

GOOSE:

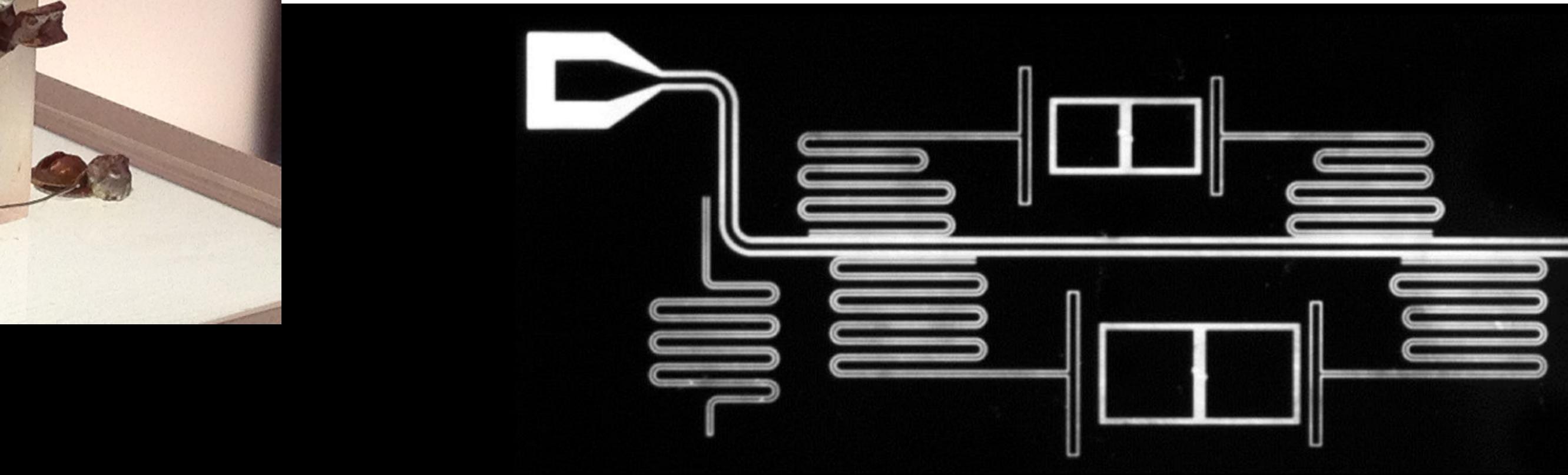
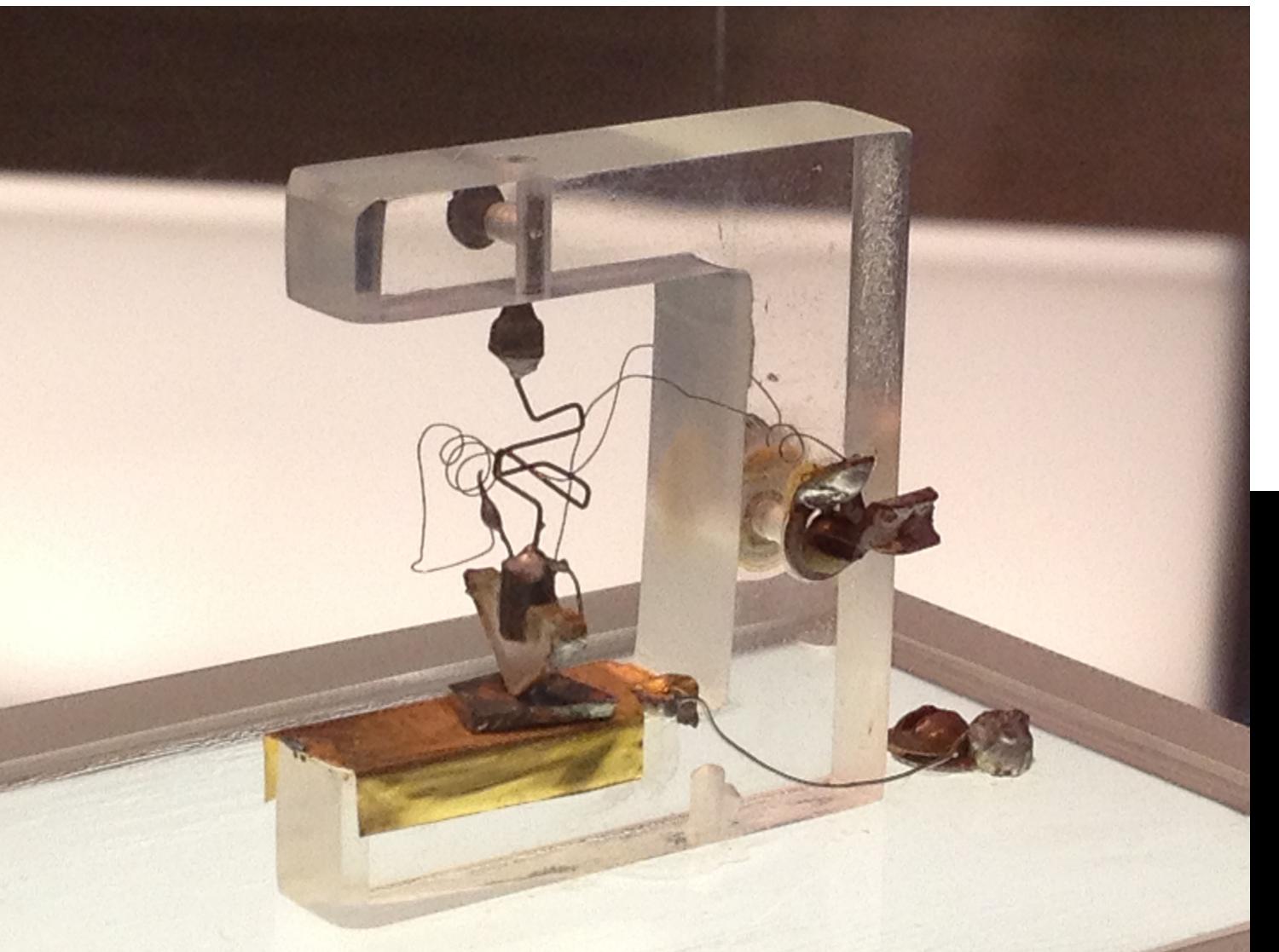
Une bibliothèque pour l'informatique quantique en OCaml

