22/4

SUPERFICIES PARAMÉTRICAS

Recordatorio: SUPERFICIE $\Sigma = \operatorname{Im} F$; $\vec{F}$ continua en D_F

*** Ejercicio 34** : Verificar si es superficie, hallar expr cartesiana y graficar

(a) $\vec{F}(u,v) = (u, v, u^2+v^2)$ con $u^2+v^2 \leq 9$

$$\begin{cases} x(u,v) = u \\ y(u,v) = v \\ z(u,v) = u^2+v^2 \end{cases}$$

$\vec{F}$ continua en Dom $\vec{F}$ ya que sus componentes son continuas → es superficie $\Sigma = \operatorname{Im} F$

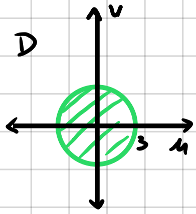
- Desparametrizar → hallar expr cartesiana

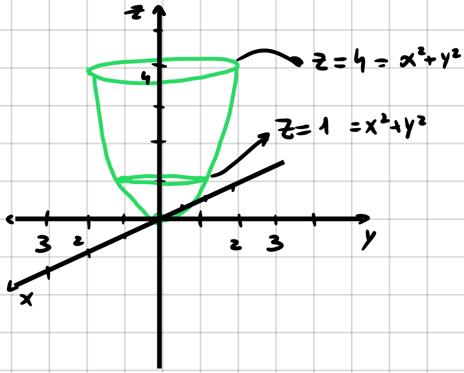
$$\begin{cases} x^2+y^2 \leq 9 \\ z = x^2+y^2 \end{cases}$$

$x^2+y^2 \leq 9$ → "círculo radio 3"

$z = x^2+y^2$ → paraboloide

D





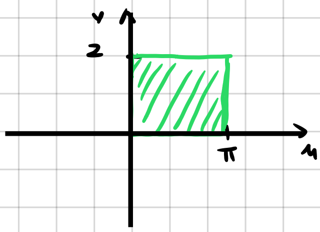
(b) $\vec{F}(u,v) = (2\cos(u), 2\,\text{sen}(u), v)$ con $(u,v) \in [0,\pi] \times [0,2]$

- Verificar superficie

$$\begin{cases} x(u,v) = 2\cos(u) \\ y(u,v) = 2\,\text{sen}(u) \\ z(u,v) = v \end{cases}$$

→ F es continua ya que todas sus comp lo son → la img de F es sup

- Dominio



- Desparametrizacion

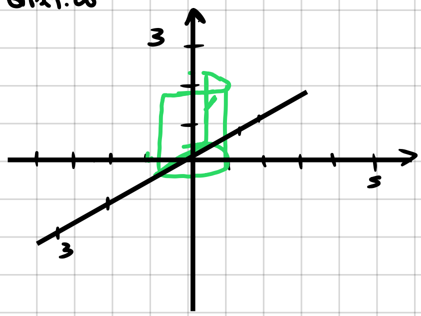
$$\begin{cases} x^2+y^2 = 2^2 \\ 0 \leq z \leq 2 \end{cases}$$

$x^2+y^2 = 2^2$ → $\begin{cases} x(u,v) = 2\cos(u) \\ y(u,v) = 2\,\text{sen}(u) \end{cases}$

$y \geq 0 \rightarrow u \in [0, \pi]$

$0 \leq z \leq 2$ → $z(u,v) = v$

- Gráfico



(c) $\vec{F}(x,y) = (x, y, 2-4x-6y)$ con $\{(x,y) \in \mathbb{R}^2 \,/\, 2x+3y \leq 1,\ x \geq 0,\ y \geq 0\}$

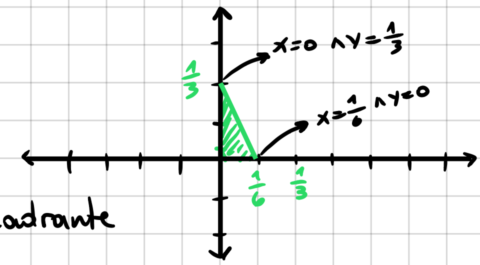
$$\begin{cases} x = x \\ y = y \\ z = 2-4x-6y \end{cases}$$

→ los componentes son continuos, así que $\vec{F}$ continua, $\operatorname{Im} F$ superficie

