INDIAN INSTITUTE OF SCIENCE

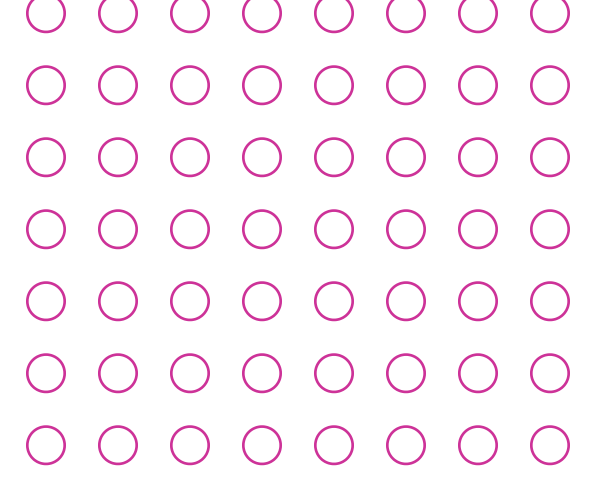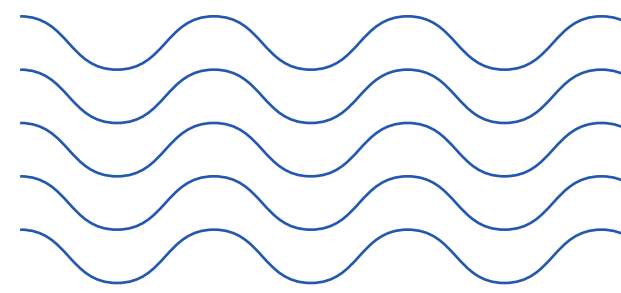भारतीय विज्ञान संस्थान

QπAI

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SCAN ME

A step in the right direction.

$125 Billion
Estimated Quantum
Computing market size
by 2030
Source: GlobeNewsWire

30000+ Jobs
Globally in Quantum
Computing by 2025
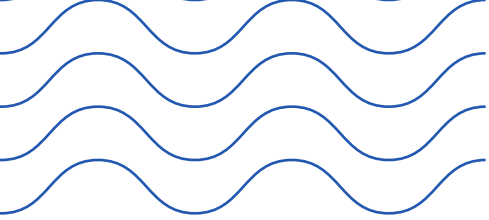Source: Wiley-VCH

₹48k Crore
The Indian AI market is
valuation as of August
2020.
Source: Analytics India Magazine

40%
of global organizations
are adding more jobs
due to AI adoption.
Source: Dun & Bradstreet

Course Overview

Discover Quantum & AI from the fundamentals and advance your way through Artificial Intelligence algorithms, Machine Learning techniques and Quantum programs. Gain strong foundational technical knowledge and write, build, test, train and deploy AI/ML/Quantum solutions. Throughout the course, you will be introduced to real-world problems and applications to prepare you for what the future holds.
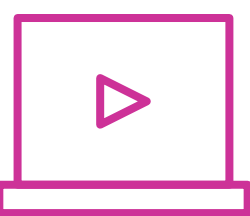
Learning Experience

Industry Perspective
Taught by industry leaders and professors

Assignments & Projects
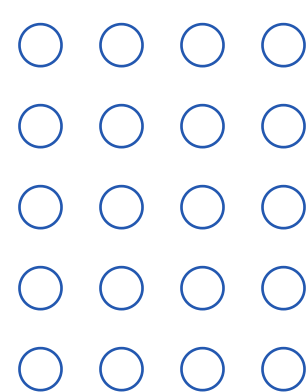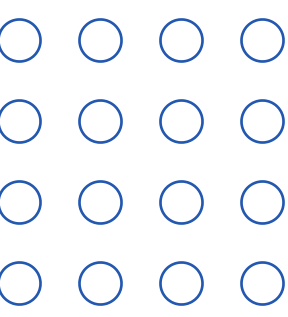Guided learning and implementation

