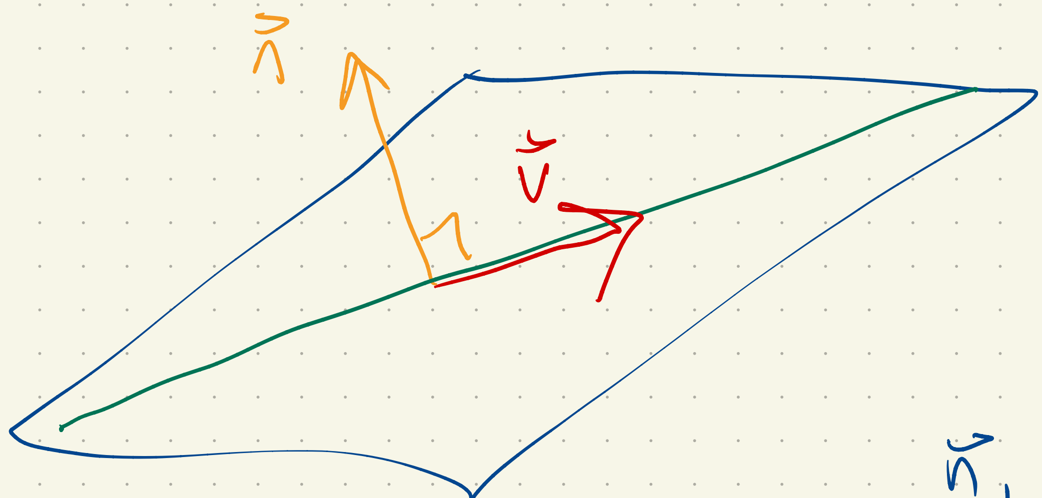
$P(1,0,2)$

$$5(x-1)+14(y-0)-16(z-2)=0$$

Given $x+y+z=1$ what's the line of intersection?

$x-2y+3z=1$



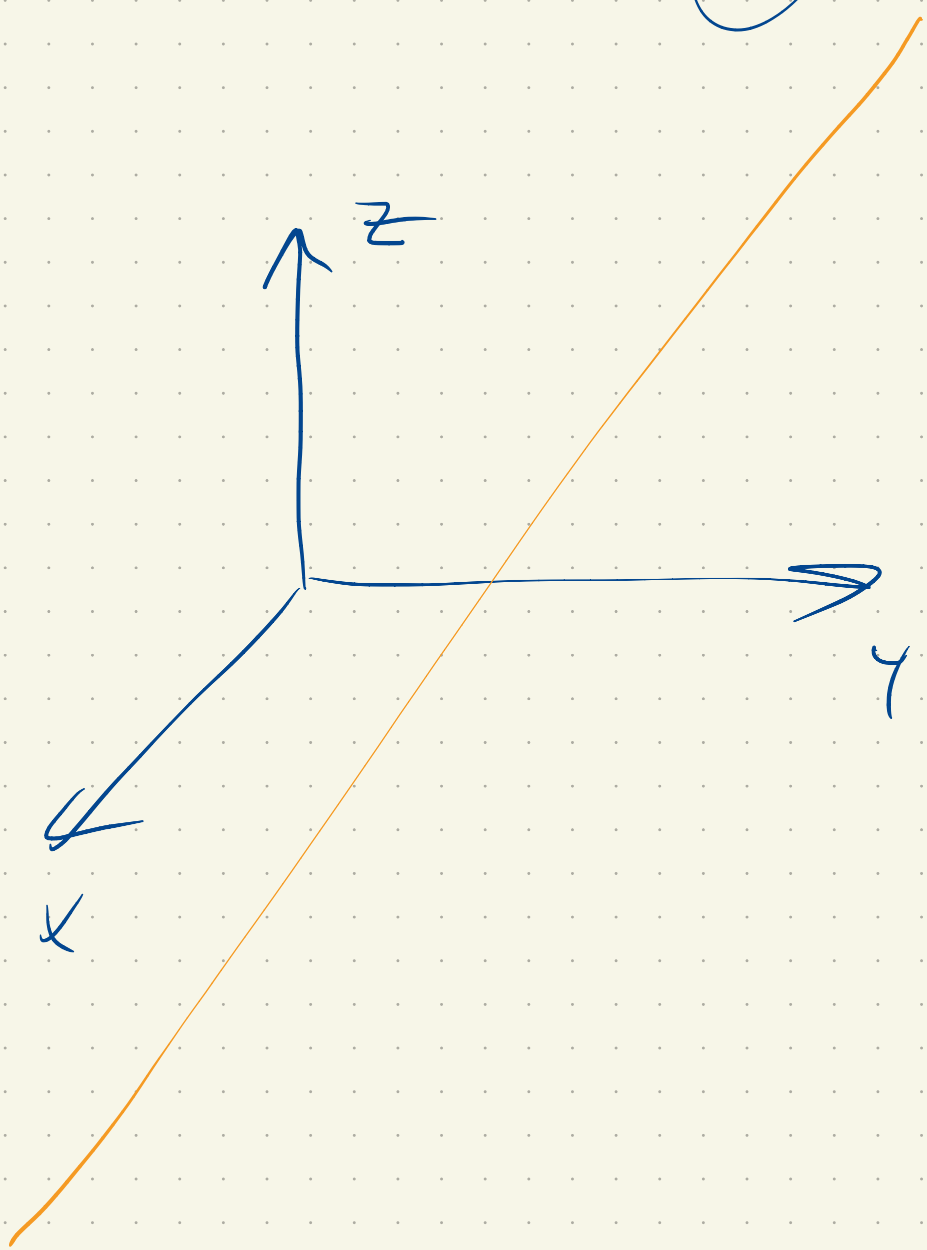
direction perpendicular to both normal vectors

