

# Triangles

1.0.1

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# Chapter 1

## Namespace Index

### 1.1 Namespace List

Here is a list of all namespaces with brief descriptions:

<a href="#">geom</a>	<a href="#">Line.hh</a> <a href="#">Line</a> class implementation . . . . .	<a href="#">7</a>
<a href="#">geom::detail</a>	. . . . .	<a href="#">19</a>





## Chapter 2

# Class Index

### 2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

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<a href="#">Line</a> class implementation . . . . .	<a href="#">21</a>
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## Chapter 3

# File Index

### 3.1 File List

Here is a list of all files with brief descriptions:

include/intersection/intersection.hh . . . . .	45
include/primitives/line.hh . . . . .	47
include/primitives/plane.hh . . . . .	50
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include/primitives/vector.hh . . . . .	56
lib/intersection/intersection.cc . . . . .	65
lib/primitives/line.cc . . . . .	65
lib/primitives/plane.cc . . . . .	65
lib/primitives/triangle.cc . . . . .	65
lib/primitives/vector.cc . . . . .	65



## Chapter 4

# Namespace Documentation

### 4.1 geom Namespace Reference

[line.hh](#) [Line](#) class implementation

#### Namespaces

- [detail](#)

#### Classes

- class [Line](#)  
*[Line](#) class implementation.*
- class [Plane](#)  
*[Plane](#) class realization.*
- class [Triangle](#)  
*[Triangle](#) class implementation.*
- class [Vector](#)  
*[Vector](#) class realization.*

#### Typedefs

- using [VectorD](#) = [Vector](#)< double >
- using [VectorF](#) = [Vector](#)< float >

## Functions

- `template<std::floating_point T>`  
`std::variant< std::monostate, Line< T >, Plane< T > > intersect (const Plane< T > &pl1, const Plane< T > &pl2)`
- `template<std::floating_point T>`  
`bool isIntersect (const Triangle< T > &tr1, const Triangle< T > &tr2)`
- `template<std::floating_point T>`  
`std::ostream & operator<< (std::ostream &ost, const Line< T > &line)`  
*Line print operator.*
- `template<std::floating_point T>`  
`bool operator== (const Line< T > &lhs, const Line< T > &rhs)`  
*Line equality operator.*
- `template<std::floating_point T>`  
`bool operator== (const Plane< T > &lhs, const Plane< T > &rhs)`  
*Plane equality operator.*
- `template<std::floating_point T>`  
`std::ostream & operator<< (std::ostream &ost, const Plane< T > &pl)`  
*Plane print operator.*
- `template<std::floating_point T>`  
`std::ostream & operator<< (std::ostream &ost, const Triangle< T > &tr)`  
*Triangle print operator.*
- `template<std::floating_point T>`  
`Vector< T > operator+ (const Vector< T > &lhs, const Vector< T > &rhs)`  
*Overloaded + operator.*
- `template<std::floating_point T>`  
`Vector< T > operator- (const Vector< T > &lhs, const Vector< T > &rhs)`  
*Overloaded - operator.*
- `template<Number nT, std::floating_point T>`  
`Vector< T > operator* (const nT &val, const Vector< T > &rhs)`  
*Overloaded multiple by value operator.*
- `template<Number nT, std::floating_point T>`  
`Vector< T > operator* (const Vector< T > &lhs, const nT &val)`  
*Overloaded multiple by value operator.*
- `template<Number nT, std::floating_point T>`  
`Vector< T > operator/ (const Vector< T > &lhs, const nT &val)`  
*Overloaded divide by value operator.*
- `template<std::floating_point T>`  
`T dot (const Vector< T > &lhs, const Vector< T > &rhs)`  
*Dot product function.*
- `template<std::floating_point T>`  
`Vector< T > cross (const Vector< T > &lhs, const Vector< T > &rhs)`  
*Cross product function.*
- `template<std::floating_point T>`  
`bool operator== (const Vector< T > &lhs, const Vector< T > &rhs)`  
*Vector equality operator.*
- `template<std::floating_point T>`  
`bool operator!= (const Vector< T > &lhs, const Vector< T > &rhs)`  
*Vector inequality operator.*
- `template<std::floating_point T>`  
`std::ostream & operator<< (std::ostream &ost, const Vector< T > &vec)`  
*Vector print operator.*

## Variables

- `template<class T >`  
`concept Number = std::is_floating_point_v<T> || std::is_integral_v<T>`  
*Useful concept which represents floating point and integral types.*

### 4.1.1 Detailed Description

[line.hh](#) [Line](#) class implementation

[triangle.hh](#) [Triangle](#) class implementation

[Plane](#) class implementation.

### 4.1.2 Typedef Documentation

#### 4.1.2.1 VectorD

```
using geom::VectorD = typedef Vector<double>
```

Definition at line [391](#) of file [vector.hh](#).

#### 4.1.2.2 VectorF

```
using geom::VectorF = typedef Vector<float>
```

Definition at line [392](#) of file [vector.hh](#).

### 4.1.3 Function Documentation

#### 4.1.3.1 intersect()

```
template<std::floating_point T>
std::variant<std::monostate, Line<T>, Plane<T> > geom::intersect (
    const Plane< T > & p11,
    const Plane< T > & p12 )
```

Definition at line [14](#) of file [intersection.hh](#).

References [cross\(\)](#), [geom::Plane< T >::isEqual\(\)](#), and [geom::Plane< T >::norm\(\)](#).

#### 4.1.3.2 isIntersect()

```
template<std::floating_point T>
bool geom::isIntersect (
    const Triangle< T > & tr1,
    const Triangle< T > & tr2 )
```

Definition at line 48 of file [intersection.hh](#).

References [geom::Plane< T >::getBy3Points\(\)](#), [geom::detail::isIntersect2D\(\)](#), and [geom::detail::isIntersectMollerHaines\(\)](#).

#### 4.1.3.3 operator<<() [1/4]

```
template<std::floating_point T>
std::ostream& geom::operator<< (
    std::ostream & ost,
    const Line< T > & line )
```

[Line](#) print operator.

##### Template Parameters

<i>T</i>	- floating point type of coordinates
----------	--------------------------------------

##### Parameters

<i>in, out</i>	<i>ost</i>	output stream
<i>in</i>	<i>line</i>	<a href="#">Line</a> to print

##### Returns

std::ostream& modified ostream instance

Definition at line 89 of file [line.hh](#).

References [geom::Line< T >::dir\(\)](#), and [geom::Line< T >::org\(\)](#).

#### 4.1.3.4 operator==( ) [1/3]

```
template<std::floating_point T>
bool geom::operator==(
    const Line< T > & lhs,
    const Line< T > & rhs )
```

[Line](#) equality operator.



## Template Parameters

<i>T</i>	- floating point type of coordinates
----------	--------------------------------------

## Parameters

in	<i>lhs</i>	1st line
in	<i>rhs</i>	2nd line

## Returns

true if lines are equal  
false if lines are not equal

Definition at line 105 of file [line.hh](#).

References [geom::Line< T >::isEqual\(\)](#).

## 4.1.3.5 operator==( ) [2/3]

```
template<std::floating_point T>
bool geom::operator== (
    const Plane< T > & lhs,
    const Plane< T > & rhs )
```

[Plane](#) equality operator.

## Template Parameters

<i>T</i>	- floating point type of coordinates
----------	--------------------------------------

## Parameters

in	<i>lhs</i>	1st plane
in	<i>rhs</i>	2nd plane

## Returns

true if planes are equal  
false if planes are not equal

Definition at line 147 of file [plane.hh](#).

References [geom::Plane< T >::isEqual\(\)](#).

#### 4.1.3.6 `operator<<()` [2/4]

```
template<std::floating_point T>
std::ostream& geom::operator<< (
    std::ostream & ost,
    const Plane< T > & pl )
```

[Plane](#) print operator.

##### Template Parameters

<i>T</i>	- floating point type of coordinates
----------	--------------------------------------

##### Parameters

<i>in, out</i>	<i>ost</i>	output stream
<i>in</i>	<i>pl</i>	plane to print

##### Returns

`std::ostream&` modified ostream instance

Definition at line 161 of file [plane.hh](#).

References [geom::Plane< T >::dist\(\)](#), and [geom::Plane< T >::norm\(\)](#).

#### 4.1.3.7 `operator<<()` [3/4]

```
template<std::floating_point T>
std::ostream& geom::operator<< (
    std::ostream & ost,
    const Triangle< T > & tr )
```

[Triangle](#) print operator.

##### Template Parameters

<i>T</i>	- floating point type of coordinates
----------	--------------------------------------

##### Parameters

<i>in, out</i>	<i>ost</i>	output stream
<i>in</i>	<i>tr</i>	<a href="#">Triangle</a> to print

##### Returns

`std::ostream&` modified ostream instance

Definition at line 60 of file [triangle.hh](#).

#### 4.1.3.8 operator+()

```
template<std::floating_point T>
Vector<T> geom::operator+ (
    const Vector< T > & lhs,
    const Vector< T > & rhs )
```

Overloaded + operator.

##### Template Parameters

<i>T</i>	vector template parameter
----------	---------------------------

##### Parameters

in	<i>lhs</i>	first vector
in	<i>rhs</i>	second vector

##### Returns

Vector<T> sum of two vectors

Definition at line 244 of file [vector.hh](#).

#### 4.1.3.9 operator-()

```
template<std::floating_point T>
Vector<T> geom::operator- (
    const Vector< T > & lhs,
    const Vector< T > & rhs )
```

Overloaded - operator.

##### Template Parameters

<i>T</i>	vector template parameter
----------	---------------------------

##### Parameters

in	<i>lhs</i>	first vector
in	<i>rhs</i>	second vector

**Returns**

Vector<T> res of two vectors

Definition at line 260 of file [vector.hh](#).

**4.1.3.10 operator\*() [1/2]**

```
template<Number nT, std::floating_point T>
Vector<T> geom::operator* (
    const nT & val,
    const Vector< T > & rhs )
```

Overloaded multiple by value operator.

**Template Parameters**

<i>nT</i>	type of value to multiply by
<i>T</i>	vector template parameter

**Parameters**

in	<i>val</i>	value to multiply by
in	<i>rhs</i>	vector to multiply by value

**Returns**

Vector<T> result vector

Definition at line 277 of file [vector.hh](#).

**4.1.3.11 operator\*() [2/2]**

```
template<Number nT, std::floating_point T>
Vector<T> geom::operator* (
    const Vector< T > & lhs,
    const nT & val )
```

Overloaded multiple by value operator.

**Template Parameters**

<i>nT</i>	type of value to multiply by
<i>T</i>	vector template parameter

## Parameters

in	<i>val</i>	value to multiply by
in	<i>lhs</i>	vector to multiply by value

## Returns

Vector<T> result vector

Definition at line 294 of file [vector.hh](#).

## 4.1.3.12 operator/()

```
template<Number nT, std::floating_point T>
Vector<T> geom::operator/ (
    const Vector< T > & lhs,
    const nT & val )
```

Overloaded divide by value operator.