Denis Carnier, Arthur Correnson, **Christopher McNally**, Youssef Moawad



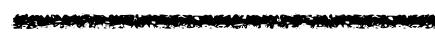
L'informatique quantique

Des bits aux qubits



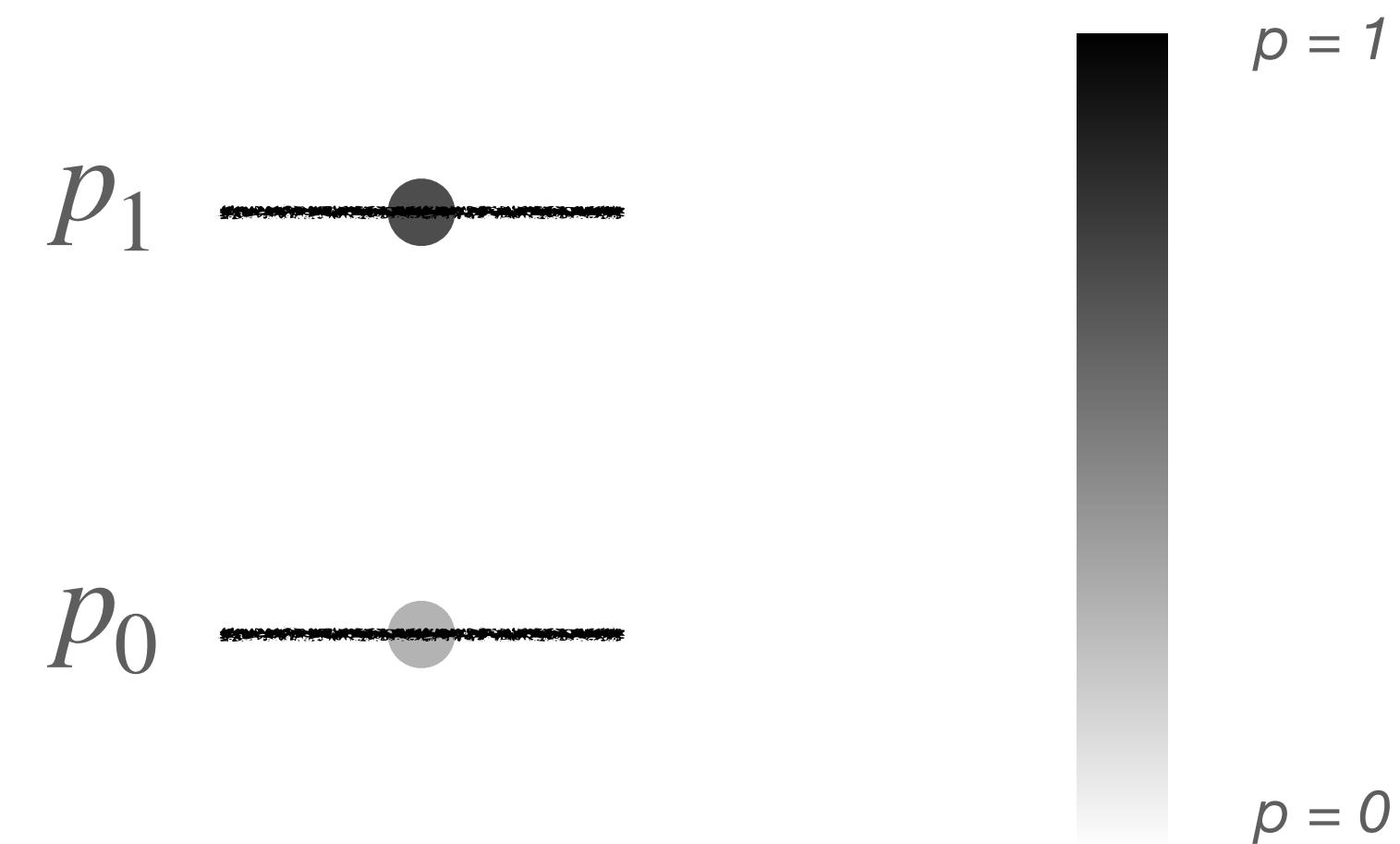
L'informatique quantique

Des bits aux qubits



L'informatique quantique

Des bits aux qubits



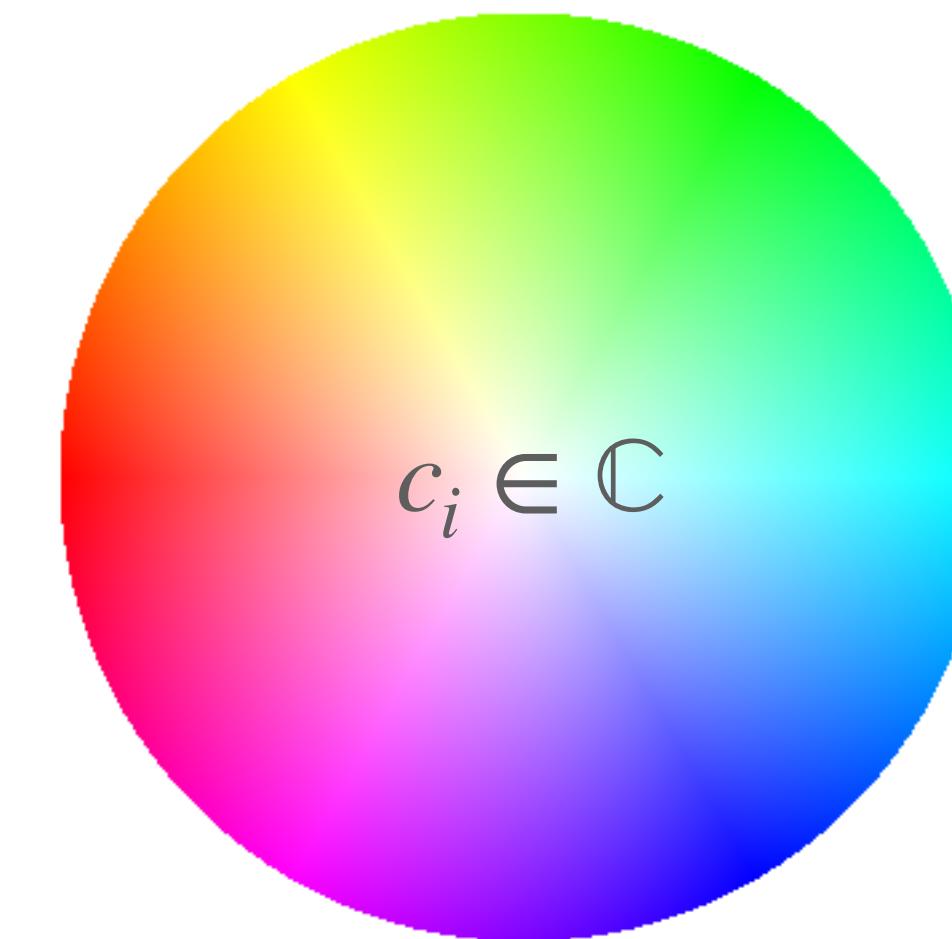
$$p_0 + p_1 = 1$$

L'informatique quantique

Des bits aux qubits

c_1

c_0

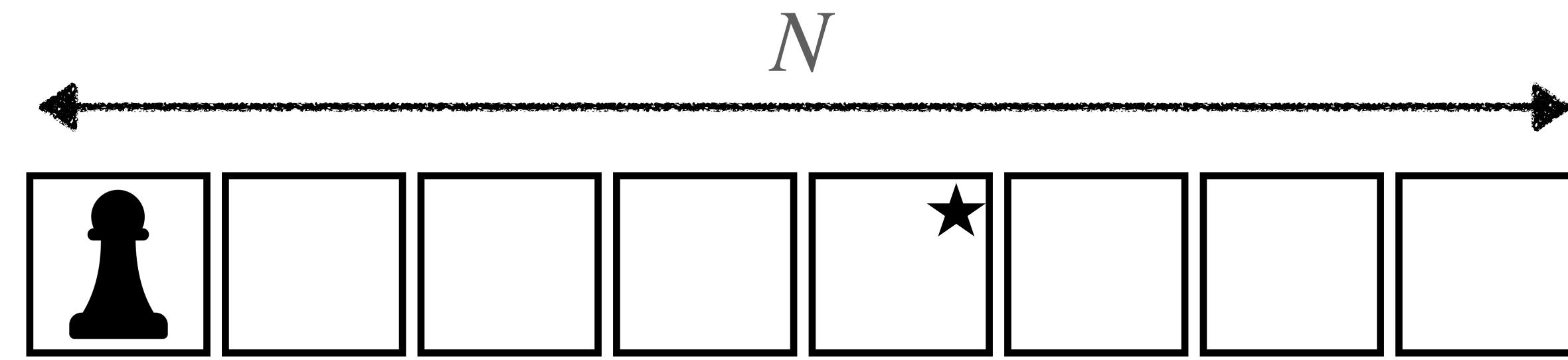


$$|c_0|^2 + |c_1|^2 = 1$$

Que peut-on faire avec ça?