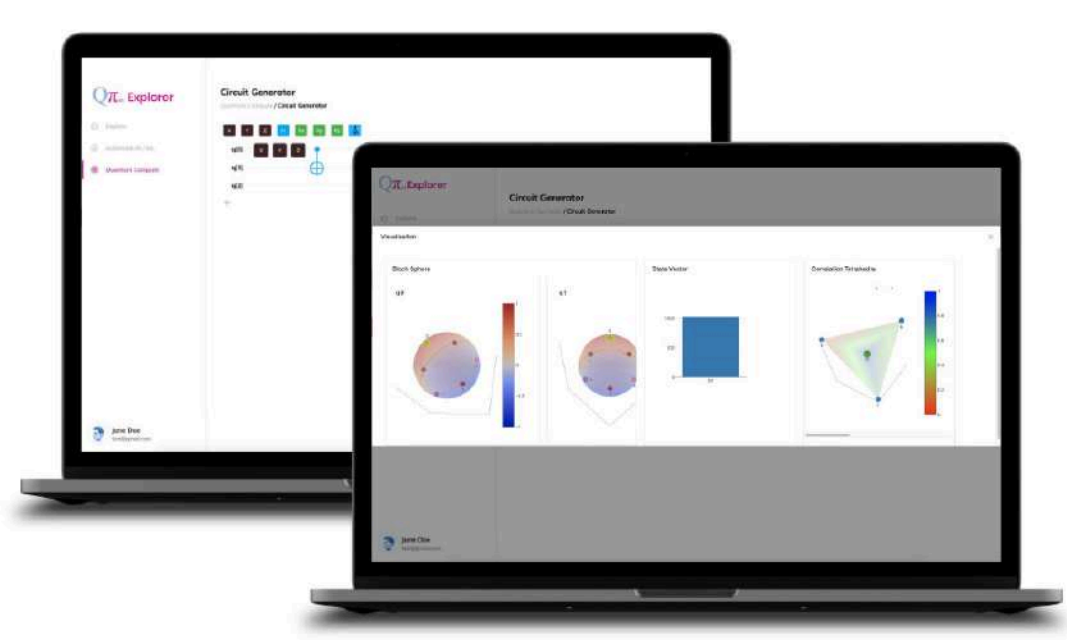### 100% Online
Theory and practical

Live Interactions
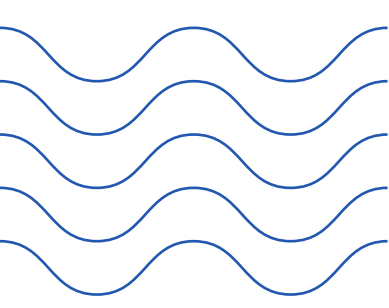Doubt clearing sessions once every month

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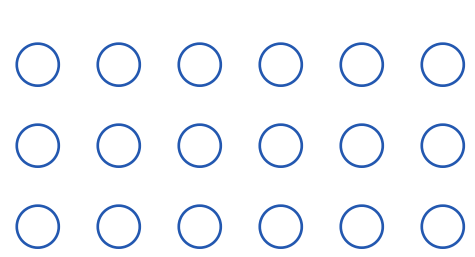
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AI Foundation
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3 Months

Explorer Access
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Course Fee
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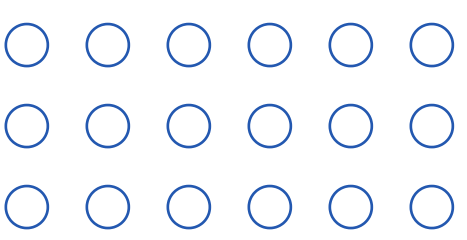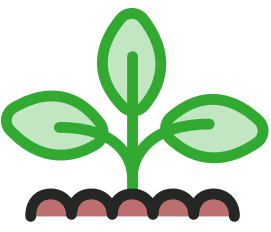## Chapter 1: Prerequisites for Artificial Intelligence

1.1 Linear Algebra
1.2 Probability Theory, Bayes Theorem and Statistics
1.3 Calculus and Optimization

Chapter 2: Machine Learning

Supervised Machine Learning:
2.1 Introduction to Machine Learning, Supervised and Unsupervised techniques
2.2 Linear and Multiple Linear Regression, Performance Metrics, Regularization
2.3 Classification Models: KNN, Logistic Regression
2.4 Support Vector Machines; Classification Performance Metrics
2.5 Decision Trees, Bagging, Boosting and Ensemble Algorithms
Unsupervised Machine Learning:
2.6 Dimensionality Reduction: PCA
2.7 Clustering: K-Means Clustering

