Classes: Repetition — The TwoDVector class

In this exercise, we are going to implement a two dimensional Python vector with some of the operations that are performed in Mathematics on these vectors.

Task 1: Create a class TwoDVector. A TwoDVector has two components, and x-coordinate and a y-coordinate. Create an constructor, a str and a repr dunder. A two dimensional vector should be displayed to the user as a pair such as

(2,3)

with x-component 2 and y-component 3. For the repr, we want to have more information, so we write the same vector as

<Vector: self.x = 2, self.y = 3>

Task 2: Python allows us to overwrite functions such as len and abs. For the latter, we need to define a dunder __abs__(self). Do so.

Task 3: Implement equality and inequality operators

Task 4: Implement addition and subtraction

Task 5: Implement the += and the -= operator using __iadd__ and __isub__ dunder.

Task 6: Implement dot multiplication: $(a, b) \cdot (x, y) = a\,x + b\,y$. The dot product is a scalar, but you can still implement it using the __mul__ dunder.

Task 7: Scalar multiplication is defined by $x \cdot (a, b) = (x\,a, x\,b)$. As the vector is on the right of the operation, we can use the __rmul__ dunder to implement it. Do so.

Task 8: Implement rotation by an angle θ: $\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix}$.

Task 9: Implement reflection along the normal a of a hyperplane, using the formula $v \longrightarrow v - 2\frac{v \cdot a}{a \cdot a} a$.