Une accélération quantique

Chercher dans des bases de données



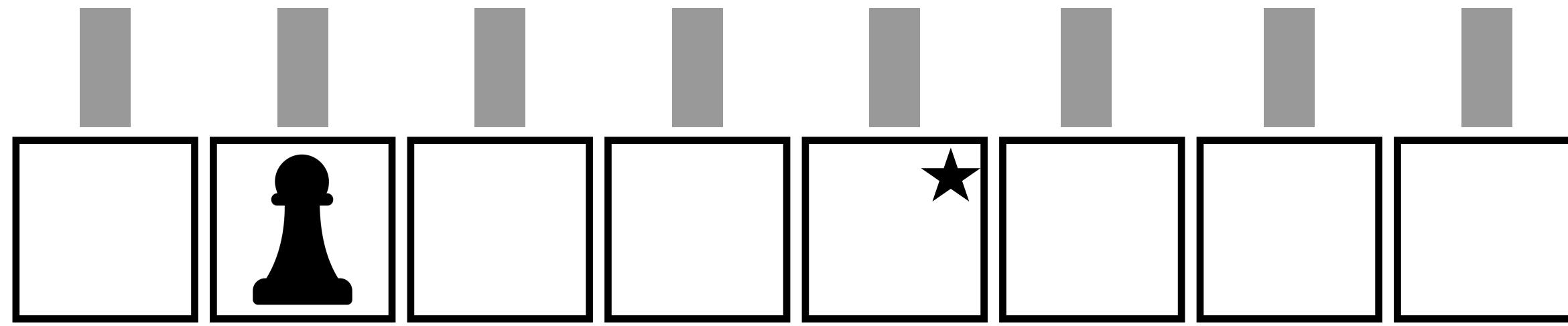
Borne inférieure classique: $\Omega(N)$ étapes.

Une accélération quantique

Algorithmes aléatoires

$p = 0$

$p = 1$



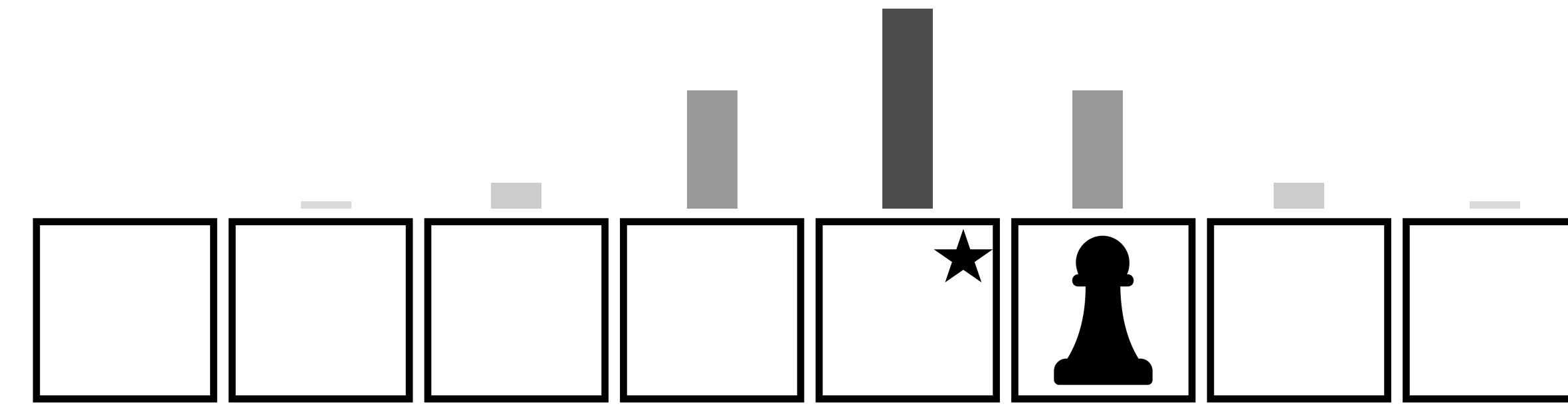
Ceci prend aussi $\Omega(N)$ échantillons.

Une accélération quantique

Algorithmes aléatoires

$p = 0$

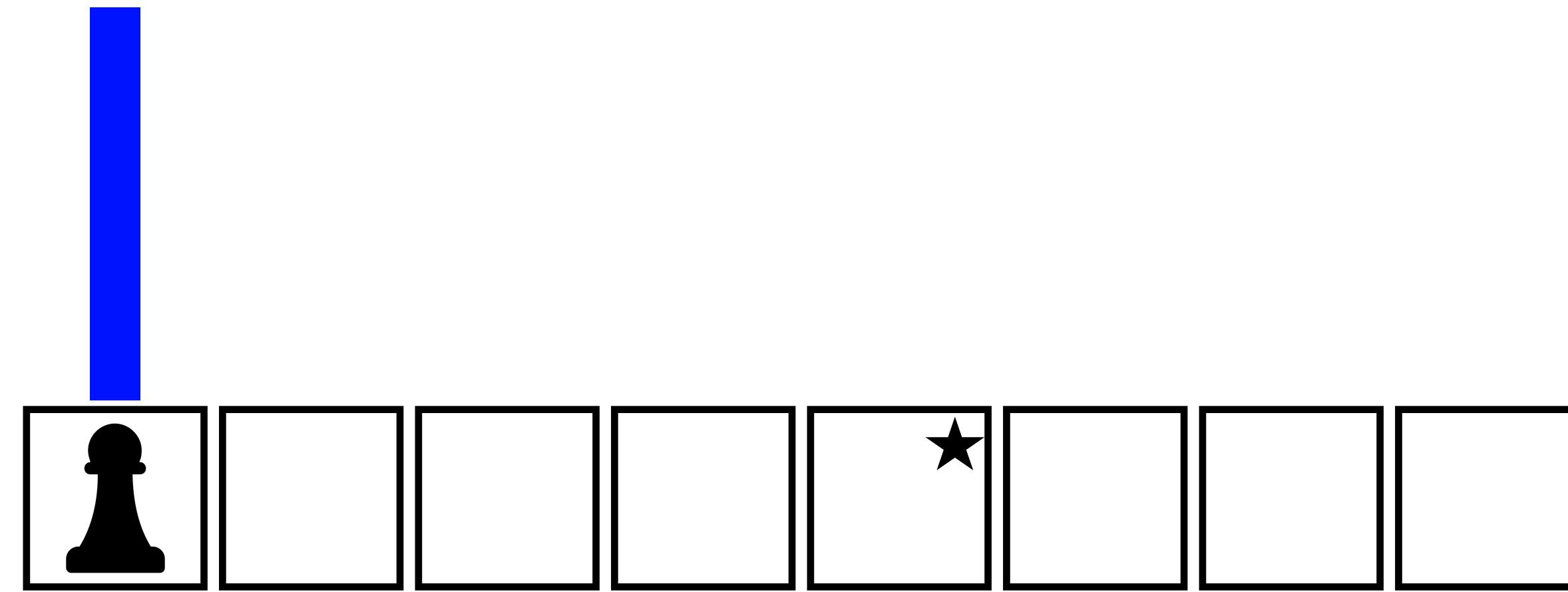
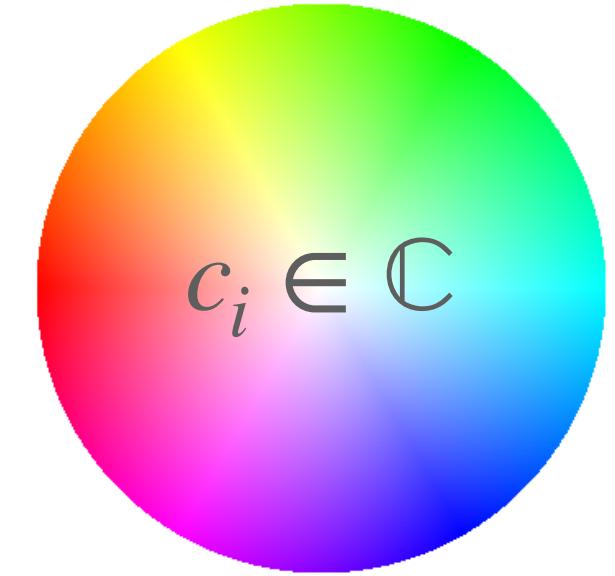
$p = 1$



