

Graphpp

0.1

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# Chapter 1

## Graph++ Documentation

### 1.1 Introduction

Graph++ is a C++ project that provides a comprehensive toolkit for graph analysis and exploration. The project consists of three main components: a library, a graphical user interface (GUI) application, and a unit test project. Its primary aim is to facilitate graph-related tasks such as calculating vertex degrees, chromatic numbers, Hamiltonian and Eulerian paths, and other properties. Graph++ offers a valuable platform for researchers, students, and graph enthusiasts to analyze and explore graphs effectively. Its library, GUI application, and unit test project work together to provide an instrument for graph analysis, making it a useful resource for various graph-related tasks.

#### 1.1.1 Graph++ Library

The Graph++ library serves as the foundation of the project, offering efficient implementations of various graph data structures and algorithms. It provides developers with a straightforward API to create and modify graphs. Additionally, the library includes algorithms for graph analysis, enabling users to gain insights into the structure of their graphs.

#### 1.1.2 Graph++ GUI App

The GUI application complements the library by providing a user-friendly interface for interacting with graphs. It allows users to create, edit, and visualize graphs, applying algorithms and obtaining visual feedback on graph properties. The application includes features such as graph editing tools, customizable layouts, and interactive displays of graph properties.

### 1.2 Usage

```
// Create some vertices
int vertices[10] = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9};
// Create a graph for those vertices
Graph<int>* graph = new Graph<int>();
// Add the vertices to the graph
for(int i : vertices){
    graph->addVertex(&i);
}
// Add some edges to the graph (Circular graph)
for(int i : vertices){
    int nextIndex = i + 1;
    if(nextIndex >= nbVertices){
        nextIndex = 0;
    }
    graph->addDoubleEdge(&vertices[i], &vertices[nextIndex]);
}
```



## Chapter 2

# Graph++

Vous pouvez trouver toutes les informations liées à la réalisation de ce projet dans le Wiki GitLab. Ceci n'est qu'une simple introduction au projet :

### 2.1 Introduction

Graph++ est un projet en C++ qui offre une boîte à outils complète pour l'analyse et l'exploration de graphes. Le projet se compose de trois composants principaux : une bibliothèque, une application d'interface utilisateur graphique (GUI) et un projet de tests unitaires. Son objectif principal est de faciliter les tâches liées aux graphes, telles que le calcul des degrés des sommets, des nombres chromatiques, des chemins hamiltoniens et eulériens, et d'autres propriétés. Graph++ offre une plateforme précieuse pour les chercheurs, les étudiants et les passionnés de graphes afin d'analyser et d'explorer efficacement des graphes. Sa bibliothèque, son application GUI et son projet de tests unitaires travaillent ensemble pour fournir un instrument d'analyse de graphes, en en faisant une ressource utile pour diverses tâches liées aux graphes.

### 2.2 Bibliothèque Graph++

La bibliothèque Graph++ sert de base au projet, offrant des implémentations efficaces de diverses structures de données et algorithmes de graphes. Elle fournit aux développeurs une API simple pour créer et modifier des graphes. De plus, la bibliothèque comprend des algorithmes d'analyse de graphes, permettant aux utilisateurs d'obtenir des informations sur la structure de leurs graphes.

### 2.3 Application GUI Graph++

L'application GUI complète la bibliothèque en fournissant une interface conviviale pour interagir avec les graphes. Elle permet aux utilisateurs de créer, modifier et visualiser des graphes, d'appliquer des algorithmes et d'obtenir un retour visuel sur les propriétés des graphes. L'application comprend des fonctionnalités telles que des outils d'édition de graphes, des mises en page personnalisables et des affichages interactifs des propriétés des graphes.

Utilisation

### 2.4 Installation

Vous pouvez [télécharger](#) une version compilée exécutable de l'application graphique pour Windows 64 bits.

## 2.5 Utilisation

```
{c++}  
#include <graph.h>  
///.....  
// Create some vertices  
int vertices[10] = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9};  
// Create a graph for those vertices  
Graph<int>* graph = new Graph<int>();  
// Add the vertices to the graph  
for(int i : vertices){  
    graph->addVertex(&i);  
}  
// Add some edges to the graph (Circular graph)  
for(int i : vertices){  
    int nextIndex = i + 1;  
    if(nextIndex >= nbVertices){  
        nextIndex = 0;  
    }  
    graph->addDoubleEdge(&vertices[i], &vertices[nextIndex]);  
}
```

## Chapter 3

# Hierarchical Index

### 3.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Edge< T > . . . . .	??
Edge< QVertex > . . . . .	??
Graph< T > . . . . .	??
Graph< int > . . . . .	??
Graph< QVertex > . . . . .	??
QDialog	
QMultipleInputDialog . . . . .	??
QMainWindow	
MainWindow . . . . .	??
QMemento . . . . .	??
QObject	
BasicGraphTest . . . . .	??
ComplexGraphTest . . . . .	??
MinimumDistanceGraphTest . . . . .	??
MinimumSpanningTreeTest . . . . .	??
QCaretaker . . . . .	??
QPushButton	
SelectColorButton . . . . .	??
QT_WARNING_DISABLE_DEPRECATED::qt_meta_stringdata_MainWindow_t . . . . .	??
QT_WARNING_DISABLE_DEPRECATED::qt_meta_stringdata_QMultipleInputDialog_t . . . . .	??
QT_WARNING_DISABLE_DEPRECATED::qt_meta_stringdata_SelectColorButton_t . . . . .	??
QT_WARNING_DISABLE_DEPRECATED::qt_meta_stringdata_VertexDockWidget_t . . . . .	??
queue_element< T > . . . . .	??
QVertex . . . . .	??
QWidget	
GraphDockWidget . . . . .	??
QBoard . . . . .	??
VertexDockWidget . . . . .	??





