Quantum Circuits

Simulating a Quantum Computer

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First...

First of all

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Quantum Gates 101

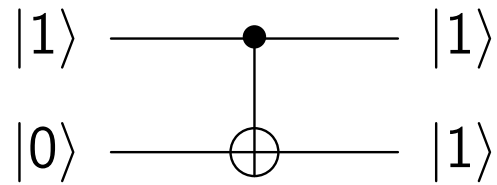


Figure: controlled-*not* gate.

Quantum Gates 101

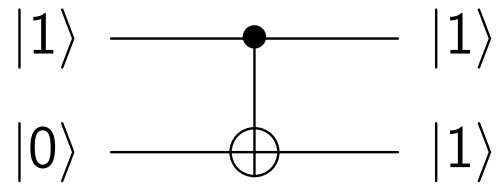


Figure: controlled-*not* gate.

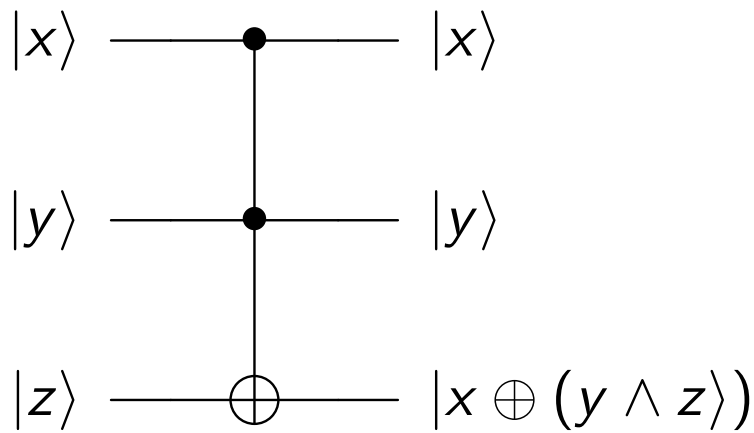


Figure: Toffoli gate.

Quantum Gates 101

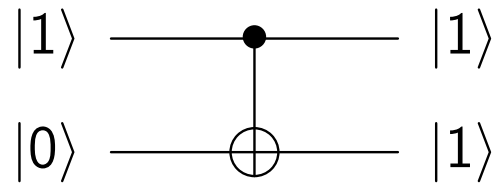


Figure: controlled-*not* gate.

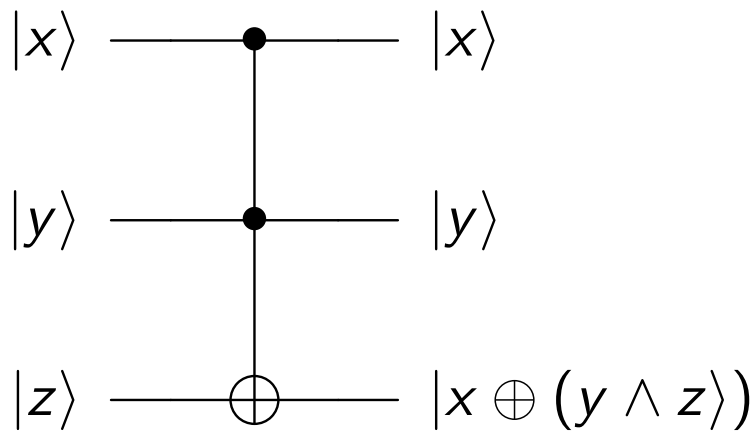


Figure: Toffoli gate.

Quantum Gates 101

Transcription to libquantum[2]

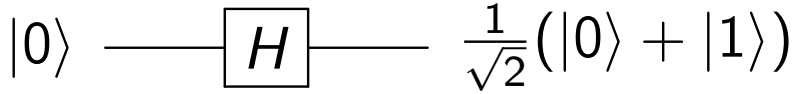
```
quantum_reg reg;
int result;
reg = quantum_new_qureg(1, 3);
quantum_print_qureg(reg);
quantum_cnot(0,1, &reg);
quantum_print_qureg(reg);
quantum_toffoli(0,1,2, &reg);
quantum_print_qureg(reg);
result = quantum_measure(reg);

printf("measured␣%i!\n", result);
```

[2] www.libquantum.de

Quantum Gates 101

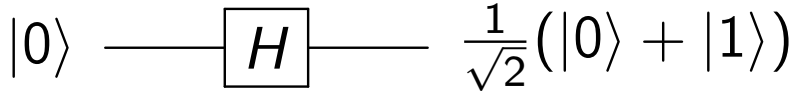
Hadamard Gate



$\frac{1}{\sqrt{2}} \approx 0.70$

Quantum Gates 101

Hadamard Gate




```
quantum_reg reg;
int result;
reg = quantum_new_qureg(0, 1);
quantum_print_qureg(reg);
quantum_hadamard(0, &reg);
quantum_print_qureg(reg);
quantum_hadamard(0, &reg);
quantum_print_qureg(reg);
result = quantum_measure(reg);

printf("measured␣%i!\n", result);
```

