The file "q4.txt" defines kets, operators, and a measurement function for simulating a four qbit quantum computer.

Each of the following operators defined in "q4.txt" is a 16×16 matrix.

Cmn	Controlled not (CNOT) operator, m is the control qbit, n is the target qbit.
Hn	Hadamard operator on qbit n.
Xn	Pauli X (NOT) operator on qbit n.
Yn	Pauli Y operator on qbit n.
Zn	Pauli Z operator on qbit n.

The initial state of the quantum computer is $|0000\rangle$, i.e., the state in which all qbits are zero. Ket vectors have 16 elements, one element for each of the 16 states represented by four qbits.

$$
\begin{aligned}
|0000\rangle &= (1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0) \\
|1000\rangle &= (0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0) \\
|0100\rangle &= (0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0) \\
|1100\rangle &= (0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0) \\
&\vdots \\
|1111\rangle &= (0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1)
\end{aligned}
$$

Function M measures the final state by drawing a graph of the probability for each of 16 states.

$$M(\psi)$$

Quantum algorithms are expressed as sequences of operators applied to the initial state $|0000\rangle$. The operator sequence should be read backwards, from right to left, although the direction makes no difference mathematically.

Deutsch-Jozsa algorithm

Let f be the oracle function. Then the Deutsch-Jozsa algorithm is

$$\psi = H_2\, H_1\, H_0\, f\, H_3\, X_3\, H_2\, H_1\, H_0\, |0000\rangle$$

Bernstein-Vazirani algorithm

Let f be the oracle function. Then the Bernstein-Vazirani algorithm is

$$\psi = H_2\, H_1\, H_0\, f\, Z_3\, H_3\, H_2\, H_1\, H_0\, |0000\rangle$$