## Chapter 4

# Class Index

### 4.1 Class List

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

<a href="#">BasicGraphTest</a>	
This class tests the different properties of a circular graph of size 10	??
<a href="#">ComplexGraphTest</a>	
This class tests the different properties of a complete graph of size 10	??
<a href="#">Edge&lt; T &gt;</a>	
Represents a graph edge as a member of an adjacency list and allows to handle the edges of a graph	??
<a href="#">Graph&lt; T &gt;</a>	
Represents a mathematical graph and allows to handle the creation, modification and analysis of it	??
<a href="#">GraphDockWidget</a>	
QWidget displaying all informations about graph analysis. Like eulerian, oriented,..	??
<a href="#">MainWindow</a>	
<a href="#">MainWindow</a> of the application. It contains a MDI, menu, tools,..	??
<a href="#">MinimumDistanceGraphTest</a>	
This class tests the minimum distance graph algorithm	??
<a href="#">MinimumSpanningTreeTest</a>	
This class tests the minimum spanning tree algorithm	??
<a href="#">QBoard</a>	
<a href="#">QBoard</a> is a widget on which we paint the graph. Like a whiteboard	??
<a href="#">QCaretaker</a>	
Caretaker of qboard state. It's part of the memento design pattern	??
<a href="#">QMemento</a>	
Memento of qboard state. It's part of the memento design pattern	??
<a href="#">QMultipleInputDialog</a>	
This class create a multiple input dialog. It can manage inputs from a list of spinBox	??
<a href="#">QT_WARNING_DISABLE_DEPRECATED::qt_meta_stringdata_MainWindow_t</a>	??
<a href="#">QT_WARNING_DISABLE_DEPRECATED::qt_meta_stringdata_QMultipleInputDialog_t</a>	??
<a href="#">QT_WARNING_DISABLE_DEPRECATED::qt_meta_stringdata_SelectColorButton_t</a>	??
<a href="#">QT_WARNING_DISABLE_DEPRECATED::qt_meta_stringdata_VertexDockWidget_t</a>	??
<a href="#">queue_element&lt; T &gt;</a>	
A structure to hold vertices in a priority queue	??
<a href="#">QVertex</a>	
Represent a vertex in the graph	??

**SelectColorButton**

A simple button to select color This code comes from here: <https://stackoverflow.com/questions/18257281/qt-color-picker-widget> . . . . . ??

**VertexDockWidget**

QWidget displaying all informations about the selected vertex. Like colors, positions,.. . . . . ??

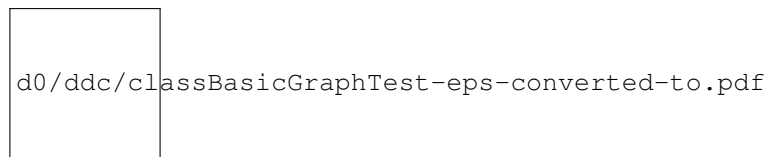
## Chapter 5

# Class Documentation

### 5.1 BasicGraphTest Class Reference

This class tests the different properties of a circular graph of size 10.

Inheritance diagram for BasicGraphTest:



#### 5.1.1 Detailed Description

This class tests the different properties of a circular graph of size 10.

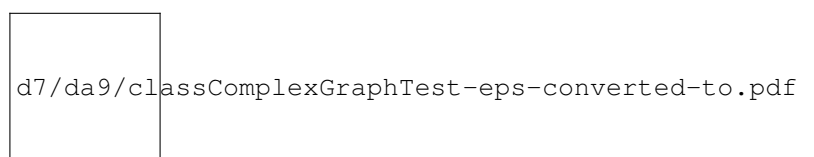
The documentation for this class was generated from the following file:

- sources/Graphpp/Tests/BasicGraphTest/tst\_basicgraphtest.cpp

### 5.2 ComplexGraphTest Class Reference

This class tests the different properties of a complete graph of size 10.

Inheritance diagram for ComplexGraphTest:



### 5.2.1 Detailed Description

This class tests the different properties of a complete graph of size 10.

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

- sources/Graphpp/Tests/ComplexGraphTest/tst\_complexgraphtest.cpp

## 5.3 Edge< T > Class Template Reference

Represents a graph edge as a member of an adjacency list and allows to handle the edges of a graph.

```
#include <edge.h>
```

### Public Member Functions

- [Edge](#) (T \*target, int weight=1)  
*A simple edge constructor.*
- T \* [getTarget](#) ()  
*Returns the target vertex of the edge.*
- int [getWeight](#) ()  
*Returns the weight of the edge.*
- void [setWeight](#) (int weight)  
*Sets the weight of the edge.*

### 5.3.1 Detailed Description

```
template<typename T>
class Edge< T >
```

Represents a graph edge as a member of an adjacency list and allows to handle the edges of a graph.

Author

The Graph++ Development Team

Date

spring 2023

An [Edge](#) is represented as a combination of a target vertex and a weight. The source vertex is not included as the edge belongs to the adjacency list corresponding to the source vertex.

### 5.3.2 Constructor & Destructor Documentation

#### 5.3.2.1 Edge()

```
template<typename T >
Edge< T >::Edge (
    T * target,
    int weight = 1 )
```

A simple edge constructor.

## Parameters

<i>target</i>	The target vertex
<i>weight</i>	The weight of the edge

## Author

Damien Tschan

## Date

17.04.2023

### 5.3.3 Member Function Documentation

#### 5.3.3.1 getTarget()

```
template<typename T >  
T * Edge< T >::getTarget
```

Returns the target vertex of the edge.

## Returns

The target vertex of the edge

## Author

Damien Tschan

## Date

17.04.2023

#### 5.3.3.2 getWeight()

```
template<typename T >  
int Edge< T >::getWeight
```

Returns the weight of the edge.

## Returns

The weight of the edge

## Author

Damien Tschan

## Date

17.04.2023

### 5.3.3.3 setWeight()

```
template<typename T >
void Edge< T >::setWeight (
    int weight )
```

Sets the weight of the edge.

#### Parameters

<i>weight</i>	The weight to set
---------------	-------------------

#### Author

Damien Tschan

#### Date

17.04.2023

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

- sources/Graphpp/Lib/edge.h

## 5.4 Graph< T > Class Template Reference

Represents a mathematical graph and allows to handle the creation, modification and analysis of it.

```
#include <graph.h>
```

### Public Member Functions

- [Graph](#) ()  
*Initializes a new graph.*
- [~Graph](#) ()  
*Deletes the current graph.*
- void [addVertex](#) (T \*vertex)  
*Adds a vertex to the graph.*
- void [addEdge](#) (T \*source, T \*target, int weight=1)  
*Adds an edge between two vertices.*
- void [addDoubleEdge](#) (T \*vertex1, T \*vertex2, int weight=1)  
*Adds two edges in opposite directions between two vertices.*
- void [addPrebuiltEdge](#) (T \*source, [Edge](#)< T > \*)  
*Adds a prebuilt edge to the graph.*
- void [removeVertex](#) (T \*vertex)  
*Removes a vertex and its linked edges from the graph and deletes them.*
- std::list< [Edge](#)< T > \* > [popVertex](#) (T \*vertex)  
*Removes a vertex and its linked edges from the graph but doesn't delete anything.*

