

QuantumGates

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1 Class Index

1.1 Class List

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

quantum::QuantumComputer QuantumComputer structure	2
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2 File Index

2.1 File List

Here is a list of all files with brief descriptions:

matrixOperation.h	6
quantumComputer.h	8
quantumGate.h	8
quantumGateOperation.h	18
qubitOperation.h	20

3 Namespace Documentation

3.1 quantum Namespace Reference

Classes

- struct [QuantumComputer](#)
[QuantumComputer](#) structure.

4 Class Documentation

4.1 quantum::QuantumComputer Struct Reference

[QuantumComputer](#) structure.

```
#include <quantumComputer.h>
```

Public Member Functions

- [QuantumComputer](#) (int regSize, double probabilities[], int arrSize)
- void [countNonZeroBaseVector](#) ()
- void [resetState](#) ()
- void [viewProbabilityForBaseVector](#) ()
Used to show probabilities of base vector.
- void [viewValuesInBaseVector](#) ()
Used to show values in base vector.
- void [viewQubitsInDiracNotation](#) ()
- void [validateProbability](#) ()
- void [normalizeRegister](#) ()
Used to normalize probabilities of base vector (register)
- void [measure](#) ()
Used to measure probabilities of base vector (not implemented yet)
- void [extendRegister](#) (int size)
Used to extend register by defined number of qubits(size)
- void [setValueInRegister](#) (int arrayIndex, double value)
Used to replace value in existing register.
- void [displayInfo](#) ()
Used to display all information about qubit.
- vector< double > [getBaseVector](#) ()

Static Public Member Functions

- static void [validateArraySize](#) (int arrSize, int regSize)

Public Attributes

- int [registerSize](#)
- int [baseVectorsCount](#)
- bool [isNormalize](#)
- bool [isMeasured](#)
- vector< double > [baseVector](#)

4.1.1 Detailed Description

[QuantumComputer](#) structure.

4.1.2 Constructor & Destructor Documentation

4.1.2.1 QuantumComputer() `quantum::QuantumComputer::QuantumComputer (int regSize, double probabilities[], int arrSize)`

[QuantumComputer](#) constructor

Parameters

<i>registerSize</i>	int
<i>probabilities</i>	double[]
<i>arraysize</i>	int

4.1.3 Member Function Documentation

4.1.3.1 countNonZeroBaseVector() `void quantum::QuantumComputer::countNonZeroBaseVector ()`

Used to count elements of vector
where element not equal zero

4.1.3.2 displayInfo() `void quantum::QuantumComputer::displayInfo ()`

Used to display all information about qubit.

4.1.3.3 extendRegister() `void quantum::QuantumComputer::extendRegister (`
 `int size)`

Used to extend register by defined number of qubits(size)

4.1.3.4 getBaseVector() `vector<double> quantum::QuantumComputer::getBaseVector ()`

Used to get created base vector

Returns

base vector

4.1.3.5 measure() `void quantum::QuantumComputer::measure ()`

Used to measure probabilities of base vector (not implemented yet)

4.1.3.6 normalizeRegister() `void quantum::QuantumComputer::normalizeRegister ()`

Used to normalize probabilities of base vector (register)

4.1.3.7 resetState() `void quantum::QuantumComputer::resetState ()`

Used to reset state of base vector

First element of vector is set to one, other elements are set to 0

4.1.3.8 setValueInRegister() `void quantum::QuantumComputer::setValueInRegister (`
 `int arrayIndex,`
 `double value)`

Used to replace value in existing register.

4.1.3.9 validateArraySize() `static void quantum::QuantumComputer::validateArraySize (`
 `int arrSize,`
 `int regSize) [static]`

Used to check register size and array size from input

Parameters

<i>arraySize</i>	int
<i>registerSize</i>	int

4.1.3.10 validateProbability() `void quantum::QuantumComputer::validateProbability ()`

Used to check probabilities of base vector

If sum of square probabilities is not equal one, [normalizeRegister\(\)](#) and [resetState\(\)](#) is executed

4.1.3.11 viewProbabilityForBaseVector() `void quantum::QuantumComputer::viewProbabilityForBaseVector ()`

Used to show probabilities of base vector.

