7
nationalities

1 goal

11
participants

8 students
3 mentors

8 different
disciplines

127 cups of
coffee

الوقاية خيرٌ من العلاج

Prevention is better than the cure.

Identification of the Problem

600%

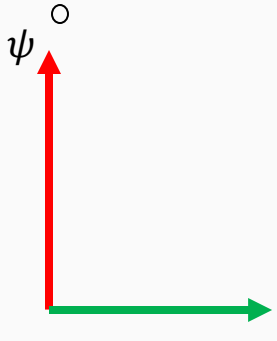
Increase in the number of Alzheimer's patients

8+ weeks

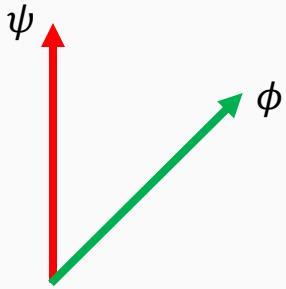
Average waiting time for an MRI scan to be analyzed for Alzheimer’s

"Safeguarding community through early detection of Alzheimer's."

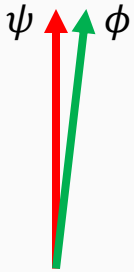
FUDAN



Not At All Similar
$Score: 0$



Somewhat Similar
$Score: 0.5$

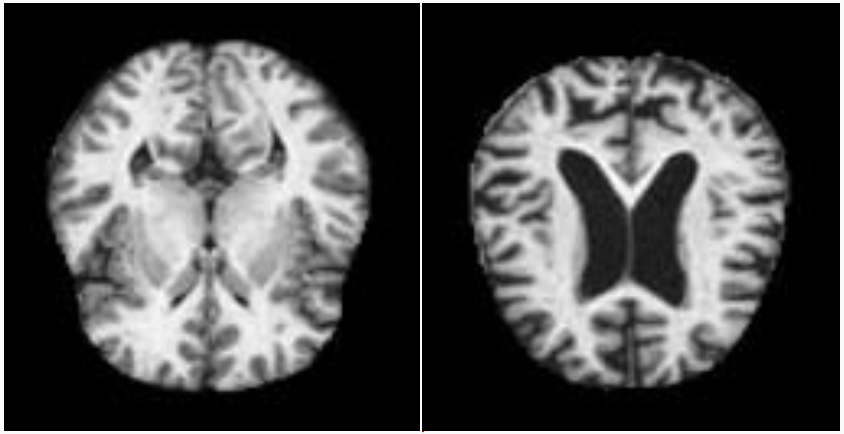


Very Similar
$Score: 0.9$