## Template Parameters

<i>nT</i>	type of value to divide by
<i>T</i>	vector template parameter

## Parameters

in	<i>val</i>	value to divide by
in	<i>lhs</i>	vector to divide by value

## Returns

Vector<T> result vector

Definition at line 311 of file [vector.hh](#).

## 4.1.3.13 dot()

```
template<std::floating_point T>
T geom::dot (
    const Vector< T > & lhs,
    const Vector< T > & rhs )
```

Dot product function.

## Template Parameters

<i>T</i>	vector template parameter
----------	---------------------------

## Parameters

in	<i>lhs</i>	first vector
in	<i>rhs</i>	second vector

## Returns

T dot production

Definition at line 327 of file [vector.hh](#).

References [geom::Vector< T >::dot\(\)](#).

Referenced by [geom::Vector< T >::isPerp\(\)](#), and [geom::Vector< T >::length2\(\)](#).

## 4.1.3.14 cross()

```
template<std::floating_point T>
Vector<T> geom::cross (
    const Vector< T > & lhs,
    const Vector< T > & rhs )
```

Cross product function.

## Template Parameters

<i>T</i>	vector template parameter
----------	---------------------------

## Parameters

in	<i>lhs</i>	first vector
in	<i>rhs</i>	second vector

## Returns

T cross production

Definition at line 341 of file [vector.hh](#).

References [geom::Vector< T >::cross\(\)](#).

Referenced by [intersect\(\)](#), and [geom::Vector< T >::isPar\(\)](#).

**4.1.3.15 operator==( ) [3/3]**

```
template<std::floating_point T>
bool geom::operator== (
    const Vector< T > & lhs,
    const Vector< T > & rhs )
```

Vector equality operator.

**Template Parameters**

<i>T</i>	vector template parameter
----------	---------------------------

**Parameters**

in	<i>lhs</i>	first vector
in	<i>rhs</i>	second vector

**Returns**

true if vectors are equal  
false otherwise

Definition at line 356 of file [vector.hh](#).

References [geom::Vector< T >::isEqual\(\)](#).

**4.1.3.16 operator!=( )**

```
template<std::floating_point T>
bool geom::operator!= (
    const Vector< T > & lhs,
    const Vector< T > & rhs )
```

Vector inequality operator.

**Template Parameters**

<i>T</i>	vector template parameter
----------	---------------------------

**Parameters**

in	<i>lhs</i>	first vector
in	<i>rhs</i>	second vector

**Returns**

true if vectors are not equal  
false otherwise

Definition at line 371 of file [vector.hh](#).

**4.1.3.17 operator<<() [4/4]**

```
template<std::floating_point T>
std::ostream& geom::operator<< (
    std::ostream & ost,
    const Vector< T > & vec )
```

[Vector](#) print operator.

**Template Parameters**

<i>T</i>	vector template parameter
----------	---------------------------

**Parameters**

<i>in, out</i>	<i>ost</i>	output stream
<i>in</i>	<i>vec</i>	vector to print

**Returns**

std::ostream& modified stream instance

Definition at line 385 of file [vector.hh](#).

References [geom::Vector< T >::x](#), [geom::Vector< T >::y](#), and [geom::Vector< T >::z](#).

**4.1.4 Variable Documentation****4.1.4.1 Number**

```
template<class T >
concept geom::Number = std::is_floating_point_v<T> || std::is_integral_v<T>
```

Useful concept which represents floating point and integral types.

@concept Number



## Template Parameters

<i>T</i>	
----------	--

Definition at line 25 of file [vector.hh](#).

## 4.2 geom::detail Namespace Reference

### Functions

- `template<std::floating_point T>`  
`bool isIntersect2D (const Triangle< T > &tr1, const Triangle< T > &tr2)`
- `template<std::floating_point T>`  
`bool isIntersectMollerHaines (const Triangle< T > &tr1, const Triangle< T > &tr2)`

### 4.2.1 Function Documentation

#### 4.2.1.1 isIntersect2D()

```
template<std::floating_point T>
bool geom::detail::isIntersect2D (
    const Triangle< T > & tr1,
    const Triangle< T > & tr2 )
```

Definition at line 33 of file [intersection.hh](#).

Referenced by [geom::isIntersect\(\)](#).

#### 4.2.1.2 isIntersectMollerHaines()

```
template<std::floating_point T>
bool geom::detail::isIntersectMollerHaines (
    const Triangle< T > & tr1,
    const Triangle< T > & tr2 )
```

Definition at line 40 of file [intersection.hh](#).

Referenced by [geom::isIntersect\(\)](#).



## Chapter 5

# Class Documentation

### 5.1 geom::Line< T > Class Template Reference

[Line](#) class implementation.

```
#include <line.hh>
```

#### Public Member Functions

- [Line](#) (const [Vector](#)< T > &[org](#), const [Vector](#)< T > &[dir](#))  
*Construct a new [Line](#) object.*
- const [Vector](#)< T > & [org](#) () const  
*Getter for origin vector.*
- const [Vector](#)< T > & [dir](#) () const  
*Getter for direction vector.*
- bool [belongs](#) (const [Vector](#)< T > &point) const  
*Checks is point belongs to line.*
- bool [isEqual](#) (const [Line](#) &line) const  
*Checks is \*this equals to another line.*

#### Static Public Member Functions

- static [Line](#) [getBy2Points](#) (const [Vector](#)< T > &p1, const [Vector](#)< T > &p2)  
*Get line by 2 points.*

#### 5.1.1 Detailed Description

```
template<std::floating_point T>  
class geom::Line< T >
```

[Line](#) class implementation.

### Template Parameters

<i>T</i>	- floating point type of coordinates
----------	--------------------------------------

Definition at line 21 of file [line.hh](#).

## 5.1.2 Constructor & Destructor Documentation

### 5.1.2.1 Line()

```
template<std::floating_point T>
geom::Line< T >::Line (
    const Vector< T > & org,
    const Vector< T > & dir )
```

Construct a new [Line](#) object.

#### Parameters

in	<i>org</i>	origin vector
in	<i>dir</i>	direction vector

Definition at line 111 of file [line.hh](#).

References [geom::Line< T >::org\(\)](#).

## 5.1.3 Member Function Documentation

### 5.1.3.1 org()

```
template<std::floating_point T>
const Vector< T > & geom::Line< T >::org
```

Getter for origin vector.

#### Returns

const Vector<T>& const reference to origin vector

Definition at line 118 of file [line.hh](#).

Referenced by [geom::Plane< T >::belongs\(\)](#), [geom::Line< T >::Line\(\)](#), and [geom::operator<<\(\)](#).

### 5.1.3.2 dir()

```
template<std::floating_point T>
const Vector< T > & geom::Line< T >::dir
```

Getter for direction vector.

#### Returns

const Vector<T>& const reference to direction vector

Definition at line 124 of file [line.hh](#).

Referenced by [geom::Plane< T >::belongs\(\)](#), and [geom::operator<<\(\)](#).

### 5.1.3.3 belongs()

```
template<std::floating_point T>
bool geom::Line< T >::belongs (
    const Vector< T > & point ) const
```

Checks is point belongs to line.

#### Parameters

in	<i>point</i>	const reference to point vector
----	--------------	---------------------------------

#### Returns

true if point belongs to line  
false if point doesn't belong to line

Definition at line 130 of file [line.hh](#).

### 5.1.3.4 isEqual()

```
template<std::floating_point T>
bool geom::Line< T >::isEqual (
    const Line< T > & line ) const
```

Checks is \*this equals to another line.

#### Parameters

in	<i>line</i>	const reference to another line
----	-------------	---------------------------------

**Returns**

true if lines are equal  
false if lines are not equal

Definition at line 136 of file [line.hh](#).

Referenced by [geom::operator==\( \)](#).

**5.1.3.5 getBy2Points()**

```
template<std::floating_point T>
Line< T > geom::Line< T >::getBy2Points (
    const Vector< T > & p1,
    const Vector< T > & p2 ) [static]
```

Get line by 2 points.

**Parameters**

in	<i>p1</i>	1st point
in	<i>p2</i>	2nd point

**Returns**

[Line](#) passing through two points

Definition at line 142 of file [line.hh](#).

The documentation for this class was generated from the following file:

- [include/primitives/line.hh](#)

**5.2 geom::Plane< T > Class Template Reference**

[Plane](#) class realization.

```
#include <plane.hh>
```

**Public Member Functions**

- [T dist](#) () const  
*Getter for distance.*
- const [Vector](#)< T > & [norm](#) () const  
*Getter for normal vector.*
- bool [belongs](#) (const [Vector](#)< T > &point) const  
*Checks if point belongs to plane.*
- bool [belongs](#) (const [Line](#)< T > &line) const  
*Checks if line belongs to plane.*
- bool [isEqual](#) (const [Plane](#) &rhs) const  
*Checks is \*this equals to another plane.*
- bool [isPar](#) (const [Plane](#) &rhs) const  
*Checks is \*this is parallel to another plane.*

## Static Public Member Functions

- static [Plane getBy3Points](#) (const [Vector](#)< T > &pt1, const [Vector](#)< T > &pt2, const [Vector](#)< T > &pt3)  
*Get plane by 3 points.*
- static [Plane getParametric](#) (const [Vector](#)< T > &org, const [Vector](#)< T > &dir1, const [Vector](#)< T > &dir2)  
*Get plane from parametric plane equation.*
- static [Plane getNormalPoint](#) (const [Vector](#)< T > &norm, const [Vector](#)< T > &point)  
*Get plane from normal point plane equation.*
- static [Plane getNormalDist](#) (const [Vector](#)< T > &norm, T constant)  
*Get plane from normal const plane equation.*

### 5.2.1 Detailed Description

```
template<std::floating_point T>
class geom::Plane< T >
```

[Plane](#) class realization.

Template Parameters

<a href="#">T</a>	- floating point type of coordinates
-------------------	--------------------------------------

Definition at line 24 of file [plane.hh](#).

### 5.2.2 Member Function Documentation

#### 5.2.2.1 dist()

```
template<std::floating_point T>
T geom::Plane< T >::dist
```

Getter for distance.

Returns

T value of distance

Definition at line 175 of file [plane.hh](#).

Referenced by [geom::operator<<\(\)](#).

### 5.2.2.2 norm()

```
template<std::floating_point T>
const Vector< T > & geom::Plane< T >::norm
```

Getter for normal vector.

#### Returns

const Vector<T>& const reference to normal vector

Definition at line 181 of file [plane.hh](#).

Referenced by [geom::intersect\(\)](#), and [geom::operator<<\(\)](#).

### 5.2.2.3 belongs() [1/2]

```
template<std::floating_point T>
bool geom::Plane< T >::belongs (
    const Vector< T > & point ) const
```

Checks if point belongs to plane.

#### Parameters

in	<i>point</i>	const referene to point vector
----	--------------	--------------------------------

#### Returns

true if point belongs to plane

false if point doesn't belong to plane

Definition at line 187 of file [plane.hh](#).

### 5.2.2.4 belongs() [2/2]

```
template<std::floating_point T>
bool geom::Plane< T >::belongs (
    const Line< T > & line ) const
```

Checks if line belongs to plane.

