Vectors

Name: _____

Preview Activity for Wednesday 9/2 · Submit via Gradescope by 11:59 p.m. the night before class.

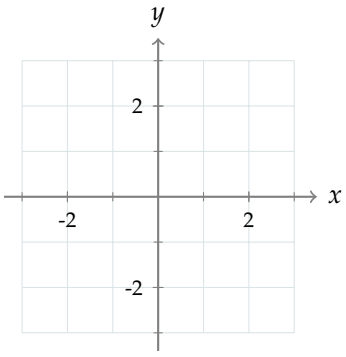
Suppose you are standing outside Noyce and someone asks how to get to Pagliai's Pizza. *"It is at 5th Avenue and Broad Street"* tells them **where the building is**. *"Go three blocks south and two blocks west"* tells them **how to get there**. These are different kinds of information!

The first names a **point**: a single location, which we write (x, y). The second names a **vector**: a direction and a distance, which we write $\langle x, y \rangle$. If we let one unit be one block, with the positive x-direction east and the positive y-direction north, then "three blocks south and two blocks west" is the vector $\langle -2, -3 \rangle$. Notice that this vector does not mention Noyce or Pagliai's. Someone standing outside the Spanish House who walks $\langle -2, -3 \rangle$ starts somewhere else and ends somewhere else, but follows the same instruction. A vector records only how far and which way; it does not record where you started or where you ended. (In the reading, "how far" is called the **magnitude** and "which way" is the **direction**.)

When we do want to name a particular trip, we write $\overrightarrow{AB}$ for the vector that takes you from the point A to the point B. The arrow reminds us that $\overrightarrow{AB}$ is a vector, while A and B are points; the same vector can be written as $\overrightarrow{AB}$ for many different pairs of points.

Activity — Getting around town[1]

(a) What is the vector $\mathbf{v} = \langle x, y \rangle$ that describes the displacement from the point $(1, 1)$ to the point $(1, -1)$? Sketch it on the axes below.

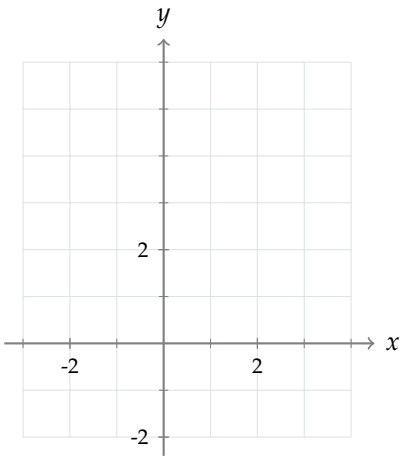


(b) How can you use the two components of $\mathbf{v}$ to determine the distance from $(1, 1)$ to $(1, -1)$?

[1] Adapted from Preview Activity 9.3.1 of *Active Calculus — Multivariable*, 2nd ed., by Nicholas Long and Mitchel T. Keller, activecalculus.org, used under CC BY-SA 4.0.

(c) Using the same coordinate system as above — one unit is one block, x pointing east and y pointing north — put the origin at **Pagliai's**, which we will call P. Then Noyce is at $N = (2, 3)$ (check that this agrees with the directions above) and the Spanish House is at $S = (-1, 5)$.

Plot the three points below, then determine the vectors $\overrightarrow{SN}$, $\overrightarrow{NP}$, and $\overrightarrow{SP}$.



(d) You and your friend are both at the Spanish House and both headed to Pagliai's. You go straight there. Your friend insists on swinging by Noyce first to turn in their calculus homework. Compare their two vectors $\overrightarrow{SN}$ and $\overrightarrow{NP}$ with your single vector $\overrightarrow{SP}$. What do you notice about the components? Write a sentence or two explaining why this had to happen, in terms of walking around town.

Reading and Reflection

Read **Stewart §12.2, pages 838–841**, beginning at "Components of a Vector" and stopping after the standard basis vectors **i**, **j**, **k**. You can skip the first three pages of the section — we will do that part together in class.

Answer the following in the **response box on Gradescope** (not on this page). A few sentences each is plenty.

1. Stewart is careful to write $\langle 3, 2 \rangle$ and $(3, 2)$ differently. What is the difference between them, and why does it matter?

2. Find the boxed formula labeled **(1)** on page 839. How does it relate to what you did in part (c) above?

3. What is one thing from the reading you would like me to go over in class?