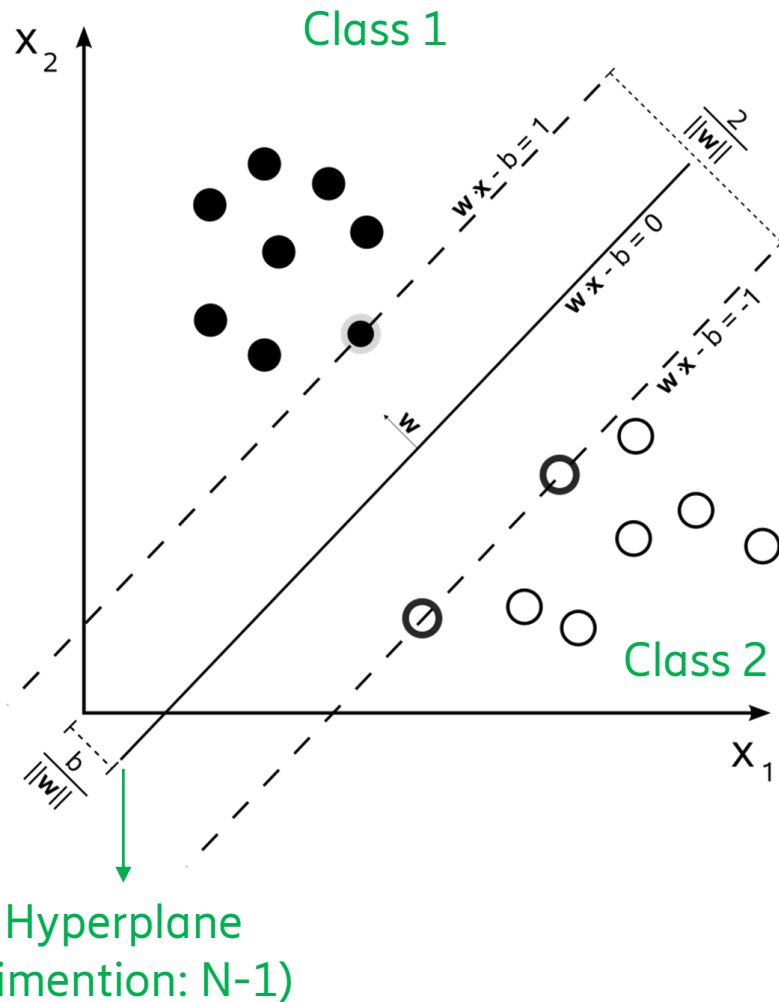
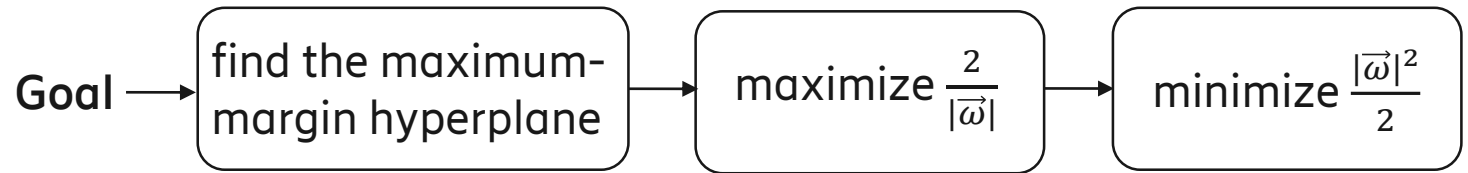


# Quantum Support Vector Machine

# Classical SVM



**M training data points:**  $\{(\vec{x}_j, y_j) : \vec{x}_j \in \mathbb{R}^N, y_j = \pm 1\}, j = 1 \dots M$



**The constraint:**

$$\begin{cases} \vec{w} \cdot \vec{x}_j + b \geq 1 & \text{if } y_j = +1 \text{ (} y_j \text{ belongs to class 1)} \\ \vec{w} \cdot \vec{x}_j + b \leq -1 & \text{if } y_j = -1 \text{ (} y_j \text{ belongs to class 2)} \end{cases} \Leftrightarrow y_i(\vec{w} \cdot \vec{x}_j + b) \geq 1$$

