



Quantum Grover Algorithm: Football Kit Regulations

Team 4: Giovanni Concheri, Mohammed Alabdullah, Giorgio Stucchi, Bernhard Jobst, Mathieu Gras

Supporters: El Amine Cherrat, Jean-Michel Torres, Marcel Pfaffhauser

Problem Statement

Detect Logos

Identify Team and Sponsors

Measure Logos Size

Checking Model

Sponsor 1

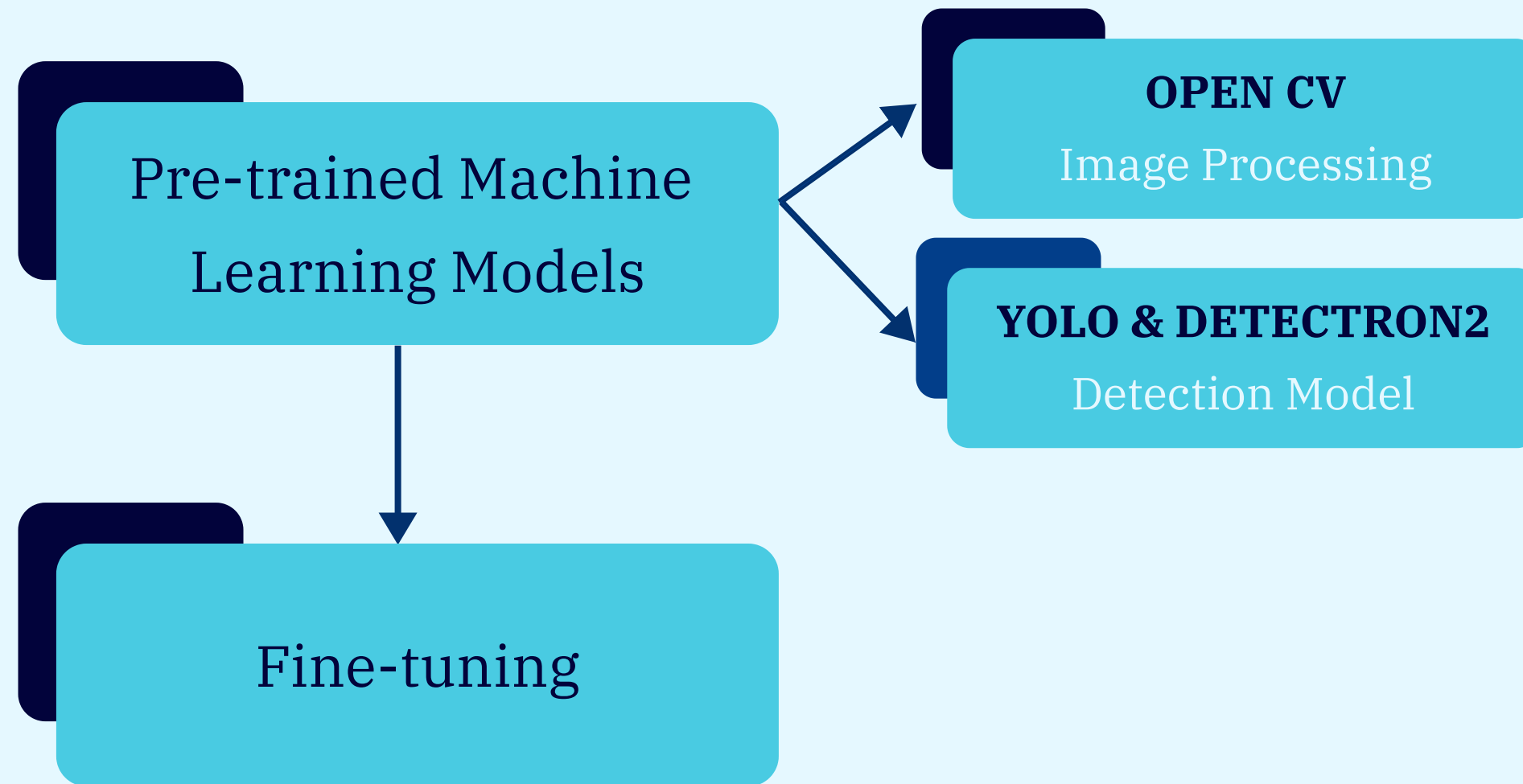
Sponsor 2

Team



Current approach: classical

IMAGE SEGMENTATION



Why no Quantum?