Chapter 3: Deep Learning

3.1 Introduction to Deep Learning, Activation Functions, Feedforward Network

3.2 Back Propagation, Loss Functions, Hyperparameter Tuning
3.3 Convolutional Neural Networks (CNN)
3.4 CNN Architectures for Image Classification
3.5 Recurrent Neural Networks
3.6 Long Short-Term Memory Models
3.7 Autoencoders

Chapter 4: Reinforcement Learning

4.1 Introduction to Reinforcement Learning and Multi Armed Bandits
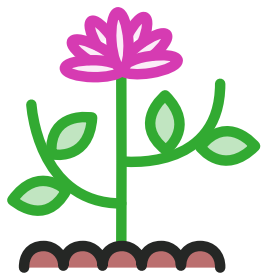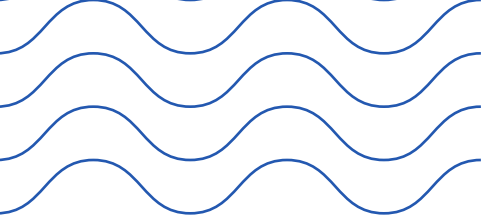4.2 Markov Decision Processes
4.3 Dynamic Programming (Value and Policy Iteration)
4.4 Monte-Carlo Methods (On-policy and Off-Policy Algorithms)

Bonus: Practical Hands-on Session

5.1 Machine Learning model generation with scikit-learn
5.2 Deep Learning model generation with PyTorch

AI Expert
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6 Months

Explorer Access
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Course Fee
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All Chapters in AI Foundation+

Chapter 5: Special Topics in Machine Learning

5.1 Dimensionality Reduction: t-SNE, Kernel PCA, Spectral Clustering

5.2 Exploratory Data Analysis

5.3 Feature Engineering, Hyperparameter Tuning, Model Selection

Chapter 6: Advanced Topics in Deep Learning

6.1 Object Detection

6.2 Semantic Segmentation

6.3 Generative Adversarial Networks

6.4 Variational Autoencoders

Chapter 7: Advanced Reinforcement Learning

7.1 Q-learning, Temporal Difference Methods

7.2 Function Approximation, DQN

7.3 Policy Gradient Techniques and Actor Critic Methods

Chapter 8: Bayesian Methods in Machine Learning

8.1 Bayesian Inference

8.2 Bayesian Optimization

8.3 Variational Methods

8.4 Gaussian Process Regression

Bonus: Practical Hands-on Session

9.1 Machine Learning model generation with scikit-learn

9.2 Deep Learning model generation with PyTorch

9.3 Reinforcement Learning agent training in openAI Gym

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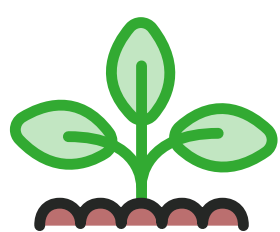
10.1 Model discovery using Pro

10.2 model generation and AutoMl

10.3 Model deployment on edge devices and cloud

10.4 End to End Project 1 with 48 hrs of cloud usage (Student can choose project)

10.5 End to End Project 2 with 96 hrs of cloud usage (Student can choose project)

10.6 End to End Project 3 with 198 hrs of cloud usage (Student can choose project)

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Chapter 1: Prerequisites for Quantum Computing

1.1 Essential Linear Algebra

1.2 Basics of Quantum Mechanics

1.3 General Lecture on Quantum Technology

1.4 Essential Computer Science

Chapter 2: Quantum States and Qubits

2.1 Single-qubit states and superposition

2.2 Single-qubit gates and measurements

2.3 Two-qubit states, entanglement, and Bell's inequality

2.4 Two-qubit gates and observable

2.5 Multi-Qubit states (GHZ and W states)

2.6 Universal gates and quantum circuit model

2.7 Quantum adiabatic computation and the Ising model

Chapter 3: Quantum Algorithms

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3.5 Quantum Factoring: Shor's Algorithm

3.6 Quantum Database Search: Grover's Algorithm

3.7 Circuit Simulations on QpiAI Explorer Software

Chapter 4: Quantum Protocols

4.1 Quantum Teleportation

4.2 Superdense Coding

4.3 Simulation of QpiAI Explorer Software

4.4 Quantum Cryptography and Key Distribution

4.5 Quantum Communication and Networks

4.5 Guest Lecture - QKD, Communications

Chapter 5: Quantum Hardware: Superconducting Qubits

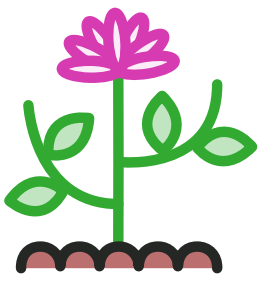5.1 Introduction to physical qubits

5.2 Circuit Quantum Electrodynamics

5.3 Transmon and Coupled Qubits

5.4 Control and Readout

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💻	Explorer Access **12 Months**
₹	Course Fee **INR 1,49,999**

