Welcome to Math 126!
with Dr. Andy Loveless

Plan for Today

1. About me & about you.
2. Tour of essential resources
3. Discuss 12.1

To do in first three days:

1. Take syllabus quiz on Canvas
2. Start the 12.1,12.2 HW
3. Go to quiz section Thurs.
    - Will start with a "Test Prep"
    - You will get a participation code which you must enter on Canvas to get credit for the day.

Upcoming Assignment Closing Dates

this Fri:	Syllabus Quiz
next Tue:	12.1, 12.2
next Thu:	12.3, 12.4(1)(2)

Everyday Resources

Canvas: canvas.uw.edu/courses/1697323

HW is on Webassign:
webassign.net/washington/login.html

Dr. Loveless Materials Page:
math.washington.edu/~aloveles

Also here is a free online basic 3D grapher which you might find fun to play with this term: https://www.math3d.org/

$\mathbb{R}^2 = 2D$

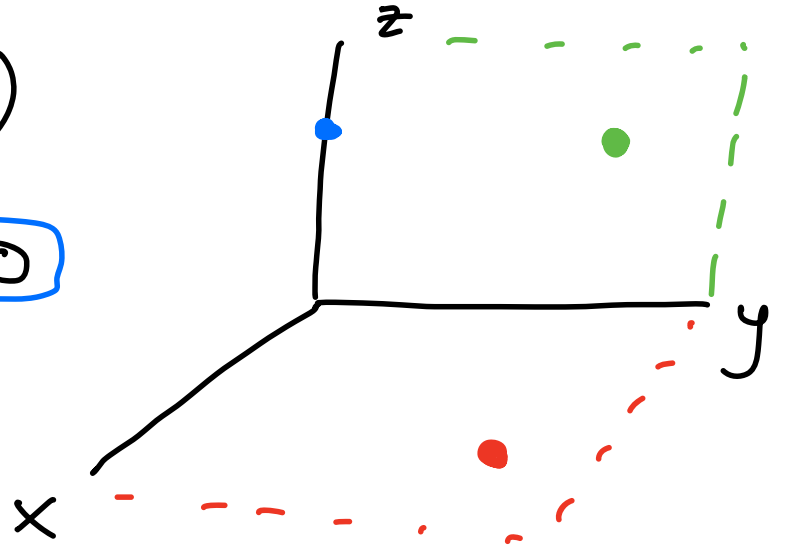
12.1 Intro to 3D

Entry Task: How can you tell if a point (x,y,z) in $\mathbb{R}^3$ is on...

all 3 numbers are real (3D)

1. ...the xy-plane? $z = 0$ $(x, y, 0)$
2. ...the yz-plane? $x = 0$ $(0, y, z)$
3. ...the z-axis? Line → $x=0, y=0$
4. ...the x-axis? $y=0,\ z=0$
5. ...the origin? $(0,0,0)$

Conditions + equations



Observations

Basic Planes

set notation → such that ... (conditions)

xy-plane $\Leftrightarrow \{(x, y, z) \mid z = 0\} \Leftrightarrow z = 0$

yz-plane $\Leftrightarrow \{(x, y, z) \mid x = 0\} \Leftrightarrow x = 0$

xz-plane $\Leftrightarrow \{(x, y, z) \mid y = 0\} \Leftrightarrow y = 0$

Q: what is $z = 3$?

↳ Plane parallel to the xy-plane but 3 units up

Basic Lines

x-axis $\Leftrightarrow \{(x, y, z) \mid y = 0 \textbf{ and } z = 0\}$

y-axis $\Leftrightarrow \{(x, y, z) \mid x = 0 \textbf{ and } z = 0\}$

z-axis $\Leftrightarrow \{(x, y, z) \mid x = 0 \textbf{ and } y = 0\}$

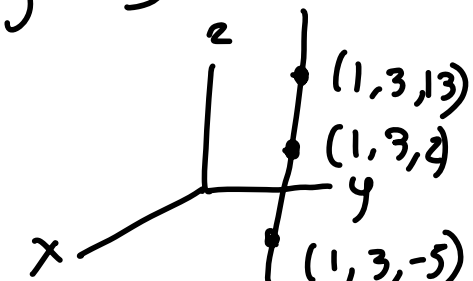
Q: What is $x = 1$, $y = 3$, $z =$ anything

