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# Advances for Quantum-Inspired Optimization (abstract only)

**Fred Glover,**[a] **Gary Kochenberger**[a,*]
[a] Entanglement, Inc., New York, New York 10012
*Corresponding author

**Abstract** In recent years, we have discovered that a mathematical formulation known as the quadratic unconstrained binary optimization (QUBO) problem can embrace an exceptional variety of important optimization problems found in industry, science, and government. The QUBO model has emerged as an underpinning of the quantum computing areas known as quantum annealing and digital annealing, and it has become a subject of study in neuromorphic computing. Through these connections, QUBO models lie at the heart of experimentation carried out with quantum computers developed by D-Wave Systems and neuromorphic computers developed by IBM. Computational experience is being amassed by both the classical and the quantum computing communities that highlights not only the potential of the QUBO model but also its effectiveness as an alternative to traditional modeling and solution methodologies.

We illustrate the process of reformulating important optimization problems as QUBO models through a series of explicit examples. We then go farther by describing important QUBO-Plus and polynomial unconstrained binary optimization models that go beyond QUBO models to embrace a wide range of additional important applications. These innovations, embodied in software made available through Entanglement, Inc., have produced the ability to solve dramatically larger problems and to obtain significantly better solutions than software being offered through D-Wave, IBM, Microsoft, Fujitsu, and other groups pursuing this area.