MA Z X SYMBOL

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MaZX`

ZXObject

NEW IN 13.2

ZXObject[{v_1, v_2, …}, {e_1, e_2, …}]
is an object containing the data of a ZX diagram.

Details and Options

- Graph[*obj*] display ZXObject obj in a graph form. ZXLayers[Graph[*obj*]] finds the layers of the graph form of *obj*.
- ZXDiagram[*obj*, $expr_1$, $expr_2$, …] add new ZX expressions $expr_1$, $expr_2$, … to the already existing ZXObject *obj*.
- Join[obj_1, obj_2, …] combines ZXObjects obj_1, obj_2, ….
- ExpressionFor[*obj*] converts *obj* to the corresponding operator expression.
- Matrix[*obj*] converts *obj* to the corresponding matrix.
- Basis[*obj*] returns the computational basis associated with ZXObject *obj*.

Examples (1)

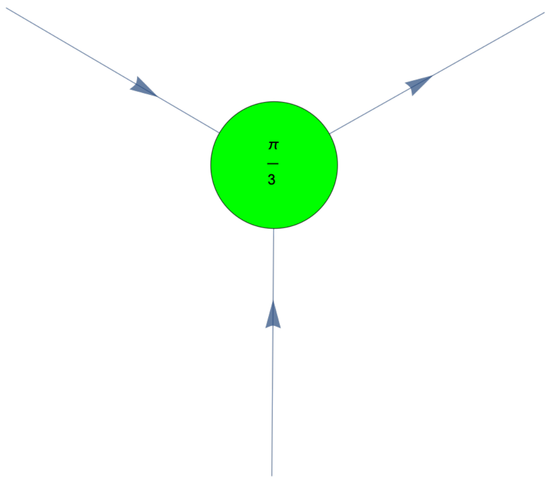
In[1]:=
```
Needs["MaZX`"]
```

Basic Examples (1)

ZXDiagram returns the ZXObject.

In[1]:=
```
obj = ZXDiagram[{{i1, i2} -> Z[1][Pi/3] -> o}, GraphLayout -> "SpringElectricalEmbedding"]
```

Out[1]=



The object is displayed in a graph form as above. However, it stores the data.

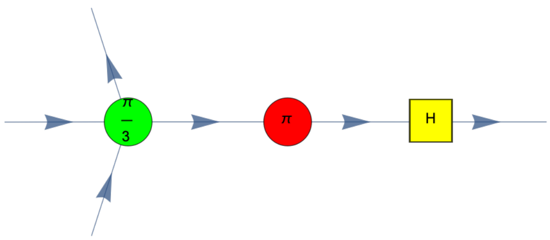
In[2]:=
```
InputForm[obj]
```

Out[2]//InputForm=
```
ZXObject[{i1, i2, o, Z[1][Pi/3]}, {i1 -> Z[1][Pi/3], i2 -> Z[1][Pi/3], Z[1][Pi/3] -> o},
 GraphLayout -> "SpringElectricalEmbedding"]
```

You can build another ZXObject based on the existing one.

In[3]:=
```
new = ZXDiagram[{obj, Z[1] -> X[1][Pi] -> H[1] -> o2}]
```

Out[3]=



Convert the object into an operator expression.

In[4]:=
```
op = ExpressionFor[obj]
```

Out[4]= $|0_o\rangle\langle 0_{i1}0_{i2}| + (-1)^{1/3}\, |1_o\rangle\langle 1_{i1}1_{i2}|$

Convert the object into the corresponding matrix representation.

In[5]:=
```
mat = Matrix[obj];
mat // MatrixForm
```

Out[5]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & e^{\frac{i\pi}{3}} \end{pmatrix}$$

Of course, the conversion of the object directly into the matrix representation must equal to the matrix representation of the operator expression above.

In[6]:=
```
Matrix[obj] - Matrix[op] // Simplify // MatrixForm
```
Out[6]//MatrixForm=

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

Find the bases that are used in the matrix representation.

In[7]:=
```
Basis[obj]
```
Out[7]= $\langle| \mathrm{In} \to \{ |0_{i1}0_{i2}\rangle, |0_{i1}1_{i2}\rangle, |1_{i1}0_{i2}\rangle, |1_{i1}1_{i2}\rangle \}, \mathrm{Out} \to \{ |0_o\rangle, |1_o\rangle \} |\rangle$

Find the graph layers in the ZX diagram.

In[8]:=
```
ZXLayers[Graph@obj]
```
Out[8]= $\left\{\{\mathrm{i1}, \mathrm{i2}\}, \left\{Z_1\left(\frac{\pi}{3}\right)\right\}, \{\mathrm{o}\}\right\}$

Find all Z spiders in the ZX diagram.

In[9]:=
```
ZSpiders[new]
```
Out[9]= $\left\{Z_1\left(\frac{\pi}{3}\right)\right\}$

Find all X spiders in the ZX diagram.

In[10]:=
```
XSpiders[new]
```
Out[10]= $\{X_1(\pi)\}$

Find all spiders, regardless of type Z or X, in the ZX diagram.

In[11]:=
```
ZXSpiders[new]
```
Out[11]= $\left\{X_1(\pi), Z_1\left(\frac{\pi}{3}\right)\right\}$

Find all Hadamard gates in the ZX diagram.

In[12]:=
```
ZXHadamards[new]
```
Out[12]= $\{H_1\}$

See Also

ZXDiagram

Related Guides

- MaZX

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."