$\vec{n}_1 = \langle 1,1,1\rangle$

$\vec{n}_2 = \langle 1,-2,3\rangle$

$\vec{v} = \vec{n}_1 \times \vec{n}_2$ -3

$= \langle 5, -2, -1 \rangle$



We need a single point on the line.

Find the spot where

$x = 0.$

$(0, y, z)$

$x + y + z = 1$

$x - 2y + 3z = 1$

$y + z = 1$

$-2y + 3z = 1$

$y + z = -2y + 3z$

$3y = 2z$

$y = \frac{2}{3} z$

$\frac{2}{3} z + z = 1$

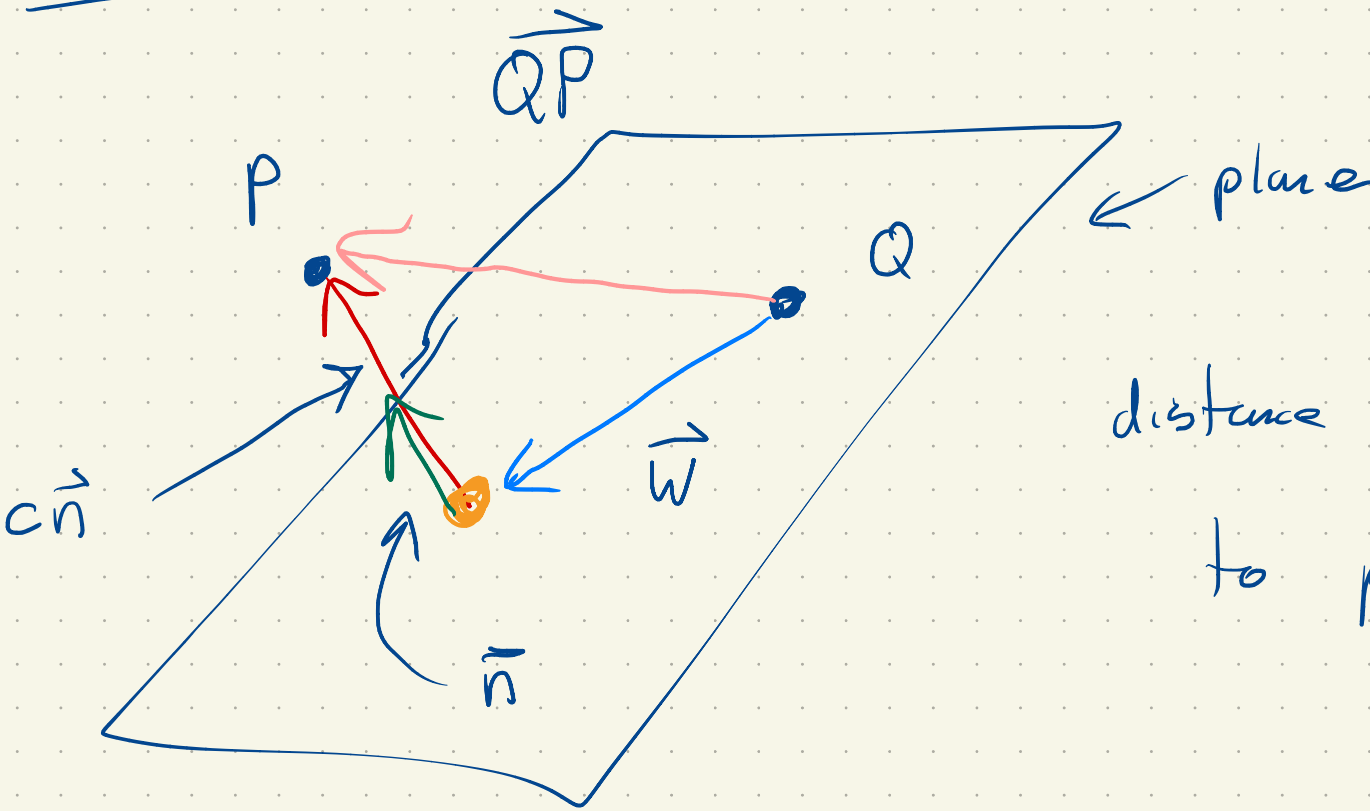
$\frac{5}{3} z = 1$

$z = \frac{3}{5}, \quad y = \frac{2}{5}$

$\left(0, \frac{2}{5}, \frac{3}{5}\right)$ ← point on line :)

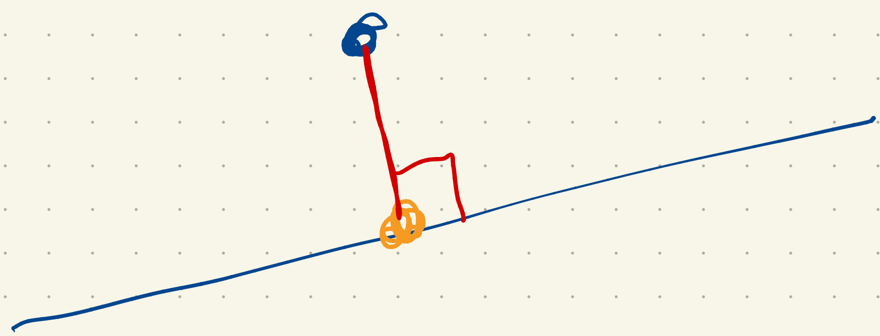
$\langle 5, -2, -1 \rangle$ ← tangent to line

$$\vec{r}(t) = \langle 0, \tfrac{2}{5}, \tfrac{3}{5} \rangle + t \langle 5, -2, -1 \rangle \quad -3$$



distance from P

to plane



$$\overrightarrow{QP} = \vec{w} + c\,\vec{n}$$

dist is $\|c\vec{n}\| = |c|\,\|\vec{n}\|$

$$\overrightarrow{QP} = \vec{w} + c\,\vec{n}$$

$$\vec{n} \cdot (\overrightarrow{QP}) = \vec{n} \cdot (\vec{w} + c\,\vec{n})$$

$$= 0 + c\,(\vec{n} \cdot \vec{n})$$

$$= c\,\|\vec{n}\|^2$$

$$\frac{\vec{n} \cdot (QP)}{\|\vec{n}\|} = c\,\|\vec{n}\|$$

$|c|\ \|\vec{n}\|$

$$\frac{|\vec{n} \cdot (\vec{QP})|}{\|\vec{n}\|} = |c|\ \|\vec{n}\| = \text{dist from } P \text{ to plane.}$$