- void **removeEdge** (Edge< T > \*edge)  
*Removes an edge from the graph and deletes it completely.*
- void **popEdge** (Edge< T > \*edge)  
*Removes an edge from the graph but doesn't delete it.*
- bool **isEmpty** ()  
*Returns whether the graph is empty.*
- bool **isEulerian** ()  
*Returns whether the graph is eulerian.*
- bool **isHamiltonian** ()  
*Returns whether the graph is hamiltonian.*
- bool **isConnected** ()  
*Returns whether the graph is connected.*
- bool **isStronglyConnected** ()  
*Returns whether the graph is strongly connected.*
- bool **isOriented** ()  
*Returns whether the graph is oriented.*
- bool **isWeighted** ()  
*Returns whether the graph is weighted.*
- int **getChromaticNumber** ()  
*Returns an estimation of the chromatic number of the graph as an integer.*
- int **getNbEdges** ()  
*Returns the amount of edges in the graph as an integer.*
- int **getNbVertices** ()  
*Returns the amount of vertices in the graph as an integer.*
- int **getVertexIndegree** (T \*vertex)  
*Returns the indegree of a vertex.*
- int **getVertexOutdegree** (T \*vertex)  
*Returns the outdegree of a vertex.*
- Graph< T > \* **getMinimumSpanningTree** ()  
*Returns a new graph which is a minimum spanning tree of the initial graph.*
- Graph< T > \* **getMinimumDistanceGraph** (T \*startingVertex)  
*Returns a new graph which is the shortest paths graph of the initial graph.*
- Graph< T > \* **getHamiltonianPath** ()  
*Returns the hamiltonian path of a graph.*
- std::string **exportToDOT** ()  
*Serializes a graph into the DOT format.*

## Public Attributes

- std::unordered\_map< T \*, std::list< Edge< T > \* > > **adjacencyList**  
*Represents a graph as an adjacency list.*

## Friends

- template<typename T2 >  
std::ostream & **operator**<< (std::ostream &os, const Graph< T2 > &p)
- template<typename T2 >  
std::istream & **operator**>> (std::istream &is, Graph< T2 > &p)

### 5.4.1 Detailed Description

```
template<typename T>  
class Graph< T >
```

Represents a mathematical graph and allows to handle the creation, modification and analysis of it.

#### Author

The Graph++ Development Team

#### Date

spring 2023

### 5.4.2 Constructor & Destructor Documentation

#### 5.4.2.1 Graph()

```
template<typename T >  
Graph< T >::Graph
```

Initializes a new graph.

#### Author

Damien Tschan

#### Date

17.04.2023

#### 5.4.2.2 ~Graph()

```
template<typename T >  
Graph< T >::~~Graph
```

Deletes the current graph.

#### Author

Jonas Flückiger

#### Date

16.05.2023



### 5.4.3 Member Function Documentation

#### 5.4.3.1 addDoubleEdge()

```
template<typename T >
void Graph< T >::addDoubleEdge (
    T * vertex1,
    T * vertex2,
    int weight = 1 )
```

Adds two edges in opposite directions between two vertices.

##### Parameters

<i>vertex1</i>	A vertex
<i>vertex2</i>	Another vertex
<i>weight</i>	The weight of the edge

##### Author

Damien Tschan

##### Date

17.04.2023

#### 5.4.3.2 addEdge()

```
template<typename T >
void Graph< T >::addEdge (
    T * source,
    T * target,
    int weight = 1 )
```

Adds an edge between two vertices.

##### Parameters

<i>source</i>	Source vertex
<i>target</i>	Target vertex
<i>weight</i>	The weight of the edge

##### Author

Damien Tschan

**Date**

17.04.2023

**5.4.3.3 addPrebuiltEdge()**

```
template<typename T >
void Graph< T >::addPrebuiltEdge (
    T * source,
    Edge< T > * edge )
```

Adds a prebuilt edge to the graph.

**Parameters**

<i>The</i>	source vertex
<i>The</i>	prebuilt edge

**Author**

Jonas Flückiger

**Date**

15.05.2023

**5.4.3.4 addVertex()**

```
template<typename T >
void Graph< T >::addVertex (
    T * vertex )
```

Adds a vertex to the graph.

**Parameters**

<i>vertex</i>	A vertex
---------------	----------

**Author**

Damien Tschan

**Date**

17.04.2023

#### 5.4.3.5 exportToDOT()

```
template<typename T >
std::string Graph< T >::exportToDOT
```

Serializes a graph into the DOT format.

The templated class will also be serialized using the out stream operator.

##### Author

Jonas Flückiger

##### Date

26.05.2023

#### 5.4.3.6 getChromaticNumber()

```
template<typename T >
int Graph< T >::getChromaticNumber
```

Returns an estimation of the chromatic number of the graph as an integer.

##### Author

Jonas Flückiger

##### Date

12.05.2023

This method uses the greedy algorithm, where each vertex is colored one after the other with the first possible color. This method can perform well depending on the order in which the vertices are colored, and depends on the shape of the graph. In this implementation, vertices are colored in order of descending degree.

#### 5.4.3.7 getHamiltonianPath()

```
template<typename T >
Graph< T > * Graph< T >::getHamiltonianPath
```

Returns the hamiltonian path of a graph.

##### Returns

A subgraph containing the hamiltonian path if it exists, an empty graph otherwise

##### Author

Damien Tschan

##### Date

09.06.2023

Since the algorithm and deduction rules are oriented toward directed graphs, each [Edge](#) is counted twice. To prevent that, when an [Edge](#) is added to the partial path, the opposite [Edge](#) is deleted. This means that this method has to be updated to fully support oriented graphs.

As not all rules are implemented, it is almost a brute force algorithm, with a complexity of  $O(n!)$

#### 5.4.3.8 getMinimumDistanceGraph()

```
template<typename T >  
Graph< T > * Graph< T >::getMinimumDistanceGraph (   
    T * startingVertex )
```

Returns a new graph which is the shortest paths graph of the initial graph.

This method uses Dijkstra's algorithm.

##### Author

Jonas Flückiger

##### Date

26.05.2023

#### 5.4.3.9 getMinimumSpanningTree()

```
template<typename T >  
Graph< T > * Graph< T >::getMinimumSpanningTree
```

Returns a new graph which is a minimum spanning tree of the initial graph.

This method uses Prim's algorithm.

##### Author

Jonas Flückiger

##### Date

15.05.2023

#### 5.4.3.10 getNbEdges()

```
template<typename T >  
int Graph< T >::getNbEdges
```

Returns the amount of edges in the graph as an integer.

##### Returns

The amount of edges in the graph as an integer

##### Author

Damien Tschan

##### Date

17.04.2023

#### 5.4.3.11 getNbVertices()

```
template<typename T >
int Graph< T >::getNbVertices
```

Returns the amount of vertices in the graph as an integer.

##### Returns

The amount of vertices in the graph as an integer

##### Author

Damien Tschan

##### Date

17.04.2023

#### 5.4.3.12 getVertexIndegree()

```
template<typename T >
int Graph< T >::getVertexIndegree (
    T * vertex )
```

Returns the indegree of a vertex.

##### Parameters

<i>vertex</i>	A vertex
---------------	----------

##### Returns

The indegree of the vertex

##### Author

Damien Tschan

##### Date

17.04.2023

#### 5.4.3.13 getVertexOutdegree()

```
template<typename T >
int Graph< T >::getVertexOutdegree (
    T * vertex )
```

Returns the outdegree of a vertex.

