CLAIMS

What is claimed is:

1. A computer-implemented method for transformation of an optimization problem to facilitate its resolution, the method comprising:

casting the optimization problem into a quadratic unconstrained binary model; and

transforming the optimization problem into an optimization problem having the quadratic unconstrained binary model with reduced connectivity, wherein transforming the optimization problem comprises:

partitioning decision variables in the quadratic unconstrained binary model into two or more groups, each of the two or more groups comprising at least one decision variable node; and

introducing a register variable node between adjacent pairs of the at least one decision variable node in the two or more groups to hold partial values of a sum in a linear constraint to form the optimization problem with reduced connectivity.

2. The method in accordance with Claim 1, wherein transforming the optimization problem comprises forming a graphical visualization transformation of the quadratic unconstrained binary model before the partitioning step.

3. The method in accordance with Claim 2, wherein the graphical visualization transformation comprises a graph network having nodes and edges.

4. The method in accordance with Claim 3, wherein the nodes are qubits.

5. The method in accordance with any of the preceding claims, wherein casting the optimization problem comprises casting the optimization problem in a form of a quadratic unconstrained binary model by turning linear equality constraints into quadratic penalties of the quadratic unconstrained binary model.

6. The method in accordance with any of the preceding claims, wherein introducing a register node comprises introducing two or more register variable nodes to form the optimization problem with reduced connectivity, each of the two or more register variable nodes introduced between adjacent pairs of the at least one decision variable node in the two or more groups to hold the partial values of a sum in a linear constraint, and wherein transforming the optimization problem comprises forming a register variable edge between adjacent pairs of the introduced two or more register variable nodes.

7. The method in accordance with any of the preceding claims, wherein each of the two or more groups are different from one another.

8. The method in accordance with any of the preceding claims, wherein the quadratic unconstrained binary model comprises a quadratic unconstrained binary optimization (QUBO) model or an Ising model based on a range of variables in the quadratic unconstrained binary model.

9. The method in accordance with any of the preceding claims, wherein at least one register variable node comprises a plurality of register variables.

10. The method in accordance with any of the preceding claims, wherein the partitioned decision variables are interconnected with one another.

11. The method in accordance with any of the preceding claims, further comprising removing a last decision variable node from the configuration of more than one decision variable nodes in the reduced connectivity optimization problem.

12. The method in accordance with any of the preceding claims, further comprising performing a Houdayer move on the reduced connectivity optimization problem thus resulting in a new optimization problem, the method further comprising casting the new optimization problem into a new quadratic unconstrained binary model and transforming the new quadratic unconstrained binary model by the steps of partitioning decision variables and introducing a register variable.

13. The method in accordance with Claim 12, wherein performing the Houdayer move on the reduced connectivity optimization problem comprises:

converting the two or more groups comprising the at least one decision variable node in an underlying graph of the reduced connectivity optimization problem to a corresponding two or more groups comprising at least one decision variable node in an underlying graph of the new optimization problem;

performing the Houdayer move on the underlying graph of the new optimization problem to generate a new set of two or more groups comprising at least one decision variable node; and

converting the new set of two or more groups comprising at least one decision variable nodes to a corresponding two or more groups comprising at least one decision variable node in the underlying graph of the reduced connectivity optimization problem.

14. The method in accordance with any of the preceding claims, wherein the step of partitioning decision variables comprises partitioning the decision variables in the quadratic unconstrained binary model into one or more groups in a quantum system.

15. A system for transformation of an optimization problem to facilitate resolution of the optimization problem, the system comprising:

one or more processors; and

storage means connected to the one or more processors, the storage means comprising instructions for controlling the one or more processors to:

cast the optimization problem into a quadratic unconstrained binary model; and

transform the optimization problem into an optimization problem having the quadratic unconstrained binary model with reduced connectivity, wherein transforming the optimization problem comprises instructions to control the processor to:

partition decision variables in the quadratic unconstrained binary model into two or more groups, each of the two or more groups comprising at least one decision variable node; and

introduce a register variable node between adjacent pairs of the at least one decision variable node in the two or more groups to hold partial values of a sum in a linear constraint to form the optimization problem with reduced connectivity.

16. The system in accordance with Claim 15, wherein the instructions to control the one or more processors to cast the optimization problem comprise instructions to control the one or more processors to cast the optimization problem in a form of a quadratic unconstrained binary model by turning linear equality constraints into quadratic penalties of the quadratic unconstrained binary model.

17. The system in accordance with Claim 15 or 16, wherein the instructions to control the one or more processors to introduce the register variable node comprise instructions to control the one or more processors to introduce more than one register variable node, each of the more than one register variable node introduced between different adjacent pairs of the at least one decision variable node in the two or more partitioned groups, and wherein transforming the optimization problem comprises forming a register variable edge between adjacent pairs of the more than one register variable nodes introduced.

18. The system in accordance with any of Claims 15 to 17, wherein the quadratic unconstrained binary model comprises a quadratic unconstrained binary optimization (QUBO) model or an Ising model based on a range of variables in the quadratic unconstrained binary model.

19. The system in accordance with any of Claims 15 to 18, wherein the instructions to control the one or more processors further comprise instructions to remove a last decision variable node from the configuration of more than one decision variable nodes in the reduced connectivity optimization problem.