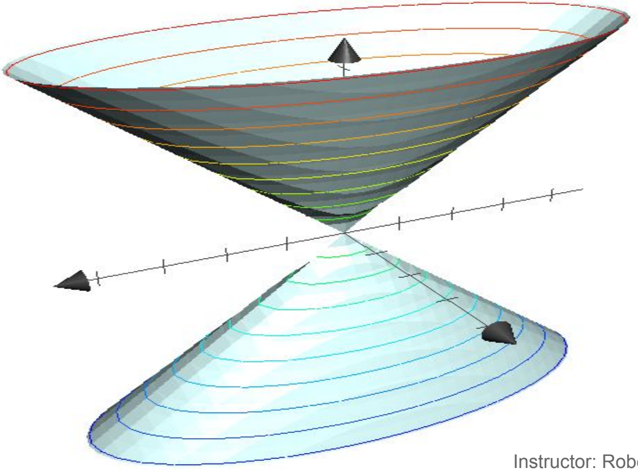
# 12.6 Lecture: Cylinders and Quadric Surfaces

Jeremiah Southwick
(Let's be honest though, the slides are by Robert Vandermolen)

Spring 2019

# CALCULUS III



Instructor: Robert Vandermolen

(12.6)

# Contour Graphing!

Two calculus classes later we are really good at graphing in 2-dimensions, so let's use this to our advantage...

Instead of drawing the whole picture, we will first just draw slices of the picture

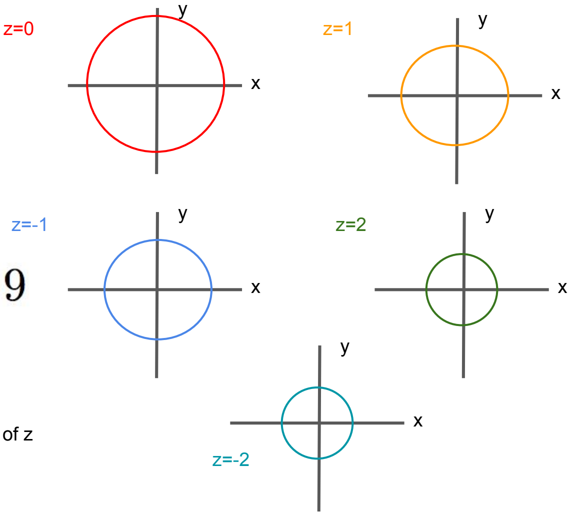
Let's try it with the following surface first:

$$x^2 + y^2 + z^2 = 9$$

# Contour Graphing!

We begin by choosing different values for z and graphing the function's
x and y-coordinates

$$x^2 + y^2 + z^2 = 9$$

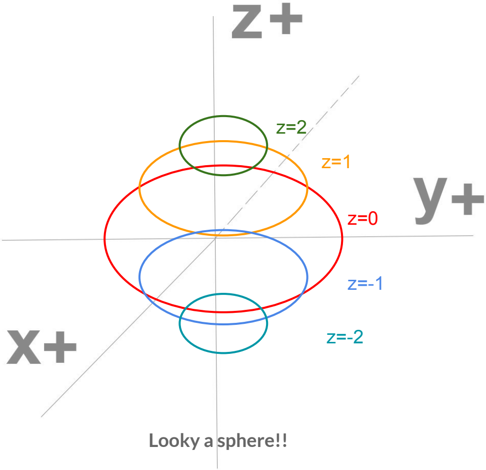



Why didn't I pick values of z past 3 or below -3?

# Contour Graphing!

Now we put the contours together!

$$x^2 + y^2 + z^2 = 9$$

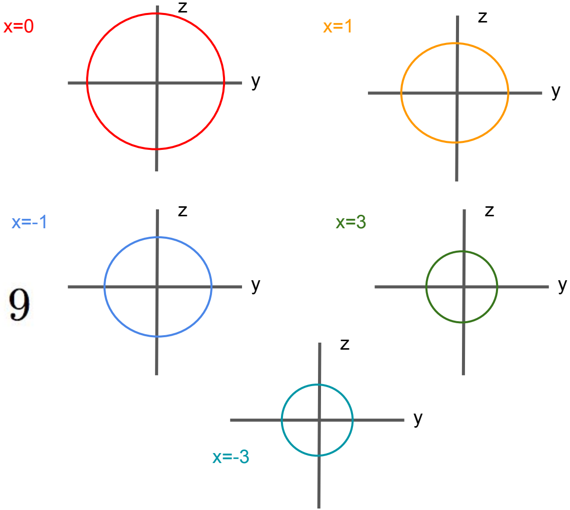



Looky a sphere!!