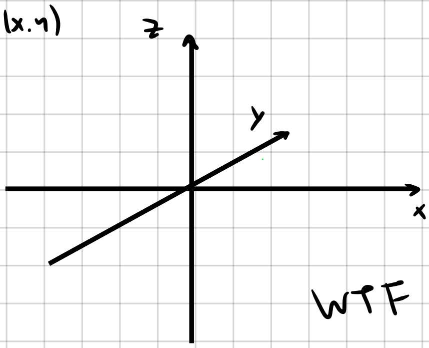
- Gráfico dominio

$$\begin{cases} 2x+3y \leq 1 \\ y \leq \dfrac{1-2x}{3} \end{cases}$$

$\begin{cases} x \geq 0 \\ y \geq 0 \end{cases}$ → primer cuadrante



- gráfico $\vec{F}(x,y)$



WTF

- expr cartesiana

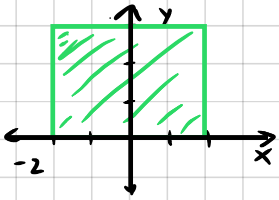
$$\begin{cases} z = 2-4x-6y \\ 2x+3y \leq 1 \\ x \geq 0 \\ y \geq 0 \end{cases}$$

$z = 2-4x-6y$ → plano

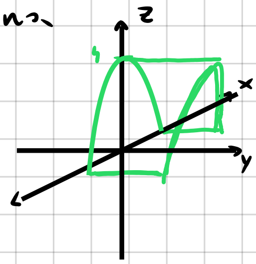
(d) $\vec{F}(x,y) = (x, y, 4-x^2)$ con $(x,y) \in [-2,2] \times [0,3]$ • Expresión cartesiana • Gráfico

$\begin{cases} x(x,y) = x \\ y(x,y) = y \\ z(x,y) = 4-x^2 \end{cases}$ → todos los comp son cont $Im\vec{F}$ sup

• Dominio



$\begin{cases} z = 4-x^2 \\ -2 \leq x \leq 2 \\ 0 \leq y \leq 3 \end{cases}$



* Ejercicio 35 : Hallar ecuación vectorial para las superficies $u \in [0, 2\pi]$ $v \in \mathbb{R}$

(a) $x^2 + y^2 = 16$ → circunferencia en $\mathbb{R}^2$ → cilindro en $\mathbb{R}^3$ $\begin{cases} x = 4\cos(u) \\ y = 4\operatorname{sen}(u) \\ z = v \end{cases}$ $\vec{F}(u,v) = (4\cos(u), 4\operatorname{sen}(u), v)$

(b) $z = xy$ $\vec{F}(u,v) = (u, v, uv)$, $(u,v) \in \mathbb{R}^2$ (c) $y = x$ $\vec{F}(u,v) = (u, u, v)$, $(u,v) \in \mathbb{R}^2$

(d) $x^2 - 4x + y^2 - z = 0$ → $z = (x-2)^2 - 4 + y^2$ (paraboloide) $\vec{F}(u,v) = (u, v, u^2 - 4u + v^2)$

* Ejercicio 36 Determinar ecuación de líneas coord. Interpretar gráficamente

(a) $\vec{F}(u,v) = (\cos(u), \operatorname{sen}(u), v)$ con $(u,v) \in [0,2\pi] \times [0,2]$

$C_{u=u_0}$ $\vec{F}(u_0, v) = (\cos(u_0), \operatorname{sen}(u_0), v)$, $u_0 \in [0, 2\pi]$, $v \in [0,2]$ → segmento de longitud 2

$C_{v=v_0}$ $\vec{F}(u, v_0) = (\cos u, \operatorname{sen} u, v)$, $v_0 \in [0,2]$, $u \in [0, 2\pi]$ → circunferencia radio 1

(b) $\vec{F}(u,v) = (u, v, u^2 + 4v^2)$, $(u,v) \in \mathbb{R}^2$

$C_{u=u_0}$: $\vec{F}(u_0, v, u_0^2 + 4v^2)$, → parábola en $\mathbb{R}^3$ $z = u_0^2 + 4v^2$

$C_{v=v_0}$ $\vec{F}(u, v_0, u^2 + 4v_0^2)$ → parábola $z = u^2 + 4v_0^2$

(c) $\vec{F}(x,y) = (x, y, \underbrace{1 + x + y}_{})$, $(x,y) \in \mathbb{R}^2$ → plano

