

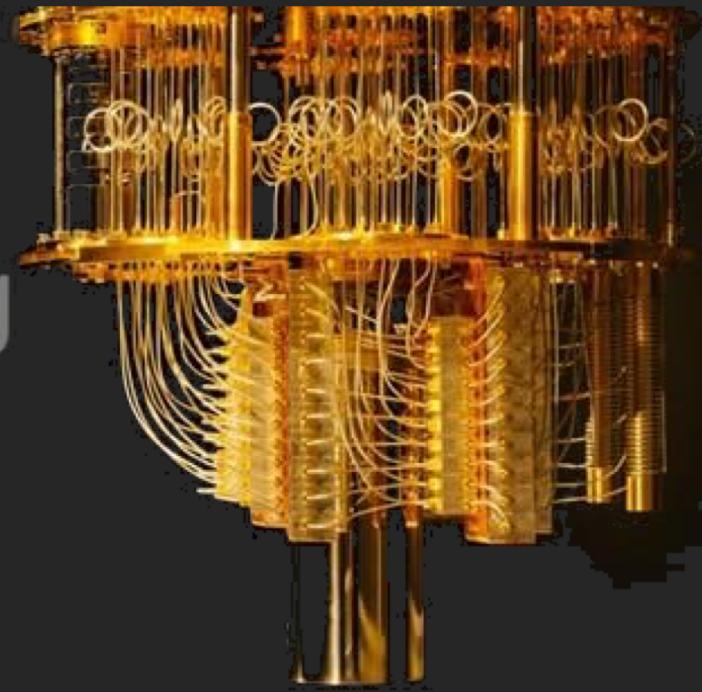
Amaia  
Ane  
Iván  
Mikel  
Rubén

# Tic-Tac-Q

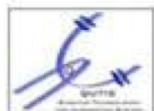
## Bilbao Quantum Computing HACKATHON

9 y 10 de diciembre 2019

INSCRIPCIONES: [www.ilb.eus](http://www.ilb.eus)