#### Parameters

in	<i>line</i>	const referene to line
----	-------------	------------------------



**Returns**

true if line belongs to plane  
false if line doesn't belong to plane

Definition at line 193 of file [plane.hh](#).

References [geom::Line< T >::dir\(\)](#), and [geom::Line< T >::org\(\)](#).

**5.2.2.5 isEqual()**

```
template<std::floating_point T>
bool geom::Plane< T >::isEqual (
    const Plane< T > & rhs ) const
```

Checks is \*this equals to another plane.

**Parameters**

<code>in</code>	<code>rhs</code>	const reference to another plane
-----------------	------------------	----------------------------------

**Returns**

true if planes are equal  
false if planes are not equal

Definition at line 199 of file [plane.hh](#).

Referenced by [geom::intersect\(\)](#), and [geom::operator==\(\)](#).

**5.2.2.6 isPar()**

```
template<std::floating_point T>
bool geom::Plane< T >::isPar (
    const Plane< T > & rhs ) const
```

Checks is \*this is parallel to another plane.

**Parameters**

<code>in</code>	<code>rhs</code>	const reference to another plane
-----------------	------------------	----------------------------------

**Returns**

true if planes are parallel  
false if planes are not parallel

Definition at line 205 of file [plane.hh](#).

References [geom::Plane< T >::isPar\(\)](#).

Referenced by [geom::Plane< T >::isPar\(\)](#).

#### 5.2.2.7 getBy3Points()

```
template<std::floating_point T>
Plane< T > geom::Plane< T >::getBy3Points (
    const Vector< T > & pt1,
    const Vector< T > & pt2,
    const Vector< T > & pt3 ) [static]
```

Get plane by 3 points.

##### Parameters

in	<i>pt1</i>	1st point
in	<i>pt2</i>	2nd point
in	<i>pt3</i>	3rd point

##### Returns

[Plane](#) passing through three points

Definition at line 211 of file [plane.hh](#).

Referenced by [geom::isIntersect\(\)](#).

#### 5.2.2.8 getParametric()

```
template<std::floating_point T>
Plane< T > geom::Plane< T >::getParametric (
    const Vector< T > & org,
    const Vector< T > & dir1,
    const Vector< T > & dir2 ) [static]
```

Get plane from parametric plane equation.

##### Parameters

in	<i>org</i>	origin vector
in	<i>dir1</i>	1st direction vector
in	<i>dir2</i>	2nd direction vector

## Returns

[Plane](#)Definition at line 218 of file [plane.hh](#).References [geom::Vector< T >::cross\(\)](#).**5.2.2.9 getNormalPoint()**

```
template<std::floating_point T>
Plane< T > geom::Plane< T >::getNormalPoint (
    const Vector< T > & norm,
    const Vector< T > & point ) [static]
```

Get plane from normal point plane equation.

## Parameters

in	<i>norm</i>	normal vector
in	<i>point</i>	point lying on the plane

## Returns

[Plane](#)Definition at line 226 of file [plane.hh](#).References [geom::Vector< T >::normalized\(\)](#).**5.2.2.10 getNormalDist()**

```
template<std::floating_point T>
Plane< T > geom::Plane< T >::getNormalDist (
    const Vector< T > & norm,
    T constant ) [static]
```

Get plane form normal const plane equation.

## Parameters

in	<i>norm</i>	normal vector
in	<i>constant</i>	distance

Returns

[Plane](#)

Definition at line 233 of file [plane.hh](#).

References [geom::Vector< T >::normalized\(\)](#).

The documentation for this class was generated from the following file:

- [include/primitives/plane.hh](#)

## 5.3 [geom::Triangle< T >](#) Class Template Reference

[Triangle](#) class implementation.

```
#include <triangle.hh>
```

### Public Member Functions

- [Triangle](#) (const [Vector< T >](#) &p1, const [Vector< T >](#) &p2, const [Vector< T >](#) &p3)  
*Construct a new [Triangle](#) object from 3 points.*
- const [Vector< T >](#) & [operator\[\]](#) (std::size\_t idx) const  
*Overloaded operator[] to get access to vertices.*

### 5.3.1 Detailed Description

```
template<std::floating_point T>
class geom::Triangle< T >
```

[Triangle](#) class implementation.

Template Parameters

<i>T</i>	- floating point type of coordinates
----------	--------------------------------------

Definition at line 24 of file [triangle.hh](#).

### 5.3.2 Constructor & Destructor Documentation

#### 5.3.2.1 [Triangle\(\)](#)

```
template<std::floating_point T>
geom::Triangle< T >::Triangle (
```

```
const Vector< T > & p1,
const Vector< T > & p2,
const Vector< T > & p3 )
```

Construct a new [Triangle](#) object from 3 points.

#### Parameters

in	<i>p1</i>	1st point
in	<i>p2</i>	2nd point
in	<i>p3</i>	3rd point

Definition at line 72 of file [triangle.hh](#).

### 5.3.3 Member Function Documentation

#### 5.3.3.1 operator[]()

```
template<std::floating_point T>
const Vector< T > & geom::Triangle< T >::operator[] (
    std::size_t idx ) const
```

Overloaded operator[] to get access to vertices.

#### Parameters

in	<i>idx</i>	index of vertex
----	------------	-----------------

#### Returns

const Vector<T>& const reference to vertex

Definition at line 77 of file [triangle.hh](#).

The documentation for this class was generated from the following file:

- include/primitives/[triangle.hh](#)

## 5.4 geom::Vector< T > Class Template Reference

[Vector](#) class realization.

```
#include <vector.hh>
```

## Public Member Functions

- [Vector](#) (T coordX, T coordY, T coordZ)  
*Construct a new [Vector](#) object from 3 coordinates.*
- [Vector](#) (T coordX={})  
*Construct a new [Vector](#) object with equals coordinates.*
- [Vector](#) & [operator+=](#) (const [Vector](#) &vec)  
*Overloaded += operator Increments vector coordinates by corresponding coordinates of vec.*
- [Vector](#) & [operator-=](#) (const [Vector](#) &vec)  
*Overloaded -= operator Decrements vector coordinates by corresponding coordinates of vec.*
- [Vector](#) [operator-](#) () const  
*Unary - operator.*
- template<Number nType>  
[Vector](#) & [operator\\*=  
Overloaded \\*= by number operator.](#) (nType val)
- template<Number nType>  
[Vector](#) & [operator/=](#) (nType val)  
*Overloaded /= by number operator.*
- T [dot](#) (const [Vector](#) &rhs) const  
*Dot product function.*
- [Vector](#) [cross](#) (const [Vector](#) &rhs) const  
*Cross product function.*
- T [length2](#) () const  
*Calculate squared length of a vector function.*
- T [length](#) () const  
*Calculate length of a vector function.*
- [Vector](#) [normalized](#) () const  
*Get normalized vector function.*
- [Vector](#) & [normalize](#) ()  
*Normalize vector function.*
- T & [operator\[\]](#) (size\_t i)  
*Overloaded operator [] (non-const version) To get access to coordinates.*
- T [operator\[\]](#) (size\_t i) const  
*Overloaded operator [] (const version) To get access to coordinates.*
- bool [isPar](#) (const [Vector](#) &rhs) const  
*Check if vector is parallel to another.*
- bool [isPerp](#) (const [Vector](#) &rhs) const  
*Check if vector is perpendicular to another.*
- bool [isEqual](#) (const [Vector](#) &rhs) const  
*Check if vector is equal to another.*
- template<Number nType>  
[Vector](#)< T > & [operator\\*=  
Overloaded \\*= by number operator.](#) (nType val)
- template<Number nType>  
[Vector](#)< T > & [operator/=](#) (nType val)

## Static Public Member Functions

- static bool [isNumEq](#) (T lhs, T rhs)  
*Check equality (with threshold) of two floating point numbers function.*
- static void [setThreshold](#) (T thres)  
*Set new threshold value.*
- static void [getThreshold](#) ()  
*Get current threshold value.*
- static void [setDefThreshold](#) ()  
*Set threshold to default value.*

## Public Attributes

- `T x {}`  
*Vector* coordinates.
- `T y {}`
- `T z {}`

### 5.4.1 Detailed Description

```
template<std::floating_point T>
class geom::Vector< T >
```

*Vector* class realization.

Template Parameters

<i>T</i>	- floating point type of coordinates
----------	--------------------------------------

Definition at line 34 of file [vector.hh](#).

### 5.4.2 Constructor & Destructor Documentation

#### 5.4.2.1 Vector() [1/2]

```
template<std::floating_point T>
geom::Vector< T >::Vector (
    T coordX,
    T coordY,
    T coordZ ) [inline]
```

Construct a new *Vector* object from 3 coordinates.

Parameters

in	<i>coordX</i>	x coordinate
in	<i>coordY</i>	y coordinate
in	<i>coordZ</i>	z coordinate

Definition at line 55 of file [vector.hh](#).

#### 5.4.2.2 Vector() [2/2]

```
template<std::floating_point T>
geom::Vector< T >::Vector (
    T coordX = {} ) [inline], [explicit]
```

Construct a new [Vector](#) object with equals coordinates.

#### Parameters

in	<i>coordX</i>	coordinate (default to {})
----	---------------	----------------------------

Definition at line 63 of file [vector.hh](#).

### 5.4.3 Member Function Documentation

#### 5.4.3.1 operator+=()

```
template<std::floating_point T>
Vector< T > & geom::Vector< T >::operator+= (
    const Vector< T > & vec )
```

Overloaded += operator Increments vector coordinates by corresponding coordinates of vec.

#### Parameters

in	<i>vec</i>	vector to incremented with
----	------------	----------------------------

#### Returns

[Vector](#)& reference to current instance

Definition at line 395 of file [vector.hh](#).

References [geom::Vector< T >::x](#), [geom::Vector< T >::y](#), and [geom::Vector< T >::z](#).

#### 5.4.3.2 operator-=()

```
template<std::floating_point T>
Vector< T > & geom::Vector< T >::operator-= (
    const Vector< T > & vec )
```

Overloaded -= operator Decrements vector coordinates by corresponding coordinates of vec.

#### Parameters

in	<i>vec</i>	vector to decremented with
----	------------	----------------------------



**Returns**

[Vector](#)& reference to current instance

Definition at line 405 of file [vector.hh](#).

References [geom::Vector< T >::x](#), [geom::Vector< T >::y](#), and [geom::Vector< T >::z](#).

**5.4.3.3 operator-()**

```
template<std::floating_point T>
Vector< T > geom::Vector< T >::operator-
```

Unary - operator.

**Returns**

[Vector](#) negated [Vector](#) instance

Definition at line 415 of file [vector.hh](#).

**5.4.3.4 operator\*=( ) [1/2]**

```
template<std::floating_point T>
template<Number nType>
Vector& geom::Vector< T >::operator*= (
    nType val )
```

Overloaded \*= by number operator.

**Template Parameters**

<i>nType</i>	numeric type of value to multiply by
--------------	--------------------------------------

**Parameters**

in	<i>val</i>	value to multiply by
----	------------	----------------------

**Returns**

[Vector](#)& reference to vector instance

#### 5.4.3.5 operator/=( ) [1/2]

```
template<std::floating_point T>
template<Number nType>
Vector& geom::Vector< T >::operator/= (
    nType val )
```

Overloaded /= by number operator.