...ou moins, avec une distribution biaisée.

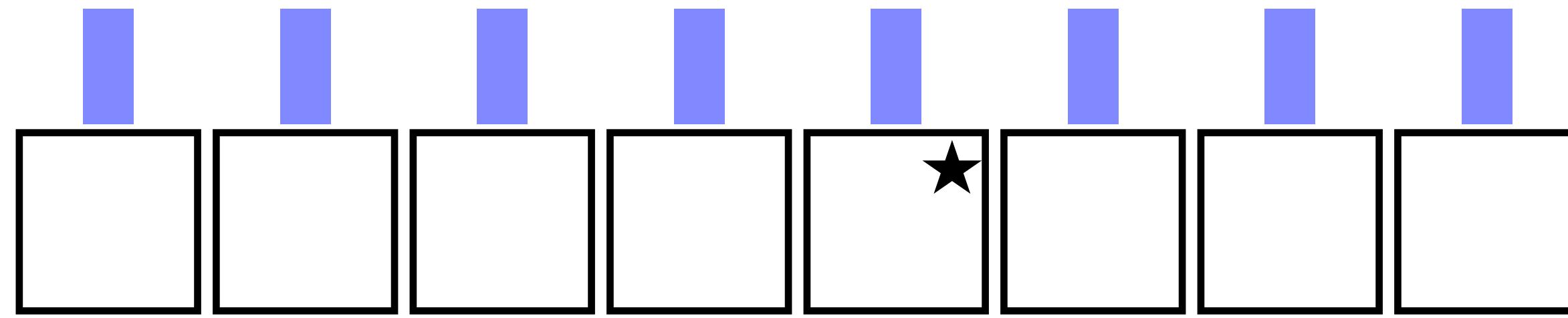
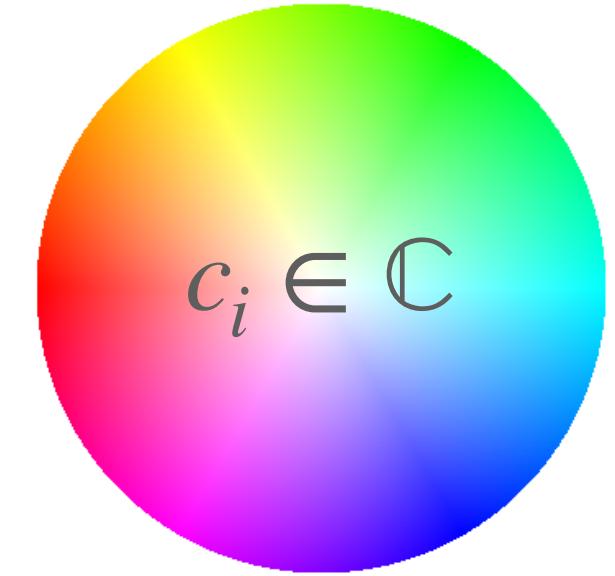
Une accélération quantique