$C_{x=x_0}$ $\vec{F}(x_0, y, 1 + x_0 + y)$ → rectas $z = 1 + x_0 + y$

$C_{y=y_0}$ $\vec{F}(x, y_0, 1 + x + y_0)$ → rectas

(d) $\vec{F}(x,y) = (x, y, \sqrt{10 - x^2 - y^2})$, $\{(x,y) \in \mathbb{R}^2 / x^2 + y^2 \leq 9\}$

$z = \underbrace{\sqrt{10 - x^2 - y^2}}_{\geq 0}$

$z^2 = 10 - x^2 - y^2$, $z > 0$

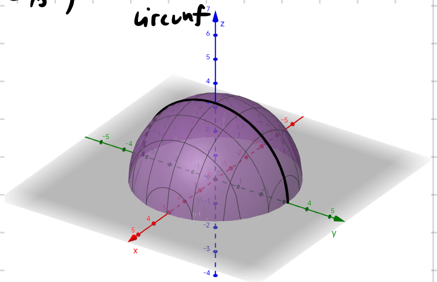
cono?

$C_{x=x_0}$ $\vec{F}(x_0, y) = (x_0, y, \sqrt{10 - x_0^2 - y^2})$ → arco de circunferencia

$C_{y=y_0}$ $\vec{F}(x, y_0) = (x, y_0, \sqrt{10 - x^2 - y_0^2})$ → arco de circunf

$\underbrace{x^2 + y^2 = 10 - z^2}_{\text{circunf que varía rad}}$ → esfera superior

como $x^2 + y^2 \leq 9$



* Ejercicio 37 : $S \quad x = \vec{F}(\mu,v) = (\mu+v, \mu-v, \mu v), \quad (\mu,v) \in \mathbb{R}^2$

(a) Hallar ecuación cartesiana de superficie S

$$\left\{\begin{array}{l} x(\mu,v) = \mu+v \\ y(\mu,v) = \mu - v \\ z(\mu,v) = \mu . v \end{array}\right.$$

~~no importa los valores que toman, ya que al fin y al cabo, μ y v generan todo el plano xy~~

~~expresión cartesiana~~ $\cancel{\boxed{z = xy}}$

$\cancel{x(\mu,v) + y(\mu,v) = (\mu+v)+(\mu-v) = 2\mu}$

$\cancel{x(\mu,v) . y(\mu,v) = (\mu+v)(\mu-v) = \mu^2 - v^2}$

$$\left\{\begin{array}{l} x(\mu,v) = \mu+v \\ y(\mu,v) = \mu - v \\ z(\mu,v) = \mu . v \end{array}\right. \quad \left\{\begin{array}{l} x = \mu+v \\ y = \mu - v \\ z = \mu . v \end{array}\right. \rightarrow \left\{\begin{array}{l} \mu = x - v \\ \mu = y + v \\ z = \mu . v \end{array}\right.$$

$x - v = y + v$

$x = y + 2v \rightarrow \boxed{v = \frac{x-y}{2}}$

$$\left\{\begin{array}{l} v = x - \mu \\ v = \mu - y \end{array}\right. \rightarrow x - \mu = \mu - y \quad \boxed{\mu = \frac{x+y}{2}}$$

$\vec{F}_2 = \left(x, y, \frac{x^2-y^2}{4}\right)$

$$\underbrace{z = \left(\frac{x-y}{2}\right)\left(\frac{x+y}{2}\right) = \frac{x^2-y^2}{4}}_{f(x,y) = \frac{x^2-y^2}{4}}$$

(b) Hallar ecuación plano tangente en $(3,-1,2)$

$\rightarrow$ usar parametrización $\vec{F}_2(x,y) = \left(x, y, \frac{x^2-y^2}{4}\right) \rightarrow F(3,-1) = (3,-1,2)$

$\rightarrow$ Hallar Normal en $\vec{F}(x,y)$

$$\frac{\partial \vec{F}}{\partial x}(x,y) \times \frac{\partial \vec{F}}{\partial y}(x,y) = \begin{vmatrix} i & j & k \\ 1 & 0 & \frac{x}{2} \\ 0 & 1 & \frac{-y}{2} \end{vmatrix} = \check{i}\left(-\frac{x}{2}\right) - \check{j}\left(-\frac{y}{2}\right) + \check{k}(1) = \underbrace{\left(\frac{-x}{2}, \frac{y}{2}, 1\right)}_{\vec{N}(x,y)}$$