**Parameters**

<i>vertex</i>	A vertex
---------------	----------

**Returns**

The outdegree of the vertex

**Author**

Damien Tschan

**Date**

17.04.2023

**5.4.3.14 isConnected()**

```
template<typename T >  
bool Graph< T >::isConnected
```

Returns whether the graph is connected.

**Returns**

Whether the graph is connected

**Author**

Damien Tschan

**Date**

08.05.2023

**5.4.3.15 isEmpty()**

```
template<typename T >  
bool Graph< T >::isEmpty
```

Returns whether the graph is empty.

**Returns**

Whether the graph is empty

**Author**

Damien Tschan

**Date**

05.06.2023

#### 5.4.3.16 isEulerian()

```
template<typename T >  
bool Graph< T >::isEulerian
```

Returns whether the graph is eulerian.

##### Returns

Whether the graph is eulerian

##### Author

Damien Tschan

##### Date

08.05.2023

#### 5.4.3.17 isHamiltonian()

```
template<typename T >  
bool Graph< T >::isHamiltonian
```

Returns whether the graph is hamiltonian.

##### Returns

Whether the graph is hamiltonian

##### Author

Damien Tschan

##### Date

05.06.2023



#### 5.4.3.18 isOriented()

```
template<typename T >  
bool Graph< T >::isOriented
```

Returns whether the graph is oriented.

##### Returns

Whether the graph is oriented

##### Author

Damien Tschan

##### Date

24.04.2023

#### 5.4.3.19 isStronglyConnected()

```
template<typename T >  
bool Graph< T >::isStronglyConnected
```

Returns whether the graph is strongly connected.

##### Returns

Whether the graph is strongly connected

##### Author

Damien Tschan

##### Date

24.04.2023

#### 5.4.3.20 isWeighted()

```
template<typename T >
bool Graph< T >::isWeighted
```

Returns whether the graph is weighted.

##### Returns

Whether the graph is weighted

##### Author

Damien Tschan

##### Date

24.04.2023

#### 5.4.3.21 popEdge()

```
template<typename T >
void Graph< T >::popEdge (
    Edge< T > * edge )
```

Removes an edge from the graph but doesn't delete it.

##### Parameters

<i>edge</i>	An edge
-------------	---------

##### Author

Damien Tschan

##### Date

01.06.2023

As the targeted edge is a parameter of the function, it doesn't need to be returned (the caller already knows it)

#### 5.4.3.22 popVertex()

```
template<typename T >
std::list< Edge< T > * > Graph< T >::popVertex (
    T * vertex )
```

Removes a vertex and its linked edges from the graph but doesn't delete anything.

**Parameters**

<i>vertex</i>	A vertex
---------------	----------

**Author**

Damien Tschan

**Date**

01.06.2023

**Returns**

a list of all removed edges (removed from the graph but not deleted)

As the targeted vertex is a parameter of the function, it doesn't need to be returned (the caller already knows it)

**5.4.3.23 removeEdge()**

```
template<typename T >
void Graph< T >::removeEdge (
    Edge< T > * edge )
```

Removes an edge from the graph and deletes it completely.

**Parameters**

<i>edge</i>	An edge
-------------	---------

**Author**

Damien Tschan

**Date**

01.06.2023

**5.4.3.24 removeVertex()**

```
template<typename T >
void Graph< T >::removeVertex (
    T * vertex )
```

Removes a vertex and its linked edges from the graph and deletes them.

**Parameters**

<i>vertex</i>	A vertex
---------------	----------

**Author**

Damien Tschan

**Date**

01.06.2023

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

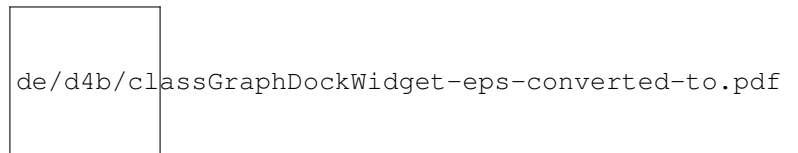
- sources/Graphpp/Lib/graph.h

## 5.5 GraphDockWidget Class Reference

QWidget displaying all informations about graph analysis. Like eulerian, oriented,...

```
#include <graphdockwidget.h>
```

Inheritance diagram for GraphDockWidget:



### Public Member Functions

- void [setSelectedGraph](#) ([Graph](#)< [QVertex](#) > \*graph)  
*Set the selected graph.*
- [GraphDockWidget](#) (QWidget \*parent)  
*Constructor of the dock widget about graph analysis.*

#### 5.5.1 Detailed Description

QWidget displaying all informations about graph analysis. Like eulerian, oriented,...

**Author**

Plumey Simon

**Date**

spring 2023

## 5.5.2 Constructor & Destructor Documentation

### 5.5.2.1 GraphDockWidget()

```
GraphDockWidget::GraphDockWidget (
    QWidget * parent )
```

Constructor of the dock widget about graph analysis.

## Parameters

<code>QWidget</code>	parent
----------------------	--------

## Author

Plumey Simon

### 5.5.3 Member Function Documentation

#### 5.5.3.1 setSelectedGraph()

```
void GraphDockWidget::setSelectedGraph (
    Graph< QVertex > * graph )
```

Set the selected graph.

## Parameters

<code>Graph&lt;QVertex&gt;*</code>	graph of <code>QVertex</code>
------------------------------------	-------------------------------

## Author

Plumey Simon

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

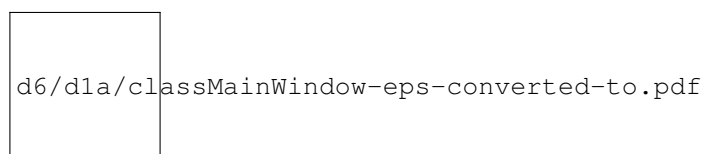
- sources/Graphpp/App/graphdockwidget.h
- sources/Graphpp/App/graphdockwidget.cpp

## 5.6 MainWindow Class Reference

[MainWindow](#) of the application. It contains a MDI, menu, tools,...

```
#include <mainwindow.h>
```

Inheritance diagram for MainWindow:



## Public Member Functions

- [MainWindow](#) ()

*Constructor main window.*

### 5.6.1 Detailed Description

[MainWindow](#) of the application. It contains a MDI, menu, tools,...

#### Author

Plumey Simon & Jonas Flückiger

#### Date

spring 2023

### 5.6.2 Constructor & Destructor Documentation

#### 5.6.2.1 MainWindow()

```
MainWindow::MainWindow ( )
```

Constructor main window.