##### Template Parameters

<i>nType</i>	numeric type of value to divide by
--------------	------------------------------------

##### Parameters

in	<i>val</i>	value to divide by
----	------------	--------------------

##### Returns

Vector& reference to vector instance

##### Warning

Does not check if val equals 0

#### 5.4.3.6 dot()

```
template<std::floating_point T>
T geom::Vector< T >::dot (
    const Vector< T > & rhs ) const
```

Dot product function.

##### Parameters

<i>rhs</i>	vector to dot product with
------------	----------------------------

##### Returns

T dot product of two vectors

Definition at line 443 of file [vector.hh](#).

References [geom::Vector< T >::x](#), [geom::Vector< T >::y](#), and [geom::Vector< T >::z](#).

Referenced by [geom::dot\(\)](#).

#### 5.4.3.7 cross()

```
template<std::floating_point T>
Vector< T > geom::Vector< T >::cross (
    const Vector< T > & rhs ) const
```

Cross product function.

##### Parameters

<i>rhs</i>	vector to cross product with
------------	------------------------------

##### Returns

Vector cross product of two vectors

Definition at line 449 of file [vector.hh](#).

References [geom::Vector< T >::x](#), [geom::Vector< T >::y](#), and [geom::Vector< T >::z](#).

Referenced by [geom::cross\(\)](#), and [geom::Plane< T >::getParametric\(\)](#).

#### 5.4.3.8 length2()

```
template<std::floating_point T>
T geom::Vector< T >::length2
```

Calculate squared length of a vector function.

##### Returns

T length<sup>2</sup>

Definition at line 455 of file [vector.hh](#).

References [geom::dot\(\)](#).

#### 5.4.3.9 length()

```
template<std::floating_point T>
T geom::Vector< T >::length
```

Calculate length of a vector function.

##### Returns

T length

Definition at line 461 of file [vector.hh](#).

#### 5.4.3.10 normalized()

```
template<std::floating_point T>
Vector< T > geom::Vector< T >::normalized
```

Get normalized vector function.

##### Returns

Vector normalized vector

Definition at line 467 of file [vector.hh](#).

References [geom::Vector< T >::normalize\(\)](#).

Referenced by [geom::Plane< T >::getNormalDist\(\)](#), and [geom::Plane< T >::getNormalPoint\(\)](#).

#### 5.4.3.11 normalize()

```
template<std::floating_point T>
Vector< T > & geom::Vector< T >::normalize
```

Normalize vector function.

##### Returns

Vector& reference to instance

Definition at line 475 of file [vector.hh](#).

Referenced by [geom::Vector< T >::normalized\(\)](#).

#### 5.4.3.12 operator[]() [1/2]

```
template<std::floating_point T>
T & geom::Vector< T >::operator[] (
    size_t i )
```

Overloaded operator [] (non-const version) To get access to coordinates.

##### Parameters

<i>i</i>	index of coordinate (0 - x, 1 - y, 2 - z)
----------	---

**Returns**

T& reference to coordinate value

**Note**

Coordinates calculated by mod 3

Definition at line 484 of file [vector.hh](#).

**5.4.3.13 operator[]()** [2/2]

```
template<std::floating_point T>
T geom::Vector< T >::operator[] (
    size_t i ) const
```

Overloaded operator [] (const version) To get access to coordinates.

**Parameters**

<i>i</i>	index of coordinate (0 - x, 1 - y, 2 - z)
----------	---

**Returns**

T coordinate value

**Note**

Coordinates calculated by mod 3

Definition at line 500 of file [vector.hh](#).

**5.4.3.14 isPar()**

```
template<std::floating_point T>
bool geom::Vector< T >::isPar (
    const Vector< T > & rhs ) const
```

Check if vector is parallel to another.

**Parameters**

<i>in</i>	<i>rhs</i>	vector to check parallelism with
-----------	------------	----------------------------------

**Returns**

true if vector is parallel  
false otherwise

Definition at line 516 of file [vector.hh](#).

References [geom::cross\(\)](#).

**5.4.3.15 isPerp()**

```
template<std::floating_point T>
bool geom::Vector< T >::isPerp (
    const Vector< T > & rhs ) const
```

Check if vector is perpendicular to another.

**Parameters**

<i>in</i>	<i>rhs</i>	vector to check perpendicularity with
-----------	------------	---------------------------------------

**Returns**

true if vector is perpendicular  
false otherwise

Definition at line 522 of file [vector.hh](#).

References [geom::dot\(\)](#).

**5.4.3.16 isEqual()**

```
template<std::floating_point T>
bool geom::Vector< T >::isEqual (
    const Vector< T > & rhs ) const
```

Check if vector is equal to another.

**Parameters**

<i>in</i>	<i>rhs</i>	vector to check equality with
-----------	------------	-------------------------------

**Returns**

true if vector is equal  
false otherwise

**Note**

Equality check performs using `isNumEq(T lhs, T rhs)` function

Definition at line 528 of file `vector.hh`.

References `geom::Vector< T >::x`, `geom::Vector< T >::y`, and `geom::Vector< T >::z`.

Referenced by `geom::operator==()`.

**5.4.3.17 isNumEq()**

```
template<std::floating_point T>
bool geom::Vector< T >::isNumEq (
    T lhs,
    T rhs ) [static]
```

Check equality (with threshold) of two floating point numbers function.

**Parameters**

in	<i>lhs</i>	first number
in	<i>rhs</i>	second number

**Returns**

true if numbers equals with threshold ( $|lhs - rhs| < \text{threshold}$ )  
false otherwise

**Note**

Threshold defined by `threshold_` static member

Definition at line 534 of file `vector.hh`.

**5.4.3.18 setThreshold()**

```
template<std::floating_point T>
void geom::Vector< T >::setThreshold (
    T thres ) [static]
```

Set new threshold value.

**Parameters**

in	<i>thres</i>	value to set
----	--------------	--------------

Definition at line 540 of file [vector.hh](#).

#### 5.4.3.19 getThreshold()

```
template<std::floating_point T>
void geom::Vector< T >::getThreshold [static]
```

Get current threshold value.

Definition at line 546 of file [vector.hh](#).

#### 5.4.3.20 setDefThreshold()

```
template<std::floating_point T>
void geom::Vector< T >::setDefThreshold [static]
```

Set threshold to default value.

##### Note

default value equals float point epsilon

Definition at line 552 of file [vector.hh](#).

#### 5.4.3.21 operator\*=( ) [2/2]

```
template<std::floating_point T>
template<Number nType>
Vector<T>& geom::Vector< T >::operator*= (
    nType val )
```

Definition at line 422 of file [vector.hh](#).

#### 5.4.3.22 operator/=( ) [2/2]

```
template<std::floating_point T>
template<Number nType>
Vector<T>& geom::Vector< T >::operator/= (
    nType val )
```

Definition at line 433 of file [vector.hh](#).



## 5.4.4 Member Data Documentation

### 5.4.4.1 x

```
template<std::floating_point T>
T geom::Vector< T >::x {}
```

Vector coordinates.

Definition at line 46 of file [vector.hh](#).

Referenced by [geom::Vector< T >::cross\(\)](#), [geom::Vector< T >::dot\(\)](#), [geom::Vector< T >::isEqual\(\)](#), [geom::Vector< T >::operator+](#), [geom::Vector< T >::operator-=\(\)](#), and [geom::operator<<\(\)](#).

### 5.4.4.2 y

```
template<std::floating_point T>
T geom::Vector< T >::y {}
```

Definition at line 46 of file [vector.hh](#).

Referenced by [geom::Vector< T >::cross\(\)](#), [geom::Vector< T >::dot\(\)](#), [geom::Vector< T >::isEqual\(\)](#), [geom::Vector< T >::operator+](#), [geom::Vector< T >::operator-=\(\)](#), and [geom::operator<<\(\)](#).

### 5.4.4.3 z

```
template<std::floating_point T>
T geom::Vector< T >::z {}
```

Definition at line 46 of file [vector.hh](#).

Referenced by [geom::Vector< T >::cross\(\)](#), [geom::Vector< T >::dot\(\)](#), [geom::Vector< T >::isEqual\(\)](#), [geom::Vector< T >::operator+](#), [geom::Vector< T >::operator-=\(\)](#), and [geom::operator<<\(\)](#).

The documentation for this class was generated from the following file:

- [include/primitives/vector.hh](#)



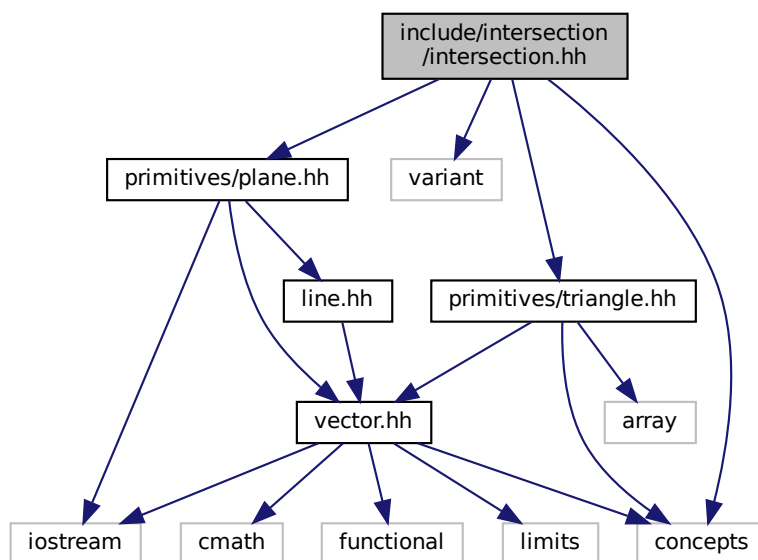
## Chapter 6

# File Documentation

### 6.1 include/intersection/intersection.hh File Reference

```
#include <concepts>
#include <variant>
#include "primitives/plane.hh"
#include "primitives/triangle.hh"
```

Include dependency graph for intersection.hh:



### Namespaces

- [geom](#)
  - [line.hh](#) *Line* class implementation
- [geom::detail](#)

## Functions

- `template<std::floating_point T>`  
`std::variant< std::monostate, Line< T >, Plane< T > >` [geom::intersect](#) (const Plane< T > &pl1, const Plane< T > &pl2)
- `template<std::floating_point T>`  
`bool` [geom::detail::isIntersect2D](#) (const Triangle< T > &tr1, const Triangle< T > &tr2)
- `template<std::floating_point T>`  
`bool` [geom::detail::isIntersectMollerHaines](#) (const Triangle< T > &tr1, const Triangle< T > &tr2)
- `template<std::floating_point T>`  
`bool` [geom::isIntersect](#) (const Triangle< T > &tr1, const Triangle< T > &tr2)