L'algorithme de Grover : la vie en couleur



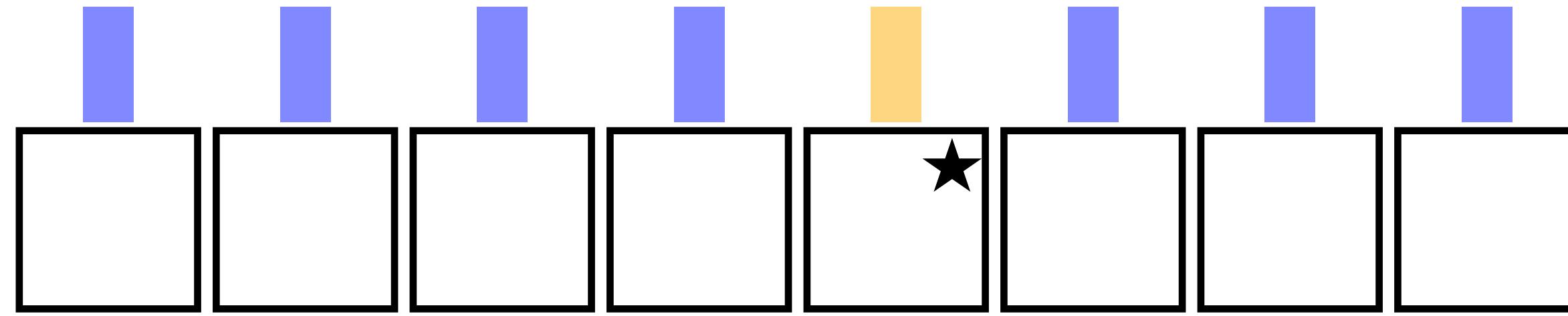
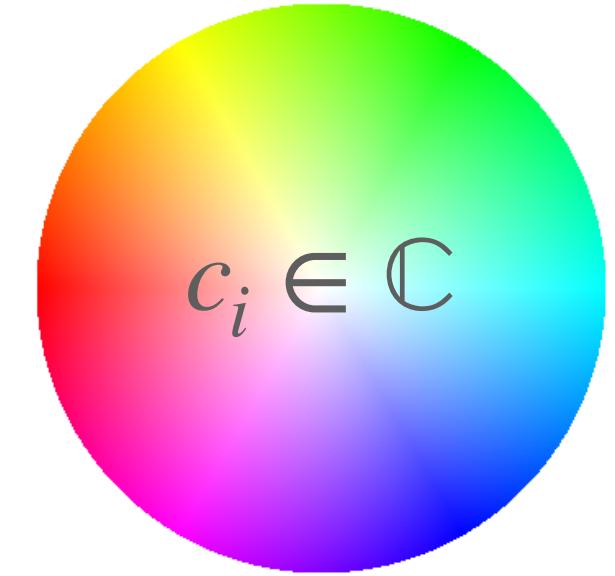
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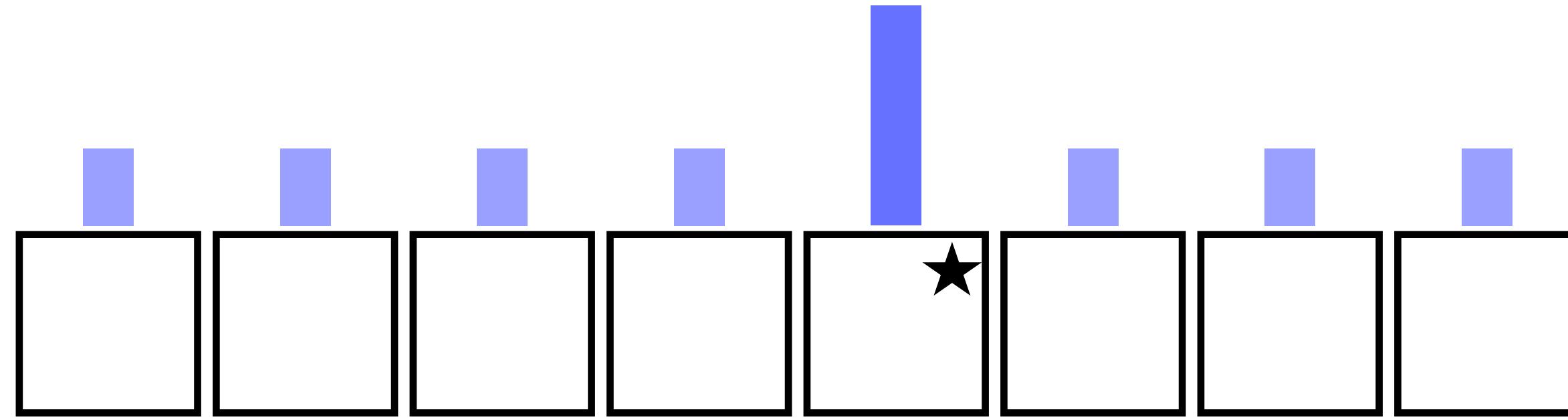
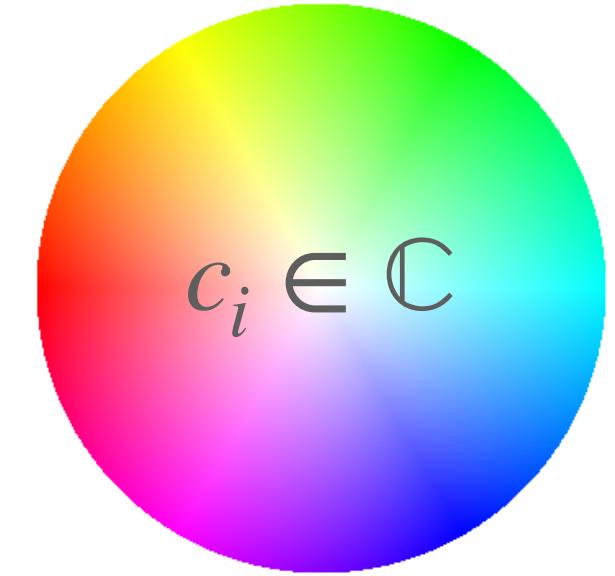
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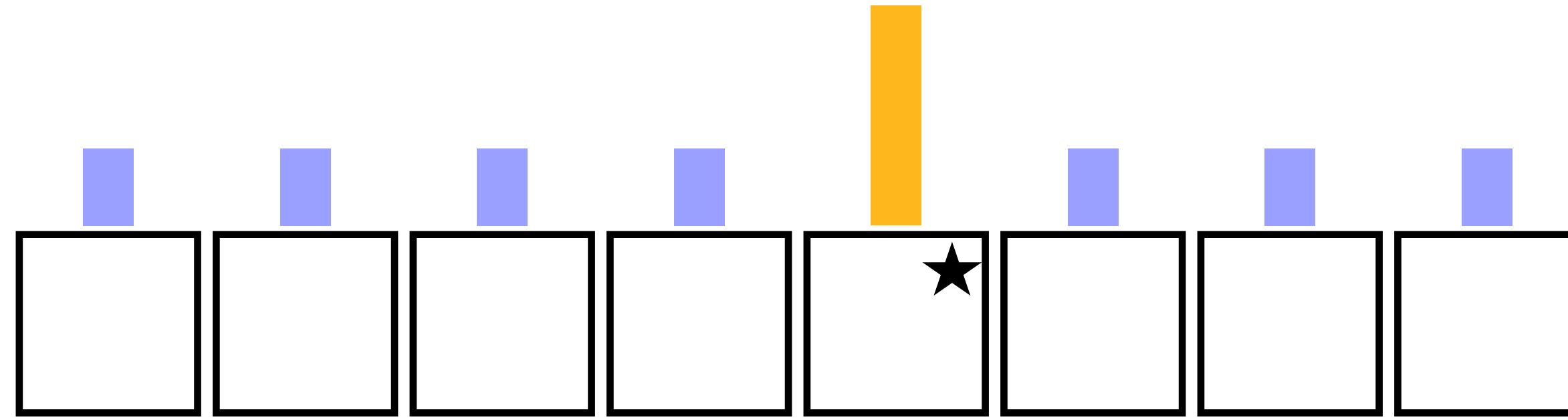