$\rightarrow$ Hallar normal en $\vec{F}(3,-1)$

$\vec{N}(3,-1) = \left(-\frac{3}{2}, \frac{-1}{2}, 1\right) \rightarrow (-3,-1,2)$

$\rightarrow$ plano tg $\quad \vec{N}(3,-1)[x - (3,-1,2)] = 0 \Rightarrow (-3,-1,2)(x-3, y+1, z-2) = \overbrace{-3x+9-y+1+2z-4 = 0}^{\text{plano tg } = -3x - y + 2z + 6 = 0}$

(c) Analizar recta normal int eje y

• recta normal $= \lambda \vec{N}(3,-1) + (3,-1,2) = \lambda(-3,-1,2) + (3,-1,2), \; \lambda \in \mathbb{R}$

• recta eje y $= y(0,1,0)$ $\quad$ $\underline{\text{intersecc } (6,0,0)}$

$\rightarrow$ Hallar intersección

$$\left\{\begin{array}{ll} -3\lambda + 3 = 0 & \rightarrow \lambda = -1 \\ -\lambda - 1 = y & \rightarrow \lambda = -1 = y = -1 \\ 2\lambda + 2 = 0 & \rightarrow \lambda = -1 \end{array}\right.$$

Hay intersecc en $\lambda = -1$

(d) puntos de S con plano tangente paralelo al plano de ec $x+y+z=0$

$\rightarrow$ punto donde vector normal $= (1,1,1)$

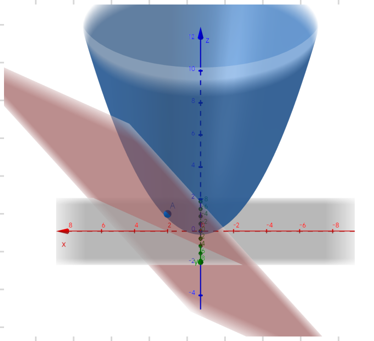
$\rightarrow$ Hallar (x,y,z) donde $\vec{N}(x,y) = \left(\frac{-x}{2}, \frac{y}{2}, 1\right) = (1,1,1)$

$$\left\{\begin{array}{l} \frac{-x}{2} = 1 \rightarrow x = -2 \\ \frac{y}{2} = 1 \rightarrow y = 2 \\ 1 = 1 \end{array}\right.$$

El punto $\vec{F}(-2,2) = \left(-2, 2, \frac{(-2)^2 - 2^2}{4}\right) = (-2,2,0)$

tiene plano tg paralelo a $x+y+z=0$

* Ejercicio 38   Hallar plano tg y recta normal



(a) Paraboloide elíptico $4x^2+y^2-16z=0$ en punto $(2,4,2)$

→ parametrización $\vec{F}(x,y) = \left(x, y, \frac{x^2}{4}+\frac{y^2}{16}\right)$ ↷ $\vec{F}(2,4) = (2,4,1+1)$

→ Hallar $\vec{N}(x,y)$

$$\frac{\partial \vec{F}}{\partial x}(x,y) \times \frac{\partial \vec{F}}{\partial y}(x,y) = \begin{vmatrix} \check{i} & \check{j} & \check{k} \\ 1 & 0 & \frac{x}{2} \\ 0 & 1 & \frac{y}{8} \end{vmatrix} = \left(-\frac{x}{2}, -\frac{y}{8}, 1\right)$$

→ $\vec{N}(2,4) = \left(-1, -\frac{1}{2}, 1\right)$

↓ múltiplo $x-2$

$(2, 1, -2)$

→ Hallar plano

$$(2,1,-2)(x-2, y-4, z-2) = 2x+y-2z-4=0$$

→ recta Normal

$$\lambda(2,1,-2)+(2,4,2), \quad \lambda \in \mathbb{R}$$

(b) Porción de sup cónica circular $\vec{X} = (v, 2+\cos(u), 2\,\mathrm{sen}(u))$, $0 \leq u \leq \pi$, $0 \leq v \leq 4$ $Q_0 = \left(2, \frac{3}{2}, \sqrt{3}\right)$