## 6.2 intersection.hh

```

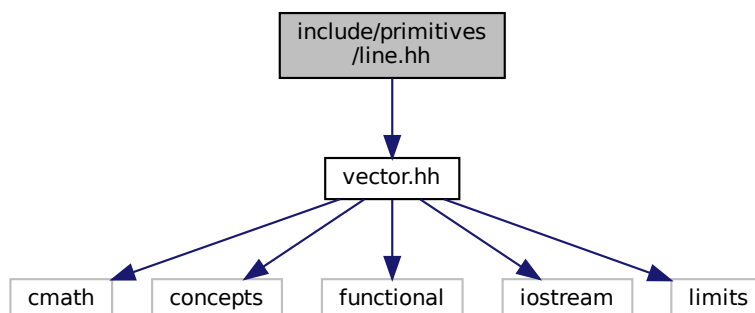
00001 #ifndef __INCLUDE_INTERSECTION_INTERSECTION_HH__
00002 #define __INCLUDE_INTERSECTION_INTERSECTION_HH__
00003
00004 #include <concepts>
00005 #include <variant>
00006
00007 #include "primitives/plane.hh"
00008 #include "primitives/triangle.hh"
00009
00010 namespace geom
00011 {
00012
00013 template <std::floating_point T>
00014 std::variant<std::monostate, Line<T>, Plane<T>> intersect(const Plane<T> &pl1,
00015                                                         const Plane<T> &pl2)
00016 {
00017     auto dir = cross(pl1.norm(), pl2.norm());
00018
00019     if (Vector<T>{0} == dir)
00020     {
00021         if (pl1.isEqual(pl2))
00022             return pl1;
00023
00024         return {};
00025     }
00026     return {};
00027 }
00028
00029 namespace detail
00030 {
00031
00032 template <std::floating_point T>
00033 bool isIntersect2D(const Triangle<T> &tr1, const Triangle<T> &tr2)
00034 {
00035     assert(false && "Not implemented yet");
00036     return false;
00037 }
00038
00039 template <std::floating_point T>
00040 bool isIntersectMollerHaines(const Triangle<T> &tr1, const Triangle<T> &tr2)
00041 {
00042     assert(false && "Not implemented yet");
00043     return false;
00044 }
00045 } // namespace detail
00046
00047 template <std::floating_point T>
00048 bool isIntersect(const Triangle<T> &tr1, const Triangle<T> &tr2)
00049 {
00050     auto pl1 = Plane<T>::getBy3Points(tr1[0], tr1[1], tr1[2]);
00051     auto pl2 = Plane<T>::getBy3Points(tr2[0], tr2[1], tr2[2]);
00052
00053     if (pl1 == pl2)
00054         return detail::isIntersect2D(tr1, tr2);
00055
00056     if (pl1.isPar(pl2))
00057         return false;
00058
00059     return detail::isIntersectMollerHaines(tr1, tr1);
00060 }
00061
00062 } // namespace geom
00063
00064 #endif // __INCLUDE_INTERSECTION_INTERSECTION_HH__

```

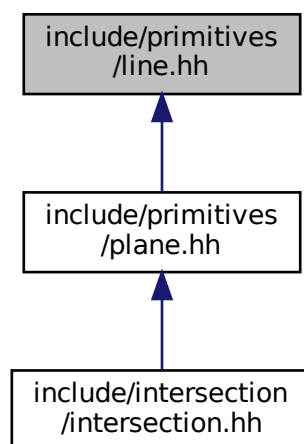
## 6.3 include/primitives/line.hh File Reference

```
#include "vector.hh"
```

Include dependency graph for line.hh:



This graph shows which files directly or indirectly include this file:



### Classes

- class [geom::Line< T >](#)  
*Line class implementation.*

### Namespaces

- [geom](#)  
*line.hh Line class implementation*

## Functions

- `template<std::floating_point T>`  
`std::ostream & geom::operator<< (std::ostream &ost, const Line< T > &line)`  
*Line print operator.*
- `template<std::floating_point T>`  
`bool geom::operator== (const Line< T > &lhs, const Line< T > &rhs)`  
*Line equality operator.*

## 6.4 line.hh

```

00001 #ifndef __INCLUDE_PRIMITIVES_LINE_HH__
00002 #define __INCLUDE_PRIMITIVES_LINE_HH__
00003
00004 #include "vector.hh"
00005
00006 /**
00007  * @brief line.hh
00008  * Line class implementation
00009  */
00010
00011 namespace geom
00012 {
00013
00014 /**
00015  * @class Line
00016  * @brief Line class implementation
00017  *
00018  * @tparam T - floating point type of coordinates
00019  */
00020 template <std::floating_point T>
00021 class Line final
00022 {
00023 private:
00024 /**
00025  * @brief Origin and direction vectors
00026  */
00027 Vector<T> org_{}, dir_{};
00028
00029 public:
00030 /**
00031  * @brief Construct a new Line object
00032  *
00033  * @param[in] org origin vector
00034  * @param[in] dir direction vector
00035  */
00036 Line(const Vector<T> &org, const Vector<T> &dir);
00037
00038 /**
00039  * @brief Getter for origin vector
00040  *
00041  * @return const Vector<T>& const reference to origin vector
00042  */
00043 const Vector<T> &org() const;
00044
00045 /**
00046  * @brief Getter for direction vector
00047  *
00048  * @return const Vector<T>& const reference to direction vector
00049  */
00050 const Vector<T> &dir() const;
00051
00052 /**
00053  * @brief Checks is point belongs to line
00054  *
00055  * @param[in] point const reference to point vector
00056  * @return true if point belongs to line
00057  * @return false if point doesn't belong to line
00058  */
00059 bool belongs(const Vector<T> &point) const;
00060
00061 /**
00062  * @brief Checks is *this equals to another line
00063  *
00064  * @param[in] line const reference to another line
00065  * @return true if lines are equal
00066  * @return false if lines are not equal
00067  */
00068 bool isEqual(const Line &line) const;

```

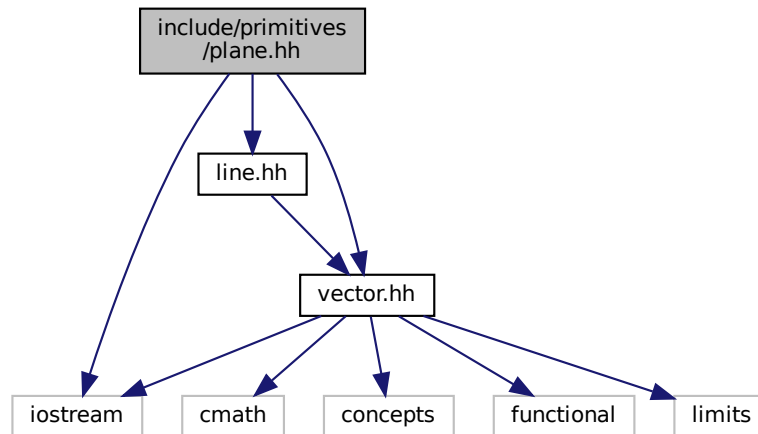
```

00069
00070 /**
00071  * @brief Get line by 2 points
00072  *
00073  * @param[in] p1 1st point
00074  * @param[in] p2 2nd point
00075  * @return Line passing through two points
00076  */
00077 static Line getBy2Points(const Vector<T> &p1, const Vector<T> &p2);
00078 };
00079
00080 /**
00081  * @brief Line print operator
00082  *
00083  * @tparam T - floating point type of coordinates
00084  * @param[in, out] ost output stream
00085  * @param[in] line Line to print
00086  * @return std::ostream& modified ostream instance
00087  */
00088 template <std::floating_point T>
00089 std::ostream &operator<<(std::ostream &ost, const Line<T> &line)
00090 {
00091     ost << line.org() << " + " << line.dir() << " * t";
00092     return ost;
00093 }
00094
00095 /**
00096  * @brief Line equality operator
00097  *
00098  * @tparam T - floating point type of coordinates
00099  * @param[in] lhs 1st line
00100  * @param[in] rhs 2nd line
00101  * @return true if lines are equal
00102  * @return false if lines are not equal
00103  */
00104 template <std::floating_point T>
00105 bool operator==(const Line<T> &lhs, const Line<T> &rhs)
00106 {
00107     return lhs.isEqual(rhs);
00108 }
00109
00110 template <std::floating_point T>
00111 Line<T>::Line(const Vector<T> &org, const Vector<T> &dir) : org_{org}, dir_{dir}
00112 {
00113     if (dir_ == Vector<T>{0})
00114         throw std::logic_error{"Direction vector equals zero."};
00115 }
00116
00117 template <std::floating_point T>
00118 const Vector<T> &Line<T>::org() const
00119 {
00120     return org_;
00121 }
00122
00123 template <std::floating_point T>
00124 const Vector<T> &Line<T>::dir() const
00125 {
00126     return dir_;
00127 }
00128
00129 template <std::floating_point T>
00130 bool Line<T>::belongs(const Vector<T> &point) const
00131 {
00132     return dir_.cross(point - org_) == Vector<T>{0};
00133 }
00134
00135 template <std::floating_point T>
00136 bool Line<T>::isEqual(const Line<T> &line) const
00137 {
00138     return belongs(line.org_) && dir_.isPar(line.dir_);
00139 }
00140
00141 template <std::floating_point T>
00142 Line<T> Line<T>::getBy2Points(const Vector<T> &p1, const Vector<T> &p2)
00143 {
00144     return Line<T>{p1, p2 - p1};
00145 }
00146
00147 } // namespace geom
00148
00149 #endif // __INCLUDE_PRIMITIVES_LINE_HH__

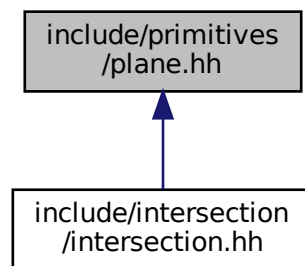
```

## 6.5 include/primitives/plane.hh File Reference

```
#include <iostream>
#include "line.hh"
#include "vector.hh"
Include dependency graph for plane.hh:
```



This graph shows which files directly or indirectly include this file:



### Classes

- class `geom::Plane< T >`  
*Plane* class realization.