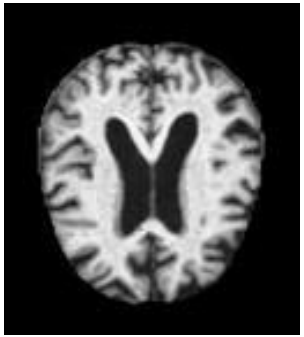
$$\langle \psi | \phi \rangle$$

Non-Demented

Demented

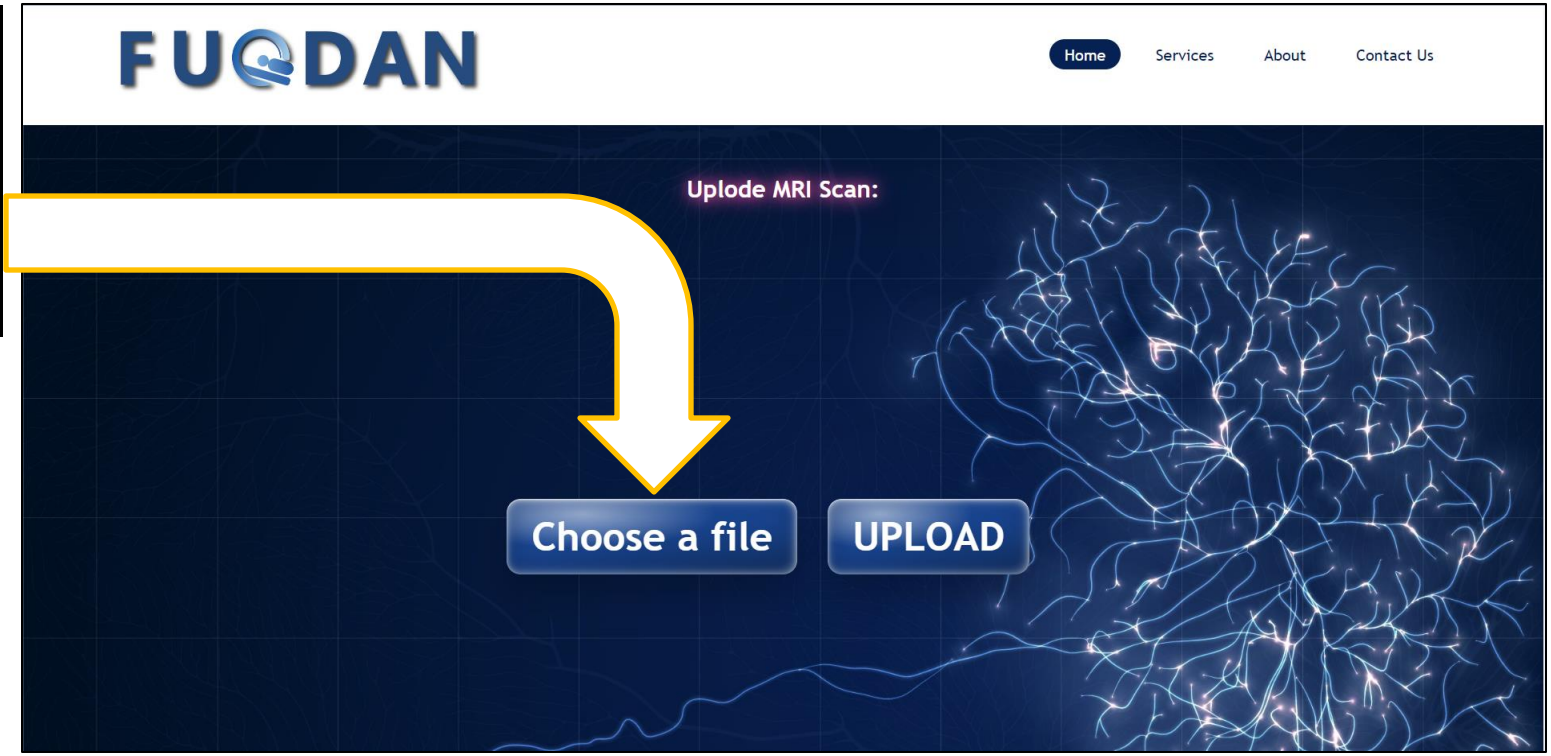


$$\langle \quad | \quad \rangle$$



MRI Scan

MRI Scan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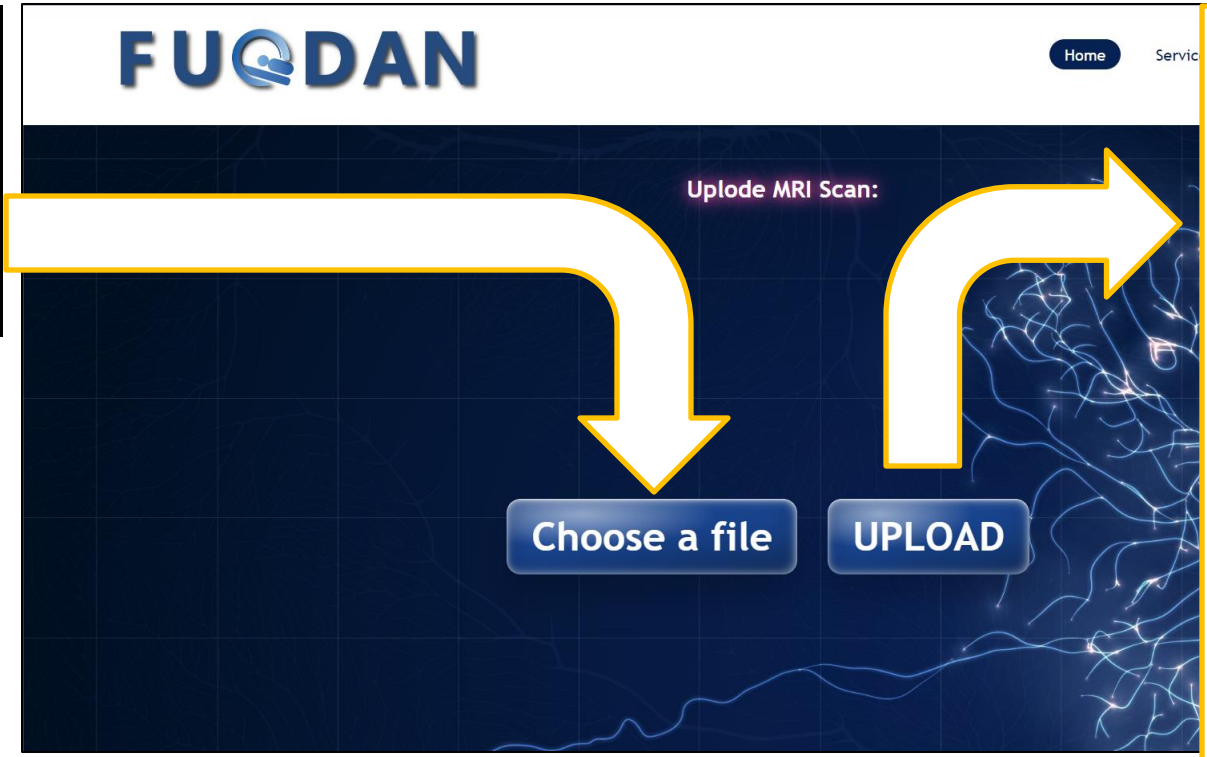
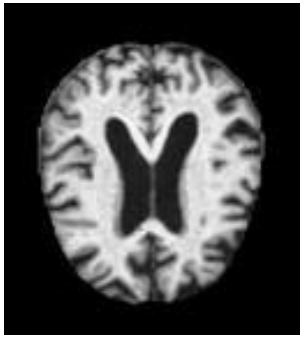
MRI Scan

