

MA Z X SYMBOL

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MaZX`

ZXForm

NEW IN 13.2**ZXForm** [*qc*]converts quantum circuit *qc* to a **ZXObject**.

▼ Details and Options

- **ZXForm** only supports gates acting on up to two qubits.

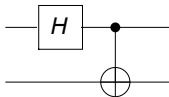
▼ Examples (4)

In[1]:= Needs["MaZX`"]

▼ Basic Examples (1)

Consider the entangler quantum circuit as an example.

```
In[1]:= Let[Qubit, S]
        qc = QuantumCircuit[S[1, 6], CNOT[S[1], S[2]]]
```

Out[1]=

Note that its matrix representation looks like this.

```
In[2]:= mat = Matrix[qc];
        mat // MatrixForm
```

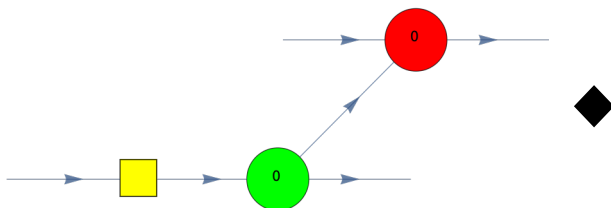
Out[2]//MatrixForm=

$$\begin{pmatrix} \frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} & 0 \\ 0 & \frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} \\ 0 & \frac{1}{\sqrt{2}} & 0 & -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & 0 & -\frac{1}{\sqrt{2}} & 0 \end{pmatrix}$$

Convert the quantum circuit to the corresponding **ZXObject**.

```
In[3]:= obj = ZXForm[qc]
```

```
Out[3]=
```



Check the corresponding matrix.

```
In[4]:= new = Matrix[obj];  
new // MatrixForm
```

```
Out[4]//MatrixForm=
```

$$\begin{pmatrix} \frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} & 0 \\ 0 & \frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} \\ 0 & \frac{1}{\sqrt{2}} & 0 & -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & 0 & -\frac{1}{\sqrt{2}} & 0 \end{pmatrix}$$

```
In[5]:= mat = new // MatrixForm
```

```
Out[5]//MatrixForm=
```

$$\begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

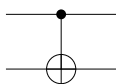
▼ Scope (2)

▼ Controlled-NOT (CNOT) gate (1)

```
In[1]:= Let[Qubit, S]
```

```
In[2]:= qc = QuantumCircuit[CNOT[S[1], S[2]]]  
mat = Matrix[qc];  
mat // MatrixForm
```

```
Out[2]=
```

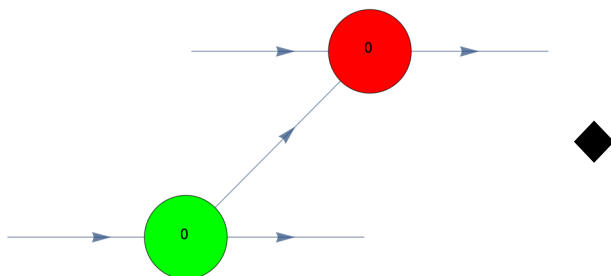


```
Out[2]//MatrixForm=
```

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{pmatrix}$$

```
In[3]:= obj = ZXForm[qc]
new = Matrix[obj];
new // MatrixForm
```

Out[3]=



Out[3]//MatrixForm=

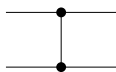
$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{pmatrix}$$

Controlled-Z (CZ) gate (1)

```
In[1]:= Let[Qubit, S]
```

```
In[2]:= qc = QuantumCircuit[CZ[S[1], S[2]]]
mat = Matrix[qc];
mat // MatrixForm
```

Out[2]=

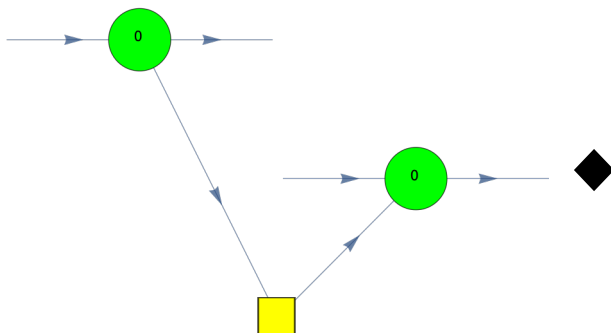


Out[2]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix}$$

```
In[3]:= obj = ZXForm[qc]
new = Matrix[obj];
new // MatrixForm
```

Out[3]=



Out[3]//MatrixForm=

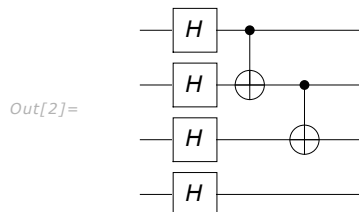
$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix}$$

▼ Properties & Relations (1)

Here is a quantum circuit.

```
In[1]:= Let[Qubit, S]

In[2]:= qc = QuantumCircuit[
  S[{1, 2, 3, 4}, 6],
  CNOT[S[1], S[2]],
  CNOT[S[2], S[3]]
]
```



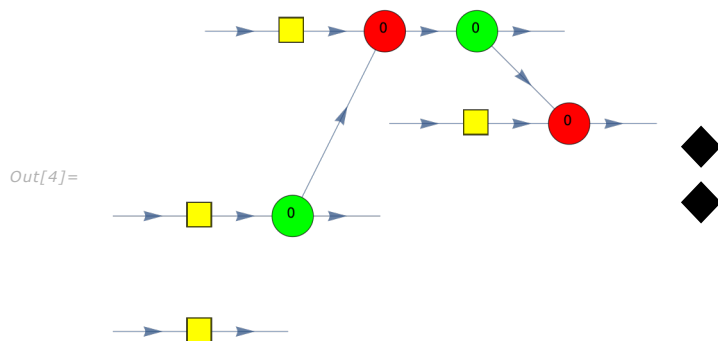
Calculating the matrix representation of such a quantum circuit is routine.

```
In[3]:= EchoTiming[mat = Matrix[qc];]

0.007975
```

Convert it into a ZX diagram.

```
In[4]:= obj = ZXForm[qc]
```



Calculate the matrix representation from the ZX diagram above. This is faster than the matrix calculation based on the quantum circuit model.

```
In[5]:= EchoTiming[new = Matrix[obj];]

0.013459
```




Tech Notes

- Quantum Computation: Overview
- Quantum Information Systems with Q3
- Q3: Quick Start



Related Guides

- MaZX
- Q3
- Quantum Information Systems

Related Links

- R. Duncan, A. Kissinger, S. Perdrix, and J. van de Wetering, Quantum 4, 279 (2020) , "Graph-theoretic Simplification of Quantum Circuits with the ZX-calculus."
- M. Nielsen and I. L. Chuang (2022) , Quantum Computation and Quantum Information (Cambridge University Press, 2011).
- Mahn-Soo Choi (2022) , A Quantum Computation Workbook (Springer, 2022).