### Namespaces

- `geom`  
*line.hh* *Line* class implementation



## Functions

- `template<std::floating_point T>`  
`bool geom::operator== (const Plane< T > &lhs, const Plane< T > &rhs)`  
*Plane equality operator.*
- `template<std::floating_point T>`  
`std::ostream & geom::operator<< (std::ostream &ost, const Plane< T > &pl)`  
*Plane print operator.*

## 6.6 plane.hh

```

00001 #ifndef __INCLUDE_PRIMITIVES_PLANE_HH__
00002 #define __INCLUDE_PRIMITIVES_PLANE_HH__
00003
00004 #include <iostream>
00005
00006 #include "line.hh"
00007 #include "vector.hh"
00008
00009 /**
00010  * @brief
00011  * Plane class implementation
00012  */
00013
00014 namespace geom
00015 {
00016
00017 /**
00018  * @class Plane
00019  * @brief Plane class realization
00020  *
00021  * @tparam T - floating point type of coordinates
00022  */
00023 template <std::floating_point T>
00024 class Plane final
00025 {
00026 private:
00027 /**
00028  * @brief Normal vector, length equals to 1
00029  */
00030 Vector<T> norm_{};
00031
00032 /**
00033  * @brief Distance from zero to plane
00034  */
00035 T dist_{};
00036
00037 /**
00038  * @brief Construct a new Plane object from normal vector and distance
00039  *
00040  * @param[in] norm normal vector
00041  * @param[in] dist distance from plane to zero
00042  */
00043 Plane(const Vector<T> &norm, T dist);
00044
00045 public:
00046 /**
00047  * @brief Getter for distance
00048  *
00049  * @return T value of distance
00050  */
00051 T dist() const;
00052
00053 /**
00054  * @brief Getter for normal vector
00055  *
00056  * @return const Vector<T>& const reference to normal vector
00057  */
00058 const Vector<T> &norm() const;
00059
00060 /**
00061  * @brief Checks if point belongs to plane
00062  *
00063  * @param[in] point const referene to point vector
00064  * @return true if point belongs to plane
00065  * @return false if point doesn't belong to plane
00066  */
00067 bool belongs(const Vector<T> &point) const;
00068

```

```

00069  /**
00070   * @brief Checks if line belongs to plane
00071   *
00072   * @param[in] line const referene to line
00073   * @return true if line belongs to plane
00074   * @return false if line doesn't belong to plane
00075   */
00076  bool belongs(const Line<T> &line) const;
00077
00078  /**
00079   * @brief Checks is *this equals to another plane
00080   *
00081   * @param[in] rhs const reference to another plane
00082   * @return true if planes are equal
00083   * @return false if planes are not equal
00084   */
00085  bool isEqual(const Plane &rhs) const;
00086
00087  /**
00088   * @brief Checks is *this is parallel to another plane
00089   *
00090   * @param[in] rhs const reference to another plane
00091   * @return true if planes are parallel
00092   * @return false if planes are not parallel
00093   */
00094  bool isPar(const Plane &rhs) const;
00095
00096  /**
00097   * @brief Get plane by 3 points
00098   *
00099   * @param[in] pt1 1st point
00100   * @param[in] pt2 2nd point
00101   * @param[in] pt3 3rd point
00102   * @return Plane passing through three points
00103   */
00104  static Plane getBy3Points(const Vector<T> &pt1, const Vector<T> &pt2,
00105                           const Vector<T> &pt3);
00106
00107  /**
00108   * @brief Get plane from parametric plane equation
00109   *
00110   * @param[in] org origin vector
00111   * @param[in] dir1 1st direction vector
00112   * @param[in] dir2 2nd direction vector
00113   * @return Plane
00114   */
00115  static Plane getParametric(const Vector<T> &org, const Vector<T> &dir1,
00116                           const Vector<T> &dir2);
00117
00118  /**
00119   * @brief Get plane from normal point plane equation
00120   *
00121   * @param[in] norm normal vector
00122   * @param[in] point point lying on the plane
00123   * @return Plane
00124   */
00125  static Plane getNormalPoint(const Vector<T> &norm, const Vector<T> &point);
00126
00127  /**
00128   * @brief Get plane form normal const plane equation
00129   *
00130   * @param[in] norm normal vector
00131   * @param[in] constant distance
00132   * @return Plane
00133   */
00134  static Plane getNormalDist(const Vector<T> &norm, T constant);
00135 };
00136
00137 /**
00138   * @brief Plane equality operator
00139   *
00140   * @tparam T - floating point type of coordinates
00141   * @param[in] lhs 1st plane
00142   * @param[in] rhs 2nd plane
00143   * @return true if planes are equal
00144   * @return false if planes are not equal
00145   */
00146 template <std::floating_point T>
00147 bool operator==(const Plane<T> &lhs, const Plane<T> &rhs)
00148 {
00149     return lhs.isEqual(rhs);
00150 }
00151
00152 /**
00153   * @brief Plane print operator
00154   *
00155   * @tparam T - floating point type of coordinates

```

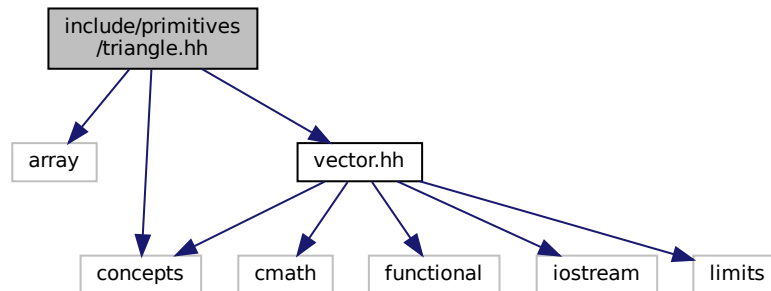
```

00156 * @param[in, out] ost output stream
00157 * @param[in] pl plane to print
00158 * @return std::ostream& modified ostream instance
00159 */
00160 template <std::floating_point T>
00161 std::ostream &operator<<(std::ostream &ost, const Plane<T> &pl)
00162 {
00163     ost << pl.norm() << " * X = " << pl.dist();
00164     return ost;
00165 }
00166
00167 template <std::floating_point T>
00168 Plane<T>::Plane(const Vector<T> &norm, T dist) : norm_(norm), dist_(dist)
00169 {
00170     if (norm == Vector<T>{0})
00171         throw std::logic_error{"normal vector equals to zero"};
00172 }
00173
00174 template <std::floating_point T>
00175 T Plane<T>::dist() const
00176 {
00177     return dist_;
00178 }
00179
00180 template <std::floating_point T>
00181 const Vector<T> &Plane<T>::norm() const
00182 {
00183     return norm_;
00184 }
00185
00186 template <std::floating_point T>
00187 bool Plane<T>::belongs(const Vector<T> &pt) const
00188 {
00189     return Vector<T>::isNumEq(norm_.dot(pt), dist_);
00190 }
00191
00192 template <std::floating_point T>
00193 bool Plane<T>::belongs(const Line<T> &line) const
00194 {
00195     return norm_.isPerp(line.dir()) && belongs(line.org());
00196 }
00197
00198 template <std::floating_point T>
00199 bool Plane<T>::isEqual(const Plane &rhs) const
00200 {
00201     return (norm_ * dist_ == rhs.norm_ * rhs.dist_) && (norm_.isPar(rhs.norm_));
00202 }
00203
00204 template <std::floating_point T>
00205 bool Plane<T>::isPar(const Plane &rhs) const
00206 {
00207     return norm_.isPar(rhs.norm_);
00208 }
00209
00210 template <std::floating_point T>
00211 Plane<T> Plane<T>::getBy3Points(const Vector<T> &pt1, const Vector<T> &pt2,
00212                                const Vector<T> &pt3)
00213 {
00214     return getParametric(pt1, pt2 - pt1, pt3 - pt1);
00215 }
00216
00217 template <std::floating_point T>
00218 Plane<T> Plane<T>::getParametric(const Vector<T> &org, const Vector<T> &dir1,
00219                                  const Vector<T> &dir2)
00220 {
00221     auto norm = dir1.cross(dir2);
00222     return getNormalPoint(norm, org);
00223 }
00224
00225 template <std::floating_point T>
00226 Plane<T> Plane<T>::getNormalPoint(const Vector<T> &norm, const Vector<T> &pt)
00227 {
00228     auto normalized = norm.normalized();
00229     return Plane{normalized, normalized.dot(pt)};
00230 }
00231
00232 template <std::floating_point T>
00233 Plane<T> Plane<T>::getNormalDist(const Vector<T> &norm, T dist)
00234 {
00235     auto normalized = norm.normalized();
00236     return Plane{normalized, dist};
00237 }
00238
00239 } // namespace geom
00240
00241 #endif // __INCLUDE_PRIMITIVES_PLANE_HH__

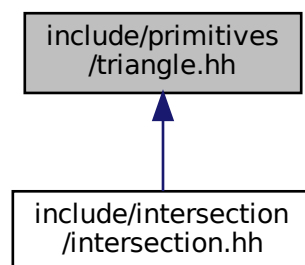
```

## 6.7 include/primitives/triangle.hh File Reference

```
#include <array>
#include <concepts>
#include "vector.hh"
Include dependency graph for triangle.hh:
```



This graph shows which files directly or indirectly include this file:



### Classes

- class `geom::Triangle< T >`  
*Triangle class implementation.*

### Namespaces

- `geom`  
*line.hh Line class implementation*

## Functions

- `template<std::floating_point T>`  
`std::ostream & geom::operator<< (std::ostream &ost, const Triangle< T > &tr)`  
*Triangle print operator.*

## 6.8 triangle.hh

```

00001 #ifndef __INCLUDE_PRIMITIVES_TRIANGLE_HH__
00002 #define __INCLUDE_PRIMITIVES_TRIANGLE_HH__
00003
00004 #include <array>
00005 #include <concepts>
00006
00007 #include "vector.hh"
00008
00009 /**
00010  * @brief triangle.hh
00011  * Triangle class implementation
00012  */
00013
00014 namespace geom
00015 {
00016
00017 /**
00018  * @class Triangle
00019  * @brief Triangle class implementation
00020  *
00021  * @tparam T - floating point type of coordinates
00022  */
00023 template <std::floating_point T>
00024 class Triangle final
00025 {
00026 private:
00027     /**
00028      * @brief Vertices of triangle
00029      */
00030     std::array<Vector<T>, 3> vertices_;
00031
00032 public:
00033     /**
00034      * @brief Construct a new Triangle object from 3 points
00035      *
00036      * @param[in] p1 1st point
00037      * @param[in] p2 2nd point
00038      * @param[in] p3 3rd point
00039      */
00040     Triangle(const Vector<T> &p1, const Vector<T> &p2, const Vector<T> &p3);
00041
00042     /**
00043      * @brief Overloaded operator[] to get access to vertices
00044      *
00045      * @param[in] idx index of vertex
00046      * @return const Vector<T>& const reference to vertex
00047      */
00048     const Vector<T> &operator[](std::size_t idx) const;
00049 };
00050
00051 /**
00052  * @brief Triangle print operator
00053  *
00054  * @tparam T - floating point type of coordinates
00055  * @param[in, out] ost output stream
00056  * @param[in] tr Triangle to print
00057  * @return std::ostream& modified ostream instance
00058  */
00059 template <std::floating_point T>
00060 std::ostream &operator<<(std::ostream &ost, const Triangle<T> &tr)
00061 {
00062     ost << "Triangle: {";
00063     for (size_t i : {0, 1, 2})
00064         ost << tr[i] << (i == 2 ? " : ", " ");
00065
00066     ost << "}";
00067
00068     return ost;
00069 }
00070
00071 template <std::floating_point T>
00072 Triangle<T>::Triangle(const Vector<T> &p1, const Vector<T> &p2, const Vector<T> &p3)
00073     : vertices_{p1, p2, p3}

```

```

00074 {}
00075
00076 template <std::floating_point T>
00077 const Vector<T> &Triangle<T>::operator[] (std::size_t idx) const
00078 {
00079     return vertices_[idx % 3];
00080 }
00081
00082 } // namespace geom
00083
00084 #endif // __INCLUDE_PRIMITIVES_TRIANGLE_HH__