Time

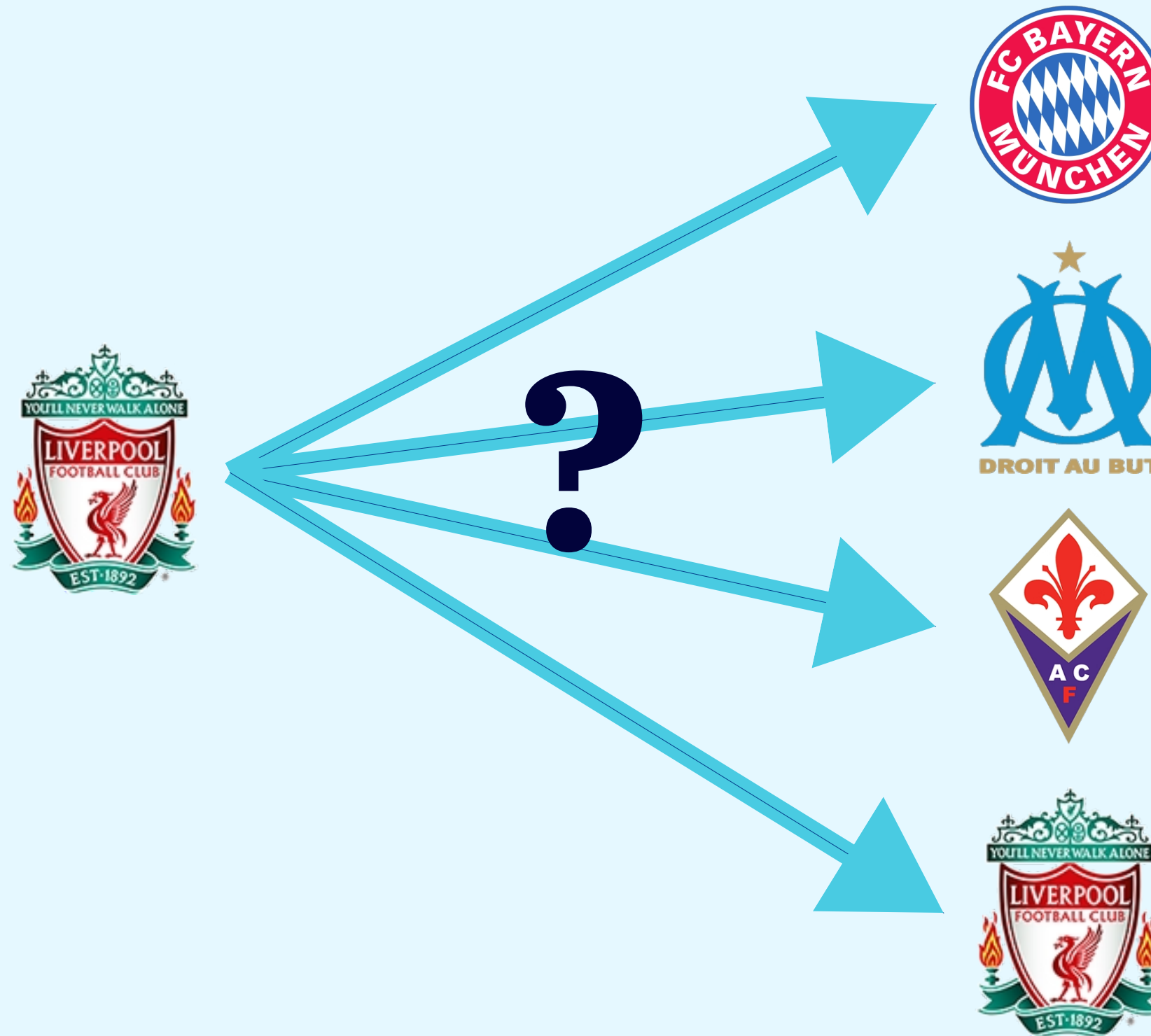
Accuracy



Accuracy 80%

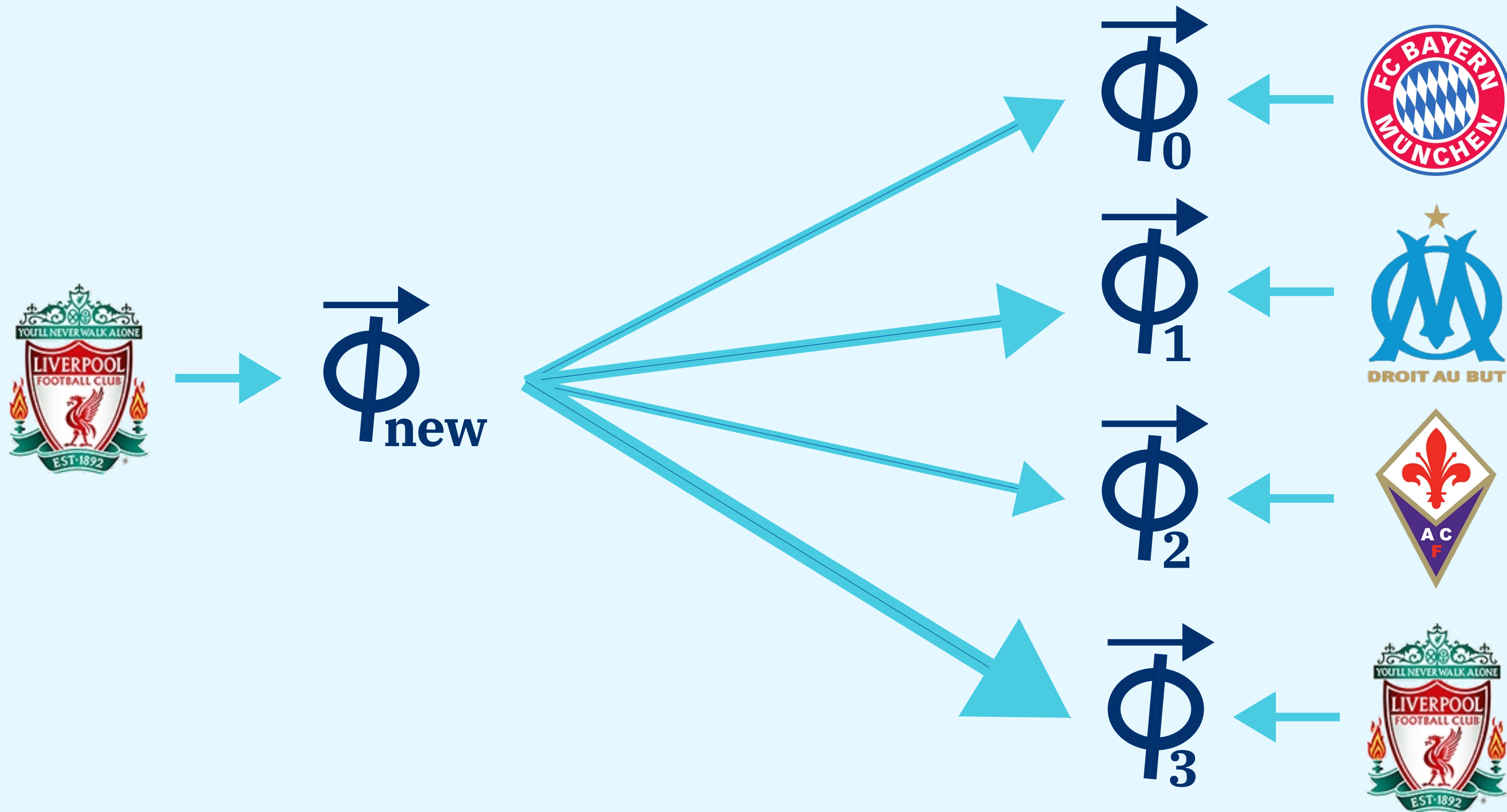
Current approach: classical

FEATURE VECTOR EXTRACTION AND MATCHING



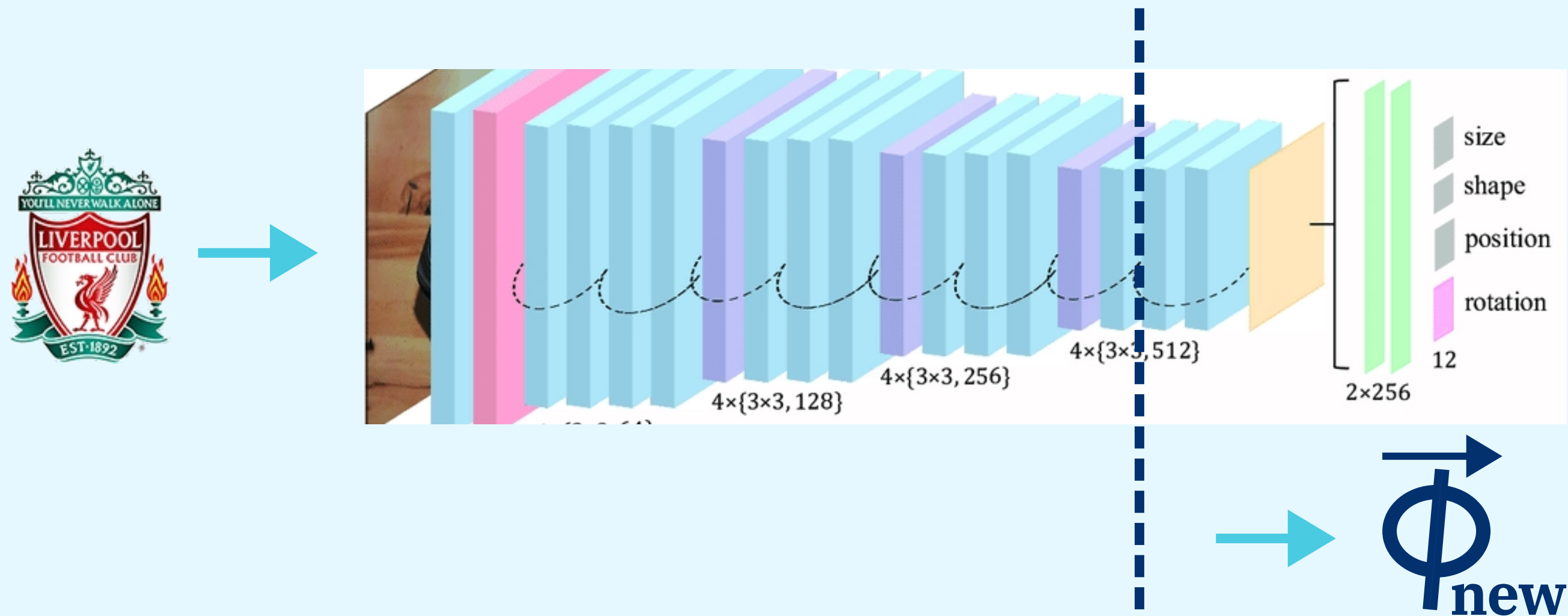
Current approach: classical

FEATURE VECTOR EXTRACTION AND MATCHING



Current approach: classical

FEATURE VECTOR EXTRACTION AND MATCHING



$\Rightarrow \sim 70\%$ accuracy without retraining



Our Quantum Approach

Build a feature map (logo to features)

Choose a distance in the feature space

Build an oracle encoding the distances to our input logo

Data Matching using Quantum Maximum finding algorithm

Our Quantum Approach

Input

Computed Feature Vector $\vec{\phi}_{new}$ and Database Feature Vectors $\{\vec{\phi}_i\}$

