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CONSTRUCTING BIO-LOGICAL MOLECULAR PARALLEL ADDER AND MULTIPLIER USING THE ADLEMAN-LIPTON MODEL

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Abstract. *The advantages of bioinformatics computing have attracted many researchers to solve many NP problems in recent years. As Adleman proposed before, the deoxyribonucleic acid (DNA) strands employed towards calculating solution to The NP-complete Hamiltonian Path Problem (HPP). Lipton also demonstrated that Adleman's techniques could be used to solve the satisfiability (SAT) problem. Our paper proposes a new bio-logical molecular model using the Adleman-Lipton model. First we developed all of the basic logical gates (bio-logical units) such as parallel AND, parallel OR, and parallel XOR which are used to construct bio-logic arithmetic units for NP problem solving. Two of the bio-logic arithmetic units that are developed in this paper are parallel adder and parallel multiplier.*
Keywords: Bioinformatics computing, NP problem, Hamiltonian path problem, Satisfiability (SAT) problem, Adleman-Lipton model

1. **Introduction.** The power of massive storage and parallel computation attracts many researchers to use DNA computation model to solve the many NP problems [4-6]. In 1994, Adleman [1] successfully solved an instance of the directed Hamiltonian path problem (HPP) with molecular computation. He demonstrated the NP problem could be solved by DNA computing. However, the computing algorithms they proposed used the bio-molecular operations. We already knew Boolean logic could form the basis for electronic digital computers, and we have also seen that logic expressions could be directly converted into a circuit representation using electronic components called gates. Combinations of gates can perform binary arithmetic on multi-bit operands, enabling computers to be built for arithmetic of any degree of precision. So, this paper uses the concept of gates, and proposes a new optimized bio-molecular computing model. We then show how to operate on bits in a bio-molecular computation. The model contains bio-logical units and bio-arithmetic units to support the uncertainty in dynamic settings.

The rest of this paper is organized as follows. Section 2 introduces background on DNA computing. Section 3 shows the construction of basic logical bio-circuit operations on bits. Then, in Section 4, we use the basic logical bio-circuit operations to construct the bio-logical arithmetic unit: parallel adder and parallel multiplier. Conclusions are drawn in the last section.