```

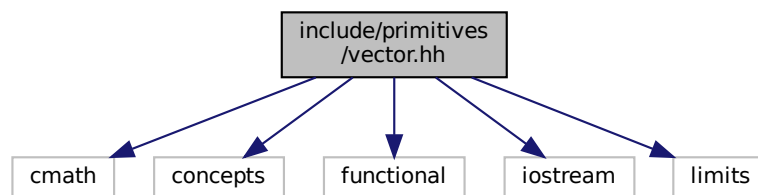
## 6.9 include/primitives/vector.hh File Reference

```

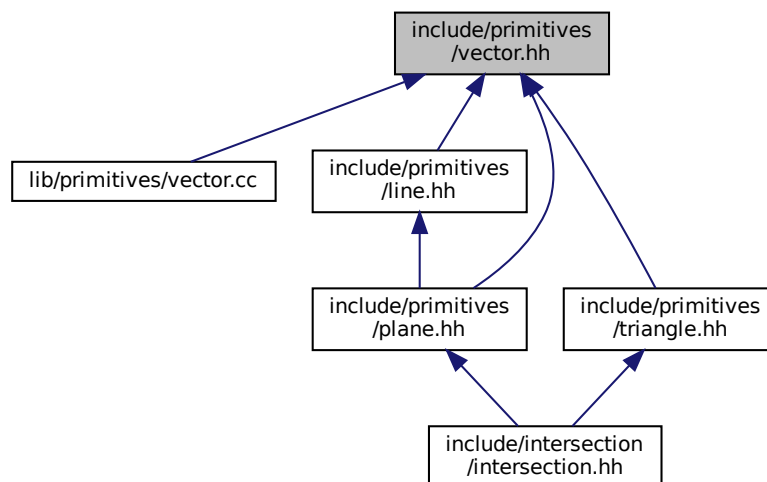
#include <cmath>
#include <concepts>
#include <functional>
#include <iostream>
#include <limits>

```

Include dependency graph for vector.hh:



This graph shows which files directly or indirectly include this file:



## Classes

- class [geom::Vector< T >](#)  
*Vector class realization.*

## Namespaces

- [geom](#)  
*line.hh Line class implementation*

## Typedefs

- using [geom::VectorD](#) = Vector< double >
- using [geom::VectorF](#) = Vector< float >

## Functions

- template<std::floating\_point T>  
Vector< T > [geom::operator+](#) (const Vector< T > &lhs, const Vector< T > &rhs)  
*Overloaded + operator.*
- template<std::floating\_point T>  
Vector< T > [geom::operator-](#) (const Vector< T > &lhs, const Vector< T > &rhs)  
*Overloaded - operator.*
- template<Number nT, std::floating\_point T>  
Vector< T > [geom::operator\\*](#) (const nT &val, const Vector< T > &rhs)  
*Overloaded multiple by value operator.*
- template<Number nT, std::floating\_point T>  
Vector< T > [geom::operator\\*](#) (const Vector< T > &lhs, const nT &val)  
*Overloaded multiple by value operator.*
- template<Number nT, std::floating\_point T>  
Vector< T > [geom::operator/](#) (const Vector< T > &lhs, const nT &val)  
*Overloaded divide by value operator.*
- template<std::floating\_point T>  
T [geom::dot](#) (const Vector< T > &lhs, const Vector< T > &rhs)  
*Dot product function.*
- template<std::floating\_point T>  
Vector< T > [geom::cross](#) (const Vector< T > &lhs, const Vector< T > &rhs)  
*Cross product function.*
- template<std::floating\_point T>  
bool [geom::operator==](#) (const Vector< T > &lhs, const Vector< T > &rhs)  
*Vector equality operator.*
- template<std::floating\_point T>  
bool [geom::operator!=](#) (const Vector< T > &lhs, const Vector< T > &rhs)  
*Vector inequality operator.*
- template<std::floating\_point T>  
std::ostream & [geom::operator<<](#) (std::ostream &ost, const Vector< T > &vec)  
*Vector print operator.*

## Variables

- `template<class T >`  
`concept geom::Number = std::is_floating_point_v<T> || std::is_integral_v<T>`  
*Useful concept which represents floating point and integral types.*

### 6.9.1 Detailed Description

Vector class implementation

Definition in file [vector.hh](#).

### 6.10 vector.hh

```
00001 #ifndef __INCLUDE_PRIMITIVES_VECTOR_HH__
00002 #define __INCLUDE_PRIMITIVES_VECTOR_HH__
00003
00004 #include <cmath>
00005 #include <concepts>
00006 #include <functional>
00007 #include <iostream>
00008 #include <limits>
00009
00010 /**
00011  * @file vector.hh
00012  * Vector class implementation
00013  */
00014
00015 namespace geom
00016 {
00017
00018 /**
00019  * @concept Number
00020  * @brief Useful concept which represents floating point and integral types
00021  */
00022  * @tparam T
00023  */
00024 template <class T>
00025 concept Number = std::is_floating_point_v<T> || std::is_integral_v<T>;
00026
00027 /**
00028  * @class Vector
00029  * @brief Vector class realization
00030  */
00031  * @tparam T - floating point type of coordinates
00032  */
00033 template <std::floating_point T>
00034 struct Vector final
00035 {
00036 private:
00037     /**
00038      * @brief Threshold static variable for numbers comparision
00039      */
00040     static inline T threshold_ = 1e3 * std::numeric_limits<T>::epsilon();
00041
00042 public:
00043     /**
00044      * @brief Vector coordinates
00045      */
00046     T x{}, y{}, z{};
00047
00048     /**
00049      * @brief Construct a new Vector object from 3 coordinates
00050      */
00051     * @param[in] coordX x coordinate
00052     * @param[in] coordY y coordinate
00053     * @param[in] coordZ z coordinate
00054     */
00055     Vector(T coordX, T coordY, T coordZ) : x(coordX), y(coordY), z(coordZ)
00056     {}
00057
00058     /**
00059      * @brief Construct a new Vector object with equals coordinates
00060      */
00061     * @param[in] coordX coordinate (default to {})
```



```

00062     */
00063     explicit Vector(T coordX = {}) : Vector(coordX, coordX, coordX)
00064     {}
00065
00066     /**
00067      * @brief Overloaded += operator
00068      * Increments vector coordinates by corresponding coordinates of vec
00069      * @param[in] vec vector to incremented with
00070      * @return Vector& reference to current instance
00071      */
00072     Vector &operator+=(const Vector &vec);
00073
00074     /**
00075      * @brief Overloaded -= operator
00076      * Decrements vector coordinates by corresponding coordinates of vec
00077      * @param[in] vec vector to decremented with
00078      * @return Vector& reference to current instance
00079      */
00080     Vector &operator-=(const Vector &vec);
00081
00082     /**
00083      * @brief Unary - operator
00084      *
00085      * @return Vector negated Vector instance
00086      */
00087     Vector operator-() const;
00088
00089     /**
00090      * @brief Overloaded *= by number operator
00091      *
00092      * @tparam nType numeric type of value to multiply by
00093      * @param[in] val value to multiply by
00094      * @return Vector& reference to vector instance
00095      */
00096     template <Number nType>
00097     Vector &operator*=(nType val);
00098
00099     /**
00100      * @brief Overloaded /= by number operator
00101      *
00102      * @tparam nType numeric type of value to divide by
00103      * @param[in] val value to divide by
00104      * @return Vector& reference to vector instance
00105      *
00106      * @warning Does not check if val equals 0
00107      */
00108     template <Number nType>
00109     Vector &operator/=(nType val);
00110
00111     /**
00112      * @brief Dot product function
00113      *
00114      * @param rhs vector to dot product with
00115      * @return T dot product of two vectors
00116      */
00117     T dot(const Vector &rhs) const;
00118
00119     /**
00120      * @brief Cross product function
00121      *
00122      * @param rhs vector to cross product with
00123      * @return Vector cross product of two vectors
00124      */
00125     Vector cross(const Vector &rhs) const;
00126
00127     /**
00128      * @brief Calculate squared length of a vector function
00129      *
00130      * @return T length^2
00131      */
00132     T length2() const;
00133
00134     /**
00135      * @brief Calculate length of a vector function
00136      *
00137      * @return T length
00138      */
00139     T length() const;
00140
00141     /**
00142      * @brief Get normalized vector function
00143      *
00144      * @return Vector normalized vector
00145      */
00146     Vector normalized() const;
00147
00148     /**

```

```

00149     * @brief Normalize vector function
00150     *
00151     * @return Vector& reference to instance
00152     */
00153     Vector &normalize();
00154
00155     /**
00156     * @brief Overloaded operator [] (non-const version)
00157     * To get access to coordinates
00158     * @param i index of coordinate (0 - x, 1 - y, 2 - z)
00159     * @return T& reference to coordinate value
00160     *
00161     * @note Coordinates calculated by mod 3
00162     */
00163     T &operator[](size_t i);
00164
00165     /**
00166     * @brief Overloaded operator [] (const version)
00167     * To get access to coordinates
00168     * @param i index of coordinate (0 - x, 1 - y, 2 - z)
00169     * @return T coordinate value
00170     *
00171     * @note Coordinates calculated by mod 3
00172     */
00173     T operator[](size_t i) const;
00174
00175     /**
00176     * @brief Check if vector is parallel to another
00177     *
00178     * @param[in] rhs vector to check parallelism with
00179     * @return true if vector is parallel
00180     * @return false otherwise
00181     */
00182     bool isPar(const Vector &rhs) const;
00183
00184     /**
00185     * @brief Check if vector is perpendicular to another
00186     *
00187     * @param[in] rhs vector to check perpendicularity with
00188     * @return true if vector is perpendicular
00189     * @return false otherwise
00190     */
00191     bool isPerp(const Vector &rhs) const;
00192
00193     /**
00194     * @brief Check if vector is equal to another
00195     *
00196     * @param[in] rhs vector to check equality with
00197     * @return true if vector is equal
00198     * @return false otherwise
00199     *
00200     * @note Equality check performs using isNumEq(T lhs, T rhs) function
00201     */
00202     bool isEqual(const Vector &rhs) const;
00203
00204     /**
00205     * @brief Check equality (with threshold) of two floating point numbers function
00206     *
00207     * @param[in] lhs first number
00208     * @param[in] rhs second number
00209     * @return true if numbers equals with threshold (|lhs - rhs| < threshold)
00210     * @return false otherwise
00211     *
00212     * @note Threshold defined by threshold_ static member
00213     */
00214     static bool isNumEq(T lhs, T rhs);
00215
00216     /**
00217     * @brief Set new threshold value
00218     *
00219     * @param[in] thres value to set
00220     */
00221     static void setThreshold(T thres);
00222
00223     /**
00224     * @brief Get current threshold value
00225     */
00226     static void getThreshold();
00227
00228     /**
00229     * @brief Set threshold to default value
00230     * @note default value equals float point epsilon
00231     */
00232     static void setDefThreshold();
00233 };
00234
00235 /**

