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oscarg933 / QuantumComputing

forked from corbett/QuantumComputing

<This is an api.openload.co1010101001200101010101010.patch 🎷📀🐼🎤🎼🎶🎩🎵of IBM's Quantum Experience in simulation; a 5-qubit quantum computer with a limited set of gates. Please cite me if you end up using this academically.> https://github.com/oscarg933/https-os… Edit

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246 commits | 2 branches | 0 releases | 4 contributors | GPL-3.0

Branch: master | New pull request | Create new file | Upload files | Find file | Clone or download

This branch is 208 commits ahead of corbett:master. Pull request | Compare

oscarg933 Rename speedoflight.faster.godspeed.py.ros.md to viper.veneno.speedof… ··· Latest commit 5096e69 2 minutes ago

.github/ISSUE_TEMPLATE	Update issue templates	24 days ago
Https	Rename Oscarg933.github.io to Jenkins.github.io	16 days ago
Venen.git-github.com-therealcurls…	Create QuantumComputing.git	3 days ago
git-github.com-oscarg933	Create LeetCodePremium.git	3 hours ago
https	Create speedoflight.faster.godspeed.py.ros.md	5 minutes ago
microsoft.github.io	Create rclone-v1.45-solaris-amd64.zip	10 days ago
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BinarySerializer-master 2 2.zip	Add files via upload	23 days ago
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Carlos-master.zip	Add files via upload	25 days ago
ChaoSlingr-master.zip	Add files via upload	25 days ago
CloudFusion-master.zip	Add files via upload	25 days ago
Code Coverage Done Right | 'Cod…	Add files via upload	24 days ago
Comoquiso.jesuschristo.ros.md	Create Comoquiso.jesuschristo.ros.md	22 days ago

ConTroll_Remote_Access_Trojan-...	Add files via upload	24 days ago
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Cronos-master.zip	Add files via upload	25 days ago
Curl-2-master.zip	Add files via upload	23 days ago
DEVELOPMENT.md	Add files via upload	23 days ago
DeepRL-Agents-master.zip	Add files via upload	25 days ago
Dio.Ros-master.zip	Add files via upload	25 days ago
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Jenkins.io.md	Create Jenkins.io.md	25 days ago
Js.json.ai.md	Create Js.json.ai.md	25 days ago
KeyCode-master.zip	Add files via upload	23 days ago
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LaZagne-master.zip	Add files via upload	23 days ago
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Memory-master.zip	Add files via upload	24 days ago
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Oscar gomez	Add files via upload	23 days ago
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PyPlanet-master.zip	Add files via upload	25 days ago
Python-Rootkit-master.zip	Add files via upload	23 days ago
QuantEcon.py-master.zip	Add files via upload	24 days ago
Quantum-master.zip	Add files via upload	24 days ago
Quantum.ros	Create Quantum.ros	24 days ago
QuantumComputer.py	support for python3	a year ago
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QuantumKatas-master.zip	Add files via upload	23 days ago
QuasarRAT-master.zip	Add files via upload	24 days ago
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Trump-Filter-master.zip	Add files via upload	25 days ago
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testeakaunting-master.zip	Add files via upload	24 days ago
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vispy-master.zip	Add files via upload	25 days ago
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workbox-master.zip	Add files via upload	24 days ago
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xeer-master.zip	Add files via upload	24 days ago
yii2-master.zip	Add files via upload	24 days ago
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zipstat-master.zip	Add files via upload	23 days ago

README.md

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https://github.com/oscarg933/nuclear.git.patch

Quintuple

This is an implementation of IBM's Quantum Experience in simulation; a 5-qubit quantum computer with a limited set of gates "the world's first quantum computing platform delivered via the IBM Cloud". Their implementation is available at http://www.research.ibm.com/quantum/.

This code allows you to execute code printed from the Quantum Composer in the following syntax:

description	usage
available qubit list	q[0], q[1], q[2], q[3], q[4]
1-qubit gate list	h,t,tdg,s,sdg,x,y,z,id
1-qubit gate action	gate q[i];
2-qubit CNOT gate list	cx
2-qubit CNOT gate action	cx q[control], q[target];
measurement operation list	measure, bloch
measurement operation action	operation q[i];

It is much easier to dig into the internals of how the quantum computer computes by seeing and tracing the linear algebra representation of gates and states and their interactions as desired–for IBM's examples or for one's own code.