• Hallar u y v para $\vec{F}(u,v) = Q_0$

$$\begin{cases} v = 2 \\ 2+\cos(u) = 3/2 \\ 2\,\mathrm{sen}(u) = \sqrt{3} \end{cases} \rightarrow \begin{cases} v=2 \\ \cos(u) = -\frac{1}{2} \\ \mathrm{sen}(u) = \frac{\sqrt{3}}{2} \end{cases} \rightarrow \begin{cases} v=2 \\ u = \frac{2}{3}\pi \\ u = \frac{2}{3}\pi \end{cases}$$

∘ Hallar Normal $\vec{N}(u,v)$

$$\vec{N}(u,v) = \frac{\partial \vec{F}}{\partial u}(u,v) \times \frac{\partial \vec{F}}{\partial v}(u,v) = \begin{vmatrix} \check{i} & \check{j} & \check{k} \\ 0 & -\mathrm{sen}(u) & 2\cos(u) \\ 1 & 0 & 0 \end{vmatrix} = (0, 2\cos(u), \mathrm{sen}(u))$$

↷ $\vec{N}\left(2, \frac{2\pi}{3}\right) = \left(0, -1, \frac{\sqrt{3}}{2}\right)$

∘ plano normal

$$(0,-2,\sqrt{3})\left(x-2, y-\frac{3}{2}, z-\sqrt{3}\right) = -2y+\sqrt{3}z = 0$$

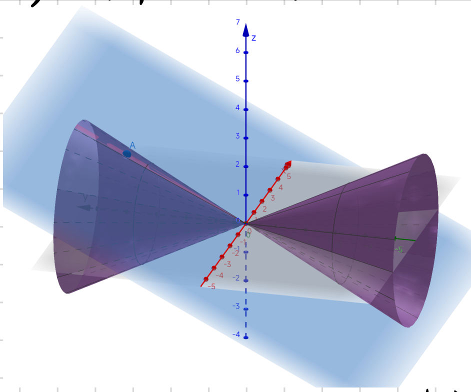
recta tg

$$\lambda(0,-2,\sqrt{3})+\left(2,\frac{3}{2},\sqrt{3}\right)$$

$\boxed{24/4}$

(c) Porción superficie cilíndrica elíptica $\vec{X} = \underbrace{(v\cos(u), 2v, v\,\mathrm{sen}(u))}_{\vec{F}(u,v)}$, $0 \leq u \leq \pi$, $0 \leq v \leq 3$. $Q_0 = (0,4,2)$

• Hallar (u_0, v_0) para $F(u_0, v_0) = Q_0$



$$\begin{cases} v_0\cos(u_0) = 0 \\ 2v_0 = 4 \\ v_0\,\mathrm{sen}(u_0) = 2 \end{cases} \Rightarrow \begin{cases} \cos(u_0) = 0 \rightarrow u_0 = \frac{\pi}{2} \\ v_0 = 2 \\ \mathrm{sen}(u_0) = 1 \rightarrow u_0 = \frac{\pi}{2} \end{cases}$$

$F\left(\frac{\pi}{2}, 2\right) = Q_0$

• Hallar vector $\vec{N}$ en Q_0

$$\frac{\partial F}{\partial u}(u,v) \times \frac{\partial F}{\partial v}(u,v) = \begin{vmatrix} i & j & k \\ -v\,\mathrm{sen}(u) & 0 & v\cos(u) \\ \cos(u) & 2 & \mathrm{sen}(u) \end{vmatrix} = \left(-2v\cos(u), v\cos^2(u)+v\,\mathrm{sen}^2(u), -2v\,\mathrm{sen}(u)\right)$$

$$\vec{N}(u,v) = (-2v\cos(u), v, -2v\,\mathrm{sen}(u))$$

$$\vec{N}\left(\frac{\pi}{2}, 2\right) = (0, 2, -4)$$

• Hallar plano tangente

$$(0,2,-4)(x, y-4, z-2) = 0$$

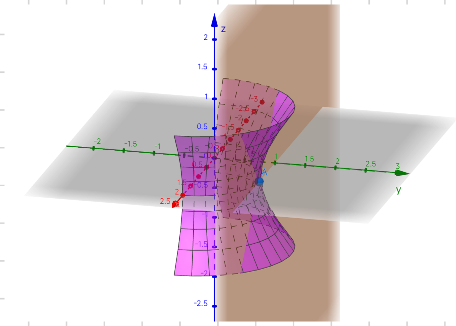
$$2y-4z=0$$

∘ recta normal

$$\lambda(0,2,-4)+(0,4,2), \quad \lambda \in \mathbb{R}$$

ⓓ Porción de hiperboloide de una hoja $\vec{x} = \vec{F}(\mu, v) = (\cos(\mu)\cosh(v) + 1,\ \operatorname{sen}(\mu)\cosh(v), \operatorname{senh}(v))$