4.1.3.12 viewQubitsInDiracNotation() `void quantum::QuantumComputer::viewQubitsInDiracNotation ()`

Used to show qubit/s in Dirac notation

eg. for qubit 0 - $|0\rangle$

4.1.3.13 viewValuesInBaseVector() `void quantum::QuantumComputer::viewValuesInBaseVector ()`

Used to show values in base vector.

4.1.4 Member Data Documentation

4.1.4.1 baseVector `vector<double> quantum::QuantumComputer::baseVector`

4.1.4.2 baseVectorsCount `int quantum::QuantumComputer::baseVectorsCount`

4.1.4.3 isMeasured `bool quantum::QuantumComputer::isMeasured`

4.1.4.4 isNormalize `bool quantum::QuantumComputer::isNormalize`

4.1.4.5 registerSize `int quantum::QuantumComputer::registerSize`

5 File Documentation

5.1 matrixOperation.h File Reference

```
#include <complex>
```

Typedefs

- `typedef vector< vector< complex< double > > > vector2d`
Used as alias for declaration of two dimensional vector.

Functions

- `vector2d getPreparedVectorForHermitianMatrix` (int dimension)
- `vector2d getRandomHermitianMatrix` (int dimension)
- `vector2d makeConjugateTranspose` (`vector2d` matrix)
- `void showMatrix` (`vector2d` matrix)

5.1.1 Typedef Documentation

5.1.1.1 [vector2d](#) `typedef vector<vector<complex<double> > > vector2d`

Used as alias for declaration of two dimensional vector.

5.1.2 Function Documentation

5.1.2.1 [getPreparedVectorForHermitianMatrix\(\)](#) `vector2d getPreparedVectorForHermitianMatrix (
int dimension)`

Used to get defined vector for declared dimension

Parameters

<i>dimension</i>	int
------------------	-----

Returns

defined matrix as two dimensional vector

5.1.2.2 getRandomHermitianMatrix() `vector2d` getRandomHermitianMatrix (
 `int dimension`)

Used to get random hermitian matrix.

Hermitian matrix - https://pl.wikipedia.org/wiki/Macierz_hermitowska

Parameters

<i>dimension</i>	int
------------------	-----

Returns

hermitian matrix as two dimensional vector

5.1.2.3 makeConjugateTranspose() `vector2d` makeConjugateTranspose (
 `vector2d matrix`)

Used to make conjugate transpose of matrix.

Conjugate transpose - https://en.wikipedia.org/wiki/Conjugate_transpose#Example

Parameters

<i>matrix</i>	<code>vector2d</code>
---------------	-----------------------

Returns

conjugate transposed matrix as two dimensional vector

5.1.2.4 showMatrix() `void` showMatrix (
 `vector2d matrix`)

Used to show all elements of matrix

Parameters

<i>matrix</i>	vector2d
<i>dimension</i>	int

5.2 quantumComputer.h File Reference

```
#include <vector>
```

Classes

- struct [quantum::QuantumComputer](#)
QuantumComputer structure.

Namespaces

- [quantum](#)

5.3 quantumGate.h File Reference

```
#include <complex>
#include <vector>
```

Typedefs

- typedef vector< vector< complex< double > > > [vector2d](#)
Used as alias for declaration of two dimensional vector.

