We can use level sets to understand functions

$$g : \mathbb{R}^3 \to \mathbb{R}$$

(* above $\mathbb{R}^3$)

Here we get level surfaces by setting $g(x,y,z) = k$

for various constants k.

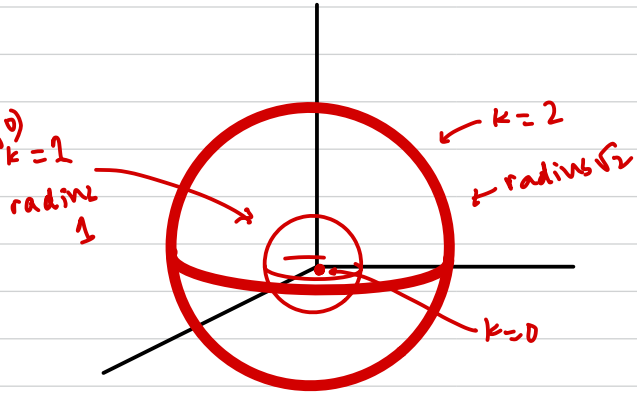
Ex $g(x,y,z) = x^2 + y^2 + z^2 \qquad (k \geq 0)$

$k = 0 \quad x^2 + y^2 + z^2 = 0$

↳ $(x,y,z) = (0,0,0)$

$k = 1 \quad x^2 + y^2 + z^2 = 1$

$k = 2 \quad x^2 + y^2 + z^2 = 2$



Important connection:

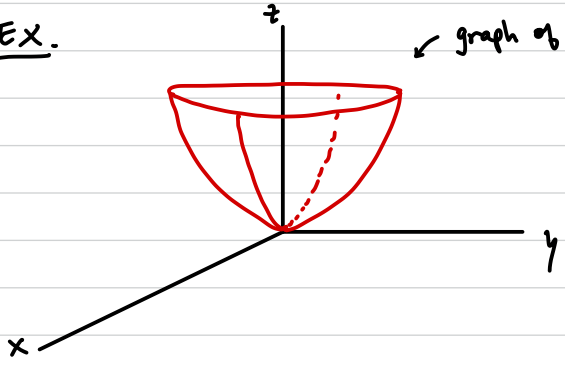
$f: \mathbb{R}^2 \to \mathbb{R}$

The graph of $f(x,y)$ is the level surface at output 0 of

$$g(x,y,z) = f(x,y) - z$$

$g: \mathbb{R}^3 \to \mathbb{R}$

Ex.



graph of $f(x,y) = 2x^2 + y^2$

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

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

$g(x,y,z)$ $\quad k = 0$

So: everything we can say about level surfaces will apply to graphs.