$D = [0, \pi] \times [-1, 1] \qquad Q_0 = (1, 1, 0)$



∘ hallar (μ, v) para $F(\mu, v) = Q_0$

$$\begin{cases} \cos(\mu)\cosh(v) + 1 = 1 \\ \operatorname{sen}(\mu)\cosh(v) = 1 \\ \operatorname{senh}(v) = 0 \end{cases} \Rightarrow \begin{cases} \cos(\mu) = 0 \longrightarrow \mu = \frac{\pi}{2} \\ \operatorname{sen}(\mu)\cosh(v) = 1 \longrightarrow \operatorname{sen}(\frac{\pi}{2})\cosh(0) = 1 \\ \operatorname{senh}(v) = 0 \longrightarrow v = 0 \end{cases}$$

~~∘ Hallar Normal en Q_0~~

$$\cancel{\frac{\partial F}{\partial \mu}(\mu, v) \times \frac{\partial F}{\partial v}(\mu, v) = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -\operatorname{sen}(\mu)\cosh(v) & \cos(\mu)\cosh(v) & 0 \\ \cos(\mu)\operatorname{senh}(v) & \operatorname{sen}(\mu)\operatorname{senh}(v) & \cosh(v) \end{vmatrix} = (\cos^2(\mu)\cosh(v), -\operatorname{sen}^2(\mu)\cosh\operatorname{senh}v,\ -\operatorname{sen}^2(\mu)\cosh(v)\operatorname{senh}(v) - \cos^2(\mu)\cosh(v)\operatorname{senh}(v))}$$

~~la normal en $Q_0 = \vec{0}$~~ → ~~no es punto regular, no admite plano tg ni recta normal~~

$$\cancel{\vec{N}(\mu, v) = (\cos^2\mu\cosh v, -\operatorname{sen}^2(\mu)\cosh v\operatorname{senh} v, -\cosh\operatorname{senh}(v))}$$

$$\cancel{\vec{N}(\tfrac{\pi}{2}, 0) = (0, 0, 0)}$$

∘ Hallar derivadas parciales

$$\frac{\partial F}{\partial \mu}(\mu, v) = (-\operatorname{sen}(\mu)\cosh(v), \cos(\mu)\cosh(v), 0) \Rightarrow \frac{\partial F}{\partial \mu}(\tfrac{\pi}{2}, 0) = (-1, 0, 0)$$

$$\frac{\partial F}{\partial v}(\mu, v) = (\cos(\mu)\operatorname{senh}(v), \operatorname{sen}(\mu)\operatorname{senh}(v), \cosh(v)) \Rightarrow \frac{\partial F}{\partial v}(\tfrac{\pi}{2}, 0) = (0, 0, 1)$$

∘ Hallar Normal en Q_0

$$\vec{N}_0 = \frac{\partial F}{\partial \mu}(\tfrac{\pi}{2}, 0) \times \frac{\partial F}{\partial v}(\tfrac{\pi}{2}, 0) = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{vmatrix} = (0, 1, 0)$$

