Molecular solution for the subset-sum problem on DNA -based quantum computing

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Molecular computation was proposed by Feynman in 1961 and it was showed that computing devices based on quantum theory are able to finish computations faster than the standard Turing machines. In 1994, Adleman succeeded to solve an instance of the Hamiltonian path problem in a test tube, just by handling DNA strands. Lipton investigated a special case of more general methods that could solve NP-complete problems using DNA experiments. Deutsch presented a general model of quantum computation i.e., the quantum Turing machine. Molecular solution for the subset-sum problem on DNA-based supercomputing has been offered by Chang in 2003. It has been proved, the subset-sum problem is the NP-complete problem (Cormen et al., 2003; Garey and Johnson, 1979; Cook, 1971; Karp, 1972).

Here, a finite set $S = \{s_1, ..., s_q\}$ is defined for solving subset-sum problem using DNA-based algorithm and it is supposed that every elements in S are positive integer. Now the aim is finding possible subsets S_i as a subset of S such that the sum of all elements in S_i be exactly equal to b, where b is a positive integer and can implement by Hadamard gates, NOT gates, CNOT gates, CCNOT gates, Grover's operators, and quantum measurements on a quantum computer. In order to achieve this, first we use q number Hadamard gates to construct 2^q possible subsets of a q-element set S, then we apply NOT gates, CCNOT gates and Grover's operators to construct solution space. It is demonstrated, the DNA-based quantum algorithm of an n-qubit parallel adder and a DNA based quantum algorithm of an n-qubit parallel comparator can implement using quantum gates and Grover's operators to formally verify our designed molecular solutions for the subset-sum problem. For this propose, we introduce some quantum registers again and compute solutions spaces, in each step by using 19-CCNOT gates , and NOT gates. Last algorithm is parallel comparator for comparing the sum of elements for subsets of a finite set with any given positive integer by using quantum gates and Grover's operators.