$Q = (-1, 1, 2)$

$3x - 2y + z = -3$

$P = (0, 0, 1)$

$\vec{n} = \langle 3, -2, 1 \rangle$

$\|\vec{n}\| = \sqrt{3^2 + (-2)^2 + 1}$

$= \sqrt{9 + 4 + 1}$

$= \sqrt{14}$

$$\langle 0, 0, 1 \rangle - \langle -1, 1, 2 \rangle$$

$$= \langle 1, -1, -1 \rangle = \overrightarrow{QP}$$

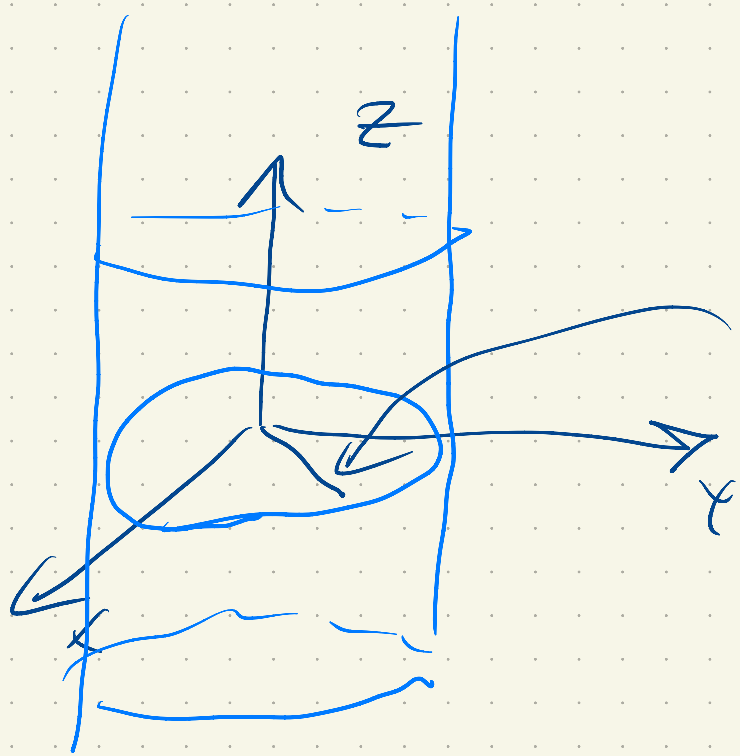
$$\vec{n} = \langle 3, -2, 1 \rangle$$

$$\vec{n} \cdot \overrightarrow{QP} = \langle 3, -2, 1 \rangle \cdot \langle 1, -1, -1 \rangle$$

$$= 3 + 2 - 1 = 4$$

$$\text{dist} = \frac{|\vec{n} \cdot \overrightarrow{QP}|}{\|\vec{n}\|} = \frac{|4|}{\sqrt{14}} = \frac{4}{\sqrt{14}}$$

Surfaces in 3-d (Section 2.6)