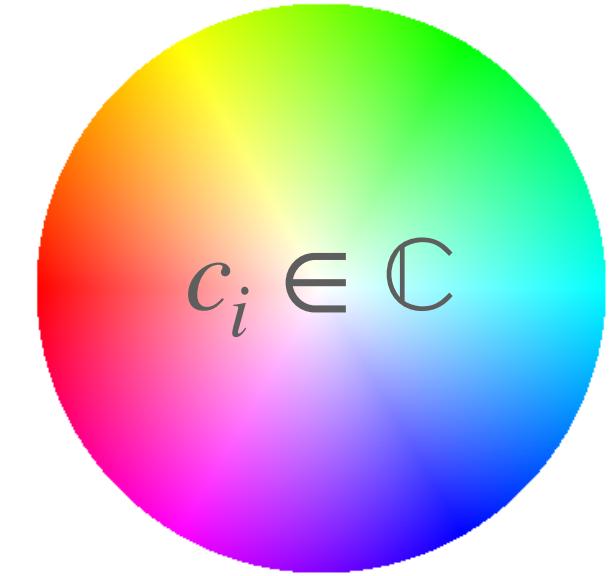
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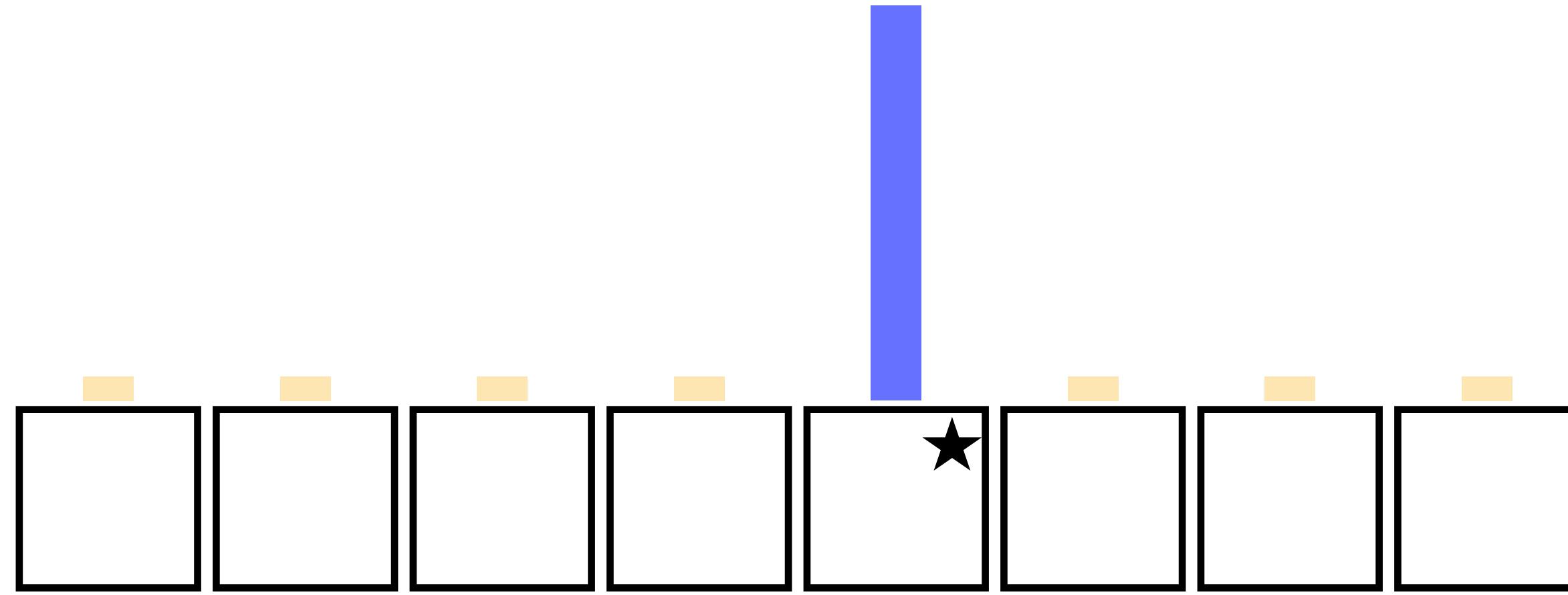
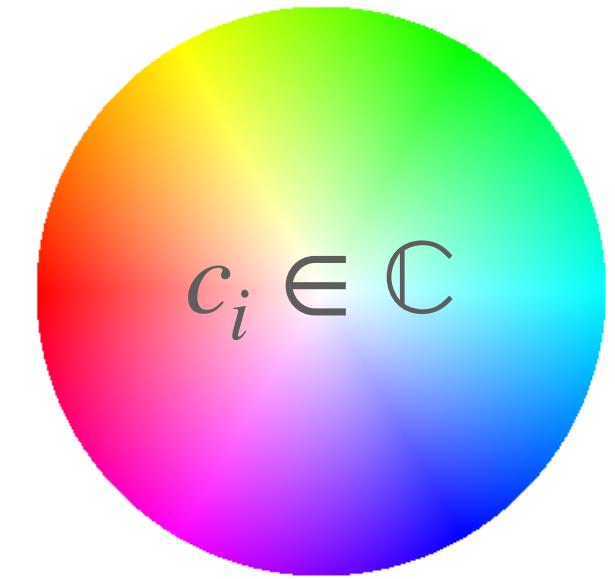
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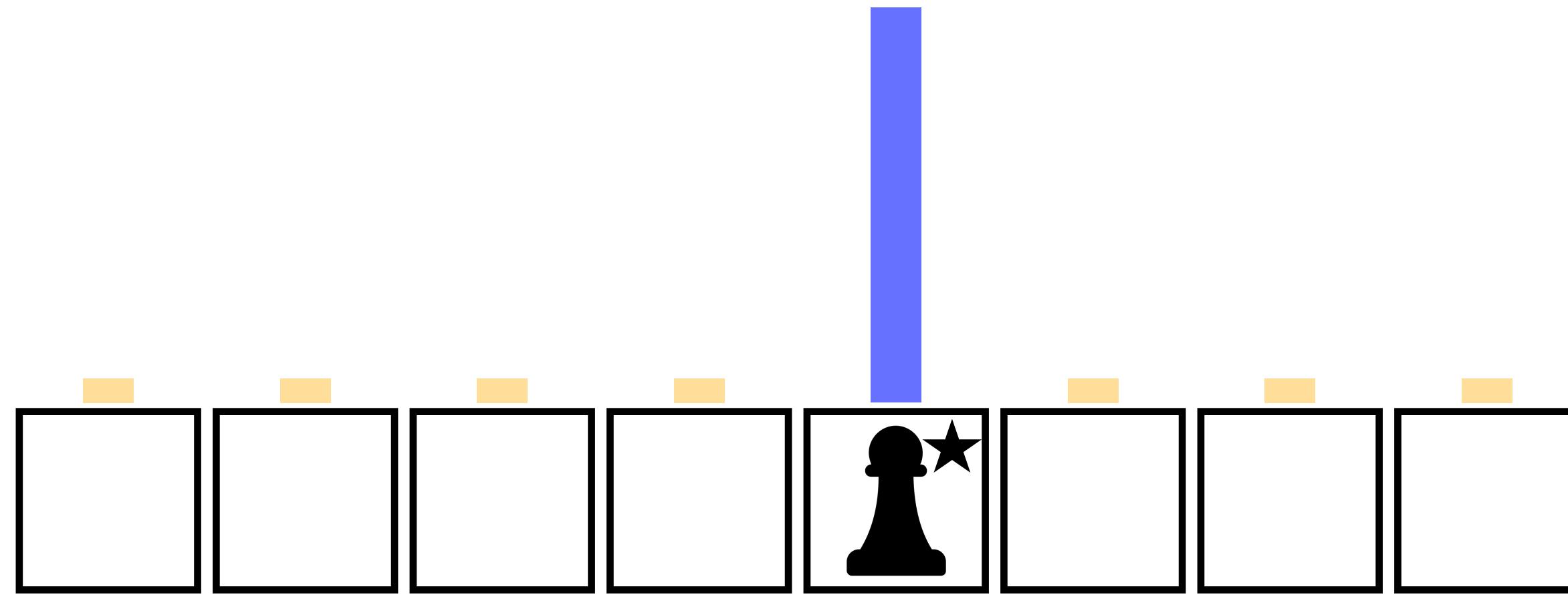
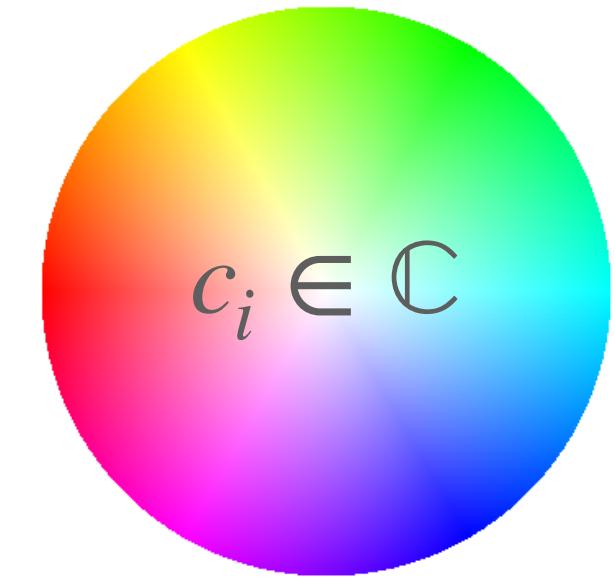
Une accélération quantique