Functions

- [vector2d getPreparedContainerForQuantumGate](#) (int dimension)
- [vector2d makeNotOnQubit](#) ([vector2d](#) qubit)
- [vector2d makeSqrtNotOnQubit](#) ([vector2d](#))
- [vector2d makeCnotOnQubit](#) ([vector2d](#) qubit)
- [vector2d makeSwapOnQubit](#) ([vector2d](#) qubit)
- [vector2d makeFredkinOnQubit](#) ([vector2d](#) qubit)
- [vector2d makeToffoliOnQubit](#) ([vector2d](#) qubit)
- [vector2d makeHadamardOnQubit](#) ([vector2d](#) qubit)
- [vector2d makeMultidimensionalHadamardOnQubit](#) ([vector2d](#) qubit, [vector2d](#) hadamardGate, int index↔
Number)
- [vector2d makePhaseShiftOnQubit](#) ([vector2d](#) qubit, double angle)
- [vector2d makePauliXOnQubit](#) ([vector2d](#) qubit)
- [vector2d makePauliYOnQubit](#) ([vector2d](#) qubit)
- [vector2d makePauliZOnQubit](#) ([vector2d](#) qubit)
- [vector2d getNotGate](#) ()

- [vector2d getSqrtNotGate \(\)](#)
- [vector2d getCnotGate \(\)](#)
- [vector2d getSwapGate \(\)](#)
- [vector2d getFredkinGate \(\)](#)
- [vector2d getToffoliGate \(\)](#)
- [vector2d getHadamardGate \(\)](#)
- [vector2d getMultidimensionalHadamardGate \(int indexNumber\)](#)
- [vector2d getPhaseShiftGate \(double angle\)](#)
- [vector2d getPauliXGate \(\)](#)
- [vector2d getPauliYGate \(\)](#)
- [vector2d getPauliZGate \(\)](#)
- void [showQuantumGate \(vector2d quantumGate\)](#)
- void [showPhaseShiftQuantumGate \(vector2d phaseShiftGate\)](#)

Variables

- const int [ONE_ARGUMENT_GATE_SIZE](#) = 2
- const int [TWO_ARGUMENTS_GATE_SIZE](#) = 4
- const int [THREE_ARGUMENTS_GATE_SIZE](#) = 8

5.3.1 Typedef Documentation

5.3.1.1 vector2d `typedef vector<vector<complex<double> > > vector2d`

Used as alias for declaration of two dimensional vector.

5.3.2 Function Documentation

5.3.2.1 getCnotGate() `vector2d getCnotGate ()`

Used to get CNOT quantum gate

Returns

CNOT quantum gate

5.3.2.2 getFredkinGate() `vector2d getFredkinGate ()`

Used to get FREDKIN quantum gate

Returns

FREDKIN quantum gate

5.3.2.3 getHadamardGate() `vector2d` getHadamardGate ()

Used to get HADAMARD quantum gate

Returns

HADAMARD quantum gate

5.3.2.4 getMultidimensionalHadamardGate() `vector2d` getMultidimensionalHadamardGate (
 `int` *indexNumber*)

Used to get multidimensional HADAMARD quantum gate

Parameters

<i>indexNumber</i>	<code>int</code>
--------------------	------------------

Returns

multidimensional HADAMARD quantum gate

5.3.2.5 getNotGate() `vector2d` getNotGate ()

Used to get NOT quantum gate

Returns

NOT quantum gate

5.3.2.6 getPauliXGate() `vector2d` getPauliXGate ()

Used to get PAULI X quantum gate

Returns

PAULI X quantum gate

5.3.2.7 getPauliYGate() `vector2d` getPauliYGate ()

Used to get PAULI Y quantum gate

Returns

PAULI Y quantum gate

5.3.2.8 getPauliZGate() `vector2d` getPauliZGate ()

Used to get PAULI Z quantum gate

Returns

PAULI Z quantum gate

5.3.2.9 getPhaseShiftGate() `vector2d` getPhaseShiftGate (`double angle`)

Used to get PHASE SHIFT quantum gate

Parameters

<i>angle</i>	double - angle as value eg. PI or -PI
--------------	---------------------------------------

