Heuristic Quadratization

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I. HEURISTIC VERSION OF ROSENBERG'S GADGET

Consider the famous gadget of Rosenberg which has been known since 1975:

$$b_1b_2b_3 \rightarrow b_1b_a + b_2b_3 - 2b_2b_a - 2b_3b_a + 3b_a. \tag{1}$$

This works because the penalty term is 0 if and only if $b_a = b_2b_3$ which makes the RHS equal the LHS.

Now consider the gadget:

$$b_1b_2b_3 \rightarrow b_1b_a + b_2b_3 - b_2b_a - b_3b_a + b_a. \tag{2}$$

The coefficients are much smaller, sometimes double or even triple as small. This makes it much easier to compile onto D-Wave's strict coupling strength limitations. The gadget does not work in 100% of the cases, but the number of cases that fail is small, and often those cases are not found by the annealer anyway because other terms in the overall Hamiltonian cause those terms not to be favored.

II. HEURISTIC VERSIONS OF QUTRIT TO QUBIT GADGETS

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