# CONTOUR GRAPHING!

We could have done the same thing by picking different values for x, and graphing the remaining coordinates

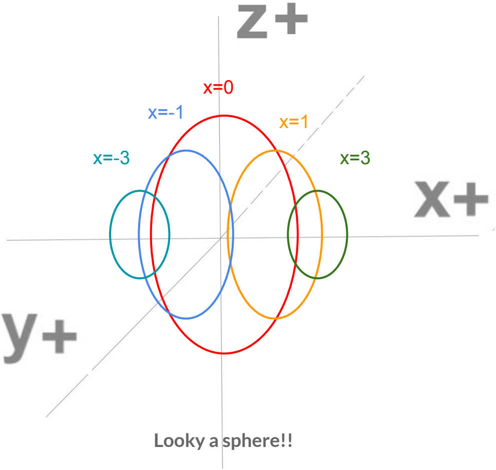
$$x^2 + y^2 + z^2 = 9$$



# Contour Graphing!

Again putting the contours together we get:

$$x^2 + y^2 + z^2 = 9$$

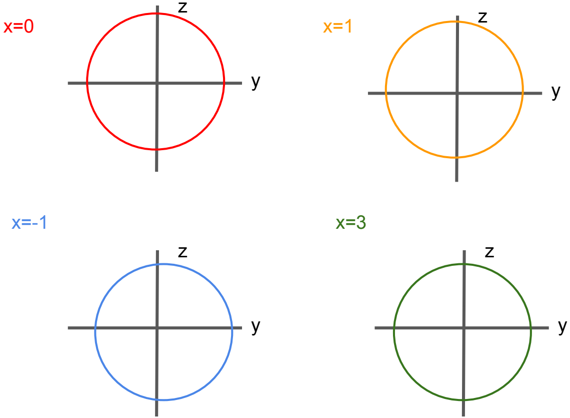



Looky a sphere!!

# Contour Graphing!

For this function when we choose different values of x the function doesn't change

$$z^2 + y^2 = 9$$

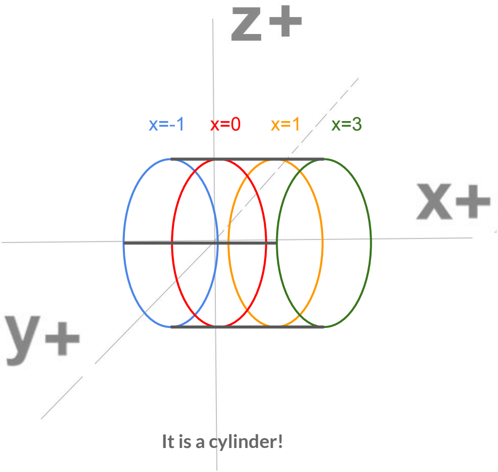



Look they are all the same!

# Contour Graphing!

When we put together the contours the picture reveals itself

$$z^2 + y^2 = 9$$




It is a cylinder!

# Quadratic Surfaces!

A basic Quadratic Surface has the form:

$$Ax^2 + By^2 + Cz^2 + Dxy + Exz + Fyz + Gx + Hy + Iz + J = 0$$

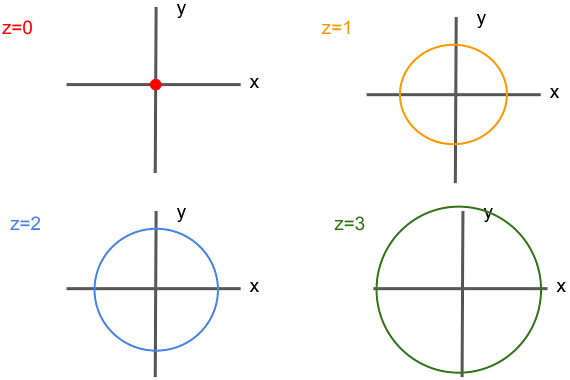
where A,B,C,D,E,F,G,H,I,J are numbers and quite often a lot of them are zero!

# Elliptic Paraboloid!

Let's do the same thing.