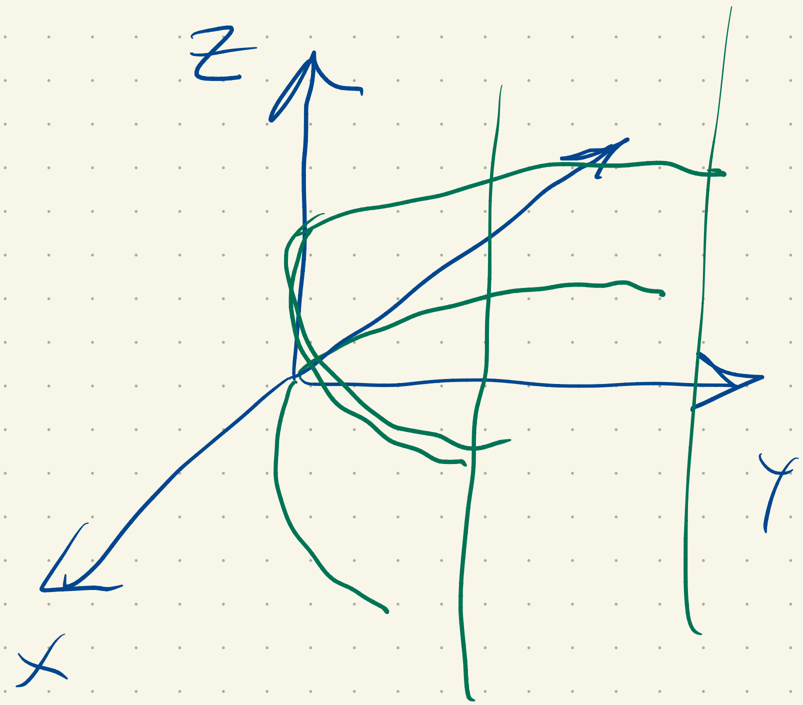
(x, y, z)

$r = 1$

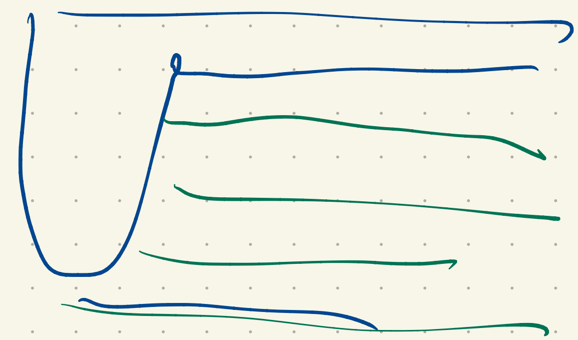
$$\boxed{x^2 + y^2 = 1}$$

$y = x^2$ (3-d)

$z = x^2$



"generalized cylinder"