L'algorithme de Grover : la vie en couleur



Une accélération quantique

L'algorithme de Grover : la vie en couleur



Complexité quantique : $\Theta(\sqrt{N})$ étapes.

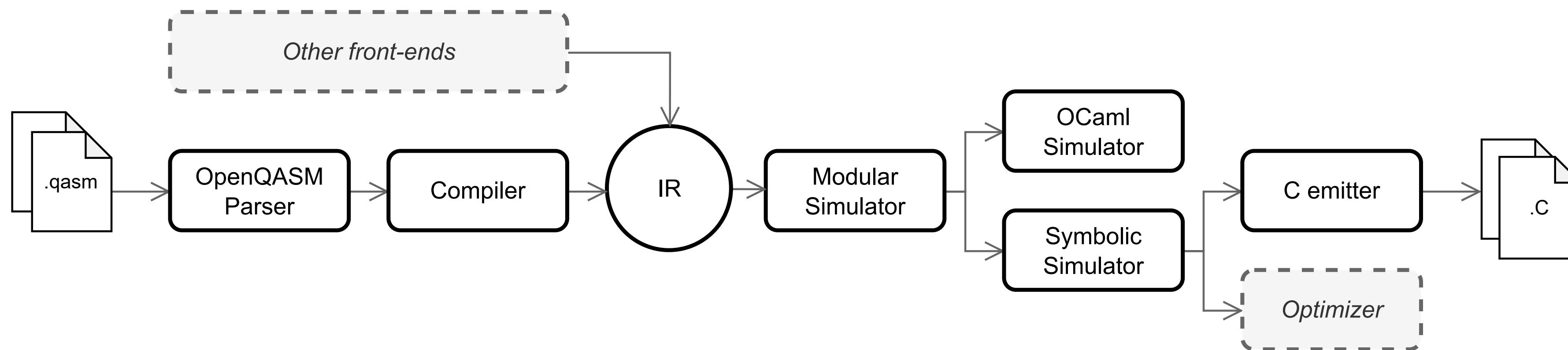
GOOSE

Démonstration

En direct!

GOOSE

Une infrastructure de compilation

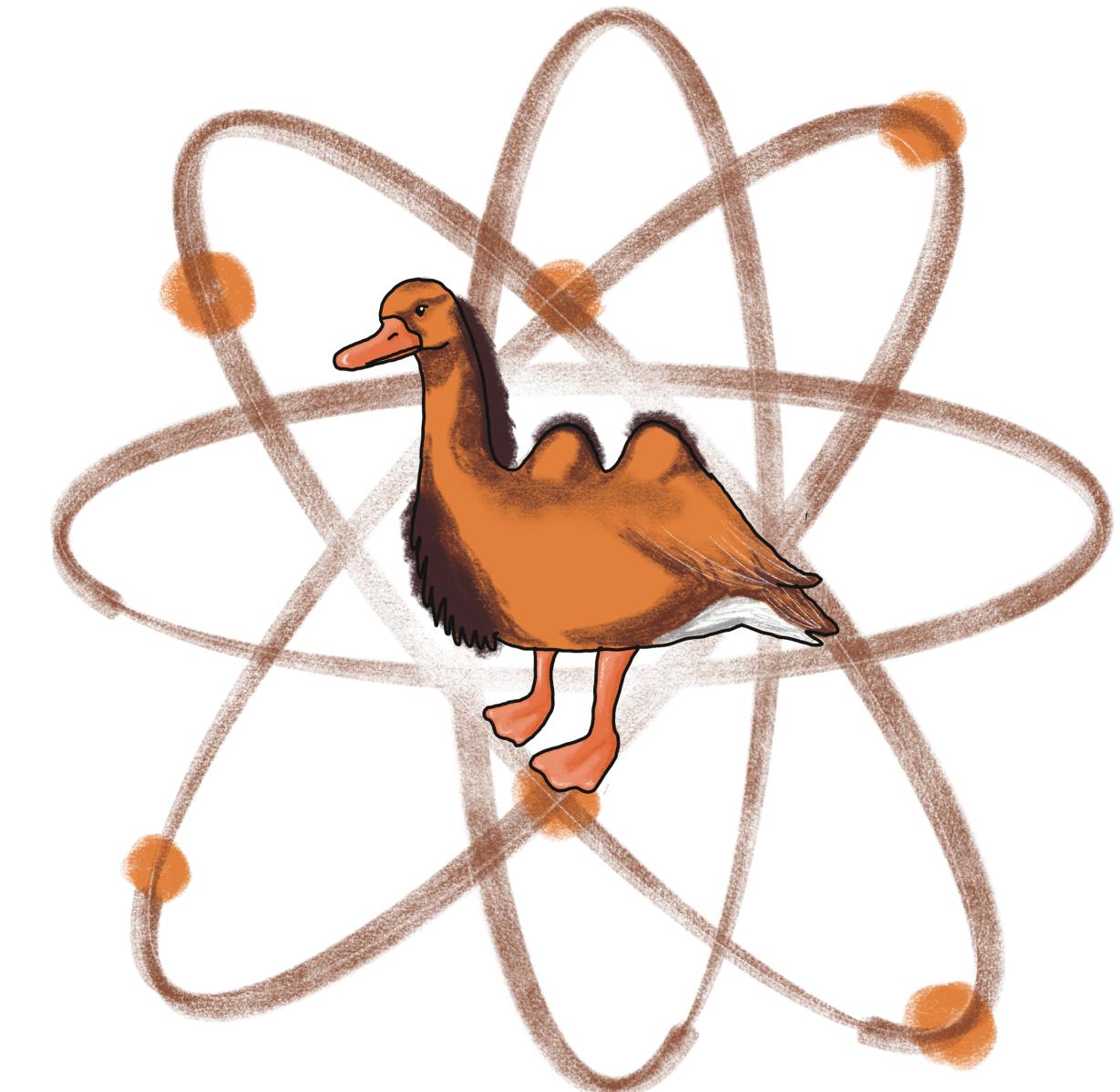


Perspectives

- Optimisations
- Vérification formelle
- D'autres front-ends
- Dessiner les diagrammes
- Stabilité d'API