Initialization

$$|i\rangle|0\rangle \xrightarrow{QRAM} |i\rangle|\phi_i\rangle$$

Compute
Distance

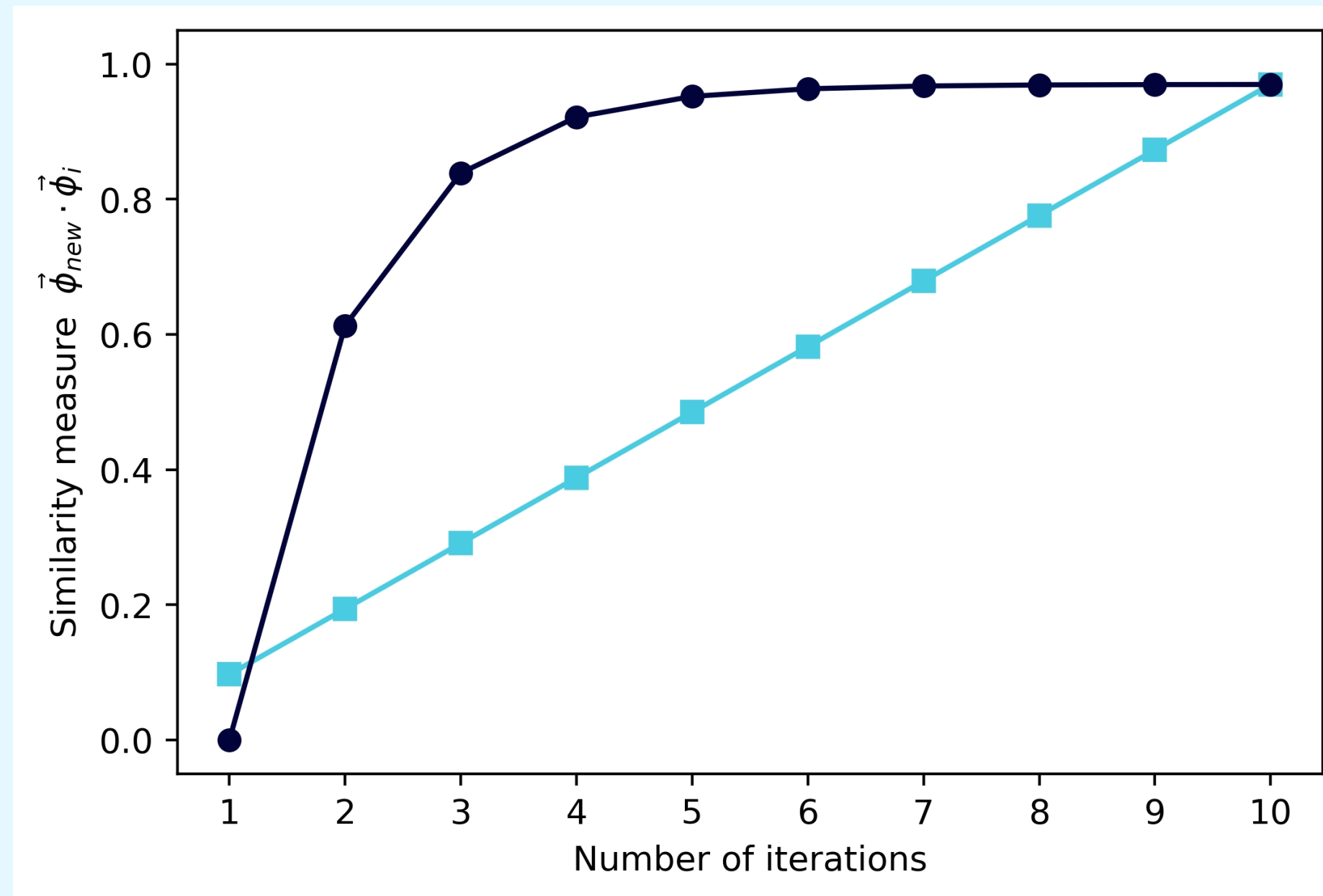
$$|i\rangle|\phi_i\rangle|\phi_{new}\rangle \rightarrow |i\rangle|\phi_i \cdot \phi_{new}\rangle$$

Max Finding
Subroutine[1]

Given a quantum oracle U_u encoding a vector $u \in R^n$, the algorithm finds $\arg \max_i(u_i)$ with probability $> 1 - \delta$ in at most $c_{\max} \sqrt{n} \log(1/\delta)$ queries to U_u .