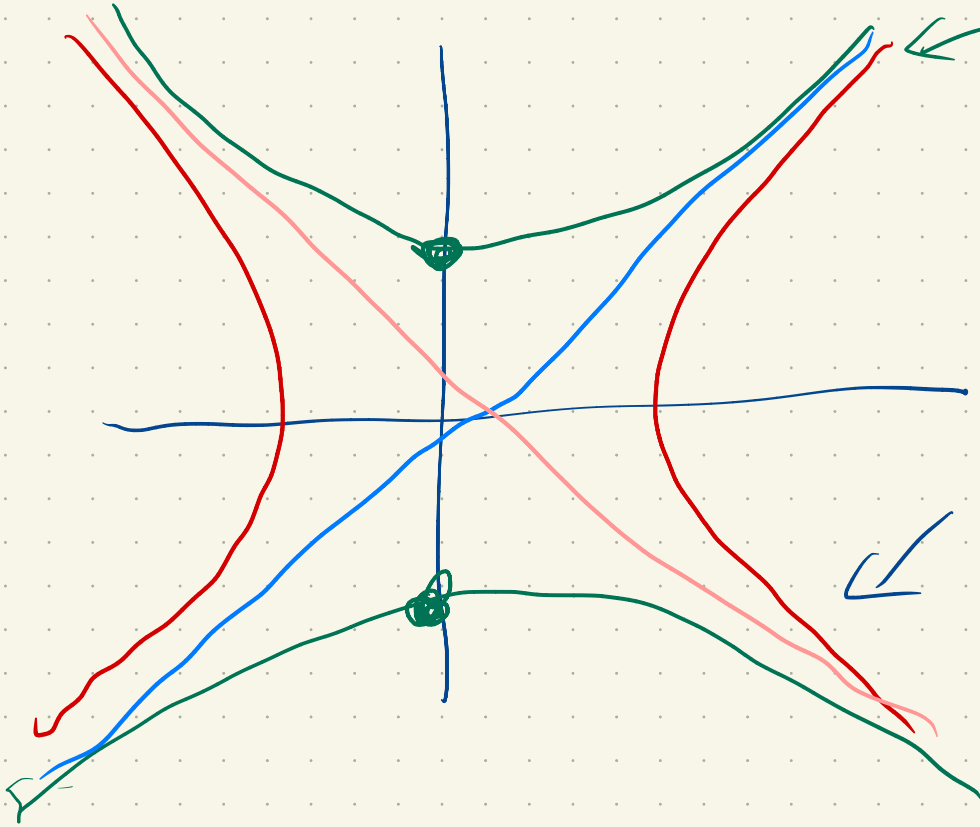


Old friends (2-d)

