

CSI 2372 – Lab Task 3

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Operator Overloading in C++



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Your task in this lab is to get yourself familiarized with operator overloading in C++. Make sure you have C++ installed, and you are familiar with the header files, and coding files. If you need help, ask your TA to help you with this.

Then, you should do the following programming task. Each programming task in the lab is a design based on the subjects you learned during lectures. There is a test code that you can use to test your design. If you have questions, ask your TAs.

Design a class for the concept of a vector in an n-dimensional space. This is not a vector in STL, this is the vector we know in math. The dimension of the vector has to be at least 2 but it can be any number. Each vector in an n-dimensional space has at n elements. Each element represents a direction in the space. For example, $v = (5, -6, 2)$ is a vector in 3-dimensional space, which has 5 in the x dimension, -6 in y dimension, and 2 in z dimension.

Your class must have the following methods. Use the name as they are in the table to be able to use the test file for testing your class design.

You are not allowed to use vector in STL. Use dynamic memory. 傻逼！

| Class Vector | |
|------------------|--|
| Method | Description |
| Vector | The default constructor that initializes the vector in 2-dimensional space |
| Vector | The default constructor that initializes the vector in n-dimensional space. It receives an array of size n to initialize the vector Vector (double * arr, int num), here num Shows the number of elements in the Vector |
| Vector | The copy constructor |
| ~Vector | The destructor |
| dimension | The dimension of the vector |
| add_dimension | Add a new dimension using the given value to the end |
| remove_dimension | Remove a dimension at the given index |
| insert_dimension | Insert a new dimension at a given position with a given value |
| magnitude | Get the length of the vector |

| | |
|--------------|---|
| operator [] | For indexing the dimensions |
| operator == | Checks if two vectors are equal (Same dimension and same element in each dimension) |
| operator != | Checks if the two vectors are not equal |
| operator = | For assigning a vector to another vector |
| operator + | For adding two vectors, the result has the dimension of the vector with the larger dimension, consider the rest of elements of the vector with a smaller dimension to be 0. |
| operator - | For subtracting two vectors, the result has the dimension of the vector with the larger dimension, consider the rest of elements of the vector with a smaller dimension to be 0. |
| operator * | For multiplying a scalar and a vector |
| operator += | Add and assign the result |
| operator -= | Subtract and assign the result |
| operator * | For multiplying a vector and a scalar |
| operator * | For internal products of two vectors, the result has the dimension of the vector with the larger dimension, consider the rest of elements of the vector with a smaller dimension to be 0. |
| operator << | For printing a vector in this format $v = (5, -6, 2)$ |

You can add any method you need.

Note:

$$v_1(x_1, x_2, x_3) + v_2(y_1, y_2, y_3, y_4) = (x_1 + y_1, x_2 + y_2, x_3 + y_3, y_4)$$

$$v_1(x_1, x_2, x_3, x_4) - v_2(y_1, y_2, y_3) = (x_1 - y_1, x_2 - y_2, x_3 - y_3, x_4)$$

$$v_1(x_1, x_2, x_3, x_4) \cdot v_2(y_1, y_2, y_3) = (x_1 \times y_1, x_2 \times y_2, x_3 \times y_3, 0)$$

$$5 \times v_1(x_1, x_2, x_3, x_4) = (5x_1, 5x_2, 5x_3, 5x_4)$$

$$\text{norm}(v_1) = \text{magnitude}(v_1) = |v_1(x_1, x_2, x_3, x_4)| = \sqrt{x_1^2 + x_2^2 + x_3^2 + x_4^2}$$