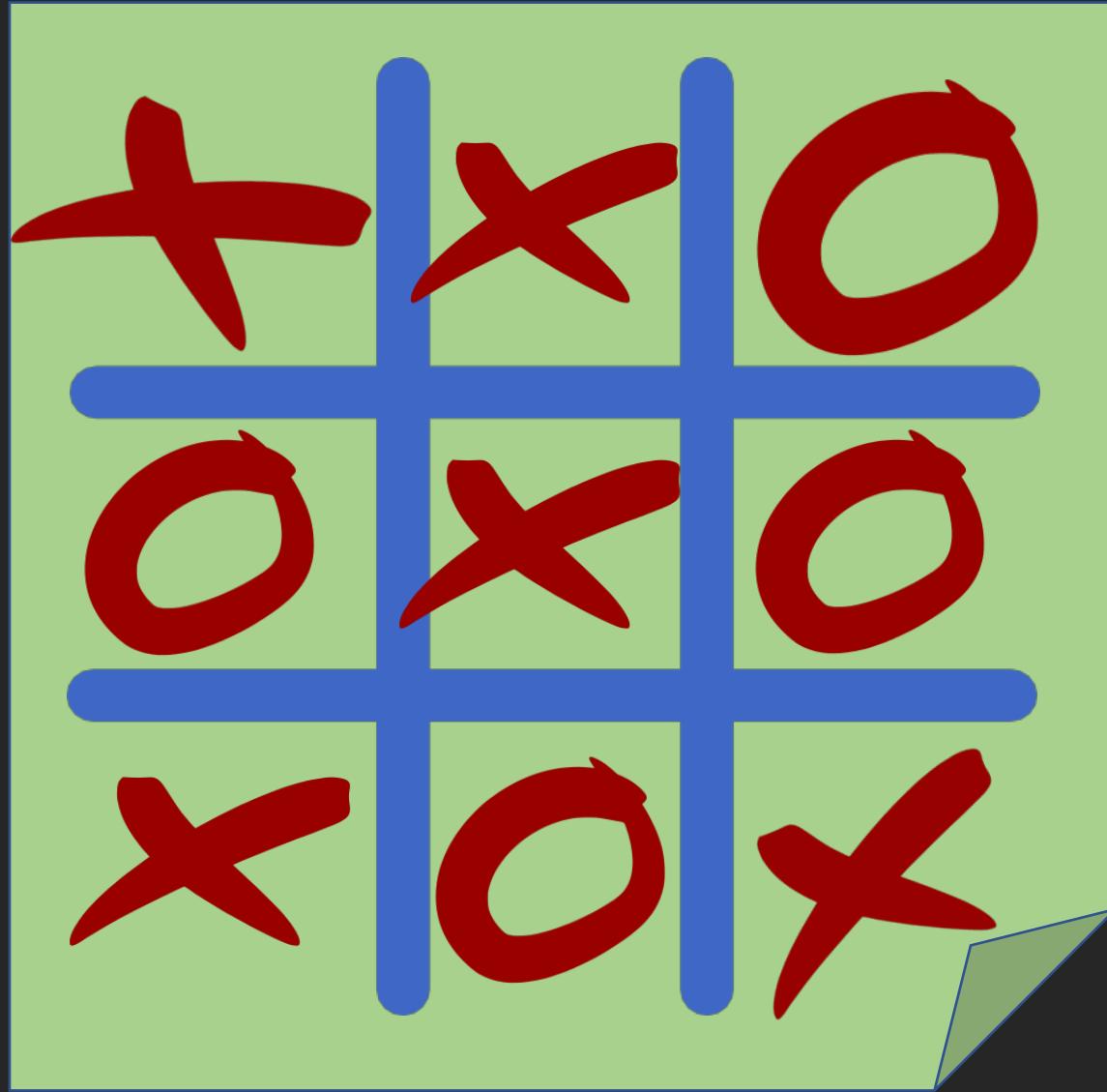
Organizado por

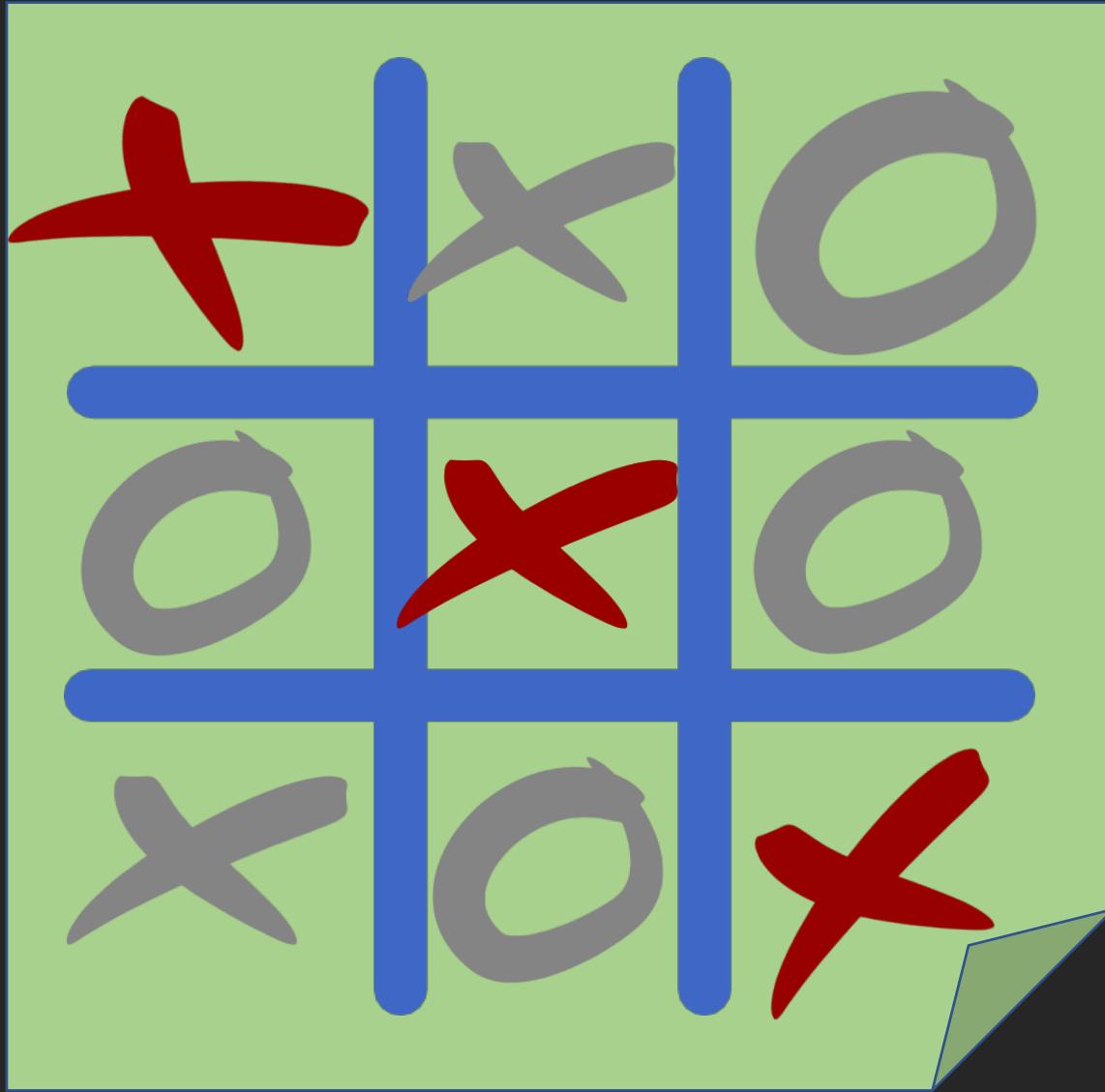


Colaboradores



What do we want?