We will start with choosing values for z

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

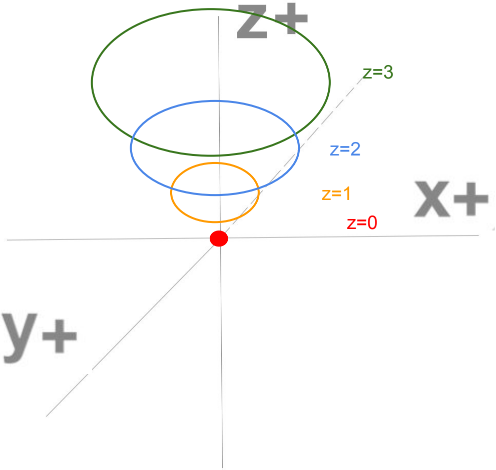



Why did I not choose negative values?

# Elliptic Paraboloid!

Now we put the contours together!

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

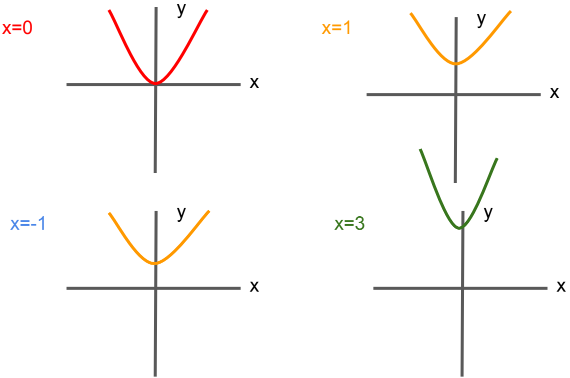


# Elliptic Paraboloid!

Let's do the same thing.

What if we did it this time choosing values for x

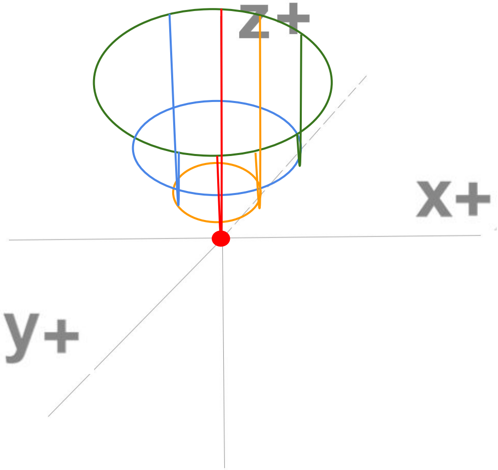
$$z = x^2 + y^2$$



# Elliptic Paraboloid!

Now we put the contours together!

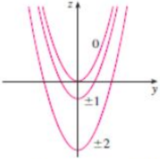
$$z = x^2 + y^2$$



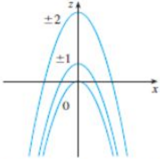
# Hyperbolic Paraboloid!

Let's do the same thing.

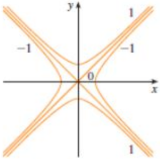
$$z = y^2 - x^2$$



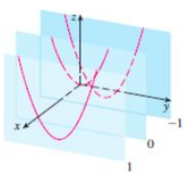

Choosing values for x

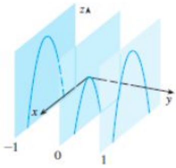


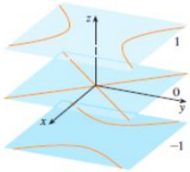

Choosing values for y




Choosing values for z



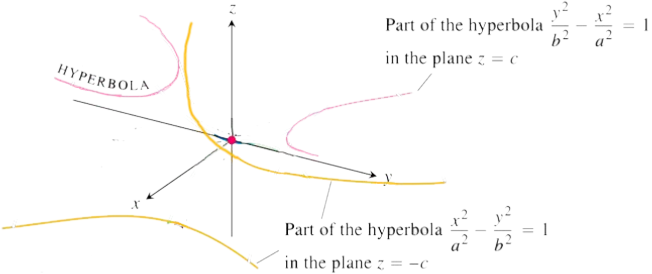



# Hyperbolic Paraboloid!

Putting it together!

