BHADALE GROUP OF COMPANIES
- IT AND REAL ESTATE

July 28 2021

Quantum ML Services Catalogue

Bhadale IT Developers Pvt. Ltd

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Bhadale Group of Companies

Bhadale Group of Companies consists of:

1. **Bhadale IT Developers Pvt. Ltd** is an IT and Computer Engineering subsidiary company

   This division provides consultation in areas of cutting edge technologies, research outsourcing, and software consultation related to data center and related engineering practices

2. **Bhadale Engineering Developers Pvt. Ltd** is a multi-engineering subsidiary company

Various divisions under this group provide design, & development of various IT and Engineering programs.

Bhadale Group has aggressive programs in place to serve the niche market. Below is related to Hybrid cloud Services

Bhadale Group IT Division, Research Services department

Below are few of our service offerings:

Quantum ML hardware solutions: Various models of hardware are designed to make best systems and optimal design that enable proper performance and quality standards to meet client business needs

Quantum ML software solutions: Various models of software are designed to make best software that enable proper performance and quality standards to meet client business needs

Quantum ML algorithms solutions: Various algorithms are offered to for optimal design that enables proper performance and quality standards to meet client business needs

Quantum ML AI assets solutions: Various AI and ML assets are designed that enable proper enterprise assets to meet client business needs and standards

Quantum ML optimization solutions: Various optimized solutions across enterprises that enable proper use of enterprise assets and better productivity to meet client business needs and standards along with cost savings and potential improvements in quality, performance and productivity

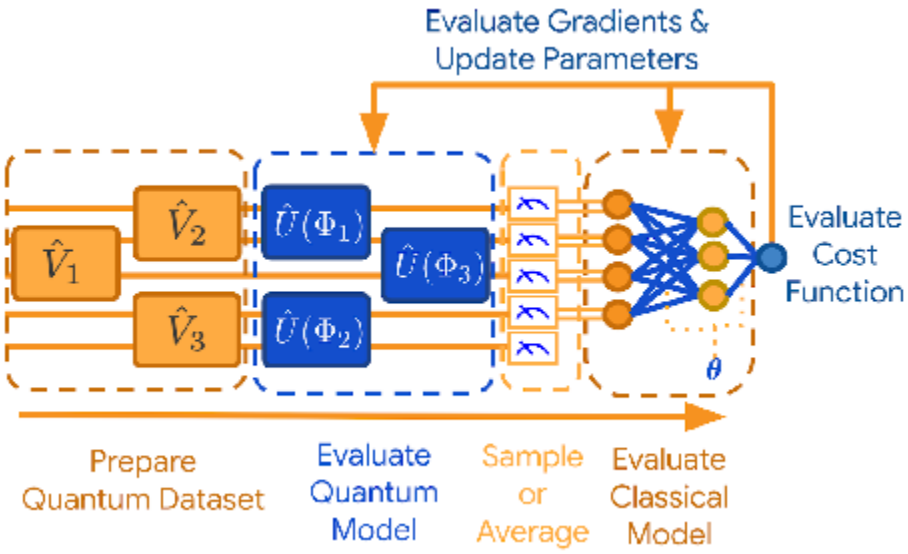
Quantum ML research solutions: Various research solutions are designed along with client managers and R&D departments that enables adoption of cutting edge technologies for client businesses

Quantum ML cloud solutions: We offer integration, migration for brown and green field projects for various AI and ML assets that enable leveraging of the public, private and hybrid cloud topologies to meet client business needs and standards

Quantum ML Industrial Solutions: We offer optimized end-to-end solutions that enable better integrated quantum cloud systems, for real time responses and handling mission critical problems

Details of the above are put in the table below

Product details



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We have a large set of subcategories; few are mentioned below with details tabulated

Service No	Service Name	Key Service features
1	**Quantum ML hardware solutions**	We offer unique solutions that enable clients to leverage on the vendor platforms in areas of quantum IaaS or in-house assembly of quantum computers. Based on unique needs like superconductor, absolute zero temperatures, Ion traps, annealing, backend designs, electro mechanical circuit designs all are part of our ambitious plan to assist clients in adopting the hardware for this purposes. We assist in design of the hardware four abstract layers: the “quantum data plane,” where the qubits reside; the “control and measurement plane,” responsible for carrying out operations and measurements on the qubits as required; the “control processor plane,” which determines the sequence of operations and measurements that the algorithm requires; and the “host processor,” a classical computer that handles access to networks, large storage arrays, and user interfaces. This host processor runs a conventional operating system/user interface, which facilitates user interactions We assist in various types of qubit generation platforms: 1) Trapped Ion qubits, very precise laser (or microwave) source that can be directed at a specific ion to affect its quantum state, another laser to “cool” and enable measurement of the ions, and a set of photon detectors to “measure” the state of the ions 2) Superconducting qubits at near absolute zero temp; we offer wirings of proper materials to reduce thermal loads, in particular from 300 K to the 3 K stage,

