OpenQASM

Open Quantum Assembly Language (**OpenQASM**; pronounced *open kazm*[1]) is an intermediate representation for quantum instructions. The language was first described in a paper published in July 2017,[1] and a reference source code implementation was released as part of IBM's Quantum Information Software Kit (Qiskit) for use with their IBM Quantum Experience cloud quantum computing platform.[2] The language has similar qualities to traditional hardware description languages such as Verilog.

OpenQASM defines its version at the head of a source file as a number, as in the declaration:

```
OPENQASM 3;
```

The level of OpenQASM's original published implementations is OpenQASM 2.0. Version 3.0 of the specification is the current one and can be viewed at the OpenQASM (https://github.com/qiskit/openqasm) repository on *GitHub*.

Examples

The following is an example of OpenQASM source code from the official library. The program adds two four-bit numbers.[3]

```
/*
 * quantum ripple-carry adder
 * Cuccaro et al, quant-ph/0410184
 */
OPENQASM 3;
include "stdgates.inc";

gate majority a, b, c {
    cx c, b;
    cx c, a;
    ccx a, b, c;
}

gate unmaj a, b, c {
    ccx a, b, c;
    cx c, a;
    cx a, b;
}

qubit[1] cin;
qubit[4] a;
qubit[4] b;
qubit[1] cout;
bit[5] ans;
uint[4] a_in = 1;  // a = 0001
uint[4] b_in = 15; // b = 1111
// initialize qubits
reset cin;
reset a;
reset b;
reset cout;

// set input states
for i in [0: 3] {
  if(bool(a_in[i])) x a[i];
  if(bool(b_in[i])) x b[i];
}
```

```
// add a to b, storing result in b
majority cin[0], b[0], a[0];
for i in [0: 2] { majority a[i], b[i + 1], a[i + 1]; }
cx a[3], cout[0];
for i in [2: -1: 0] { unmaj a[i],b[i+1],a[i+1]; }
unmaj cin[0], b[0], a[0];
measure b[0:3] -> ans[0:3];
measure cout[0] -> ans[4];
```

References

1. Cross, Andrew W.; Bishop, Lev S.; Smolin, John A.; Gambetta, Jay M. (2017). "Open Quantum Assembly Language". arXiv:1707.03429 (https://arxiv.org/abs/1707.03429) [quant-ph (https://arxiv.org/archive/quant-ph)].
2. *qiskit-openqasm: OpenQASM specification* (https://qiskit.github.io/openqasm/), International Business Machines, 2017-07-04, retrieved 2017-07-06
3. "openqasm/adder.qasm at master · QISKit/openqasm · GitHub" (https://github.com/Qiskit/openqasm/blob/master/examples/adder.qasm). *GitHub*. 29 January 2022.

External links

- OpenQASM (https://github.com/qiskit/openqasm) on *GitHub*
