**Step 0:** If three variables have the same sign and all have order 2, then it’s an ellipsoid. Otherwise do the following.

**Step 1:** Find the axis variable for the surface. The axis variable is the variable which has different sign or different degree.

**Step 2:** Figure out if there are gaps or restrictions on the axis variable.

**Step 3:** Change the axis variable from 0 to find slices as one changes the axis variable to cut out the surface.

**Step 4:** Combine and connect the slices to visualize the surface.

**Example:**

1: \(z^2 - x^2 - \frac{y^2}{4} = 1\).

Step 1: This axis variable is \(z\). \(z^2 = x^2 + \frac{y^2}{4} + 1\).

Step 2: There is the gap: \(|z| \geq 1\), i.e. \(z \in (-\infty, -1] \cup [1, \infty)\).

Step 3: The slice when \(|z| = 1\) is a point. The slice for \(|z| > 1\) is ellipse.

Step 4: It’s the hyperboloid of 2 sheets.

2: \(x^2 - 2y^2 - 2z^2 = 0\).

Step 1: The axis variable is \(x\). \(x^2 = 2y^2 + 2z^2\).

Step 2: Gap is zero \(|x| \geq 0\), i.e. \(x \in (-\infty, +\infty)\).

Step 3: The slice when \(x = 0\) is a point. The slices are ellipses when \(|x| > 0\).

Step 4: This is elliptic cone.

3: \(x^2 + 4y^2 - z = 0\).

Step 1: The axis variable is \(z\). \(x^2 + 4y^2 = z\).

Step 2: There is restriction \(z \geq 0\).

Step 3: The slice when \(z = 0\) is a point. The slices when \(z > 0\) are ellipses.

Step 4: This is elliptic paraboloid.

4: \(3x + y^2 - z^2 = 0\).

Step 1: The axis variable is \(x\). \(3x = -y^2 + z^2\).

Step 2: There is no restriction on \(x\), i.e. \(x \in (-\infty, +\infty)\).

Step 3: The slices are hyperbola.

Step 4: This is hyperbolic paraboloid.

5: \(16x^2 - y^2 + 16z^2 = 4\).

Step 1: The axis variable is \(y\). \(y^2 + 4 = 16x^2 + 16z^2\).

Step 2: There is no gap for \(y\), i.e. \(y \in (-\infty, +\infty)\).

Step 3: The slice when \(y = 0\) is a small ellipse \(16x^2 + 16z^2 = 4\). The slices when \(|y| > 0\) are growing ellipses as one increases \(|y|\).

Step 4: This is hyperboloid of one sheet.

6: \(1 - x^2 - y^2/4 - 16z^2 = 0\).

Step 0: All variables have the same sign and same order. It’s an ellipsoid.