		and miniaturized coaxes and connectors. We offer areal-connections from the qubits to their housing, or "package," and from the package to the wires fed through the cryostat, cryogenic CMOS, single-flux quantum (SFQ), reciprocal quantum logic (RQL), and adiabatic quantum flux parametrons. 3) Hybrid and emerging technologies that enable better qubit generator, analysis, state transfer and measurements like use of quantum tunneling, Hall effects, non-destructive state measurements and research developments. We tailor the hardware that enables better cohesion, interoperability, among the ML clusters like kubernetes, Tensorflow Quantum and distributed workers computing 4) Memory devices (QRAM): Light Quantum Memory, recording the state of light into the atomic cloud, solid state storage using hybrid memories, nitrogen-vacancy center in diamond storage, Alkali metal vapor isotopes, Crystals doped with rare earth isotopes
2	**Quantum ML software solutions**	1) We offer compiler system design coupled with resource estimators and simulation tools that can be developed as per needs; these are critical for algorithm design and optimization, 2) Software toolchain for digital noisy intermediate-scale quantum (NISQ) systems. Low level languages like Open QASM for hardware interfacing, software for bootstrapping software modules, apps for cloud provisioning of quantum clusters using kubernetes / containers, high level language programming like C++, Python, Q#, IBM QASM, Tensorflow based software design for quantum circuits, software to transform classical bits to qubits and vice versa and inline packages for circuit optimizations, design optimizations and various other software solutions for best performance and integrity of systems . 3) We offer various libraries to support quantum algorithms like FFT for Shor's algorithms, software for Grover's search algorithms, matplot, numpy, pytorch, post quantum cryptography algorithms, error corrections, simulators, truth tables for gate operations, state transitions, offloading of specific workloads, operating system level virtualizations, layered planes (control, data, communications, measurements) software for DSL compiler that converts the program into a quantum intermediate representation (QIR) etc

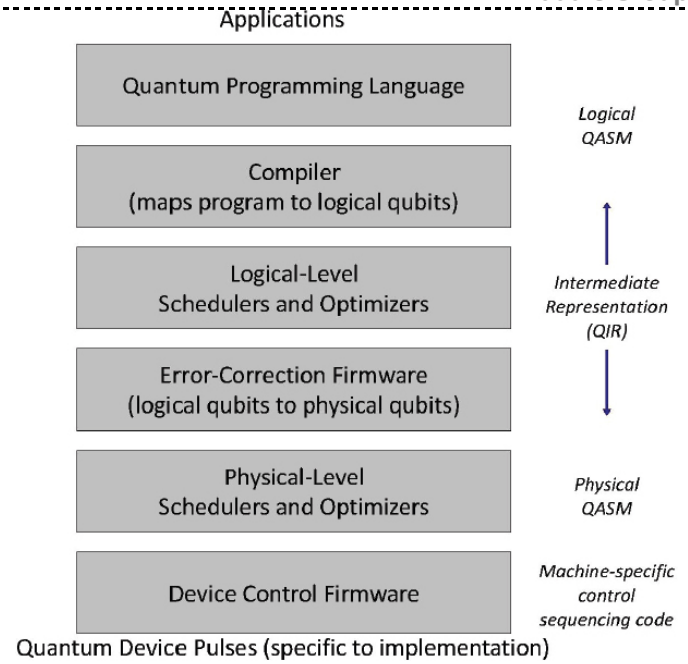

Figure: A generic tool flow for quantum programming

3	**Quantum ML algorithms solutions**	1) Noisy Intermediate-Scale Quantum (NISQ) devices based algorithms, quantum Fourier transform (QFT) algorithm for quantum factoring, finding hidden structure, and quantum phase estimation, Shor's, Grover's and quantum random walks 2) Hamiltonian Simulation Algorithms for simulation to elucidate the structure of a substance, or the behavior over time of a collection of interacting particles. These are time-evolution algorithms on a gate-based quantum computer, speedups for problems in quantum chemistry and materials simulation 3) HHL quantum algorithm to find the solution to a system of linear equations for use cases like recommendation systems 4) QEC code (QECC) algorithms, post quantum cryptography, neural networks, optimizations, combinatorial algorithms, variational Quantum Algorithms like quantum approximate optimization algorithm (QAOA) and variational quantum eigensolver (VQE) 5) Analog Quantum Algorithms like Quantum annealing using adiabatic quantum optimization, direct quantum simulation include the realization of spin Hamiltonians or the study of quantum phase transitions
4	**Quantum ML AI assets solutions**	Quantum AI assets include the counterparts of the classical neural networks like CNN, GAN, reinforced learning, various types of ensembles, boosting, optimizers, Boltzmann machine, classifiers, filters, samplers, gradients, probability based representations We offer planning, design and development of key AI assets like CNN, GAN and their quantum counterparts. We assist in your enterprise assets digital library development

5	**Quantum ML optimization solutions**	Optimization of QEC, gradients, improvements of hybrid or pure quantum circuits, Optimizing quantum heuristics with meta-learning using meta-learner model that learns how to optimize parameters of a function, Auto-ML, Quantum Alternating Operator Ansatz (QAOA), evolutionary strategies that are population-based optimizers
6	**Quantum ML research solutions**	Quantum research support for various projects in areas: 1. Quantum Networks using entanglements, photons and repeaters 2. Quantum cryptography algorithms 3. Quantum memories for RAM, ROM, Firmware 4. Quantum free space satellite communications using 5G+ protocols
7	**Quantum ML cloud solutions**	1. Tensorflow Quantum, Giskit based quantum circuits design and deployment to cloud systems like Google or IBM/ RedHat public/private cloud. 2. Integration of classical computer, analogy signals, field data and big data into the quantum paradigm, offering transformation, scaling and measurements of the hybrid systems used 3. Integration of the results into the ERP systems and business processes that enable CMM-Level 5 maturity of the business for continuous monitoring and improvements
8	**Quantum ML Industrial Solutions**	1. We offer various industrial services that enable transformation of the classical systems to the hybrid and pure quantum systems. We offer planning, workshops, client meetings and demonstrations at various locations and research labs that enable customers to judge the merit of migration 2. We assist in Industry 4.0, 5G, quantum network designs, quantum lab setup, research staff ready to use portfolio of research tools, templates and reporting documents 3. We help in development of simulation of quantum backend prior to switch over to real infrastructure from vendors that enable better in-house trainings and preparedness 4. We help top executives in assessing the merit, TCO, market potential and cost savings in investing in various models and projects

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