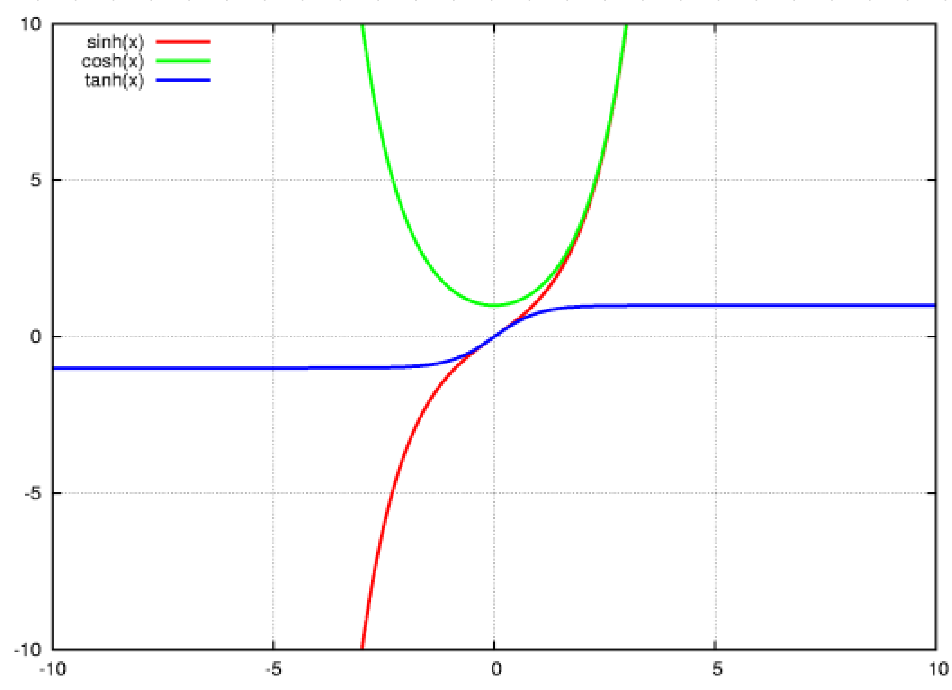
∘ Hallar plano tg

$$(0, 1, 0)(x-1, y-1, z) = 0$$

$$\boxed{y - 1 = 0}$$

∘ Hallar recta normal

$$r(\lambda) = \lambda(0, 1, 0) + (1, 1, 0), \quad \lambda \in \mathbb{R}$$



De este gráfico sabemos que:

- $\cosh(x) > 0 \quad \forall x$
- $\operatorname{senh}(x) = 0, \ x = 0$

* **Ejercicio 39** = $\varphi = D \to \mathbb{R}^3 / \varphi(\mu,v) = (v, 2\cos(\mu), 2\operatorname{sen}(\mu))$, $D = [0,2\pi] \times [0, 1]$

$\downarrow$

$\mu \in [0,2\pi]$, $v \in [0,1]$

ⓐ Demostrar φ permite parametrizar porción de sup cilíndrica

$$\varphi(\mu,v) = \begin{cases} x(\mu,v) = v \\ y(\mu,v) = 2\cos(\mu) \\ z(\mu,v) = 2\operatorname{sen}(\mu) \end{cases}$$

↪ todos los componentes de $\varphi(\mu,v)$ son continuos en D ↪ φ es continua en D

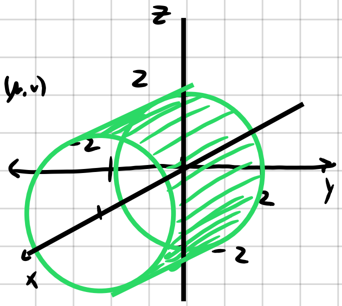
$\downarrow$

la $Im(\varphi)$ es una sup.

- Desparametrizar para graficar

$$\begin{cases} x = v \\ y = 2\cos(\mu) \\ z = 2\operatorname{sen}(\mu) \end{cases} , \quad 0 \leq x \leq 1. \quad y^2+z^2 = 4\cos^2(\mu) + 4\operatorname{sen}^2(\mu) = 4 \quad \Rightarrow \begin{cases} 0 \leq x \leq 1 \\ y^2+z^2 = 4 \end{cases}$$

- Gráfico $\varphi(\mu,v)$

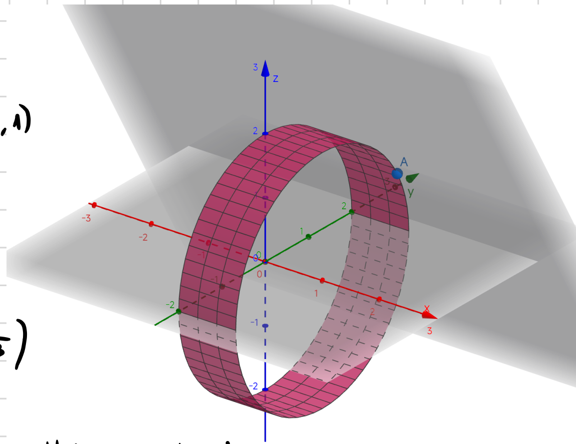


ⓑ Hallar ecuación plano tangente a sup en punto $P = (1, \sqrt{3}, 1)$ y ver intersec con ejes de coord