All Chapters in Quantum Foundation+

Chapter 6: NISQ Devices

6.1 Noise Models

6.2 Quantum Error Mitigation

6.3 Quantum Volume and Performance Metrics

6.4 Hybrid Quantum-Classical Computing

Chapter 7: Quantum Algorithms for Applications

7.1 Quantum Inspired Computing

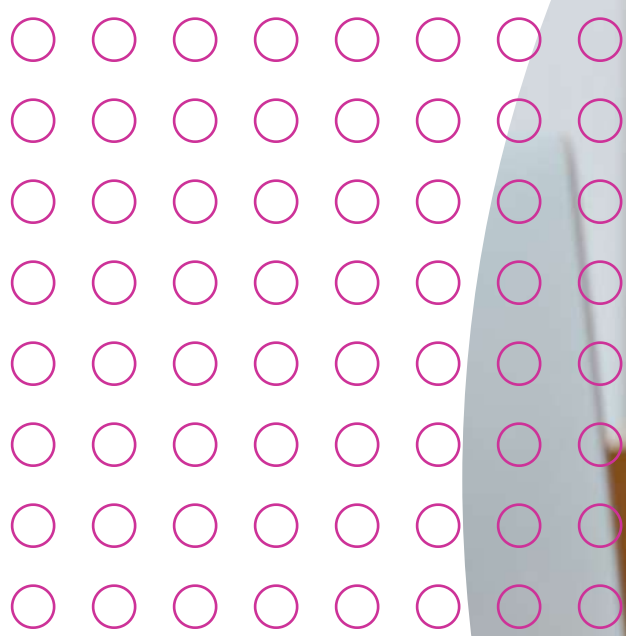7.2 Variational Quantum Algorithms

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7.5 Quantum Machine Learning: QNNs

7.6 HHL Algorithm for Solving Linear Systems

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8.2 Spin Physics and Quantum Dots

