Individual Project

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Fontys ICT

Cybersecurity Advanced

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# Version

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| Version (v) | Date | Changes |
| 1 | 12/09/2022 | Introduction Added |
| 2 | 14/09/2022 | Exercises 2.1 |

# Introduction

I have decided to focus my individual project on learning math topics related to programming, since I feel like those areas have been lacking in my HBO study thus far. I will be working from a [book](https://www.manning.com/books/math-for-programmers) whereby my proof of work will consist of exercises and mini projects.

# 2D Vectors

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**Exercise 2.1**: What is the x- and y-coordinates of the point at the tip of the dinosaur’s toe?

**Answer**: (-1, -4)

**Exercise 2.2**: Draw the point in the plane and the arrow corresponding to the point (2, −2).

**Answer**:

Chart, line chart

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**Exercise 2.3/2.4**: Complete Dino and Segment Lines.

**Answer**:

Chart, line chart

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**Exercise 2.5**: Draw the vectors (x,x\*\*2) for *x* in the range from *x* = −10 to *x* = 11) as points (dots) using the draw function. What is the result?

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**Exercise 2.6**: If the vector **u** = (−2, 0), the vector **v** = (1.5, 1.5), and the vector **w** = (4, 1), what are the results of **u** + **v**, **v** + **w**, and **u** + **w**? What is the result of **u** + **v** + **w**?

**Answer:**

* u + v = (-0.5, 1.5)
* v + w = (5.5, 2.5)
* u + w = (2, 1)
* u + v + w = (3.5, 2.5)

**Exercise 2.7-Mini Project**: Implement a revised add function that takes any number of vectors as arguments.

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**Exercise 2.8**: Write a function translate (translation, vectors) that takes a translation vector and a list of input vectors, and returns a list of the input vectors all translated by the translation vector:

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**Exercise 2.9−Mini Project**: Any sum of vectors **v** + **w** gives the same result as **w** + **v**. Explain why this is true using the definition of the vector sum on coordinates. Also, draw a picture to show why it is true geometrically.

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**Exercise 2.10**: Among the following three arrow vectors (labelled **u**, **v**, and **w**), which pair has the sum that gives the longest arrow? Which pair sums to give the shortest arrow?

A picture containing text, clock, watch, device

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**Answer:** If vectors are placed tip-to-tail we can measure the sums and see which is shortest.

**Exercise 2.11-Mini Project**: Write a Python function using vector addition to show 100 simultaneous and non-overlapping copies of the dinosaur.

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**Exercise 2.12**: Which is longer, the *x* or y component of (3, −2) + (1, 1) + (−2, −2)?

The result is (2, -3), thus the y component is longer by 1 unit.

**Exercise 2.13**: What are the components and lengths of the vectors (−6, −6) and (5, −12)?

Components:

* (-6, 0)
* (0, -6)
* (5, 0)
* (0, -12)

Lengths: (Pythagoras theorem)

* 8.48528137423857
* 13

**Exercise 2.14**: Suppose I have a vector **v** that has a length of 6 and an *x* component (1, 0). What are the possible coordinates of **v**?

1 + y\*\*2 = 36

y\*\*2 = 35

y = 5.916079783099616

The vector’s y component is either 5.9161 or -5.9161

**Exercise 2.15**: What vector in the dino\_vectors list has the longest length?

(6, 4)

**Exercise 2.16**: Suppose a vector **w** has the coordinates (√2, √3). What are the approximate coordinates of the scalar multiple π · **w**? Draw an approximation of the original vector and the new vector.

(4.442882938158366, 5.441398092702653)

Chart, line chart

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**Exercise 2.17**: Write a Python function scale(s,v) that multiplies the input vector **v** by the input scalar *s*.

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**Exercise 2.19−Mini Project**: Suppose *z* = (−1, 1) and **v** = (1, 1), and suppose *r* and *s* are real numbers. Specifically, let’s assume −3 < *r* < 3 and −1 < *s* < 1. Where are the possible points on the plane where the vector *r* · **u** + *s* · **v** could end up?

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**Exercise 2.20**: Show algebraically why a vector and its opposite have the same length.

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**Exercise 2.21**: Of the following seven vectors, represented as arrows, which two are a pair of opposite vectors?

A picture containing text, clock, gauge, watch

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V3 **and V7**

**Exercise 2.22**: Suppose **u** is any 2D vector. What are the coordinates of **u** + −**u**?

(0, 0)

Exercise 2.23: For vectors u = (−2, 0), v = (1.5, 1.5), and w = (4, 1), what are the results of the vector subtractions v − w, u − v, and w − v?

**v** − **w** = (−2.5, 0.5)

**u** − **v** = (−3.5, −1.5)

**w** − **v** = (2.5, −0.5)

**Exercise 2.24**: Write a Python function subtract (v1, v2) that returns the result of v1 - v2, taking two 2D vectors as inputs and returning a 2D vector as an output.

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**Exercise 2.25**: Write a Python function distance (v1, v2) that returns the distance between two input vectors. (Note that the subtract function from the previous exercise already gives the *displacement*.)

Write another Python function perimeter(vectors) that takes a list of vectors as an argument and returns the sum of distances from each vector to the next, including the distance from the last vector to the first. What is the perimeter of the dinosaur defined by dino\_vectors?

Distance:

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Perimeter:

Text

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Perimeter of dinosaur:

44.77115093694563

**Exercise 2.26−Mini Project**: Let **u** be the vector (1, −1). Suppose there is another vector **v** with positive integer coordinates (*n*, *m*) such that *n* > *m* and has a distance of 13 from **u**. What is the displacement from **u** to **v**?

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# References

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