#### Author

Plumey Simon

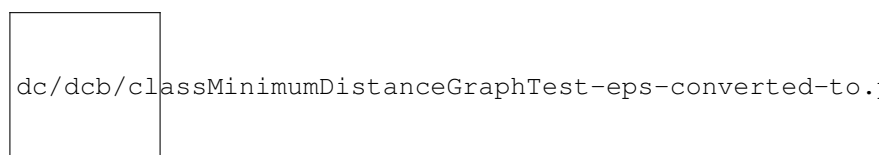
The documentation for this class was generated from the following files:

- sources/Graphpp/App/mainwindow.h
- sources/Graphpp/App/mainwindow.cpp

## 5.7 MinimumDistanceGraphTest Class Reference

This class tests the minimum distance graph algorithm.

Inheritance diagram for MinimumDistanceGraphTest:



### 5.7.1 Detailed Description

This class tests the minimum distance graph algorithm.

The tested graph is the complete graph K10, where each edge's weight is equal to the index of the source vertex multiplied by the index of the target vertex (indices range from 1 to 10). Meaning that the minimum distance graph of this graph, starting from any vertex, is composed only of the edges connected to the '1' vertex.

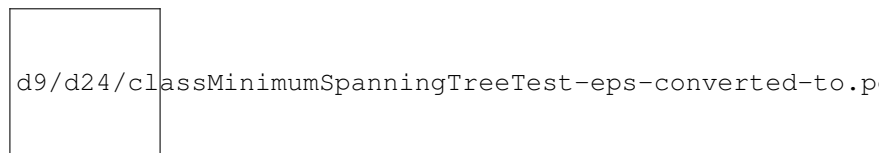
The documentation for this class was generated from the following file:

- `sources/Graphpp/Tests/MinimumDistanceGraphTest/tst_minimumdistancegraphtest.cpp`

## 5.8 MinimumSpanningTreeTest Class Reference

This class tests the minimum spanning tree algorithm.

Inheritance diagram for MinimumSpanningTreeTest:



### 5.8.1 Detailed Description

This class tests the minimum spanning tree algorithm.

The tested graph is the complete graph K10, where each edge's weight is equal to the index of the source vertex multiplied by the index of the target vertex (indices range from 1 to 10), meaning that the minimum spanning tree is composed only of the edges connected to the '1' vertex.

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

- `sources/Graphpp/Tests/MinimumSpanningTreeTest/tst_minimumspanningtreetest.cpp`

## 5.9 QBoard Class Reference

**QBoard** is a widget on which we paint the graph. Like a whiteboard.

```
#include <qboard.h>
```

Inheritance diagram for QBoard:





## Public Member Functions

- [QBoard](#) ([VertexDockWidget](#) \*vertexDockWidget, [QWidget](#) \*parent=nullptr)  
*Constructor of the [QBoard](#).*
- virtual [~QBoard](#) ()  
*Destructor of the [QBoard](#).*
- void [setSelectedTool](#) ([Tool](#) selectedTool)  
*Set the selected Tool.*
- void [exportToPng](#) ([QString](#) path)  
*Able to convert [QPainter](#) to a PNG image.*
- void [exportToDOT](#) ([QString](#) path)  
*Exports the graph of the board in a DOT text file.*
- void [saveToFile](#) ([QString](#) path)  
*Save current graph to a file.*
- void [openFile](#) ([QString](#) path)  
*Imports the graph contained in the file.*
- void [highlightMinimumDistanceGraph](#) ()  
*Highlights the current graph's minimum distance graph.*
- void [highlightMinimumSpanningTree](#) ()  
*Highlights the current graph's minimum spanning tree.*
- void [highlightHamiltonianPath](#) ()  
*Highlights the current graph's hamiltonian path.*
- [QMemento](#) [save](#) ()  
*Function to save current [QBoard](#) state and return a new [QMemento](#).*
- void [restore](#) ([QMemento](#) memento)  
*Function to restore [QBoard](#) state from a [QMemento](#).*
- [QCaretaker](#) \* [getQCaretaker](#) ()  
*Return the caretaker.*

## Public Attributes

- [Graph](#)< [QVertex](#) > \* **graph**
- [Graph](#)< [QVertex](#) > \* **highlightedGraph**

## Protected Member Functions

- void [paintEvent](#) ([QPaintEvent](#) \*) override  
*Paint event method. Called on every graph update. This method is not supposed to be called. Use this-> update() to refresh scene.*
- void [mousePressEvent](#) ([QMouseEvent](#) \*event) override  
*Method to handle the right behaviour on click depending on which tool is selected.*
- void [mouseMoveEvent](#) ([QMouseEvent](#) \*event) override  
*Method to handle the right behaviour on mouse moving depending on which tool is selected.*
- void [mouseReleaseEvent](#) ([QMouseEvent](#) \*event) override  
*Method to handle the right behaviour on release click depending on which tool is selected.*
- void [wheelEvent](#) ([QWheelEvent](#) \*event) override  
*Zoom when mouse wheel is used.*

### 5.9.1 Detailed Description

[QBoard](#) is a widget on which we paint the graph. Like a whiteboard.

#### Author

Plumey Simon & Jonas Flückiger

#### Date

spring 2023

### 5.9.2 Constructor & Destructor Documentation

#### 5.9.2.1 QBoard()

```
QBoard::QBoard (
    VertexDockWidget * vertexDockWidget,
    QWidget * parent = nullptr )
```

Constructor of the [QBoard](#).

#### Parameters

<a href="#">QWidget</a>	parent
-------------------------	--------

#### Author

Plumey Simon

#### 5.9.2.2 ~QBoard()

```
QBoard::~QBoard ( ) [virtual]
```

Destructor of the [QBoard](#).

#### Author

Plumey Simon

### 5.9.3 Member Function Documentation

### 5.9.3.1 exportToDOT()

```
void QBoard::exportToDOT (
    QString path )
```

Exports the graph of the board in a DOT text file.

#### Author

Flückiger Jonas

### 5.9.3.2 exportToPng()

```
void QBoard::exportToPng (
    QString path )
```

Able to convert QPainter to a PNG image.

#### Author

Plumey Simon

### 5.9.3.3 getQCaretaker()

```
QCaretaker * QBoard::getQCaretaker ( )
```

Return the caretaker.

#### Author

Plumey Simon

### 5.9.3.4 highlightHamiltonianPath()

```
void QBoard::highlightHamiltonianPath ( )
```

Highlights the current graph's hamiltonian path.

#### Author

Tschan Damien

#### 5.9.3.5 highlightMinimumDistanceGraph()

```
void QBoard::highlightMinimumDistanceGraph ( )
```

Highlights the current graph's minimum distance graph.

##### Author

Flückiger Jonas

#### 5.9.3.6 highlightMinimumSpanningTree()

```
void QBoard::highlightMinimumSpanningTree ( )
```

Highlights the current graph's minimum spanning tree.