8.3 Control and Readout

8.4 Scalability

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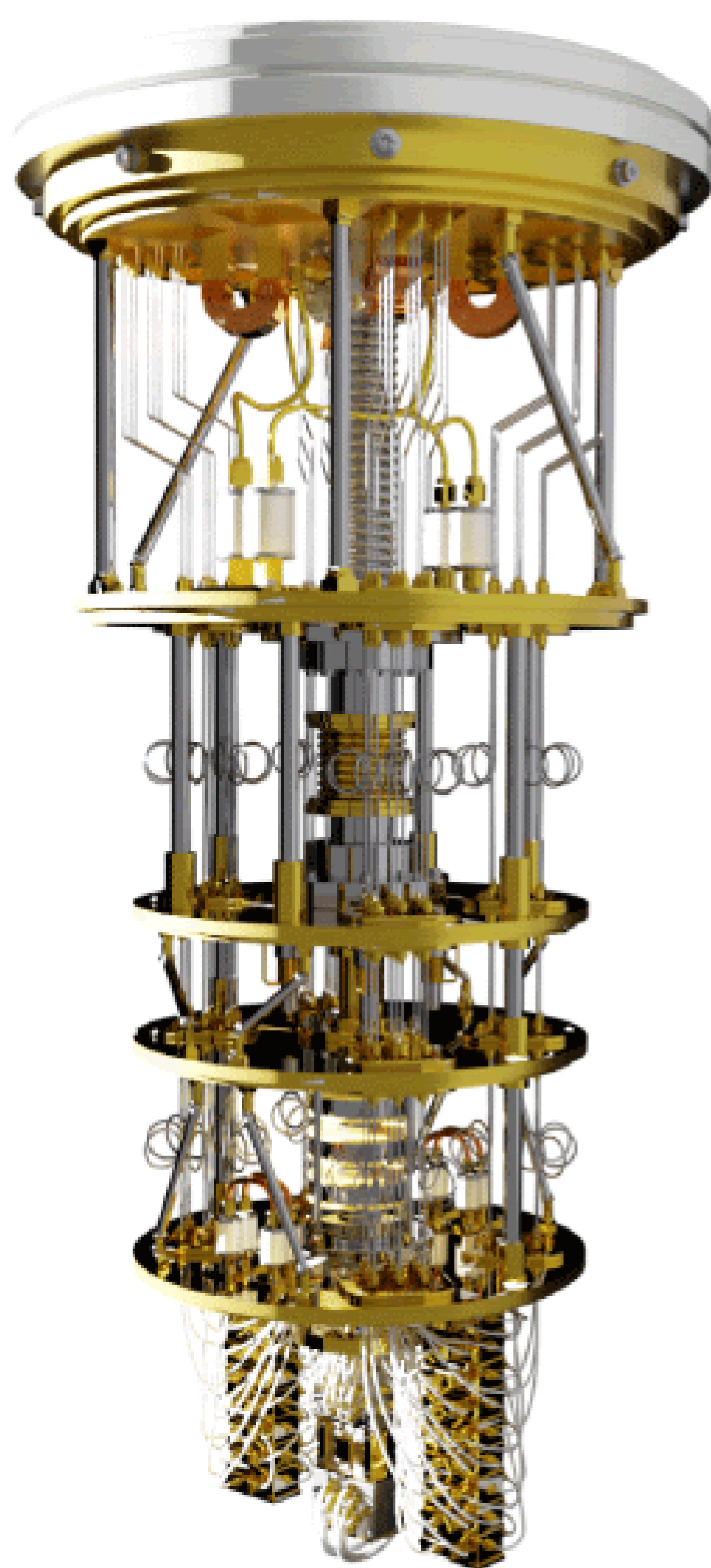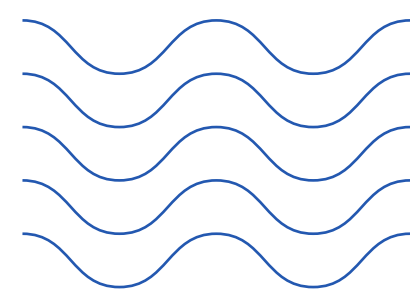
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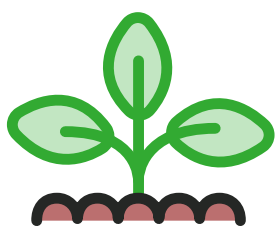
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Course Wrap-up and Future Directions

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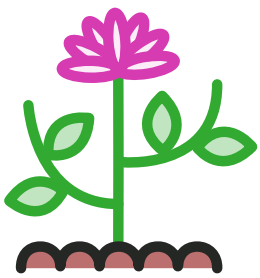5.1 Introduction to physical qubits

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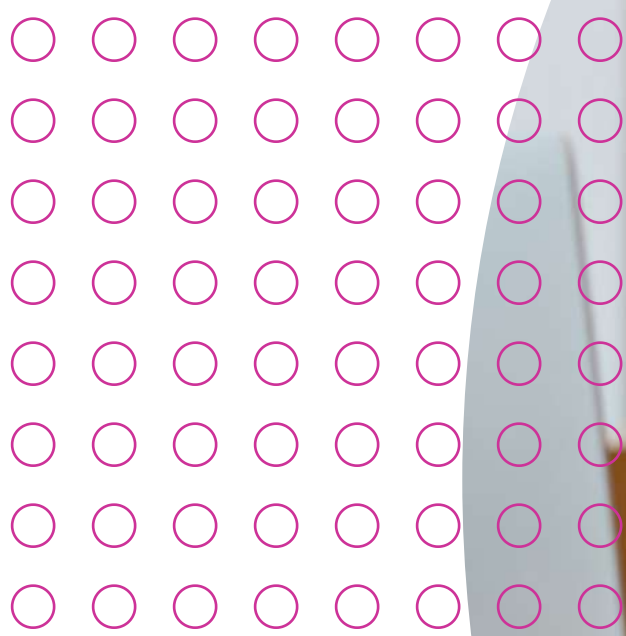7.2 Variational Quantum Algorithms

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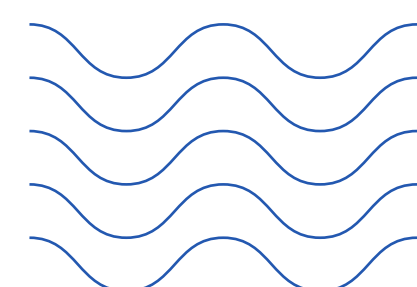
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Indian Institute of Science, Bangalore.