$\frac{1}{\sqrt{2}} \approx 0.70$

Grover Algorithm 101

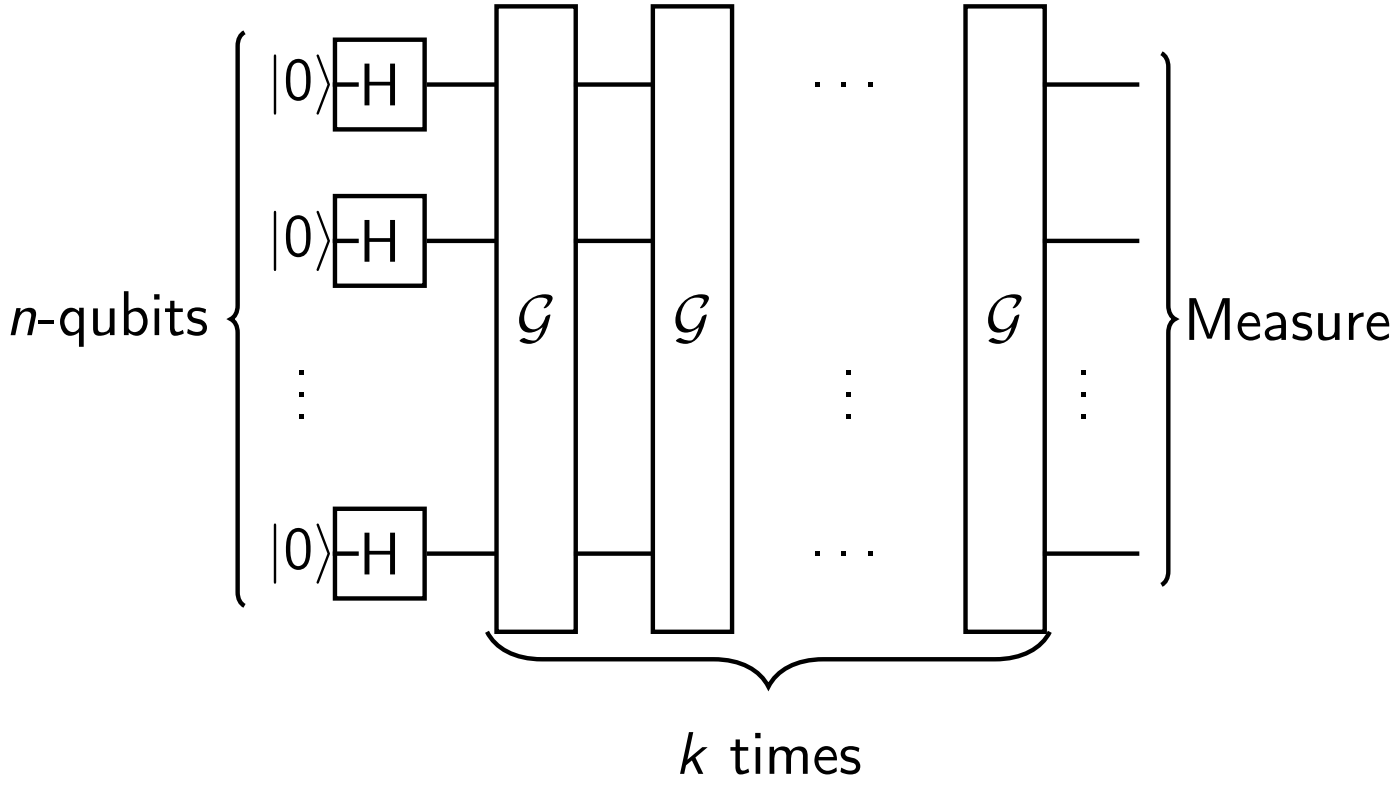


Figure: General view of Grover's algorithm

Grover Algorithm 101

Grover Algorithm

The algorithm works as follows:

- Initialized the qubits with 0, i.e., $|0^n\rangle$;
- Set the qubits in superposition applying Hadamard transformation;
- Runs k times $\mathcal{G}$;
- Measures the final state;

Grover Algorithm 101

Grover Algorithm

What is in $\mathcal{G}$ and what is k?

Grover Algorithm 101

Grover Algorithm

What is in $\mathcal{G}$ and what is k?

- $OH^n IH^n$;
- $k = \frac{\pi}{4}\sqrt{(N)}$.

Other "Simulations"

Alternatives to libquantum

- https://www.quantiki.org/wiki/list-qc-simulators

Questions

Thank you for your attention.
Questions?
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