**Computational Complexity:**  $O(\log(\epsilon^{-1}) \text{poly}(N, M))$

Dimension of  
feature space  
(input data)

Number of training  
data points

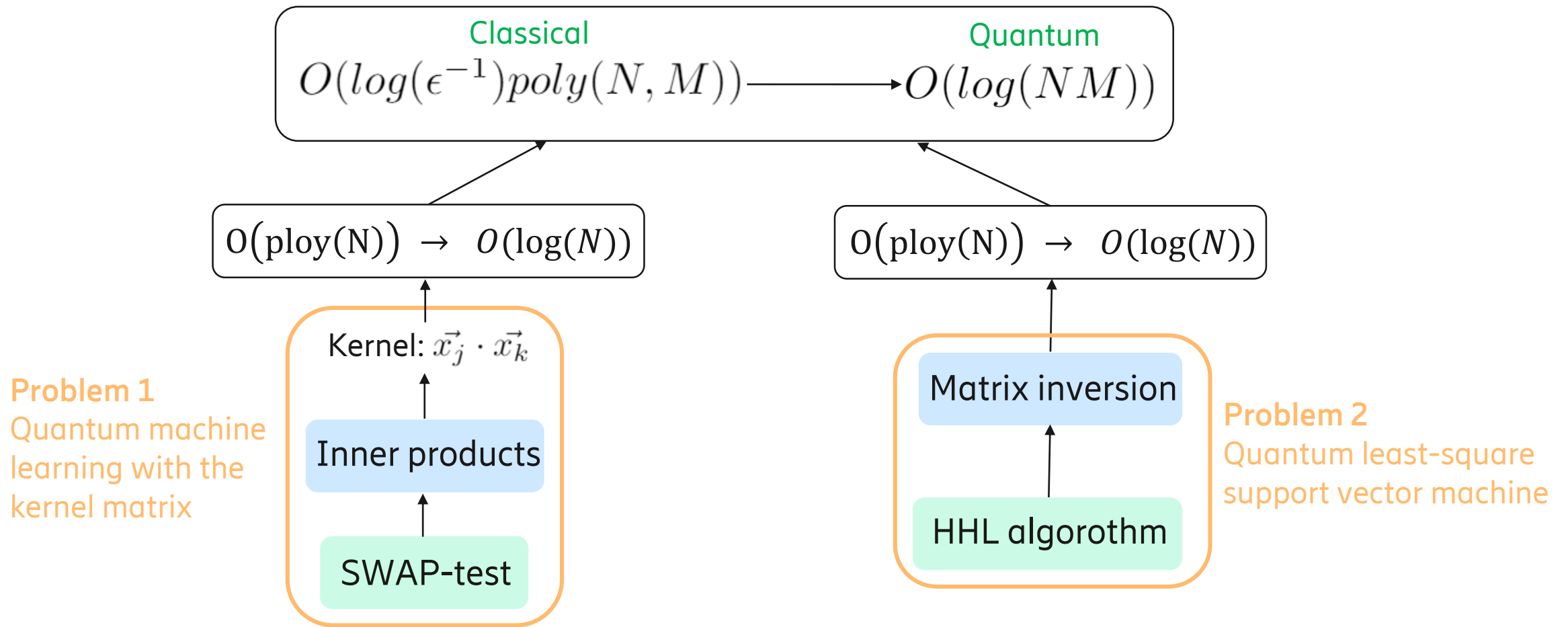
# Quantum SVM



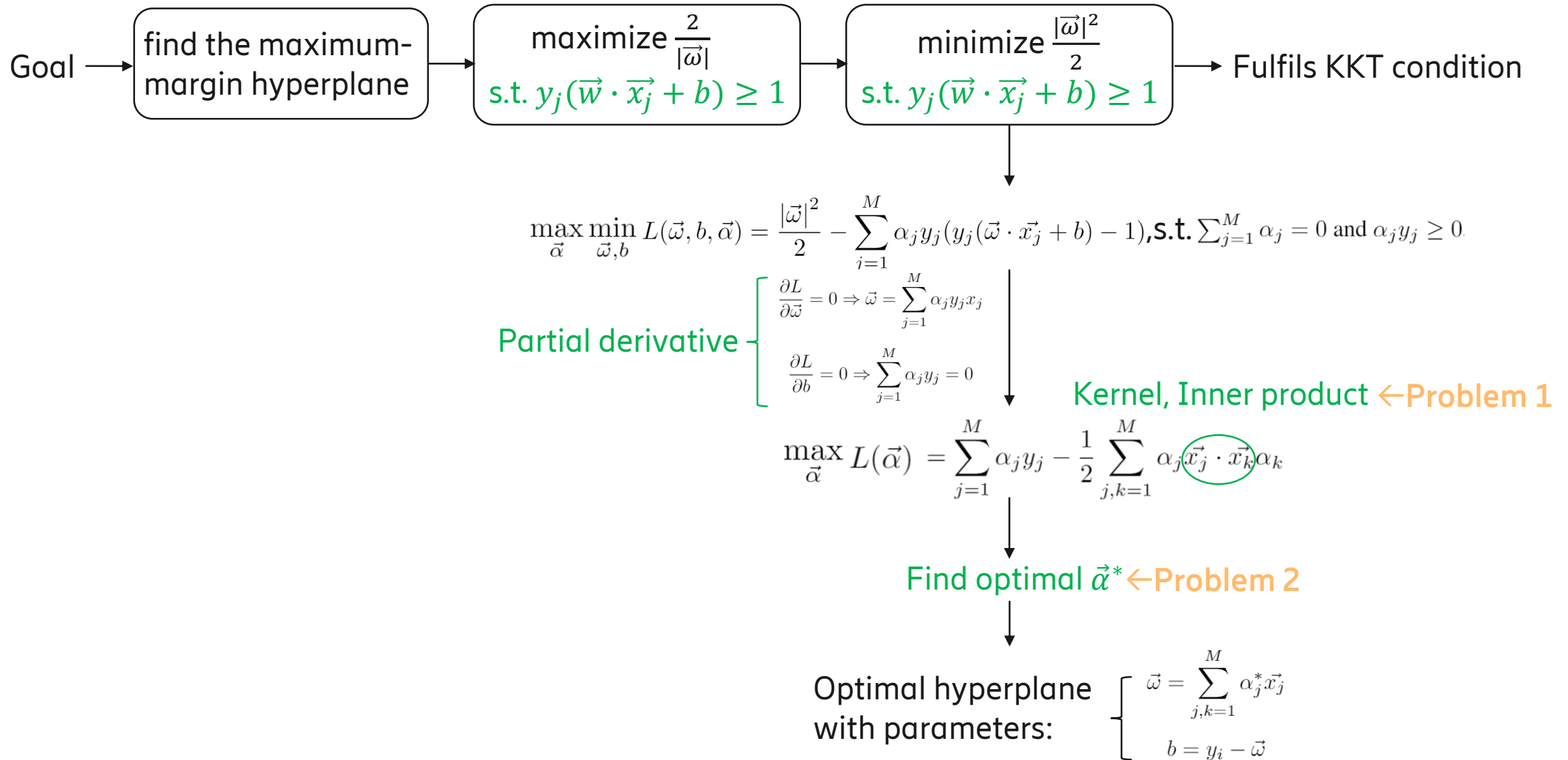
Computational Complexity:

$$O(\log(\epsilon^{-1}) \overset{\text{Classical}}{\text{poly}}(N, M)) \longrightarrow O(\log(NM)) \overset{\text{Quantum}}{\text{}} \begin{matrix} \swarrow & \searrow \\ \text{training} & \text{testing} \end{matrix}$$

# HHL based qSVM



# SVM structure



# References

- Patrick Rebentrost, Masoud Mohseni, and Seth Lloyd. Quantum support vector machine for big data classification. Physical review letters, 113(13):130503, 2014.
- Wechat article ([link](#))