Dr. Nagendra Nagaraja

CEO & Founder, QpiAI India.

PhD, Coventry University UK.

Prof. Ujjwal Sen

Professor, Quantum Information & Computation Group.

Harish-Chandra Research Institute, Allahabad.
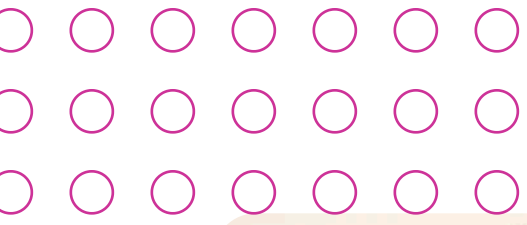
Dr. Madhu Thalakulam

Associate Professor (Physics),
IISER, Thiruvananthapuram.

PhD, Rice University, Houston.
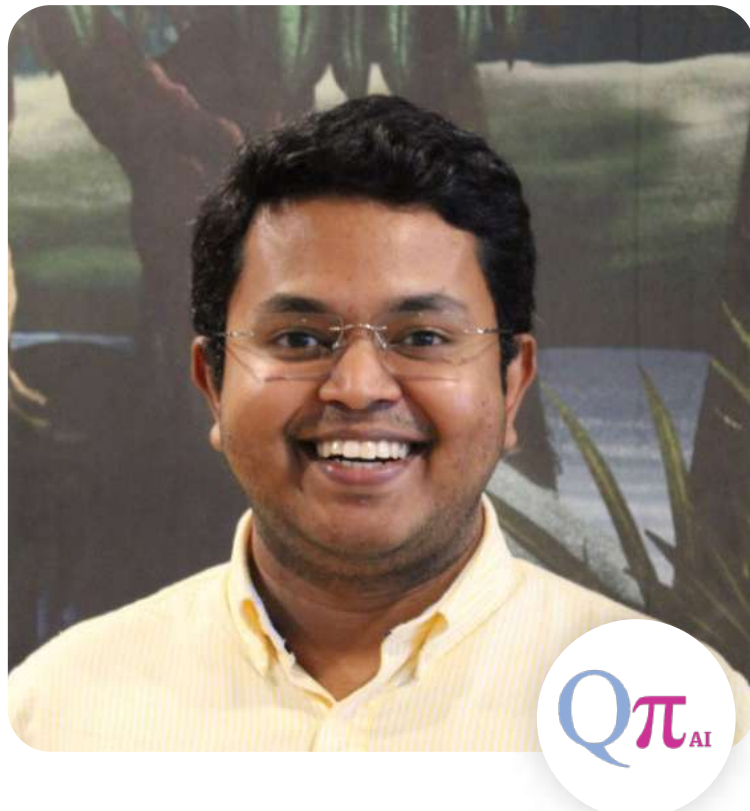
Dr. Baladitya Suri

Assistant Professor, Indian Institute of Science, Bangalore.
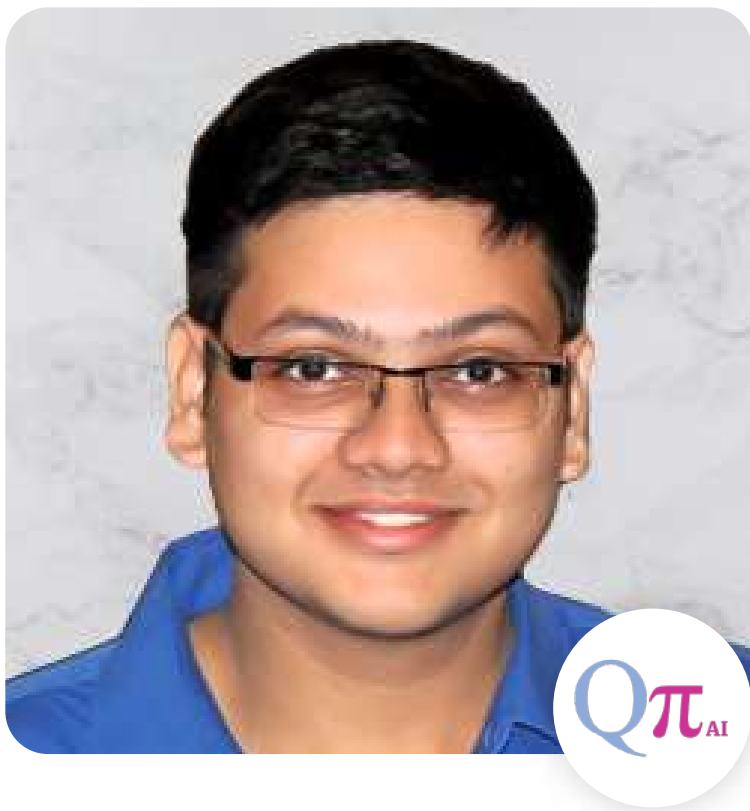
PhD, University of Maryland, USA.

