The file q4.txt defines kets, operators, and a measurement function for simulating a four qbit quantum computer. (See eigenmath.org/quantum-computer.c for the program that generates q4.txt)

Ket vectors have 16 elements, one element for each of the 16 states represented by four qbits. The following basis kets are defined in q4.txt.

$$
\begin{aligned}
&|0\rangle = |0000_2\rangle = (1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0) \\
&|1\rangle = |0001_2\rangle = (0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0) \\
&|2\rangle = |0010_2\rangle = (0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0) \\
&|3\rangle = |0011_2\rangle = (0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0) \\
&\vdots \\
&|15\rangle = |1111_2\rangle = (0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1)
\end{aligned}
$$

Operators are 16×16 matrices that rotate ket vectors. (A ket always has unit length.) The following operators are defined in q4.txt.

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.

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 $|0\rangle$. 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

$$\psi = H_2\ H_1\ H_0\ f\ H_3\ X_3\ H_2\ H_1\ H_0\ |0\rangle$$

Bernstein-Vazirani algorithm

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

$$\psi = H_2\ H_1\ H_0\ f\ Z_3\ H_3\ H_2\ H_1\ H_0\ |0\rangle$$