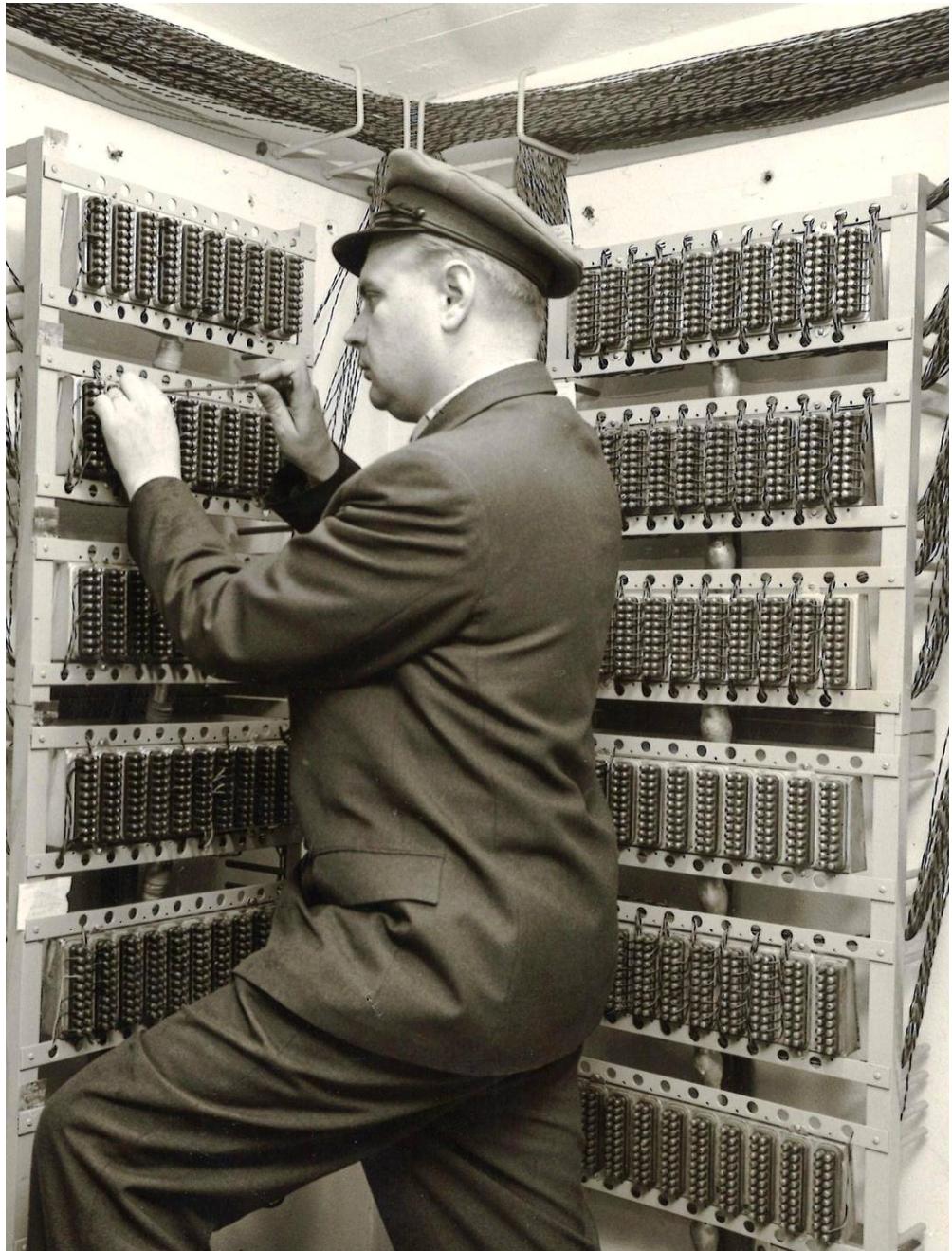
Références

- Site-web : <https://qgoose.github.io/>
- A. Cross *et al.*, *Open Quantum Assembly Language*, arXiv1707.03429v2



Les ordinateurs quantiques

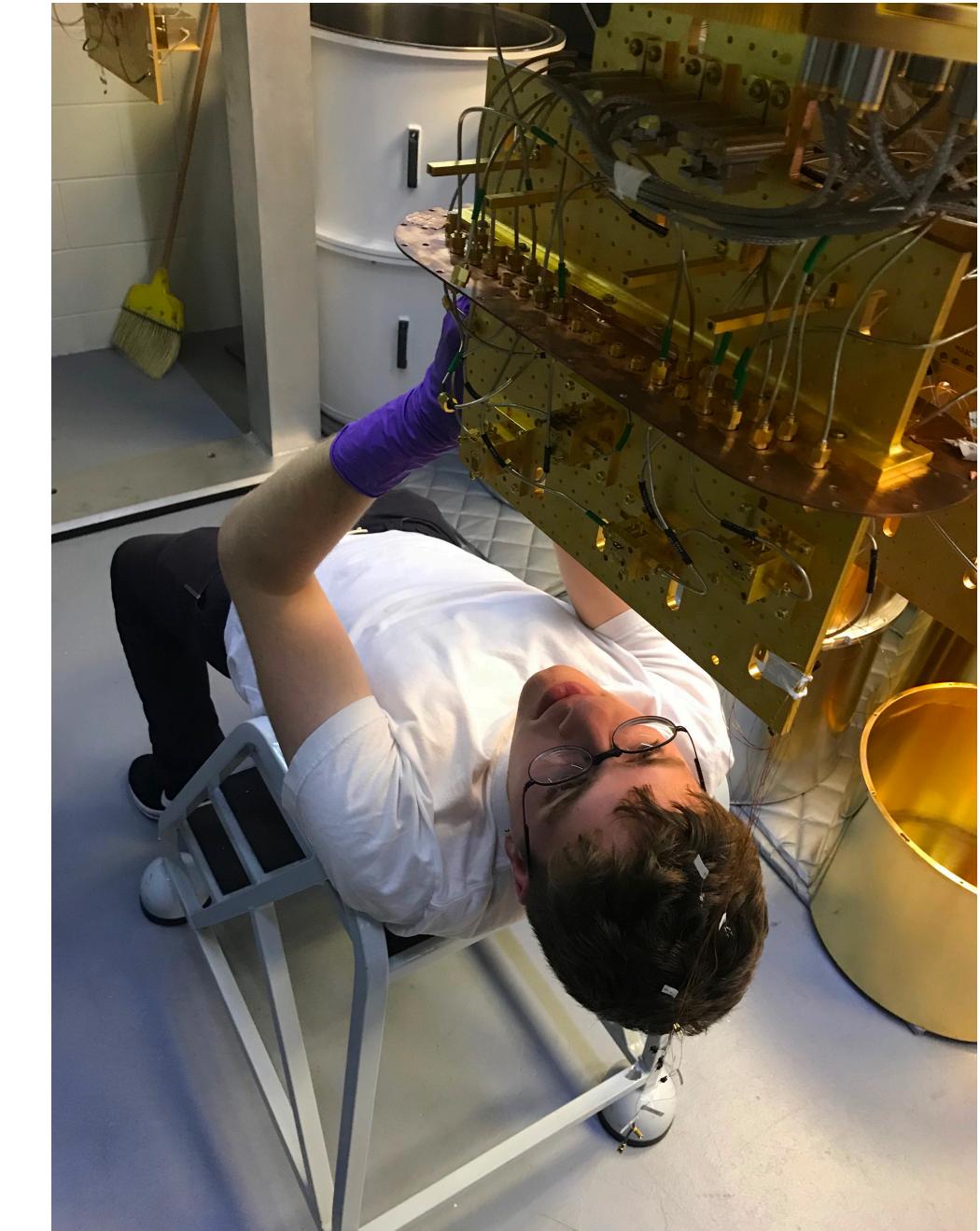
État de l'art pratique



Limitée par la durabilité des appareils

Relativement artisanale

Principalement opérés manuellement



Des questions prévues