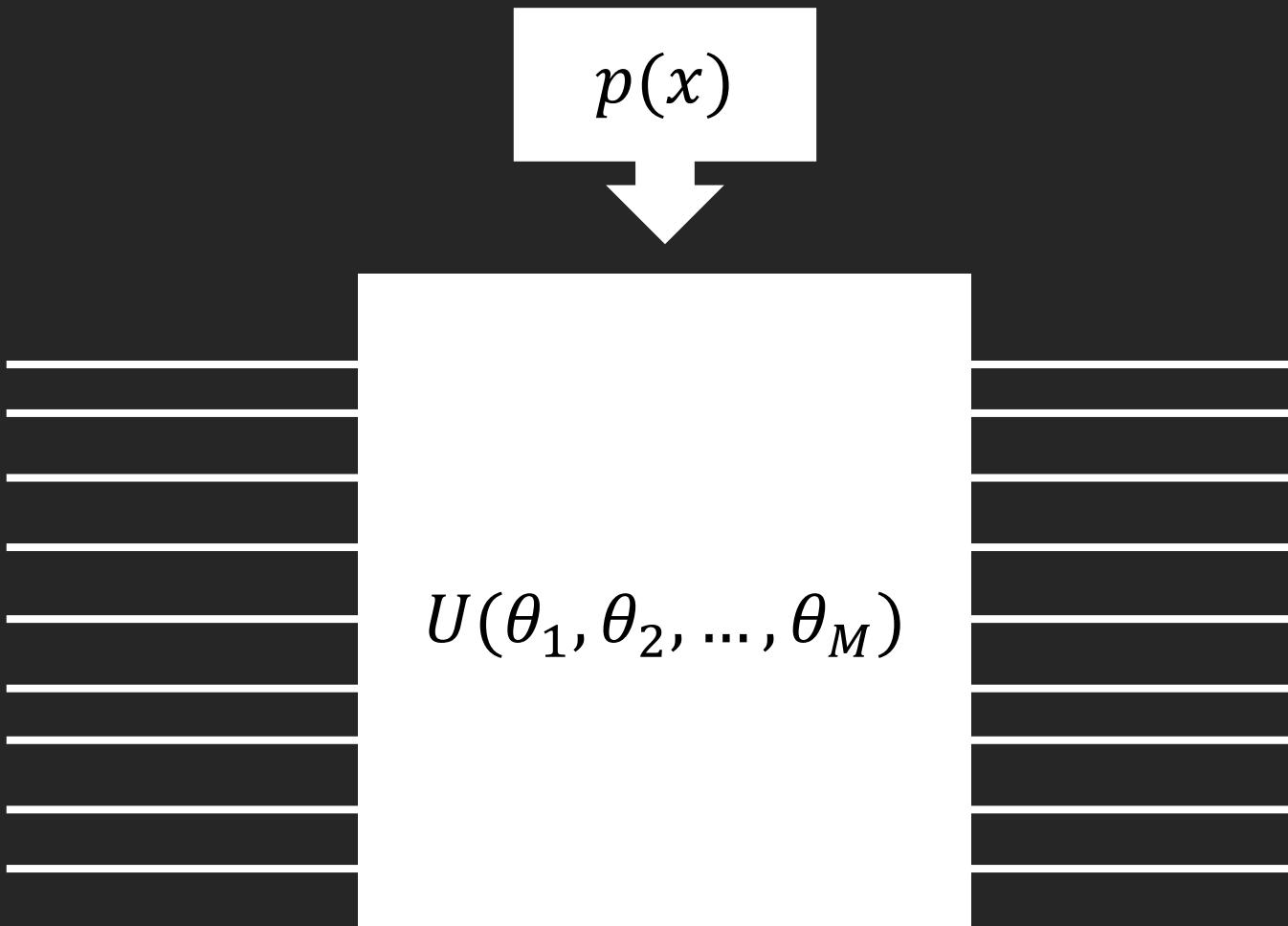




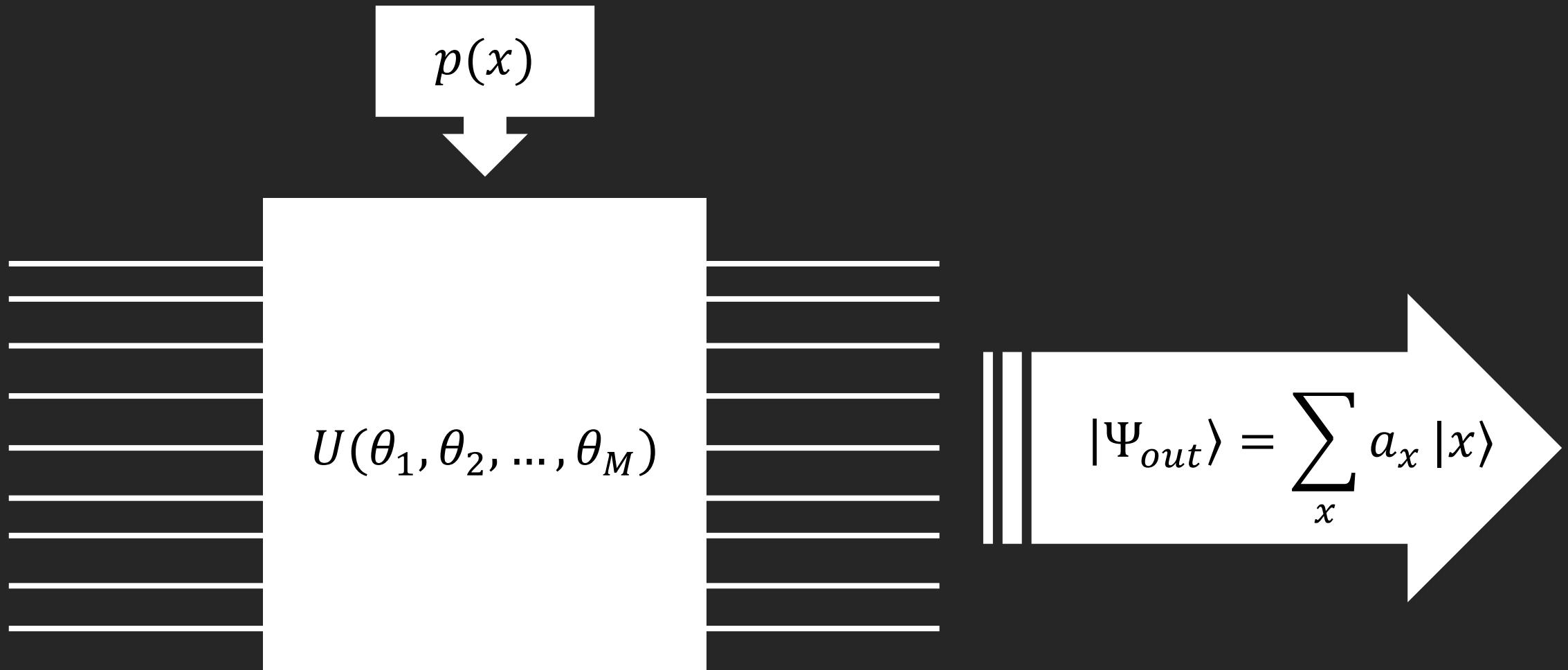
# Quantum Born Machine

$$U(\theta_1, \theta_2, \dots, \theta_M)$$

