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Display Advertising Optimization by Quantum Annealing Processor

Display advertising is an advertisement appearing on websites.

To increase advertisement efficiency, the appropriate advertisement should be displayed according to the characteristics of viewers.

To formulate mathematically, the display advertising can be represented by an optimization problem, so-called, the edge-weighed and capacitated bipartite matching problem [2], in which the vertices are either advertisement or user cluster. The weight of nodes in the bipartite graph represents the benefit, e.g., the click-through rate (CTR). Corresponding to the change of display advertising with time, the weights of nodes change with time.

The purpose of our research is to find the best matching such that CTR maximizes and the variation rate of CTR reduces. The reason is that most of the advertisers usually like to spend their budget smoothly over the time in order to reach a wider range of users.

Since to find the best matching becomes harder as the number of vertices increases, a scheme to overcome the difficulty in the display advertising is a major issue.

Quantum annealing (QA) is expected to be an efficient method to obtain the best solution for combinatorial optimization problems [1,2]. To use quantum annealing processor, we constructed a formulation from the display advertising to quadratic unconstrained binary optimization (QUBO) to use the QA. More precisely, we pruned edges and nodes with less impact to deal with as large problems as possible by quantum annealing processor with the limited number of qubits. We performed the quantum annealing version of display advertising to our advertising data sets by quantum annealing processor, D-Wave 2X. We confirmed that the quantum annealing finds a better solution to realize our purpose than the greedy method in a shorter time.

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