Dr. Vibhor Singh

Assistant Professor,
Department of Physics.

Indian Institute of Science, Bangalore.

Optimal Balance of
Academic Excellence
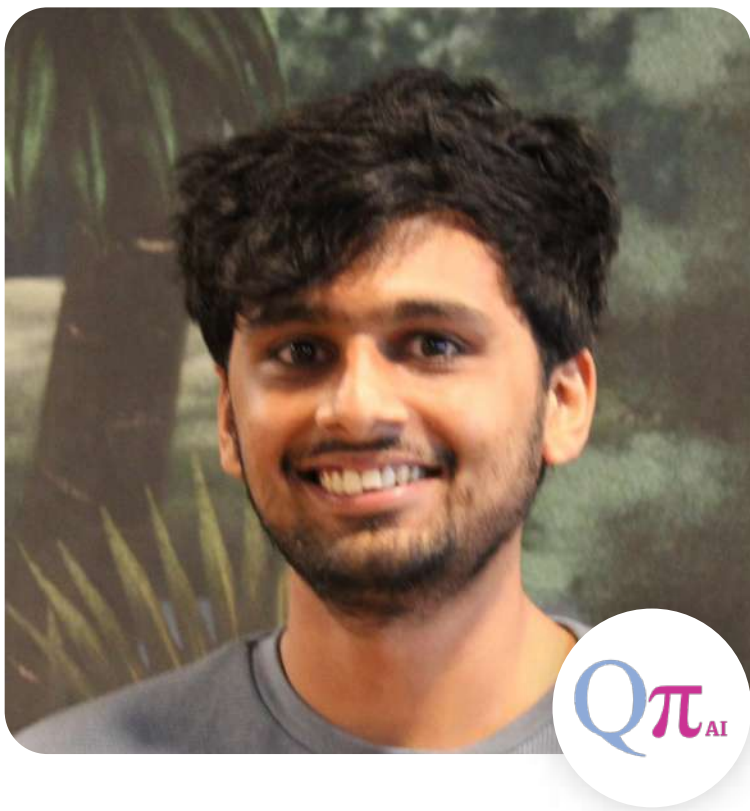
and
Industry Expertise

Sachin Kumar

VP, AI Engineering QpiAI India.

B.Tech, NIT Trichy.

Lakshya Priyadarshi

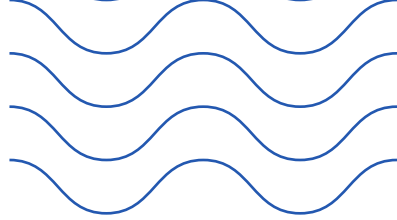**Senior Director, Quantum Software,** QpiAI India.

B.Tech, IET.

Aswanth Krishnan

VP, Software Products
QpiAI India.

MSc, NIT Karnataka.

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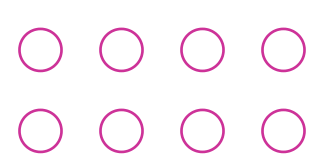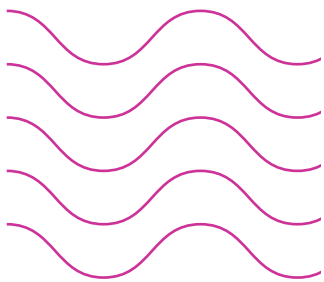
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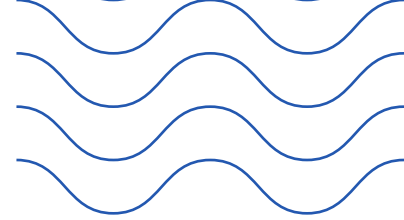
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