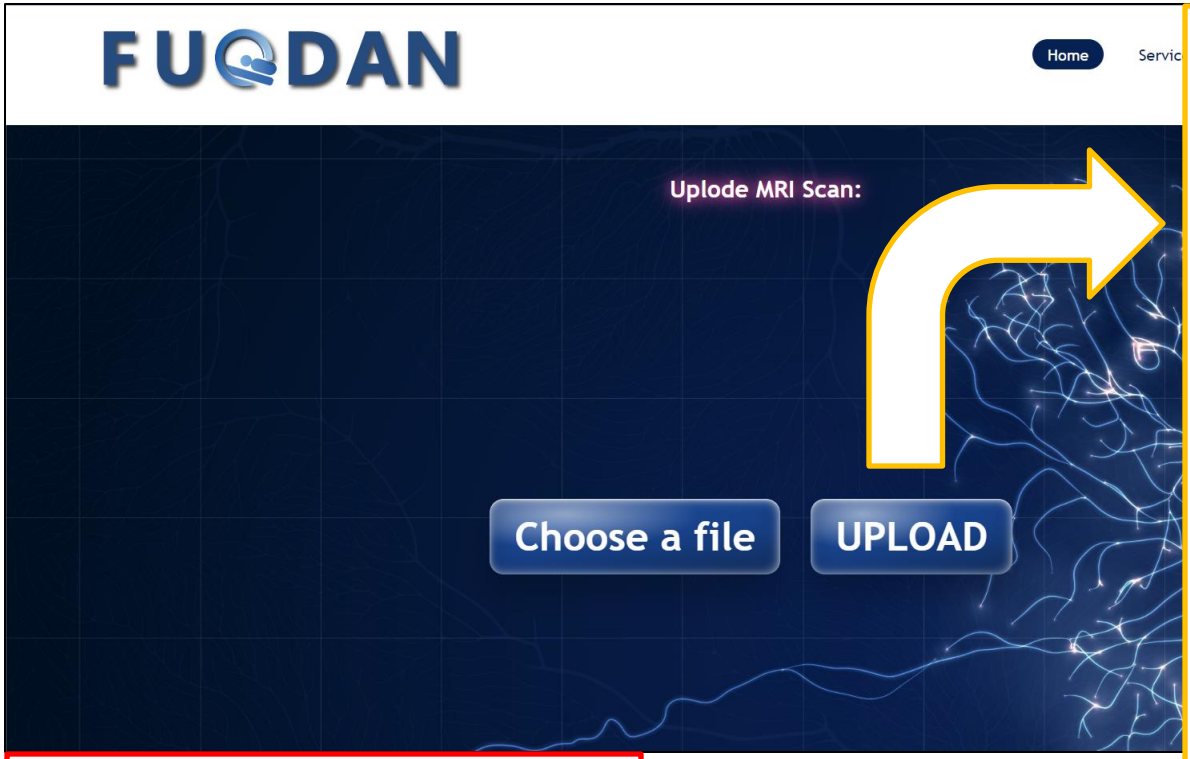


FUQDAN backend

Pre-processing
+
quantum processor



Patient MRI Scan



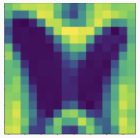
91% Alzheimer's detected in Patient MRI

Corresponding medical resources suggested to Doctors for further diagnosis

FUQDAN backend

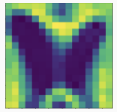
Pre-processing
+
quantum processor

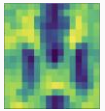
FRQI and Fidelity Estimation



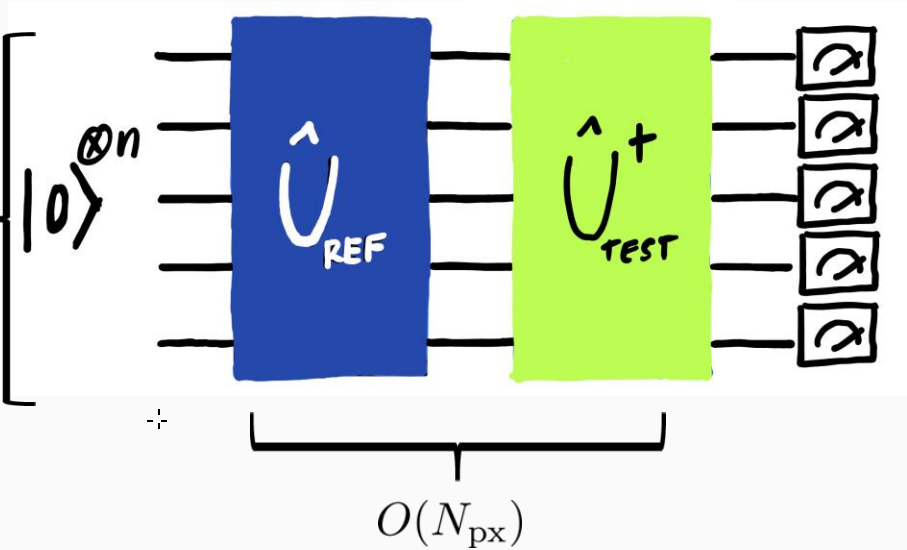
$\Rightarrow |\psi\rangle$

$\theta_0, \|0000\rangle$	$\theta_1, \|0001\rangle$	$\theta_2, \|0010\rangle$	$\theta_3, \|0011\rangle$
$\theta_4, \|0100\rangle$	$\theta_5, \|0101\rangle$	$\theta_6, \|0110\rangle$	$\theta_7, \|0111\rangle$
$\theta_8, \|1000\rangle$	$\theta_9, \|1001\rangle$	$\theta_{10}, \|1010\rangle$	$\theta_{11}, \|1011\rangle$
$\theta_{12}, \|1100\rangle$	$\theta_{13}, \|1101\rangle$	$\theta_{14}, \|1110\rangle$	$\theta_{15}, \|1111\rangle$