$x^2+y^2=3$ ← circle centered at origin w/ radius 3

$y=x^2$ parabola

$y^2-x^2=1$



$y^2 - x^2 = 1$

$x^2 - y^2 = 1$

$$x^2 - y^2 = 1$$

$$x^2 - y^2 = 0$$

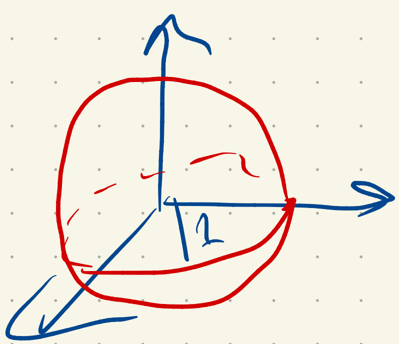
$$x^2 = y^2$$

$$x = \pm y$$

$\underbrace{x^2 + y^2 + z^2}$ $= 1$

dist squared fun

(x, y, z) to $(0,0,0)$



r^2

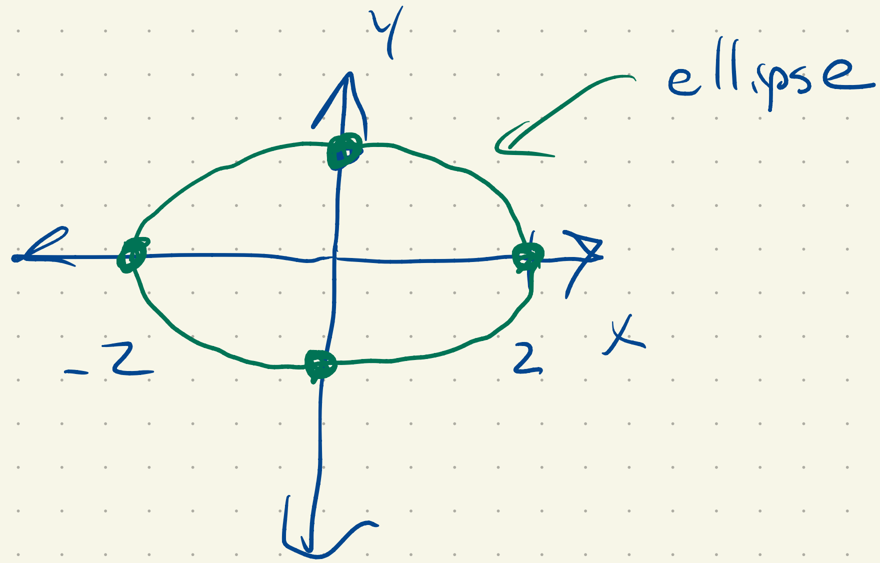
$$x^2 + y^2 + z^2 = 5$$

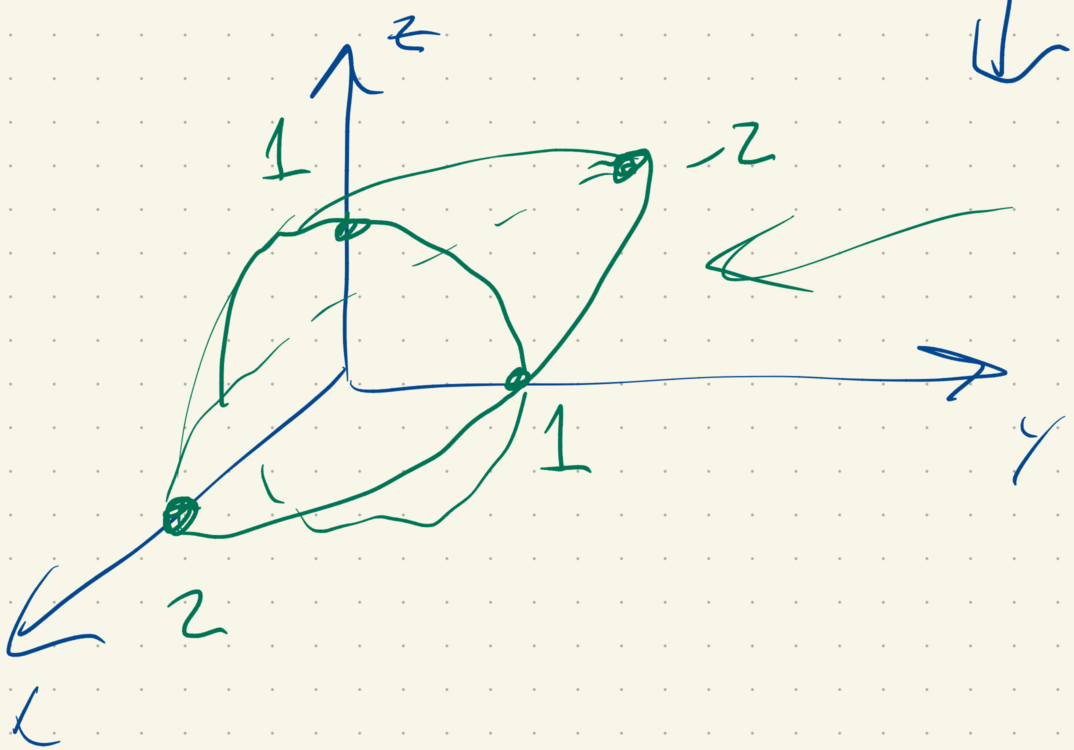
sphere with radius $\sqrt{5}$

$$\left(\frac{x}{2}\right)^2 + y^2 + z^2 = 1$$

$(2, 0)$

