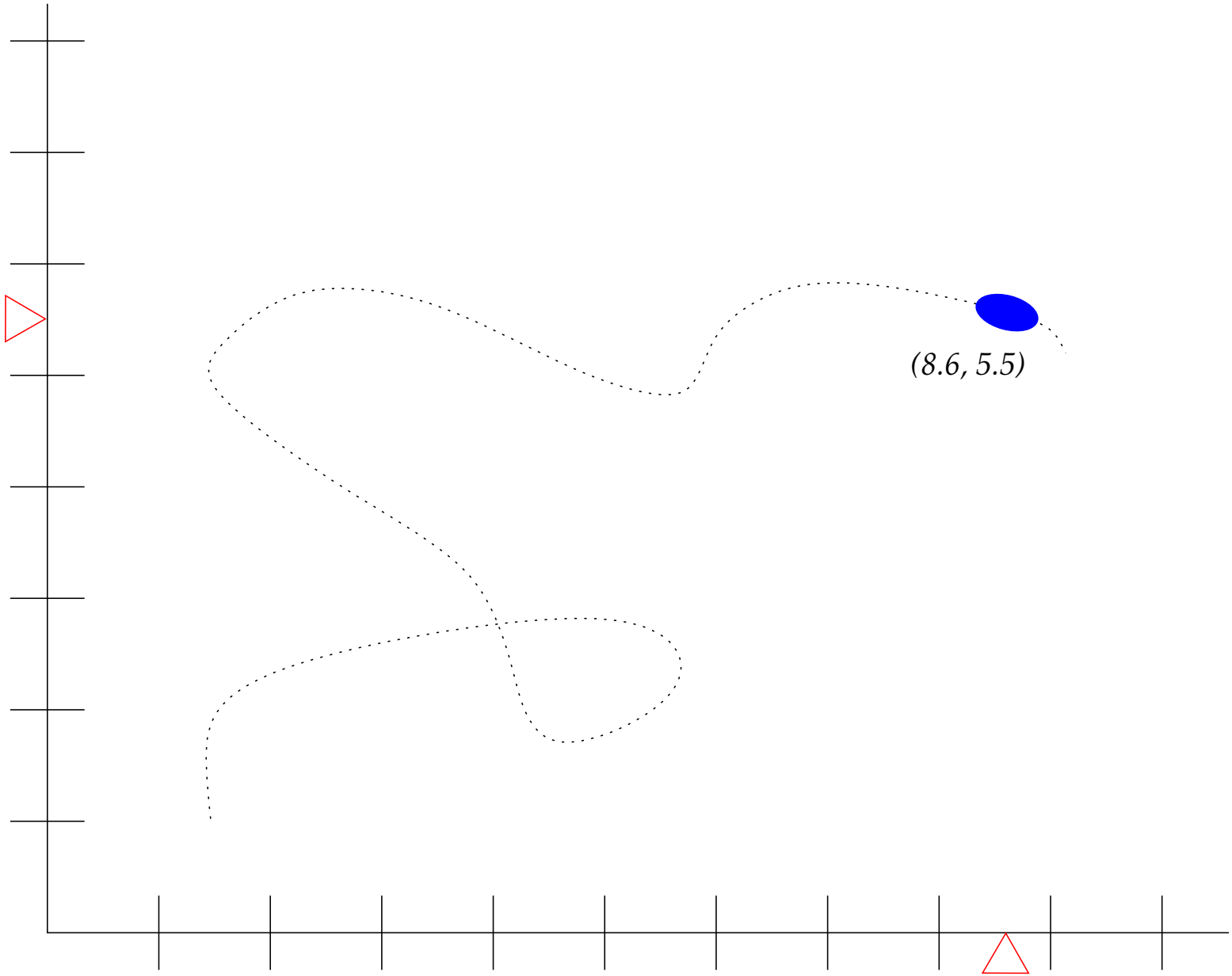


Cartesian product

Real (Cartesian) plane

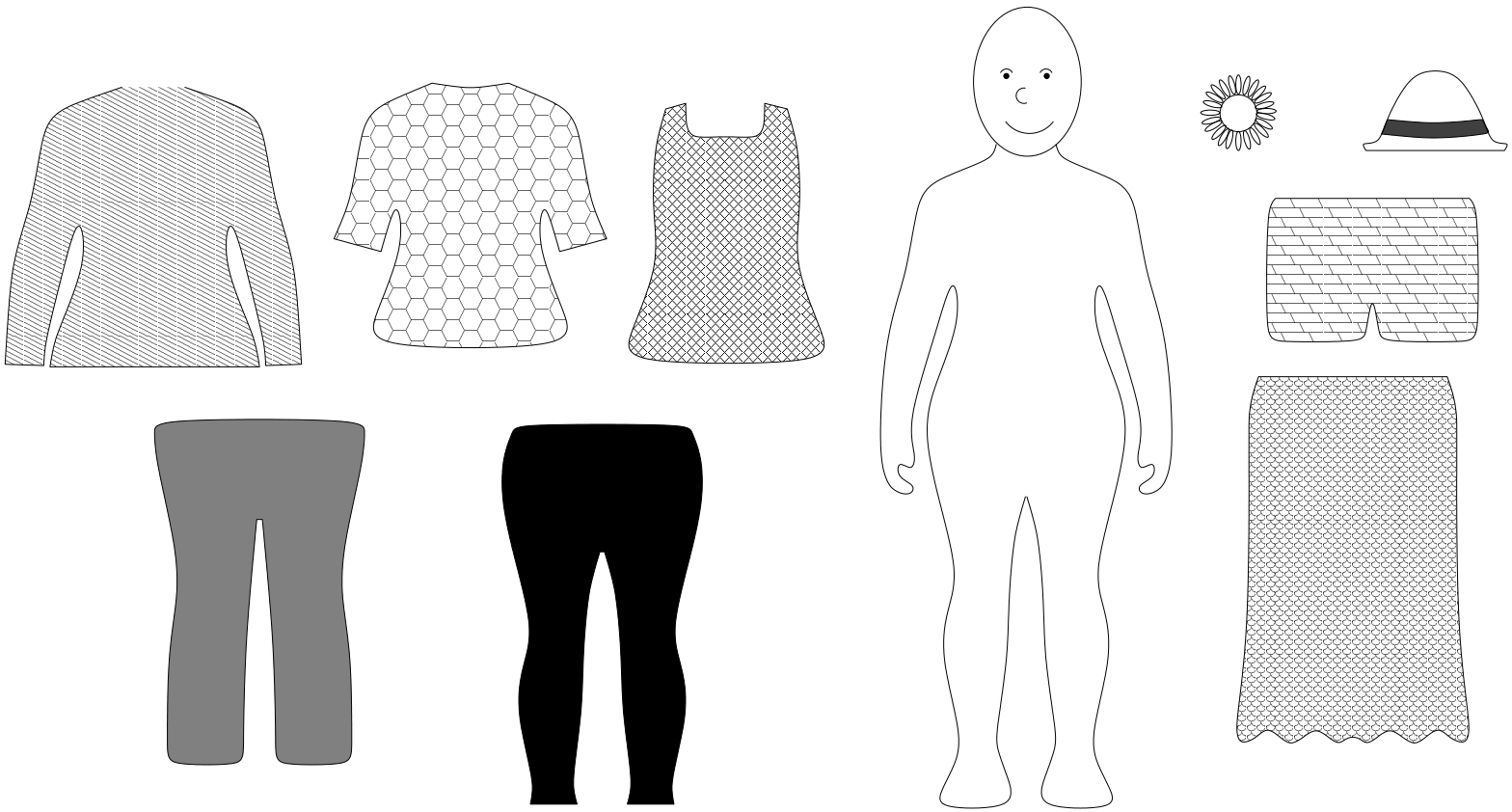
$$\mathbb{R} \times \mathbb{R} = \{(x, y) \mid x, y \in \mathbb{R}\}$$

Cartesian product of sets X and Y:

$$X \times Y = \{(x, y) \mid x \in X \text{ and } y \in Y\}$$

(The set of *ordered pairs* drawn from X and Y.)

