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# Chapter 1

## Classes

### 1.1 vector – vector object and arithmetic

- **Classes**
  - **Vector**
- **Functions**
  - **innerProduct**

This module provides an exception class.

**VectorSizeError** : Report vector size is invalid. (Mainly for operations with two vectors.)

### 1.1.1 Vector – vector class

Vector is a class for vector.

#### Initialize (Constructor)

**Vector(compo: list) → Vector**

Create Vector object from compo. compo must be a list of elements which are an integer or an instance of **RingElement**.

#### Attributes

**compo :**

It expresses component of vector.

#### Operations

Note that index is 1-origin, which is standard in mathematics field.

operator	explanation
<b>u+v</b>	Vector sum.
<b>u-v</b>	Vector subtraction.
<b>A*v</b>	Multiplication vector with matrix
<b>a*v</b>	or scalar multiplication.
<b>v//a</b>	Scalar division.
<b>v%n</b>	Reduction each elements of <b>compo</b>
<b>-v</b>	element negation.
<b>u==v</b>	equality.
<b>u!=v</b>	inequality.
<b>v[i]</b>	Return the coefficient of i-th element of Vector.
<b>v[i] = c</b>	Replace the coefficient of i-th element of Vector by c.
<b>len(v)</b>	return length of <b>compo</b> .
<b>repr(v)</b>	return representation string.
<b>str(v)</b>	return string of <b>compo</b> .

#### Examples

```
>>> A = vector.Vector([1, 2])
>>> A
Vector([1, 2])
>>> A.compo
[1, 2]
```

```
>>> B = vector.Vector([2, 1])
>>> A + B
Vector([3, 3])
>>> A % 2
Vector([1, 0])
>>> A[1]
1
>>> len(B)
2
```

## Methods

### 1.1.1.1 copy – copy itself

`copy(self) → Vector`

Return copy of self.

### 1.1.1.2 set – set other compo

`set(self, compo: list) → (None)`

Substitute **compo** with compo.

### 1.1.1.3 indexOfNoneZero – first non-zero coordinate

`indexOfNoneZero(self) → integer`

Return the first index of non-zero element of self.**compo**.

†Raise ValueError if all elements of **compo** are zero.

### 1.1.1.4 toMatrix – convert to Matrix object

`toMatrix(self, as_column: bool=False) → Matrix`

Return **Matrix** object using **createMatrix** function.

If `as_column` is True, create the column matrix with self. Otherwise, create the row matrix.

## Examples

```
>>> A = vector.Vector([0, 4, 5])
>>> A.indexOfNoneZero()
2
>>> print A.toMatrix()
0 4 5
>>> print A.toMatrix()
```

0  
4  
5

### 1.1.2 innerProduct(function) – inner product

**innerProduct(bra: *Vector*, ket: *Vector*) → *RingElement***

Return the inner product of bra and ket.

The function supports Hermitian inner product for elements in the complex number field.

†Note that the returned value depends on type of elements.

#### Examples

```
>>> A = vector.Vector([1, 2, 3])
>>> B = vector.Vector([2, 1, 0])
>>> vector.innerProduct(A, B)
4
>>> C = vector.Vector([1+1j, 2+2j, 3+3j])
>>> vector.innerProduct(C, C)
(28+0j)
```

# Bibliography