Returns

PHASE SHIFT quantum gate

5.3.2.10 getPreparedContainerForQuantumGate() `vector2d` getPreparedContainerForQuantumGate (`int dimension`)

Used to generate and get quantum gate for declared dimensions

Parameters

<i>dimension</i>	int
------------------	-----

5.3.2.11 getSqrtNotGate() `vector2d` getSqrtNotGate ()

Used to get SQRT(NOT) quantum gate

Returns

SQRT(NOT) quantum gate

5.3.2.12 getSwapGate() `vector2d` getSwapGate ()

Used to get SWAP quantum gate

Returns

SWAP quantum gate

5.3.2.13 getToffoliGate() `vector2d` getToffoliGate ()

Used to get TOFFOLI quantum gate

Returns

TOFFOLI quantum gate

5.3.2.14 makeCnotOnQubit() `vector2d` makeCnotOnQubit (
 `vector2d` *qubit*)

Used to make CNOT quantum gate on qubit

Parameters

<i>qubit</i>	<code>vector2d</code>
--------------	-----------------------

Returns

updated qubit

5.3.2.15 makeFredkinOnQubit() `vector2d` makeFredkinOnQubit (
 `vector2d` *qubit*)

Used to make FREDKIN quantum gate on qubit

Parameters

<i>qubit</i>	<code>vector2d</code>
--------------	-----------------------

Returns

updated qubit

5.3.2.16 makeHadamardOnQubit() `vector2d` makeHadamardOnQubit (
 `vector2d` qubit)

Used to make HADAMARD quantum gate on qubit

Parameters

<i>qubit</i>	vector2d
--------------	----------

Returns

updated qubit

5.3.2.17 makeMultidimensionalHadamardOnQubit() `vector2d` makeMultidimensionalHadamardOnQubit (
 `vector2d` qubit,
 `vector2d` hadamardGate,
 int indexNumber)

Used to make multidimensional HADAMARD quantum gate on qubit

Parameters

<i>qubit</i>	vector2d
<i>hadamardGate</i>	vector2d
<i>indexNumber</i>	int

Returns

updated qubit

5.3.2.18 makeNotOnQubit() `vector2d` makeNotOnQubit (
 `vector2d` qubit)

Used to make NOT quantum gate on qubit

Parameters

<i>qubit</i>	vector2d
--------------	----------

Returns

updated qubit

5.3.2.19 makePauliXOnQubit() `vector2d` makePauliXOnQubit (
 `vector2d` *qubit*)

Used to make PAULI X quantum gate on qubit

Parameters

<i>qubit</i>	vector2d
--------------	----------

Returns

updated qubit

5.3.2.20 makePauliYOnQubit() `vector2d` makePauliYOnQubit (
 `vector2d` *qubit*)

Used to make PAULI Y quantum gate on qubit

Parameters

<i>qubit</i>	vector2d
--------------	----------

Returns

updated qubit

5.3.2.21 makePauliZOnQubit() `vector2d` makePauliZOnQubit (
 `vector2d` *qubit*)

Used to make PAULI Z quantum gate on qubit

Parameters

<i>qubit</i>	vector2d
--------------	----------

Returns

updated qubit

5.3.2.22 makePhaseShiftOnQubit() `vector2d` makePhaseShiftOnQubit (
 `vector2d` *qubit*,
 `double` *angle*)

Used to make PHASE SHIFT quantum gate on qubit

Parameters

<i>qubit</i>	<code>vector2d</code>
<i>angle</i>	<code>double</code> - angle as value eg. PI or -PI

Returns

updated qubit

5.3.2.23 makeSqrtNotOnQubit() `vector2d` makeSqrtNotOnQubit (
 `vector2d`)

Used to make SQRT(NOT) quantum gate on qubit

Parameters

<i>qubit</i>	<code>vector2d</code>
--------------	-----------------------

Returns

updated qubit

5.3.2.24 makeSwapOnQubit() `vector2d` makeSwapOnQubit (
 `vector2d` *qubit*)