##### Author

Flückiger Jonas

#### 5.9.3.7 mouseMoveEvent()

```
void QBoard::mouseMoveEvent (
    QMouseEvent * event ) [override], [protected]
```

Method to handle the right behaviour on mouse moving depending on which tool is selected.

##### Parameters

<i>QMouseEvent</i>	Mouse event
--------------------	-------------

##### Author

Plumey Simon

#### 5.9.3.8 mousePressEvent()

```
void QBoard::mousePressEvent (
    QMouseEvent * event ) [override], [protected]
```

Method to handle the right behaviour on click depending on which tool is selected.

## Parameters

<i>QMouseEvent</i>	Mouse event
--------------------	-------------

## Author

Plumey Simon

### 5.9.3.9 mouseReleaseEvent()

```
void QBoard::mouseReleaseEvent (
    QMouseEvent * event ) [override], [protected]
```

Method to handle the right behaviour on release click depending on which tool is selected.

## Parameters

<i>QMouseEvent</i>	Mouse event
--------------------	-------------

## Author

Plumey Simon

### 5.9.3.10 openFile()

```
void QBoard::openFile (
    QString path )
```

Imports the graph contained in the file.

## Parameters

<i>path</i>	the path to the file
-------------	----------------------

## Author

Flückiger Jonas

### 5.9.3.11 paintEvent()

```
void QBoard::paintEvent (
    QPaintEvent * ) [override], [protected]
```

Paint event method. Called on every graph update. This method is not supposed to be called. Use `this->update()` to refresh scene.

#### Parameters

<code>QPaintEvent*</code>	
---------------------------	--

#### Author

Plumey Simon

### 5.9.3.12 `restore()`

```
void QBoard::restore (
    QMemento memento )
```

Function to restore [QBoard](#) state from a [QMemento](#).

#### Parameters

<a href="#">QMemento</a>	used to restore state of <a href="#">QBoard</a>
--------------------------	---

#### Author

Plumey Simon

### 5.9.3.13 `save()`

```
QMemento QBoard::save ( )
```

Function to save current [QBoard](#) state and return a new [QMemento](#).

#### Author

Plumey Simon

### 5.9.3.14 `saveToFile()`

```
void QBoard::saveToFile (
    QString path )
```

Save current graph to a file.

## Parameters

<i>path</i>	the path to the file
-------------	----------------------

## Author

Flückiger Jonas

**5.9.3.15 setSelectedTool()**

```
void QBoard::setSelectedTool (
    Tool selectedTool )
```

Set the selected Tool.

## Parameters

<i>Tool</i>	Selected
-------------	----------

## Author

Plumey Simon

**5.9.3.16 wheelEvent()**

```
void QBoard::wheelEvent (
    QWheelEvent * event ) [override], [protected]
```

Zoom when mouse wheel is used.

## Parameters

<i>QWheelEvent</i>	Mouse event
--------------------	-------------

## Author

Plumey Simon

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

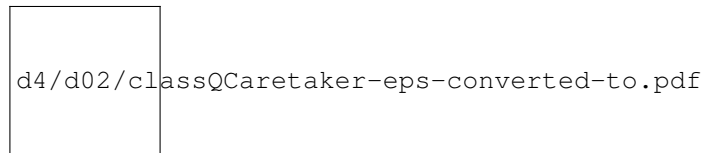
- sources/Graphpp/App/qboard.h
- sources/Graphpp/App/clickBehaviours.cpp
- sources/Graphpp/App/moveBehaviours.cpp
- sources/Graphpp/App/qboard.cpp

## 5.10 QCaretaker Class Reference

Caretaker of qboard state. It's part of the memento design pattern.

```
#include <qcaretaker.h>
```

Inheritance diagram for QCaretaker:



### Signals

- void **backupAction** ()

### Public Member Functions

- [QCaretaker](#) ([QBoard](#) \*qboard)  
*Constructor of [QCaretaker](#).*
- void [backup](#) ()  
*Save current stat of graph in a [QMemento](#) object.*
- void [undo](#) ()  
*Restore the current state from the previous memento.*
- void [redo](#) ()  
*Redo the last operation undid.*
- bool [canUndo](#) ()
- bool [canRedo](#) ()
- void [deleteDifferences](#) (std::unordered\_map< [QVertex](#) \*, std::list< [Edge](#)< [QVertex](#) > \* >> graphMap, std::unordered\_map< [QVertex](#) \*, std::list< [Edge](#)< [QVertex](#) > \* >> mementoMap)  
*Delete in memory all objects present in mapToRemove and not in currentMap.*

### 5.10.1 Detailed Description

Caretaker of qboard state. It's part of the memento design pattern.

#### Author

Plumey Simon

#### Date

spring 2023

### 5.10.2 Constructor & Destructor Documentation



### 5.10.2.1 QCaretaker()

```
QCaretaker::QCaretaker (
    QBoard * qboard )
```

Constructor of [QCaretaker](#).

Author

Plumey Simon

## 5.10.3 Member Function Documentation

### 5.10.3.1 backup()

```
void QCaretaker::backup ( )
```

Save current stat of graph in a [QMemento](#) object.

Author

Plumey Simon

### 5.10.3.2 canRedo()

```
bool QCaretaker::canRedo ( )
```

Returns

true if the caretaker can redo something. Otherwise, return false

Author

Plumey Simon

### 5.10.3.3 canUndo()

```
bool QCaretaker::canUndo ( )
```

Returns

true if the caretaker can undo something. Otherwise, return false

Author

Plumey Simon

### 5.10.3.4 deleteDifferences()

```
void QCaretaker::deleteDifferences (
    std::unordered_map< QVertex *, std::list< Edge< QVertex > * >> mapToRemove,
    std::unordered_map< QVertex *, std::list< Edge< QVertex > * >> currentMap )
```

Delete in memory all objects present in mapToRemove and not in currentMap.

## Parameters

<code>std::unordered_map&lt;QVertex*,std::list&lt;Edge&lt;↔ QVertex&gt;*&gt;&gt;&gt;</code>	mapToRemove map with all object more will be deleted (often memento map)
<code>std::unordered_map&lt;QVertex*,std::list&lt;Edge&lt;↔ QVertex&gt;*&gt;&gt;&gt;</code>	currentMap the reference map to compare the mapToRemove (often current graph map)

## Author

Plumey Simon

**5.10.3.5 redo()**

```
void QCaretaker::redo ( )
```

Redo the last operation undid.

## Author

Plumey Simon

**5.10.3.6 undo()**

```
void QCaretaker::undo ( )
```

Restore the current state from the previous memento.