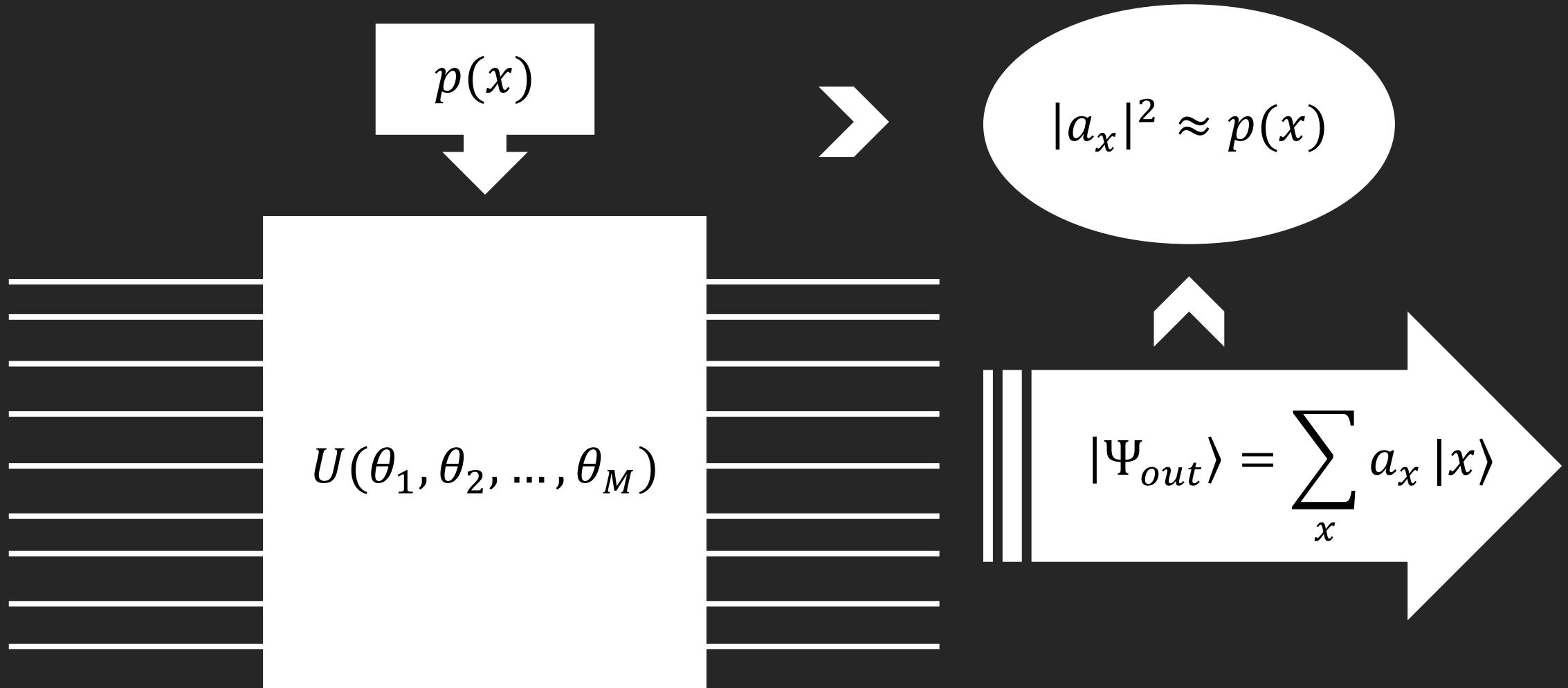
# Quantum Born Machine



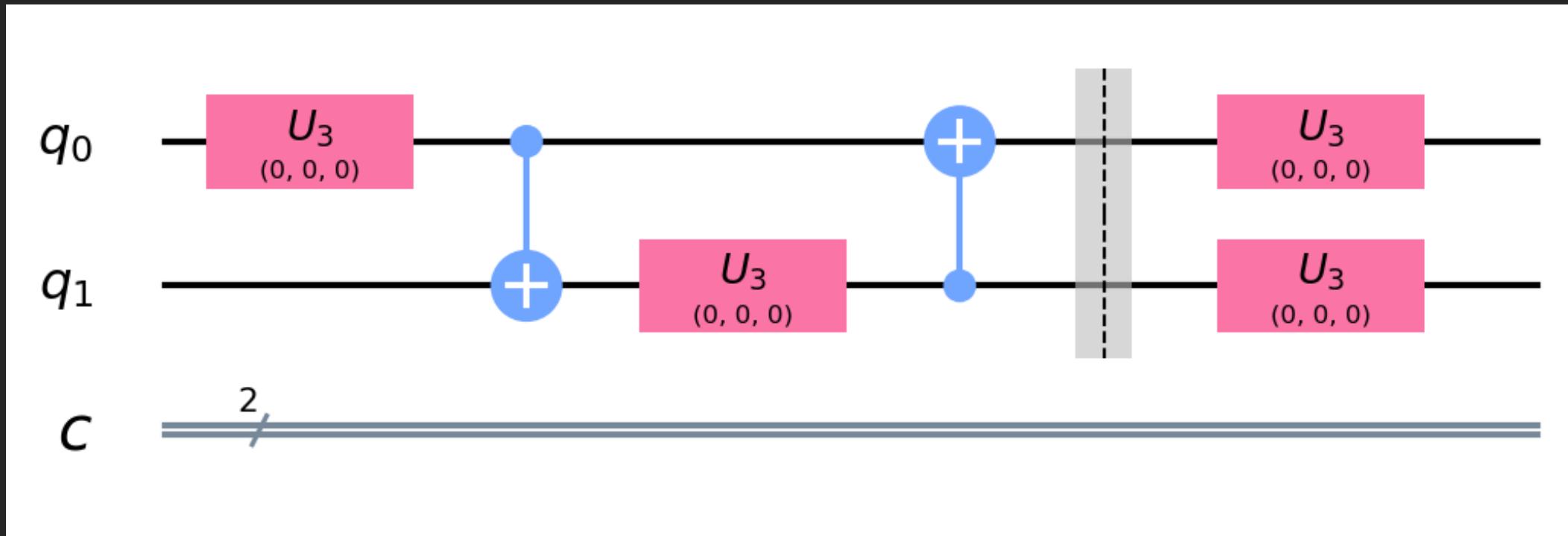
# Quantum Born Machine



# Quantum Born Machine



What we have done?