$$\left(\frac{x}{2}\right)^2 + y^2 = 1$$



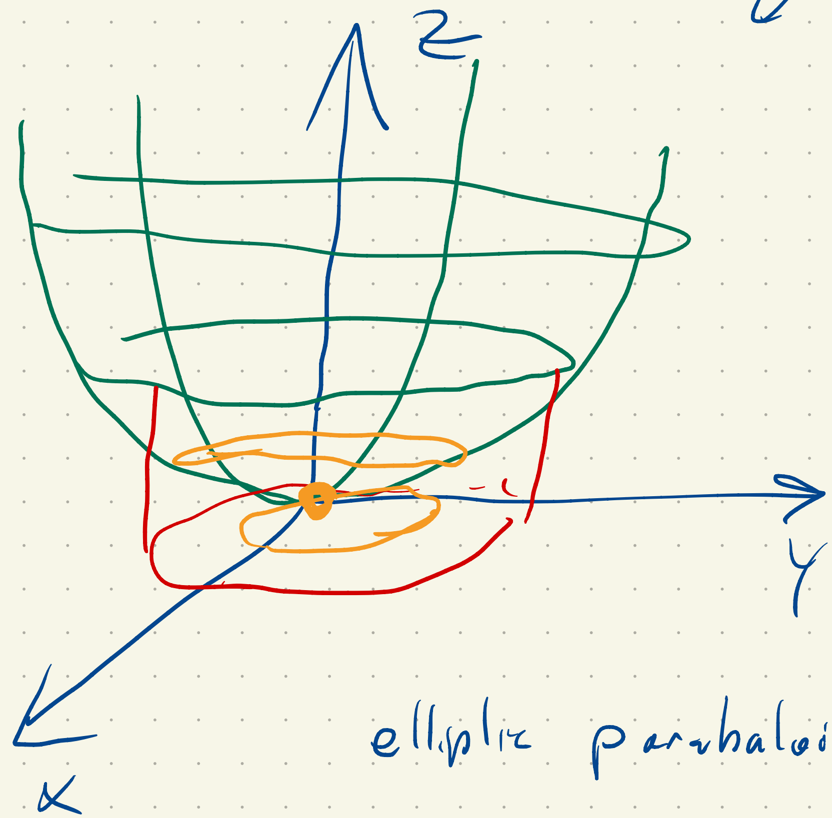


egg

ellipsoid

bowl

$z = x^2 + y^2$



$z = 1$

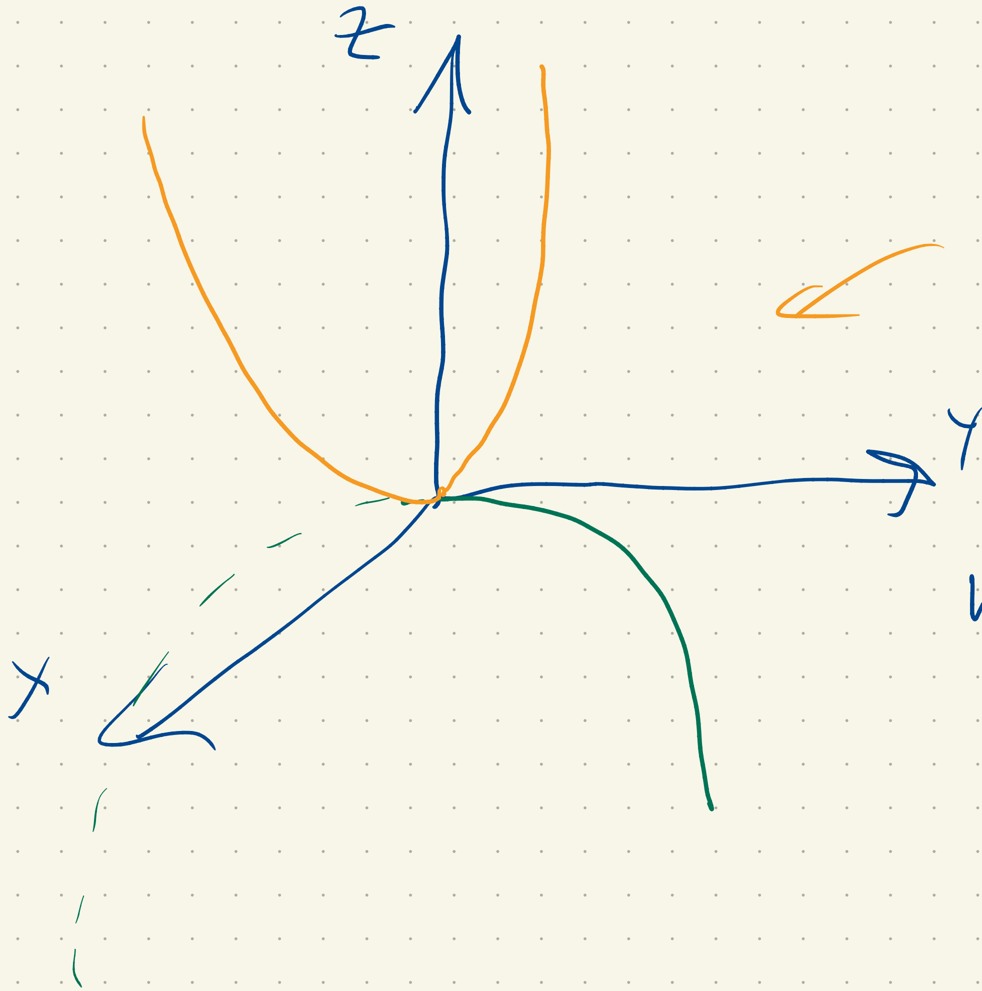
$x^2 + y^2 = 1$

elliptic paraboloid

$z = x^2 - y^2$

$z = x^2 - y^2$

saddle



hyperbolic paraboloid