## Author

Plumey Simon

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

- sources/Graphpp/App/qcaretaker.h
- sources/Graphpp/App/qcaretaker.cpp

**5.11 QMemento Class Reference**

Memento of qboard state. It's part of the memento design pattern.

```
#include <qmemento.h>
```

## Public Member Functions

- [QMemento](#) ()  
*Default constructor for data structs.*
- [QMemento](#) (std::unordered\_map< [QVertex](#) \*, std::list< [Edge](#)< [QVertex](#) > \* >> adjacencyList)  
*Constructor of [QMemento](#).*
- std::unordered\_map< [QVertex](#) \*, std::list< [Edge](#)< [QVertex](#) > \* >> [getAdjacencyList](#) ()  
*Getter of attribut adjacencyList.*

### 5.11.1 Detailed Description

Memento of qboard state. It's part of the memento design pattern.

#### Author

Plumey Simon

#### Date

spring 2023

### 5.11.2 Constructor & Destructor Documentation

#### 5.11.2.1 QMemento() [1/2]

```
QMemento::QMemento ( )
```

Default constructor for data structs.

#### Author

Flückiger Jonas

#### 5.11.2.2 QMemento() [2/2]

```
QMemento::QMemento (
    std::unordered_map< QVertex *, std::list< Edge< QVertex > * >> adjacencyList )
```

Constructor of [QMemento](#).

#### Author

Plumey Simon

### 5.11.3 Member Function Documentation

#### 5.11.3.1 getAdjacencyList()

```
std::unordered_map< QVertex *, std::list< Edge< QVertex > * > > QMemento::getAdjacencyList ( )
```

Getter of attribut adjacencyList.

#### Returns

```
std::unordered_map<QVertex *, std::list<Edge<QVertex> *>>
```

#### Author

Plumey Simon

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

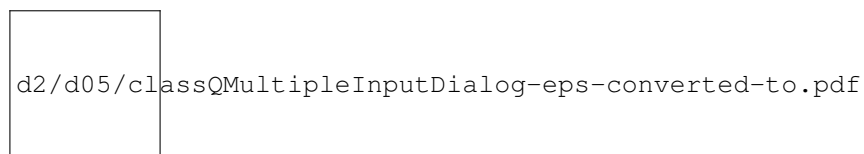
- sources/Graphpp/App/qmemento.h
- sources/Graphpp/App/qmemento.cpp

## 5.12 QMultipleInputDialog Class Reference

This class create a multiple input dialog. It can manage inputs from a list of spinBox.

```
#include <qmultipleinputdialog.h>
```

Inheritance diagram for QMultipleInputDialog:



### Public Member Functions

- [QMultipleInputDialog](#) (QString title, QList< QPair< QLabel \*, QSpinBox \* >> elements, QWidget \*parent=nullptr)  
*Constructor of [QMultipleInputDialog](#).*

### Static Public Member Functions

- static QList< int > [getInts](#) (QString title, QList< QPair< QLabel \*, QSpinBox \* >> elements, bool \*ok, QWidget \*parent=nullptr)  
*Get all spinbox values and put in a list.*

### 5.12.1 Detailed Description

This class create a multiple input dialog. It can manage inputs from a list of spinBox.

#### Author

Plumey Simon, inspired by Bobur ( <https://stackoverflow.com/a/53332748>)

#### Date

spring 2023

### 5.12.2 Constructor & Destructor Documentation

#### 5.12.2.1 QMultipleInputDialog()

```
QMultipleInputDialog::QMultipleInputDialog (
    QString title,
    QList< QPair< QLabel *, QSpinBox * >> elements,
    QWidget * parent = nullptr ) [explicit]
```

Constructor of [QMultipleInputDialog](#).

#### Parameters

<i>QString</i>	title
<i>QList&lt;QPair&lt;QLabel*,QSpinBox*&gt;&gt;</i>	list of pair of labels and spinbox
<i>QWidget</i>	parent

#### Author

Plumey Simon, inspired by Bobur

### 5.12.3 Member Function Documentation

#### 5.12.3.1 getInts()

```
QList< int > QMultipleInputDialog::getInts (
    QString title,
    QList< QPair< QLabel *, QSpinBox * >> elements,
    bool * ok,
    QWidget * parent = nullptr ) [static]
```

Get all spinbox values and put in a list.

**Author**

Plumey Simon, inspired by Bobur

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

- sources/Graphpp/App/qmultipleinputdialog.h
- sources/Graphpp/App/qmultipleinputdialog.cpp

## 5.13 QT\_WARNING\_DISABLE\_DEPRECATED::qt\_meta\_stringdata\_↔ MainWindow\_t Struct Reference

### Public Attributes

- uint **offsetsAndSizes** [40]
- char **stringdata0** [11]
- char **stringdata1** [9]
- char **stringdata2** [1]
- char **stringdata3** [10]
- char **stringdata4** [10]
- char **stringdata5** [12]
- char **stringdata6** [12]
- char **stringdata7** [5]
- char **stringdata8** [5]
- char **stringdata9** [6]
- char **stringdata10** [30]
- char **stringdata11** [29]
- char **stringdata12** [22]
- char **stringdata13** [19]
- char **stringdata14** [9]
- char **stringdata15** [7]
- char **stringdata16** [19]
- char **stringdata17** [15]
- char **stringdata18** [5]
- char **stringdata19** [5]

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

- sources/build-Graphpp-Desktop\_Qt\_6\_4\_2\_MinGW\_64\_bit-Release/App/release/moc\_mainwindow.cpp

## 5.14 QT\_WARNING\_DISABLE\_DEPRECATED::qt\_meta\_stringdata\_↔ QMultipleInputDialog\_t Struct Reference

### Public Attributes

- uint **offsetsAndSizes** [2]
- char **stringdata0** [21]

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

- sources/build-Graphpp-Desktop\_Qt\_6\_4\_2\_MinGW\_64\_bit-Release/App/release/moc\_qmultipleinputdialog.↔  
cpp

## 5.15 QT\_WARNING\_DISABLE\_DEPRECATED::qt\_meta\_stringdata\_SelectColorButton\_t Struct Reference

### Public Attributes

- uint **offsetsAndSizes** [10]
- char **stringdata0** [18]
- char **stringdata1** [13]
- char **stringdata2** [1]
- char **stringdata3** [12]
- char **stringdata4** [12]

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

- sources/build-Graphpp-Desktop\_Qt\_6\_4\_2\_MinGW\_64\_bit-Release/App/release/moc\_selectcolorbutton.↵  
cpp

## 5.16 QT\_WARNING\_DISABLE\_DEPRECATED::qt\_meta\_stringdata\_VertexDockWidget\_t Struct Reference

### Public Attributes

- uint **offsetsAndSizes** [6]
- char **stringdata0** [17]
- char **stringdata1** [14]
- char **stringdata2** [1]

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

- sources/build-Graphpp-Desktop\_Qt\_6\_4\_2\_MinGW\_64\_bit-Release/App/release/moc\_vertexdockwidget.↵  
cpp

## 5.17 queue\_element< T > Struct Template Reference

A structure to hold vertices in a priority queue.

```
#include <queue_element.h>
```

### Public Member Functions

- [queue\\_element](#) (int [priority](#), T \*[source](#), [Edge](#)< T > \*[edge](#))  
*Builds a new queue element.*

## Public Attributes

- `int priority`  
*The priority of this element in the queue.*
- `T * source`  
*The vertex from which the element was discovered.*
- `Edge< T > * edge`  
*The edge connecting the source and the element.*

### 5.17.1 Detailed Description

```
template<typename T>
struct queue_element< T >
```

A structure to hold vertices in a priority queue.