100% of the examples on the IBM tutorial are provided here, tested for and supported, and many addition tests and examples are provided. In fact, the implementation of the 5-qubit quantum computer simulator is only 675 lines, with approximately twice as many lines of test programs and examples provided.

Check out any of the test functions for example usage, and the `Programs` class contains many example programs in IBM's syntax all available in one place.

If you make use of this work, please cite my paper available on the physics arXiv as Quintuple: a Python 5-qubit quantum computer simulator to facilitate cloud quantum computing. For the making of story of this code, along with some pointers to resources on quantum computation, check out my blog post.

Example usage

```
from QuantumComputer import *
ghz_example_code="""h q[0];
                h q[1];
                x q[2];
                cx q[1], q[2];
                cx q[0], q[2];
                h q[0];
                h q[1];
                h q[2];"""
qc=QuantumComputer()
qc.execute(ghz_example_code)
Probability.pretty_print_probabilities(qc.qubits.get_quantum_register_containing("q0").get_state())
```

This will print

```
|psi>=0.70710678118654724|000>+-0.70710678118654724|111>
Pr(|000>)=0.500000; Pr(|111>)=0.500000;
```

Or, using the swap Qubits example IBM tutorial Section IV, Page 2

```
swap_example_code="""x q[2];
                cx q[1], q[2];
                h q[1];
                h q[2];
```

```
                cx q[1], q[2];
                h q[1];
                h q[2];
                cx q[1], q[2];
                measure q[1];
                measure q[2];"""
qc.reset()
qc.execute(swap_example_code)
Probability.pretty_print_probabilities(qc.qubits.get_quantum_register_containing("q2").get_state())
```

will print

```
|psi>=|10>
Pr(|10>)=1.000000;
<state>=-1.000000
```

We'll continue with this example in pure python below.

Note: using IBM's measurment code `measure q[0];` will actually collapse the state, but for convenience the internal state before collapse is stored in qubit.get_noop(). Nature doesn't give this to us, but I can give it to you!

Pure python quantum computing machinery

Quantum computing operations can also be done in pure python, either with the QuantumComputer machinery or by directly manipulating gates.

QuantumComputer machinery

```
# Swap Qubits example IBM tutorial Section IV, Page 2
qc=QuantumComputer()
qc.apply_gate(Gate.X,"q2")
qc.apply_two_qubit_gate_CNOT("q1","q2")
qc.apply_gate(Gate.H,"q1")
qc.apply_gate(Gate.H,"q2")
qc.apply_two_qubit_gate_CNOT("q1","q2")
qc.apply_gate(Gate.H,"q1")
qc.apply_gate(Gate.H,"q2")
qc.apply_two_qubit_gate_CNOT("q1","q2")
qc.measure("q1")
qc.measure("q2")
Probability.pretty_print_probabilities(qc.qubits.get_quantum_register_containing("q1").get_state())
```

Will print

```
|psi>=|10>
Pr(|10>)=1.000000;
<state>=-1.000000
```

Working with Individual States and gates

Note that states are combined by using the Kronecker product. Gates that operate on entangled states are composed from single qubit gates by the Kronecker product of the gate with the Identity. See the internals of `qc.apply_gate` or `qc.apply_two_qubit_gate_CNOT` for general examples, or feel free to use them instead.

```
# Swap Qubits example IBM tutorial Section IV, Page 2
q1=State.zero_state
q2=State.zero_state
q2=Gate.X*q2
new_state=Gate.CNOT2_01*np.kron(q1,q2)
H2_0=np.kron(Gate.H,Gate.eye)
H2_1=np.kron(Gate.eye,Gate.H)
new_state=H2_0*new_state
new_state=H2_1*new_state
new_state=Gate.CNOT2_01*new_state
new_state=H2_0*new_state
```

```
new_state=H2_1*new_state
new_state=Gate.CNOT2_01*new_state
Probability.pretty_print_probabilities(new_state)
```

Will print

```
|psi>=0.99999999999999967|10>
Pr(|10>)=1.000000;
<state>=-1.000000
```

This final manner of working with the library provides the most complete mathematical understanding of what's going on. Any individual state or gate can be printed, and it is clear how entanglement is represented as this is not done under the hood in this scenario.