

Physical limits and course synthesis

Evaluate computation using the full chain from a mathematical model to an experimental result.

THE CENTRAL QUESTION

What evidence is required before calling a quantum method useful?

A credible advantage claim names the task, baseline, resource, scale, error model, and end-to-end metric.

Prediction: state what should change in the first experiment and what must remain invariant.

KEY TERMS

problem structure
baseline
resource accounting
advantage claim

MODEL

claim = task + comparator + cost model +
evidence + limitation

FIRST WORKED EXPERIMENT

Start with one case small enough to check by hand.

1. Write the input and prediction
2. Apply the operation
3. Compare the observed evidence

Evidence to keep: matched baselines, scaling variable, uncertainty, and excluded costs.
Label basis order, shots, and simulator assumptions.

EXPERIMENT

Audit three course examples: simulator demonstration, query advantage, and hardware claim.

THE CENTRAL QUESTION

What should remain after the individual algorithms and applications fade?

Quantum computing is a disciplined chain from state and operation to measurement, evidence, and resource-aware comparison.

Prediction: state what should change in the first experiment and what must remain invariant.

KEY TERMS

state
operation
measurement
resource and limitation

MODEL

input -> transformation -> observable evidence
-> honest comparison

An evidence-based hardware case study

Choose a dated result from a primary source. Identify the task, classical comparison, accuracy, and total resources.

Distinguish a simulator demonstration, a query advantage, and useful hardware performance.

Final synthesis assessment

Trace one Q3 algorithm through state preparation, compilation, noisy execution, and readout.

Ask students to explain what would have to improve for the demonstration to become useful.