This structure is used for different graph search algorithms where vertices and the way (source and egde) through which they were discovered must be saved in a priority queue.

### 5.17.2 Constructor & Destructor Documentation

#### 5.17.2.1 queue\_element()

```
template<typename T >
queue_element< T >::queue_element (
    int priority,
    T * source,
    Edge< T > * edge ) [inline]
```

Builds a new queue element.

#### Parameters

<i>The</i>	priority of this element in the queue.
<i>The</i>	vertex from which the element was discovered.
<i>The</i>	edge connecting the source and the element.

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

- `sources/Graphpp/Lib/queue_element.h`

## 5.18 QVertex Class Reference

Represent a vertex in the graph.

```
#include <qvertex.h>
```



## Public Member Functions

- [QVertex](#) (QString name, QPointF position, QColor textColor=Qt::black, QColor backgroundColor=Qt::black, QColor borderColor=Qt::black)

Constructor of [QVertex](#).

- QString **getName** ()
- QPointF **getPosition** ()
- QColor **getTextColor** ()
- QColor **getBackgroundColor** ()
- QColor **getBorderColor** ()
- bool **isSelected** ()
- void **setName** (QString name)
- void **setPosition** (QPointF position)
- void **setTextColor** (QColor color)
- void **setBackgroundColor** (QColor color)
- void **setBorderColor** (QColor color)
- void **setSelected** (bool selected)

### 5.18.1 Detailed Description

Represent a vertex in the graph.

#### Author

Plumey Simon

#### Date

spring 2023

### 5.18.2 Constructor & Destructor Documentation

#### 5.18.2.1 QVertex()

```
QVertex::QVertex (
    QString name,
    QPointF position,
    QColor textColor = Qt::black,
    QColor backgroundColor = Qt::black,
    QColor borderColor = Qt::black )
```

Constructor of [QVertex](#).

#### Parameters

<i>QString</i>	name
<i>QPointF</i>	position
<i>QColor</i>	color of text
<i>QColor</i>	color of background
<i>QColor</i>	color of border

**Author**

Plumey Simon, inspired by Bobur

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

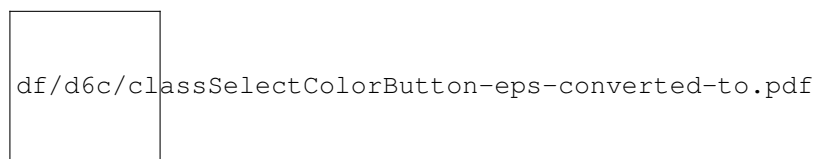
- sources/Graphpp/App/qvertex.h
- sources/Graphpp/App/qvertex.cpp

## 5.19 SelectColorButton Class Reference

A simple button to select color This code comes from here: <https://stackoverflow.com/questions/18257281/qt-select-color-button>

```
#include <selectcolorbutton.h>
```

Inheritance diagram for SelectColorButton:

**Public Slots**

- void **updateColor** ()
- void **changeColor** ()

**Signals**

- void **colorChanged** ()

**Public Member Functions**

- **SelectColorButton** (QWidget \*parent)
- void **setColor** (const QColor &color)
- const QColor & **getColor** () const

### 5.19.1 Detailed Description

A simple button to select color This code comes from here: <https://stackoverflow.com/questions/18257281/qt-select-color-button>

**Author**

Alexis Wilke

**Date**

spring 2023

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

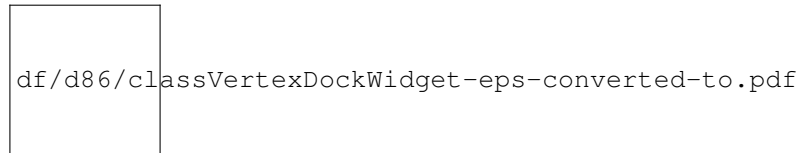
- sources/Graphpp/App/selectcolorbutton.h
- sources/build-Graphpp-Desktop\_Qt\_6\_4\_2\_MinGW\_64\_bit-Release/App/release/moc\_selectcolorbutton.↵.cpp
- sources/Graphpp/App/selectcolorbutton.cpp

## 5.20 VertexDockWidget Class Reference

QWidget displaying all informations about the selected vertex. Like colors, positions,...

```
#include <vertexdockwidget.h>
```

Inheritance diagram for VertexDockWidget:



### Signals

- void **vertexUpdated** ()

### Public Member Functions

- void **setSelectedVertex** ([QVertex](#) \*vertex)  
*Set the selected vertex.*
- void **setSelectedGraph** ([Graph](#)< [QVertex](#) > \*graph)  
*Set the selected graph (graph is used to know the degree of the selected vertex)*
- [VertexDockWidget](#) (QWidget \*parent)  
*Constructor of the dock widget about vertex properties.*

#### 5.20.1 Detailed Description

QWidget displaying all informations about the selected vertex. Like colors, positions,...

Author

Plumey Simon

Date

spring 2023

#### 5.20.2 Constructor & Destructor Documentation

##### 5.20.2.1 VertexDockWidget()

```
VertexDockWidget::VertexDockWidget (  
    QWidget * parent )
```

Constructor of the dock widget about vertex properties.

## Parameters

<i>QWidget</i>	parent
----------------	--------

## Author

Plumey Simon

## 5.20.3 Member Function Documentation

### 5.20.3.1 setSelectedGraph()

```
void VertexDockWidget::setSelectedGraph (
    Graph< QVertex > * graph )
```

Set the selected graph (graph is used to know the degree of the selected vertex)

## Parameters

<i>Graph&lt;QVertex&gt;*</i>	graph of <i>QVertex</i>
------------------------------	-------------------------

## Author

Plumey Simon

### 5.20.3.2 setSelectedVertex()

```
void VertexDockWidget::setSelectedVertex (
    QVertex * vertex )
```

Set the selected vertex.

## Parameters

<i>QVertex*</i>	vertex
-----------------	--------

## Author

Plumey Simon

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

- sources/Graphpp/App/vertexdockwidget.h

- [sources/build-Graphpp-Desktop\\_Qt\\_6\\_4\\_2\\_MinGW\\_64\\_bit-Release/App/release/moc\\_vertexdockwidget.↵](#)  
cpp
- [sources/Graphpp/App/vertexdockwidget.cpp](#)

