Lecture 1, Intro and Sections 2.1, 2.2: 3D coordinates

Introducing myself: I have been a faculty here since 2006, I from Canada, with an accent and I am allowed to say zed. I am (I think) known to be tough but fair. In this class, you will have to work to understand, and to understand to pass. I am not a stickler for details, but I don't like if you try to fool me and pretend you know more than you do. You all decided to pay more than $1000 to be here, so don't waste that money away.

Important points from the syllabus: Lots of homeworks for practice, but they don't count as cheating is now too easy. It doesn't mean these are worthless: they will help you come exam time! You get quizzes a week in advance, they count for a lot, so basically **free** points there. You will do quizzes with a partner, but you can only do up to 3 quizzes with the same partner. There are 2 unit exams and one final. Secret weapons are office hours and good discussion participation.

Homework 1 is posted and it is about today's lecture. I highly recommend that you do homework after each lecture, before the next lecture, so that you can follow what is going on in lecture. You can also ask questions in office hours as we go.

What is Math 23? Calculus in 3D.
That means we need to do geometry in 3D, differentiation, integration, in 3D.
This can be visualized, drawn, but not guessed.

The book is from Open-Stax, and we cover Chapters 2 to 6 (most sections).

No phones, laptop or tablets (or screens that others can see) in class please, unless you clear it with me first. Calculators are usually a bad idea, since they are not allowed on the tests,

Important point: We will build on early material in this class, so ask questions **early**. Don't let me go on if you don't understand a word I am saying.

OK, let's do math! We deal with space in this class, 3D space. One way to represent that is with good old cartesian coordinates, but 3 of them instead of 2.

2D cartesian coordinates figure

3D cartesian coordinates figure

What is the distance from the origin to the point $P = (1, 2, 4)$?
The *projection* of P onto the xy-plane is $Q = (1, 2, 0)$.
The distance from the origin O to Q is $|OQ| = \sqrt{1^2 + 2^2}$.
The triangle OQP is a right-angle triangle. So the distance $|OP|$ is
$|OP| = \sqrt{|OQ|^2 + 4^2} = \sqrt{1^2 + 2^2 + 4^2}$

In general, the distance from a point (x, y, z) to the origin is $d = \sqrt{x^2 + y^2 + z^2}$.
The distance between 2 points (x_1, y_1, z_1) and (x_2, y_2, z_2) is $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$.
So where are the points such that $\sqrt{x^2 + y^2 + z^2} = 3$?

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

What about $(x-1)^2+(y+2)^2+(z-3)^2=4$?

$$(x-1)^2+(y+2)^2+(z-3)^2=4$$

Or $1 \leq (x-1)^2+(y+2)^2+(z-3)^2 \leq 4$?

$$1 \leq (x-1)^2+(y+2)^2+(z-3)^2 \leq 4$$

Or $x^2+y^2=9$?

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

What about $z = 2$?

$$z = 2$$

Or $x = 2$?

$$x = 2$$

Or $x = 2$ and $y = 1$?

$$x = 2 \text{ and } y = 1$$