Used to make SWAP quantum gate on qubit

Parameters

<i>qubit</i>	<code>vector2d</code>
--------------	-----------------------

Returns

updated qubit

5.3.2.25 makeToffoliOnQubit() `vector2d` makeToffoliOnQubit (
 `vector2d` *qubit*)

Used to make TOFFOLI quantum gate on qubit

Parameters

<i>qubit</i>	vector2d
--------------	----------

Returns

updated qubit

5.3.2.26 showPhaseShiftQuantumGate() `void showPhaseShiftQuantumGate (
 vector2d phaseShiftGate)`

Used to show all elements of PHASE SHIFT quantum gate

Parameters

<i>phaseShiftGate</i>	vector2d
<i>gateSize</i>	const int

5.3.2.27 showQuantumGate() `void showQuantumGate (
 vector2d quantumGate)`

Used to show all elements of quantum gate

Parameters

<i>quantumGate</i>	vector2d
<i>gateSize</i>	const int

5.3.3 Variable Documentation

5.3.3.1 ONE_ARGUMENT_GATE_SIZE `const int ONE_ARGUMENT_GATE_SIZE = 2`

Parameters

-	size of one argument quantum gates
---	------------------------------------

5.3.3.2 THREE_ARGUMENTS_GATE_SIZE `const int THREE_ARGUMENTS_GATE_SIZE = 8`

Parameters

-	size of three argument quantum gates
---	--------------------------------------

5.3.3.3 TWO_ARGUMENTS_GATE_SIZE `const int TWO_ARGUMENTS_GATE_SIZE = 4`

Parameters

-	size of two argument quantum gates
---	------------------------------------

5.4 quantumGateOperation.h File Reference

```
#include <complex>
#include <vector>
```

Typedefs

- `typedef vector< vector< complex< double > > > vector2d`
Used as alias for declaration of two dimensional vector.

Functions

- `vector2d composeQuantumGates (vector2d firstGate, vector2d secondGate)`
- `vector2d getIdentityMatrix (int gateSize)`
- `bool isIdentityMatrixAndComposedGatesAreEqual (vector2d identityMatrix, vector2d composedGates)`
- `bool isComposeOfGatesGivesIdentityMatrix (vector2d firstGate, vector2d secondGate)`
- `bool isMatrixUnitary (vector2d quantumGate, vector2d conjugateTransposedQuantumGate)`

5.4.1 Typedef Documentation

5.4.1.1 vector2d `typedef vector<vector<complex<double> > > vector2d`

Used as alias for declaration of two dimensional vector.

5.4.2 Function Documentation

5.4.2.1 composeQuantumGates() `vector2d composeQuantumGates (vector2d firstGate, vector2d secondGate)`

Used to compose two quantum gates.

Compose - multiplication of values from two matrices, at the same indexes

Parameters

<i>firstGate</i>	vector2d
<i>secondGate</i>	vector2d

Returns

composed quantum gates

5.4.2.2 getIdentityMatrix() `vector2d getIdentityMatrix (`
`int gateSize)`

Used to get identity matrix for defined size.

Identity matrix - https://en.wikipedia.org/wiki/Identity_matrix

Parameters

<i>gateSize</i>	int
-----------------	-----

Returns

identity matrix

5.4.2.3 isComposeOfGatesGivesIdentityMatrix() `bool isComposeOfGatesGivesIdentityMatrix (`
`vector2d firstGate,`
`vector2d secondGate)`

Used to check
if composed gates gives identity matrix.

Parameters

<i>firstGate</i>	vector2d
<i>secondGate</i>	vector2d

Returns

true or false

5.4.2.4 isIdentityMatrixAndComposedGatesAreEqual() `bool isIdentityMatrixAndComposedGatesAre↔`
`Equal (`

```
vector2d identityMatrix,
vector2d composedGates )
```

Used to check
if identity matrix are the same as composed gates.