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



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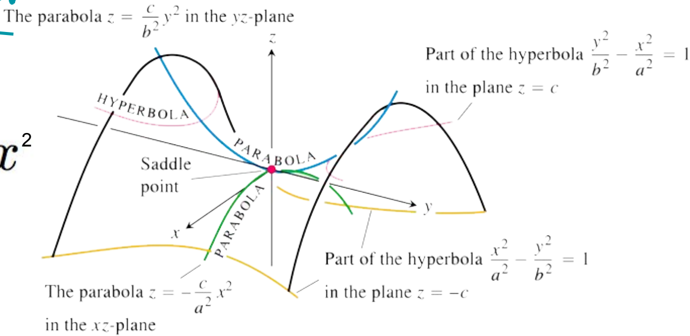
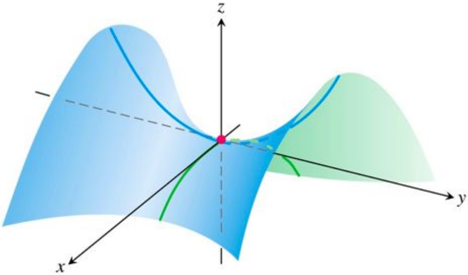


# Hyperbolic Paraboloid!

Putting it together!

$$z = y^2 - x$$



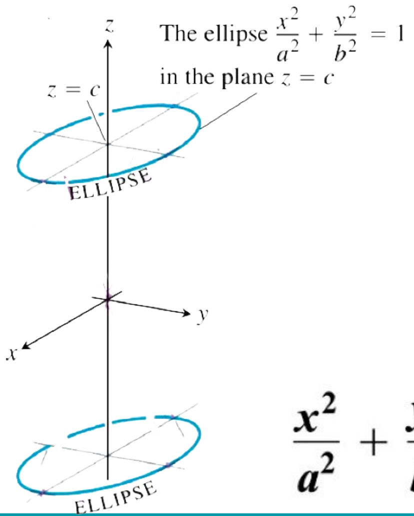
# Now You Try!

- Use this method to draw the following curve:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = \frac{z^2}{c^2}$$

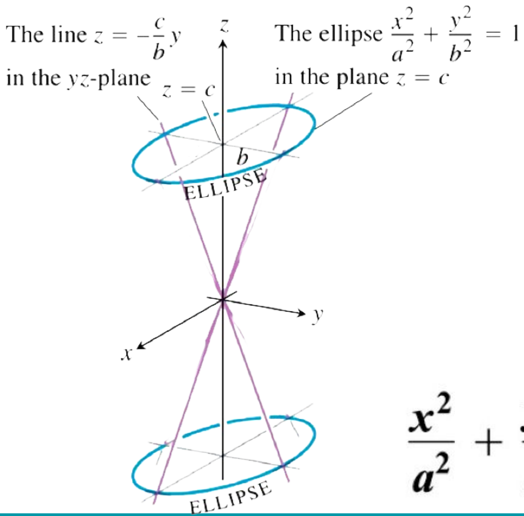
It is called an
Elliptic Cone

# ANSWER!



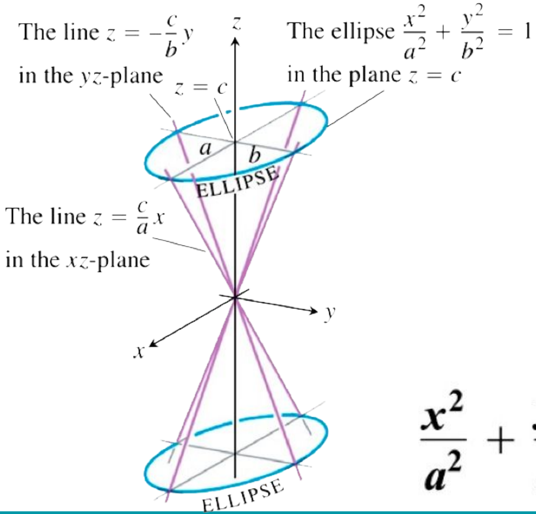

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = \frac{z^2}{c^2}$$

# Answer!



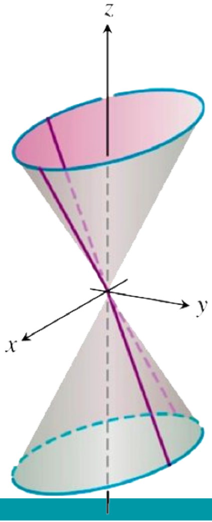

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = \frac{z^2}{c^2}$$

# Answer!




$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = \frac{z^2}{c^2}$$

## Answer!




$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = \frac{z^2}{c^2}$$