Cartesian product example



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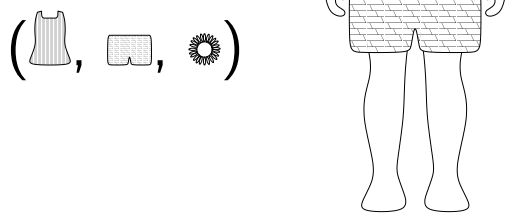

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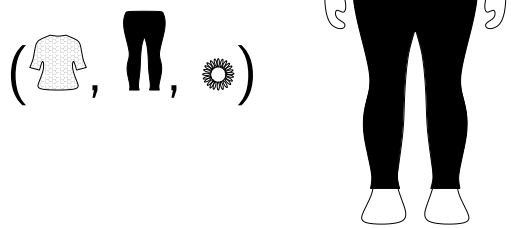

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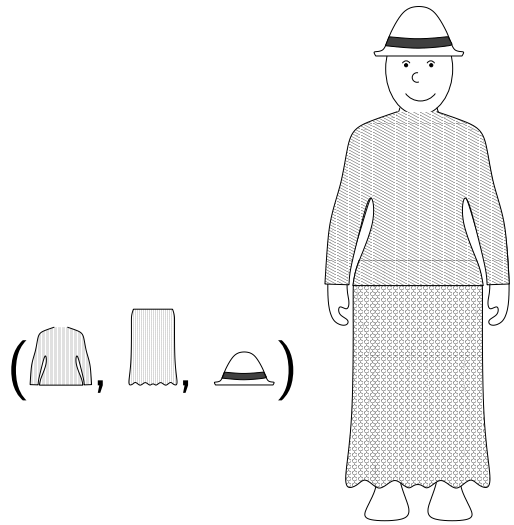

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