Parameters

<i>identityMatrix</i>	vector2d
<i>composedGates</i>	vector2d

Returns

true or false

5.4.2.5 isMatrixUnitary() `bool isMatrixUnitary (`
`vector2d quantumGate,`
`vector2d conjugateTransposedQuantumGate)`

Used to check if matrix is unitary.
Unitary matrix - https://en.wikipedia.org/wiki/Unitary_matrix

Parameters

<i>quantumGate</i>	vector2d
<i>conjugateTransposedQuantumGate</i>	vector2d

Returns

true or false

5.5 qubitOperation.h File Reference

```
#include <complex>
#include <vector>
```

Typedefs

- `typedef vector< vector< complex< double > > > vector2d`
Used as alias for declaration of two dimensional vector.

Functions

- `vector2d getPreparedContainerForQubit` (int qubitRows)
- `vector2d makeDotProductOfQubits` (vector2d firstQubit, vector2d secondQubit)
- `vector2d getQubitRepresentation` (vector< double > baseVector)
- void `showQubit` (vector2d qubit)
- void `showDotProduct` (vector2d dotProduct)

Variables

- const int `SINGLE_QUBIT_NUMBER_OF_ROWS` = 2
- const int `TWO_QUBITS_NUMBER_OF_ROWS` = 4
- const int `THREE_QUBITS_NUMBER_OF_ROWS` = 8
- const int `QUBIT_NUMBER_OF_COLUMNS` = 1

5.5.1 Typedef Documentation

5.5.1.1 vector2d `typedef vector<vector<complex<double> > > vector2d`

Used as alias for declaration of two dimensional vector.

5.5.2 Function Documentation

5.5.2.1 getPreparedContainerForQubit() `vector2d getPreparedContainerForQubit (int qubitRows)`

Used to get defined qubit for declared dimension

Parameters

<i>qubitRows</i>	int
------------------	-----

Returns

allocated qubit

5.5.2.2 getQubitRepresentation() `vector2d getQubitRepresentation (vector< double > baseVector)`

Used to get qubit as complex type 2D array

Parameters

<i>baseVector</i>	vector<double>
-------------------	----------------

Returns

qubit

5.5.2.3 makeDotProductOfQubits() `vector2d makeDotProductOfQubits (`
 `vector2d firstQubit,`
 `vector2d secondQubit)`

Used to make dot product of two qubits.

Dot product - https://en.wikipedia.org/wiki/Dot_product#Algebraic_definition

Parameters

<i>firstQubit</i>	vector2d
<i>secondQubit</i>	vector2d

Returns

dot product of qubits

5.5.2.4 showDotProduct() `void showDotProduct (`
 `vector2d dotProduct)`

Used to show dot product

Parameters

<i>dotProduct</i>	vector2d
-------------------	----------

5.5.2.5 showQubit() `void showQubit (`
 `vector2d qubit)`

Used to show all elements of qubit (2D array)

Parameters

<i>qubit</i>	vector2d
--------------	----------

5.5.3 Variable Documentation

5.5.3.1 QUBIT_NUMBER_OF_COLUMNS `const int QUBIT_NUMBER_OF_COLUMNS = 1`

Parameters

-	constant qubit column
---	-----------------------

5.5.3.2 SINGLE_QUBIT_NUMBER_OF_ROWS `const int SINGLE_QUBIT_NUMBER_OF_ROWS = 2`

Parameters

-	constant single qubit rows
---	----------------------------

5.5.3.3 THREE_QUBITS_NUMBER_OF_ROWS `const int THREE_QUBITS_NUMBER_OF_ROWS = 8`

Parameters

-	constant three qubits rows
---	----------------------------

5.5.3.4 TWO_QUBITS_NUMBER_OF_ROWS `const int TWO_QUBITS_NUMBER_OF_ROWS = 4`

Parameters

-	constant two qubits rows
---	--------------------------

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