```

```

00236 * @brief Overloaded + operator
00237 *
00238 * @tparam T vector template parameter
00239 * @param[in] lhs first vector
00240 * @param[in] rhs second vector
00241 * @return Vector<T> sum of two vectors
00242 */
00243 template <std::floating_point T>
00244 Vector<T> operator+(const Vector<T> &lhs, const Vector<T> &rhs)
00245 {
00246     Vector<T> res{lhs};
00247     res += rhs;
00248     return res;
00249 }
00250
00251 /**
00252 * @brief Overloaded - operator
00253 *
00254 * @tparam T vector template parameter
00255 * @param[in] lhs first vector
00256 * @param[in] rhs second vector
00257 * @return Vector<T> res of two vectors
00258 */
00259 template <std::floating_point T>
00260 Vector<T> operator-(const Vector<T> &lhs, const Vector<T> &rhs)
00261 {
00262     Vector<T> res{lhs};
00263     res -= rhs;
00264     return res;
00265 }
00266
00267 /**
00268 * @brief Overloaded multiple by value operator
00269 *
00270 * @tparam nT type of value to multiply by
00271 * @tparam T vector template parameter
00272 * @param[in] val value to multiply by
00273 * @param[in] rhs vector to multiply by value
00274 * @return Vector<T> result vector
00275 */
00276 template <Number nT, std::floating_point T>
00277 Vector<T> operator*(const nT &val, const Vector<T> &rhs)
00278 {
00279     Vector<T> res{rhs};
00280     res *= val;
00281     return res;
00282 }
00283
00284 /**
00285 * @brief Overloaded multiple by value operator
00286 *
00287 * @tparam nT type of value to multiply by
00288 * @tparam T vector template parameter
00289 * @param[in] val value to multiply by
00290 * @param[in] lhs vector to multiply by value
00291 * @return Vector<T> result vector
00292 */
00293 template <Number nT, std::floating_point T>
00294 Vector<T> operator*(const Vector<T> &lhs, const nT &val)
00295 {
00296     Vector<T> res{lhs};
00297     res *= val;
00298     return res;
00299 }
00300
00301 /**
00302 * @brief Overloaded divide by value operator
00303 *
00304 * @tparam nT type of value to divide by
00305 * @tparam T vector template parameter
00306 * @param[in] val value to divide by
00307 * @param[in] lhs vector to divide by value
00308 * @return Vector<T> result vector
00309 */
00310 template <Number nT, std::floating_point T>
00311 Vector<T> operator/(const Vector<T> &lhs, const nT &val)
00312 {
00313     Vector<T> res{lhs};
00314     res /= val;
00315     return res;
00316 }
00317
00318 /**
00319 * @brief Dot product function
00320 *
00321 * @tparam T vector template parameter
00322 * @param[in] lhs first vector

```

```

00323 * @param[in] rhs second vector
00324 * @return T dot production
00325 */
00326 template <std::floating_point T>
00327 T dot(const Vector<T> &lhs, const Vector<T> &rhs)
00328 {
00329     return lhs.dot(rhs);
00330 }
00331
00332 /**
00333 * @brief Cross product function
00334 *
00335 * @tparam T vector template parameter
00336 * @param[in] lhs first vector
00337 * @param[in] rhs second vector
00338 * @return T cross production
00339 */
00340 template <std::floating_point T>
00341 Vector<T> cross(const Vector<T> &lhs, const Vector<T> &rhs)
00342 {
00343     return lhs.cross(rhs);
00344 }
00345
00346 /**
00347 * @brief Vector equality operator
00348 *
00349 * @tparam T vector template parameter
00350 * @param[in] lhs first vector
00351 * @param[in] rhs second vector
00352 * @return true if vectors are equal
00353 * @return false otherwise
00354 */
00355 template <std::floating_point T>
00356 bool operator==(const Vector<T> &lhs, const Vector<T> &rhs)
00357 {
00358     return lhs.isEqual(rhs);
00359 }
00360
00361 /**
00362 * @brief Vector inequality operator
00363 *
00364 * @tparam T vector template parameter
00365 * @param[in] lhs first vector
00366 * @param[in] rhs second vector
00367 * @return true if vectors are not equal
00368 * @return false otherwise
00369 */
00370 template <std::floating_point T>
00371 bool operator!=(const Vector<T> &lhs, const Vector<T> &rhs)
00372 {
00373     return !(lhs == rhs);
00374 }
00375
00376 /**
00377 * @brief Vector print operator
00378 *
00379 * @tparam T vector template parameter
00380 * @param[in, out] ost output stream
00381 * @param[in] vec vector to print
00382 * @return std::ostream& modified stream instance
00383 */
00384 template <std::floating_point T>
00385 std::ostream &operator<<(std::ostream &ost, const Vector<T> &vec)
00386 {
00387     ost << "(" << vec.x << ", " << vec.y << ", " << vec.z << ")";
00388     return ost;
00389 }
00390
00391 using VectorD = Vector<double>;
00392 using VectorF = Vector<float>;
00393
00394 template <std::floating_point T>
00395 Vector<T> &Vector<T>::operator+=(const Vector &vec)
00396 {
00397     x += vec.x;
00398     y += vec.y;
00399     z += vec.z;
00400     return *this;
00401 }
00402
00403 template <std::floating_point T>
00404 Vector<T> &Vector<T>::operator-=(const Vector &vec)
00405 {
00406     x -= vec.x;
00407     y -= vec.y;
00408     z -= vec.z;

```

```

00410
00411     return *this;
00412 }
00413
00414 template <std::floating_point T>
00415 Vector<T> Vector<T>::operator-() const
00416 {
00417     return Vector{-x, -y, -z};
00418 }
00419
00420 template <std::floating_point T>
00421 template <Number nType>
00422 Vector<T> &Vector<T>::operator*=(nType val)
00423 {
00424     x *= val;
00425     y *= val;
00426     z *= val;
00427
00428     return *this;
00429 }
00430
00431 template <std::floating_point T>
00432 template <Number nType>
00433 Vector<T> &Vector<T>::operator/=(nType val)
00434 {
00435     x /= val;
00436     y /= val;
00437     z /= val;
00438
00439     return *this;
00440 }
00441
00442 template <std::floating_point T>
00443 T Vector<T>::dot(const Vector &rhs) const
00444 {
00445     return x * rhs.x + y * rhs.y + z * rhs.z;
00446 }
00447
00448 template <std::floating_point T>
00449 Vector<T> Vector<T>::cross(const Vector &rhs) const
00450 {
00451     return Vector{y * rhs.z - z * rhs.y, z * rhs.x - x * rhs.z, x * rhs.y - y * rhs.x};
00452 }
00453
00454 template <std::floating_point T>
00455 T Vector<T>::length2() const
00456 {
00457     return dot(*this);
00458 }
00459
00460 template <std::floating_point T>
00461 T Vector<T>::length() const
00462 {
00463     return std::sqrt(length2());
00464 }
00465
00466 template <std::floating_point T>
00467 Vector<T> Vector<T>::normalized() const
00468 {
00469     Vector res{*this};
00470     res.normalize();
00471     return res;
00472 }
00473
00474 template <std::floating_point T>
00475 Vector<T> &Vector<T>::normalize()
00476 {
00477     T len2 = length2();
00478     if (isNumEq(len2, 0) || isNumEq(len2, 1))
00479         return *this;
00480     return *this /= std::sqrt(len2);
00481 }
00482
00483 template <std::floating_point T>
00484 T &Vector<T>::operator[](size_t i)
00485 {
00486     switch (i % 3)
00487     {
00488     case 0:
00489         return x;
00490     case 1:
00491         return y;
00492     case 2:
00493         return z;
00494     default:
00495         throw std::logic_error{"Impossible case in operator[]\n"};
00496     }

```

```

00497 }
00498
00499 template <std::floating_point T>
00500 T Vector<T>::operator[](size_t i) const
00501 {
00502     switch (i % 3)
00503     {
00504     case 0:
00505         return x;
00506     case 1:
00507         return y;
00508     case 2:
00509         return z;
00510     default:
00511         throw std::logic_error{"Impossible case in operator[]\n"};
00512     }
00513 }
00514
00515 template <std::floating_point T>
00516 bool Vector<T>::isPar(const Vector &rhs) const
00517 {
00518     return cross(rhs).isEqual(Vector<T>{0});
00519 }
00520
00521 template <std::floating_point T>
00522 bool Vector<T>::isPerp(const Vector &rhs) const
00523 {
00524     return isNumEq(dot(rhs), 0);
00525 }
00526
00527 template <std::floating_point T>
00528 bool Vector<T>::isEqual(const Vector &rhs) const
00529 {
00530     return isNumEq(x, rhs.x) && isNumEq(y, rhs.y) && isNumEq(z, rhs.z);
00531 }
00532
00533 template <std::floating_point T>
00534 bool Vector<T>::isNumEq(T lhs, T rhs)
00535 {
00536     return std::abs(rhs - lhs) < threshold_;
00537 }
00538
00539 template <std::floating_point T>
00540 void Vector<T>::setThreshold(T thres)
00541 {
00542     threshold_ = thres;
00543 }
00544
00545 template <std::floating_point T>
00546 void Vector<T>::getThreshold()
00547 {
00548     return threshold_;
00549 }
00550
00551 template <std::floating_point T>
00552 void Vector<T>::setDefThreshold()
00553 {
00554     threshold_ = std::numeric_limits<T>::epsilon();
00555 }
00556
00557 } // namespace geom
00558
00559 #endif // __INCLUDE_PRIMITIVES_VECTOR_HH__

```

## 6.11 lib/intersection/intersection.cc File Reference

## 6.12 intersection.cc

## 6.13 lib/primitives/line.cc File Reference

## 6.14 line.cc

## 6.15 lib/primitives/plane.cc File Reference

## 6.16 plane.cc

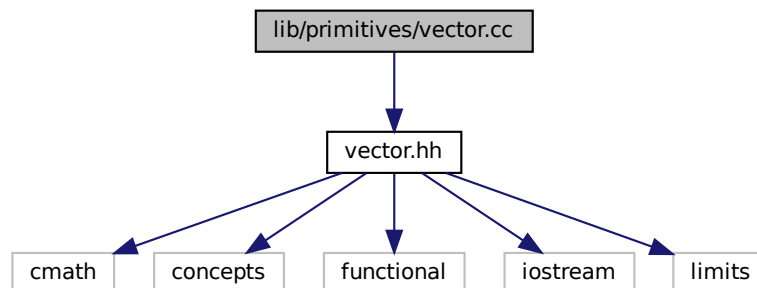
## 6.17 lib/primitives/triangle.cc File Reference

## 6.18 triangle.cc

## 6.19 lib/primitives/vector.cc File Reference

```
#include "vector.hh"
```

Include dependency graph for vector.cc:



### Namespaces

- [geom](#)  
*line.hh Line class implementation*

## 6.20 vector.cc

```

00001 #include "vector.hh"
00002
00003 namespace geom
00004 {
00005
00006 // template <std::floating_point T>
00007 // T Vector<T>::threshold_ = std::numeric_limits<T>::epsilon();
00008
00009 } // namespace geom

```