- Hallar (μ_0, v_0) donde $\varphi(\mu_0, v_0) = P$

$$\begin{cases} v_0 = 1 \\ 2\cos(\mu_0) = \sqrt{3} \\ 2\operatorname{sen}(\mu_0) = 1 \end{cases} \Rightarrow \begin{cases} v_0 = 1 \\ \cos(\mu_0) = \frac{\sqrt{3}}{2} \\ \operatorname{sen}(\mu_0) = \frac{1}{2} \end{cases} \Big\} \mu_0 = \frac{\pi}{6}$$

↪ $\varphi(\frac{\pi}{6}, 1) = (1, \sqrt{3}, 1)$



- Hallar derivadas parciales

$$\frac{\partial \varphi}{\partial \mu}(\mu,v) = (0, -2\operatorname{sen}(\mu), 2\cos(\mu)) \longrightarrow \frac{\partial \varphi}{\partial \mu}(\tfrac{\pi}{6}, 1) = (0, -1, \sqrt{3})$$

$$\frac{\partial \varphi}{\partial v}(\mu,v) = (1, 0, 0) \longrightarrow \frac{\partial \varphi}{\partial v}(\tfrac{\pi}{6}, 1) = (1, 0, 0)$$

- Hallar Normal $\vec{N}$ en P

$$\vec{N} = \frac{\partial \varphi}{\partial \mu}(\tfrac{\pi}{6}, 1) \times \frac{\partial \varphi}{\partial v}(\tfrac{\pi}{6}, 1) = \begin{vmatrix} i & j & k \\ 0 & -1 & \sqrt{3} \\ 1 & 0 & 0 \end{vmatrix} = (0, \sqrt{3}, 1)$$

- Hallar el plano tg

$$(0, \sqrt{3}, 1)(x-1, y-\sqrt{3}, z-1) = 0$$

$$\boxed{\sqrt{3}y + z - 4 = 0}$$

- Probar si plano $\sqrt{3}y + z - 4 = 0$ tiene int con recta $(x,0,0) \to$ eje x

↪ $\sqrt{3}.0 + 0 - 4 = 0 \longrightarrow \boxed{-4 = 0}$ ↪ No tiene intersec con eje x

- Probar intersección $\sqrt{3}y + z - 4 = 0$ con eje y ↪ $(0, y, 0) = y(0,1,0)$

$\sqrt{3}.y + 0 - 4 = 0 \longrightarrow \boxed{y = \frac{4}{\sqrt{3}}}$ ↪ plano intersecta eje y en punto $(0, \frac{4}{\sqrt{3}}, 0)$

- Probar intersección $\sqrt{3}y + z - 4 = 0$ con eje z ↪ $(0,0,z)$

$\sqrt{3}.0 + z - 4 = 0 \longrightarrow \boxed{z = 4}$ ↪ plano intersecta eje z en punto $(0, 0, 4)$

* Ejercicio 40 : $\vec{x} = \vec{r}(\mu) = (1+2\mu,\ 3\mu-1,\ 5\mu)$, $\mu \in \mathbb{R}$ rect normal a sup Σ en $A=(5,5,10)$

↓ Analizar si plano tg a Σ en A tiene pto intersección con eje X

- Hallar vector normal

$$\vec{r}(\mu) = (1+2\mu,\ 3\mu-1\ 5\mu) = (1,-1,0) + \mu(2,3,5) \nearrow \vec{N_0} = (2,3,5)$$

- Hallar el plano tg a Σ en A

$$\vec{N}(X-A) = 0 \Rightarrow (2,3,5)(x-5,\ y-5,\ z-10) = 0$$

$$2x + 3y + 5z - 75 = 0$$

- Chequear intersección plano tg con recta $(x,0,0)$

$$2x + 0 + 0 - 75 = 0 \rightarrow x = \frac{75}{2} = 37{,}5 \nearrow$$ Intersección con eje x en punto $\left(\frac{75}{2}, 0, 0\right)$