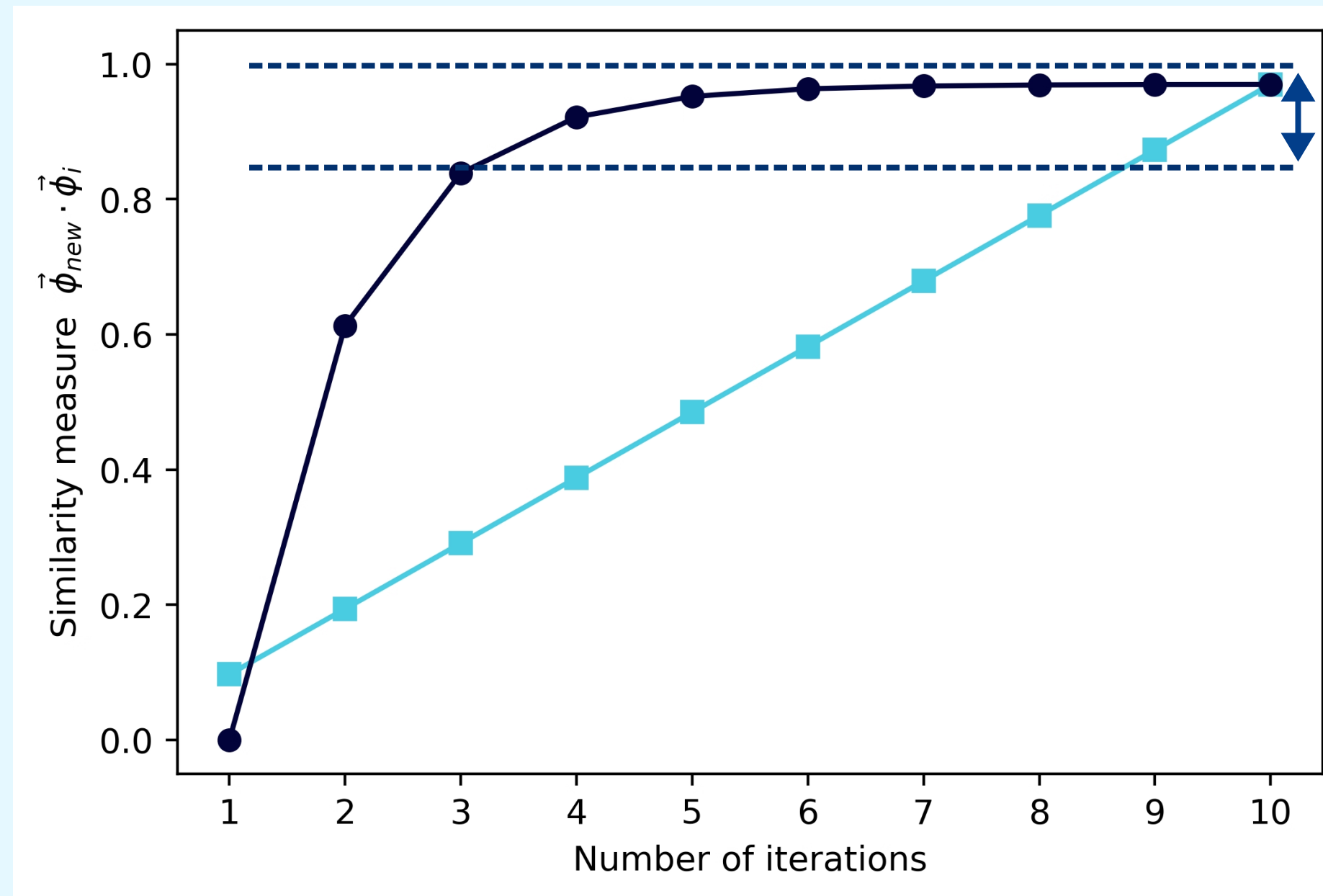
Checking the Model

Implementing a system of checks for catching bad performance:



Checking the Model

Implementing a system of checks for catching bad performance:



Retrain if there are too many points within the threshold!

Metrics

Computational
Cost:

$$\mathcal{O}(\sqrt{N})$$

Scalability:

$$\# \text{ Qubits} = \underset{\text{features}}{2d} \overset{\text{binary digits}}{p} + \log_2 \overset{\text{logos}}{N} + \text{ancillas}$$

Accuracy:

$$A = BC$$

B = logos detected/logos

C = correct matches/total matches



Thank you



Want to make a presentation like this one?

Start with a fully customizable template, create a beautiful deck in minutes, then easily share it with anyone.

Create a presentation (It's free)