X	P(x)
$ 00\rangle$	0.5
$ 01\rangle$	0.2
$ 10\rangle$	0.2
$ 11\rangle$	0.1

*Trial*

$$(\theta_1, \theta_2, \dots, \theta_M)$$



$$U(\theta_1, \theta_2, \dots, \theta_M)$$

*Final*

$$(\theta_1, \theta_2, \dots, \theta_M)$$



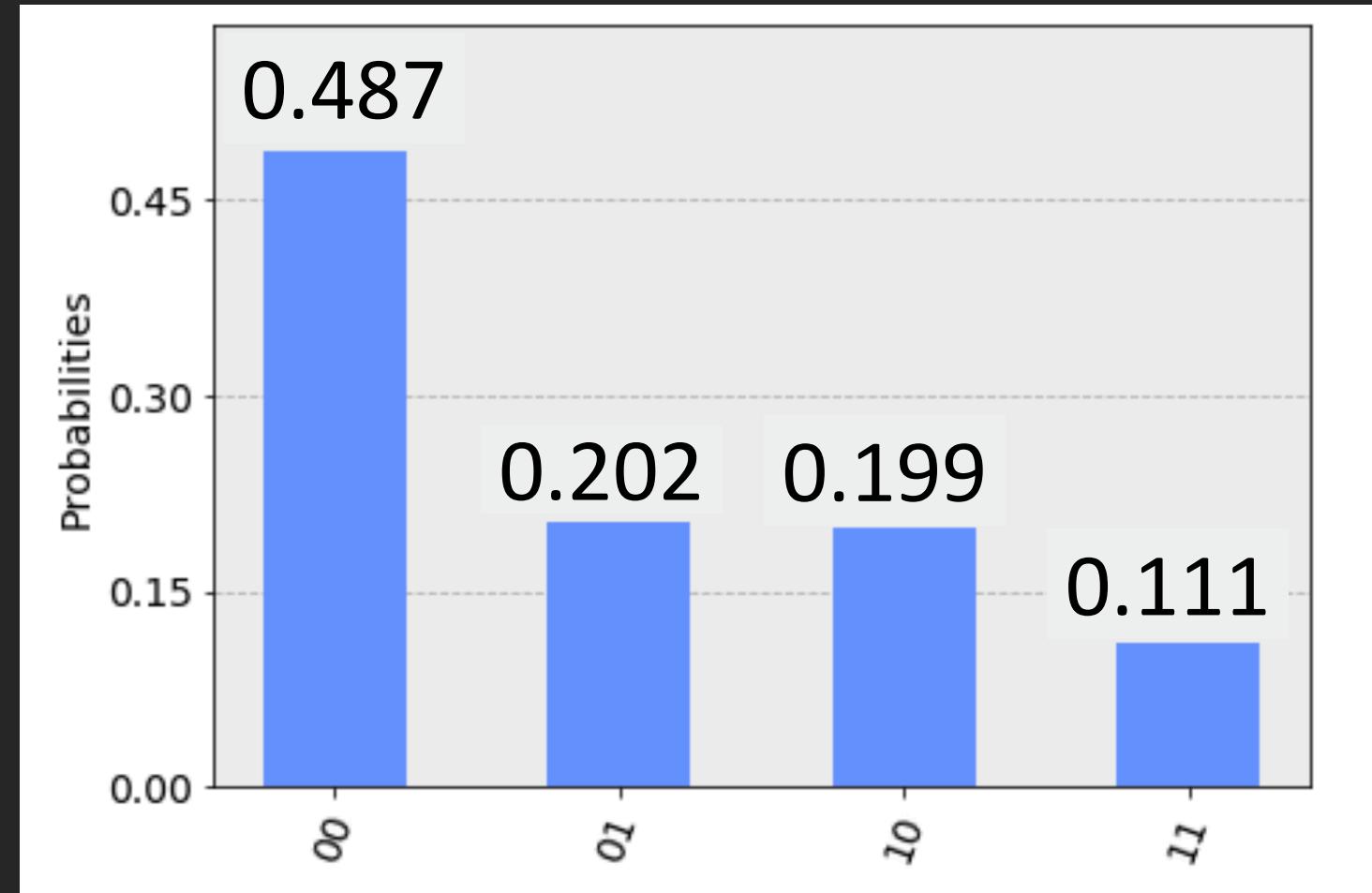
$$|a_x|^2$$

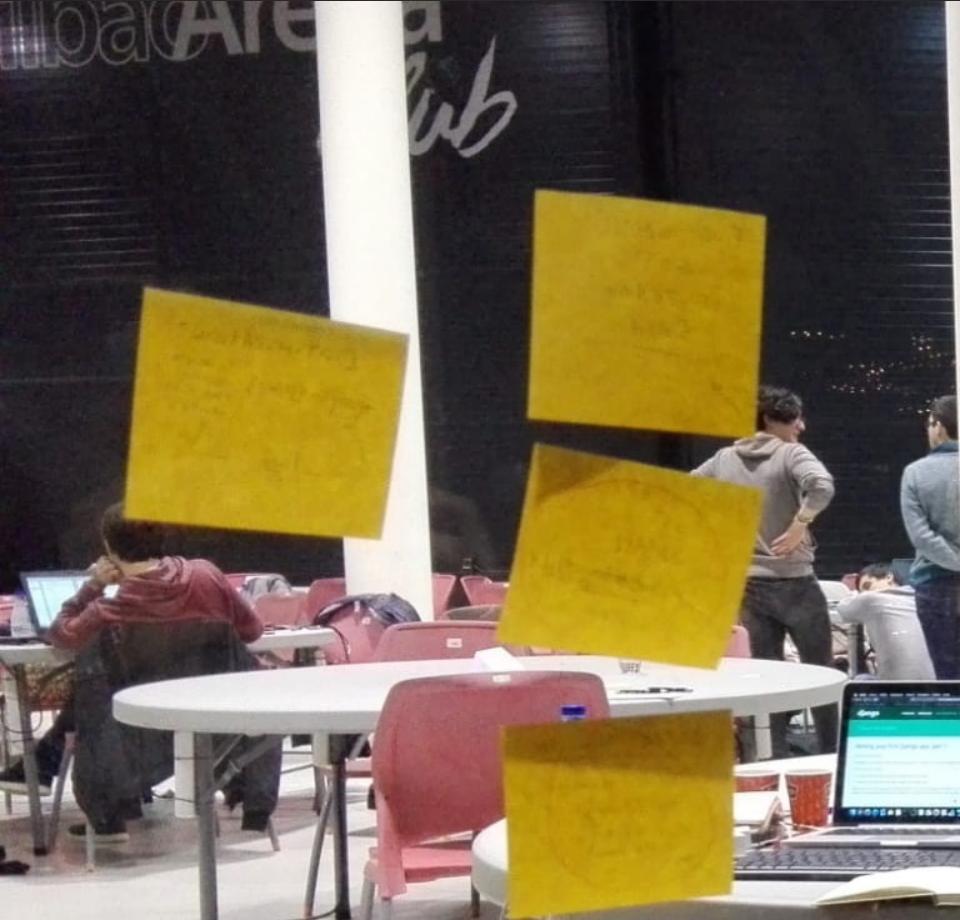


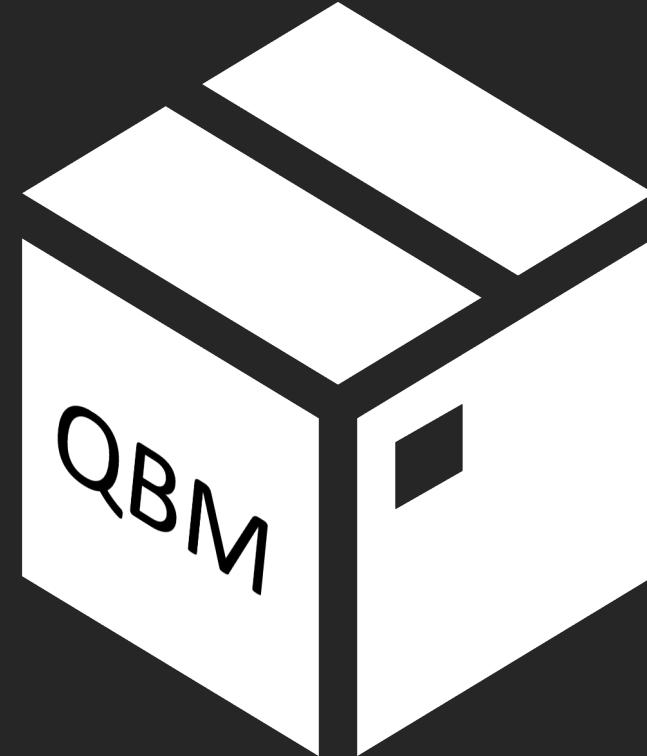
$$\begin{aligned} & \text{Minimize :} \\ & ||a_x|^2 - p(x) \end{aligned}$$