(a) in $\mathbb{R}^2$, $x = 1$, $y = 3$

↳ Point @ $(1, 3)$

(b) in $\mathbb{R}^3$, $x = 1$, $y = 3$

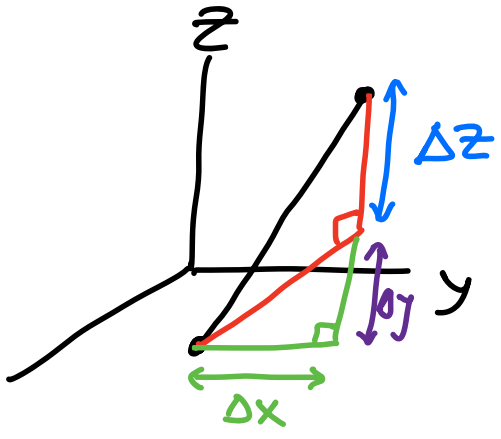
↳ Line



Distances: The distance (in a straight line) between two points in $\mathbb{R}^3$ is

$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

Δx Δy Δz



How far is (1,3,4) from...

1....the origin? $= \boxed{\sqrt{26}} = \sqrt{1^2+3^2+4^2}$

2....the xy-plane? $= \boxed{4}$ (4 units up from $z = 0$)

3....the x-axis?

$y=0 \quad z=0 \quad x=1$

$(1, 3, 4)$ to $(1, 0, 0) = \boxed{5}$

think about corresponding points

Homework Hints

There is a way to answer the following questions using only the distance formula:

Given three points

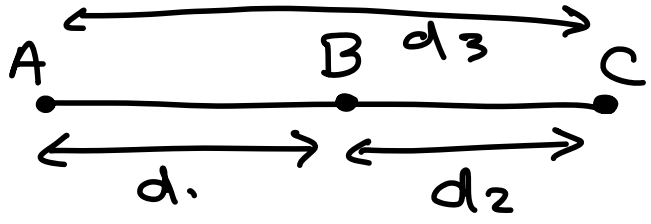
$A(a_1, a_2, a_3), B(b_1, b_2, b_3), C(c_1, c_2, c_3)$

use the distance formula

1. Are the points on the same line?

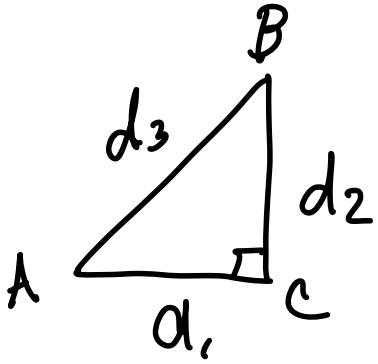
2. Do the points form a right triangle?

1



$d_1 + d_2 = d_3$ means they are on a straight line

2



$d_1^2 + d_2^2 = d_3^2$ means they do form a right triangle

Spheres *(HW 12.1/6-16)*

The equation of all points (x, y, z) on a sphere (*i.e.* the outer shell of a ball) centered at (h, k, l) with radius r is

$$(x-h)^2+(y-k)^2+(z-l)^2=r^2$$

(h, k, l)

Example:

The two points $A(1,-2,8)$ and $B(5,4,10)$ are on a sphere and the segment AB forms a diameter for the sphere.

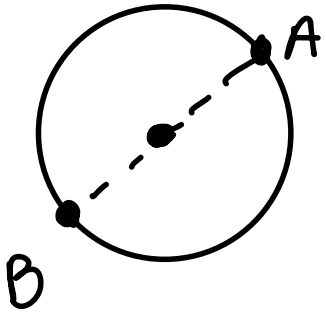
↳ half = radius

(a) Find the 3D equation for the sphere.

(b) Find the 2D equation for the circle formed from intersecting this sphere with the *xz*-plane.

$|AB| = \sqrt{(5-1)^2+(4+2)^2+(10-8)^2}$ / 2 = radius

Center = halfway point between A and B



(c) Can you visualize this? Here are some: www.math3d.org/qiwFTpqR

Example (from HW)

Describe the intersection of

$$x^2 + y^2 + (z-3)^2 = 4$$

and the *xz*-plane.

What if it was the *xy*-plane?

Example: Find the center and radius of the sphere

$$2x^2 + 2y^2 + 2z^2 = 26 + 12x$$