## Comparison obtained probability distribution

X	P(x)
$ 00\rangle$	0.5
$ 01\rangle$	0.2
$ 10\rangle$	0.2
$ 11\rangle$	0.1

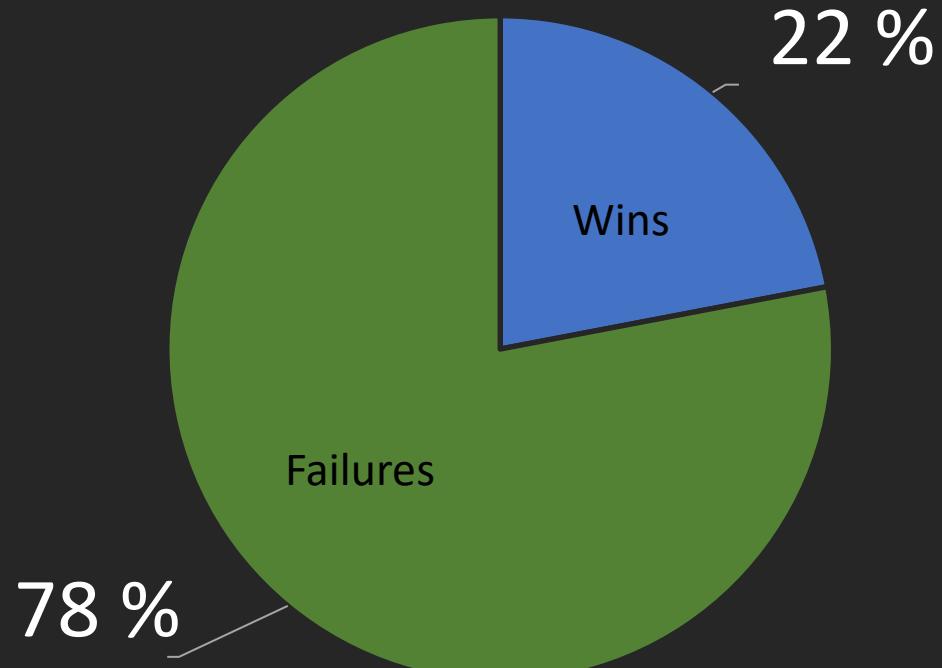




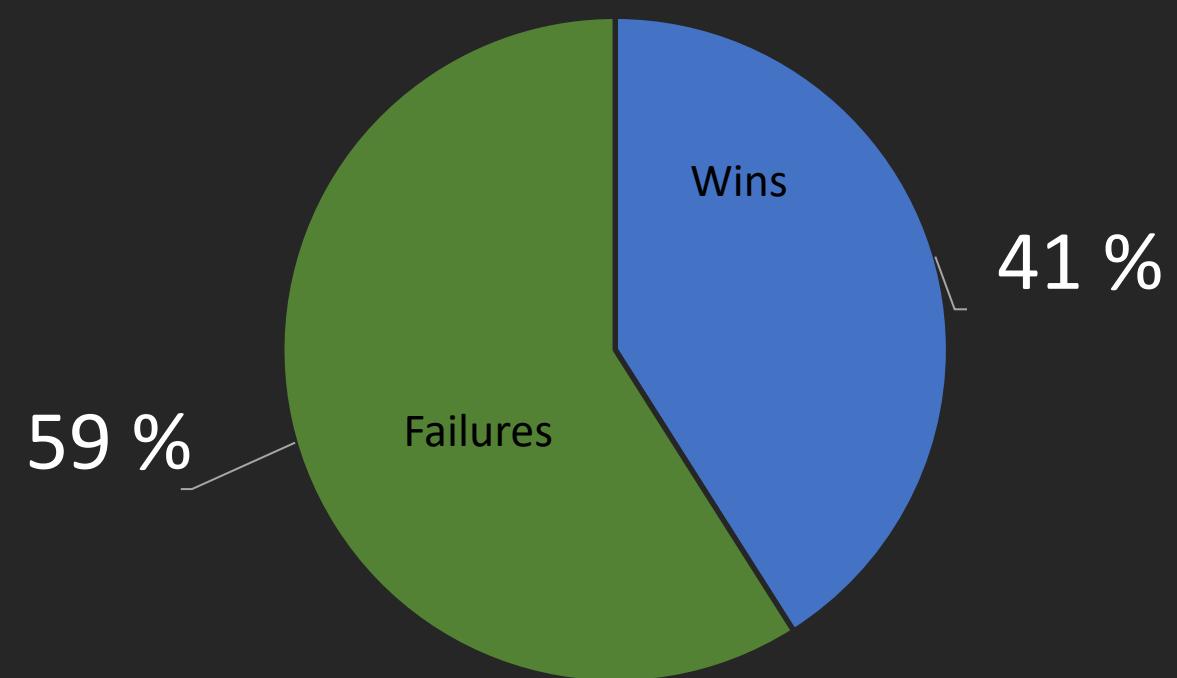


## Obtained results

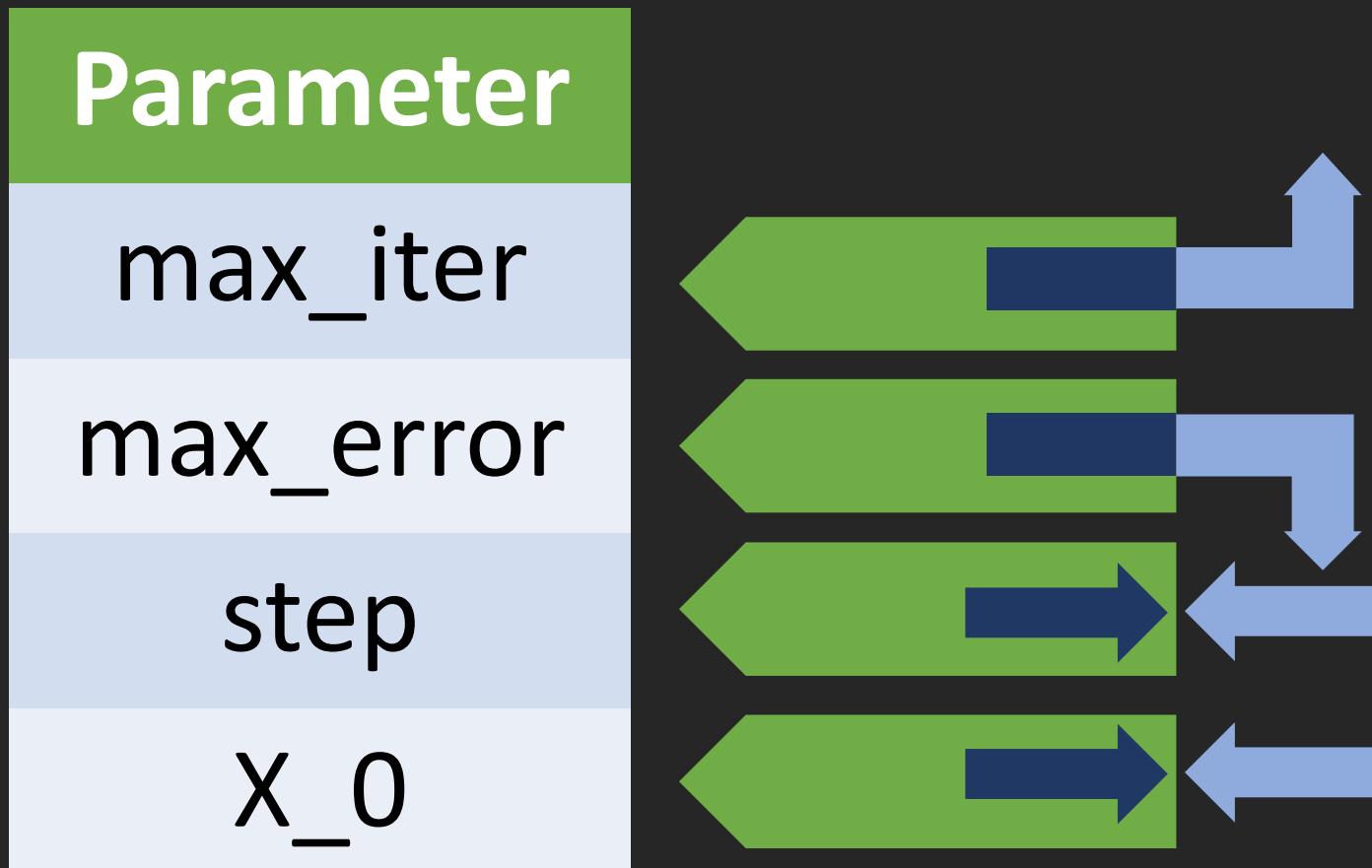
Initial parameters



New parameters



## Parameters increasing effectiveness of the tuning



## Future work

Modify  
parameters  
for better  
results

Add blank  
state to the  
cells

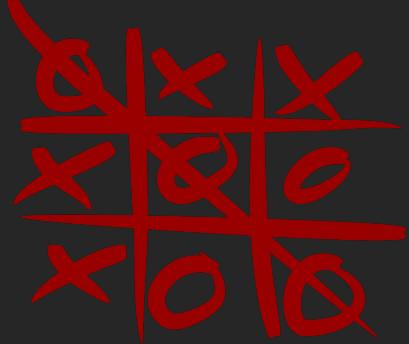
Experiment  
with smaller  
training sets

## Summing up

We wanted a QBM to generate winning solutions for Tic-Tac-Toe

We developed a 9-qubit circuit optimized to replicate a desired behaviour

We would like to continue the future work mentioned above



# Tic-Tac-Q

Amaia

Ane

Iván

Mikel

Rubén

Thank you!

Mila esker!