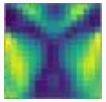
$|\psi_{ref}\rangle =$ 

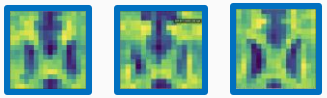
$|\psi_{test}\rangle =$ 

$$\text{Fidelity} = |\langle\psi_{ref}|\psi_{test}\rangle|^2$$

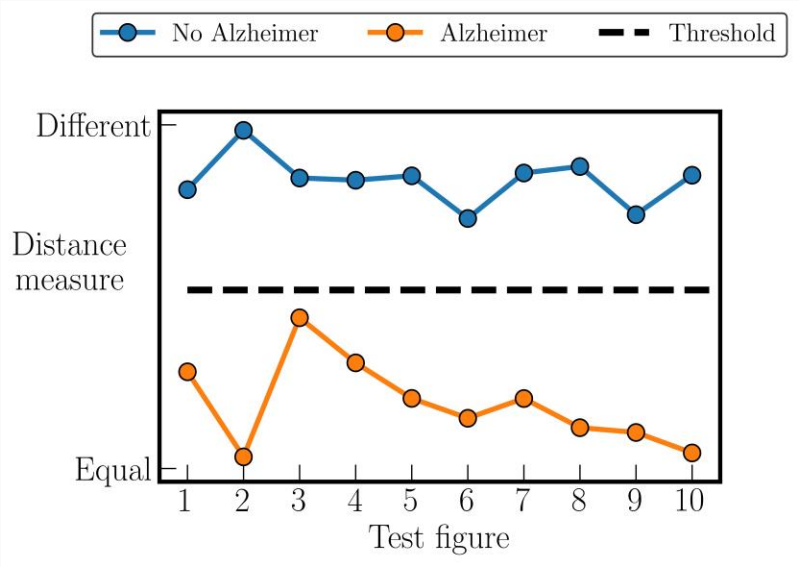


Results

$|\psi_{ref}\rangle =$ 

$|\psi_{test}\rangle =$  , ...

 , ... }



Classical vs Quantum

Computational Cost

» **Memory** complexity

- Classical: $O(N_{\text{px}})$
- Quantum: $O(\log_2 N_{\text{px}})$ → Advantage!!!

» **Time** complexity

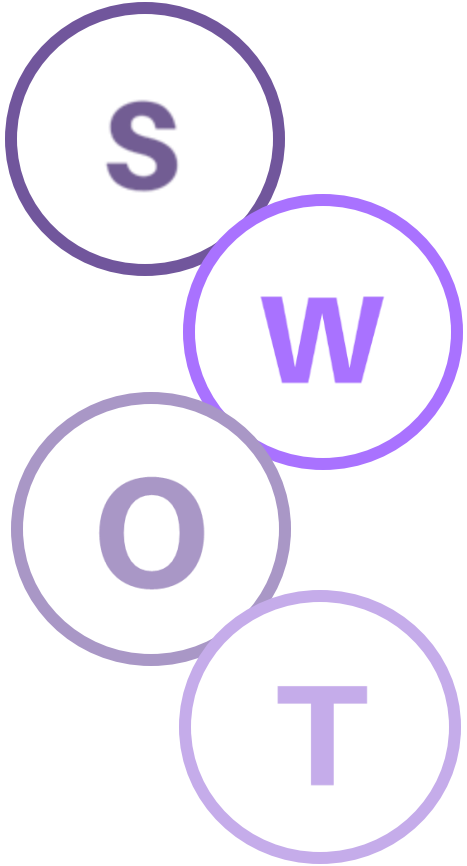
- Classical and Quantum: $O(N_{\text{px}})$

(but possible advantage with **more efficient** encoding)

Value

- Applicable to existing MRI scanners
- Less storage space
- Less waiting time for diagnosis

Business Analysis



Efficient Detection

Scalability

Lower Storage Spaces

Limited Number of Qubits

Access to Quantum Computing

Funding: **NGOs** and **Foundations**

Partnerships with **Governments**

Encouraging Research

Data Privacy

Foreign Governmental Involvement

Business Sustainability

Neurological Institute

Cleveland Clinic

2016 Outcomes

Alzheimer's Disease International

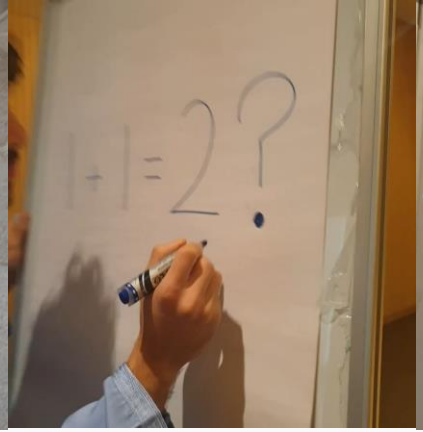
The global voice on dementia

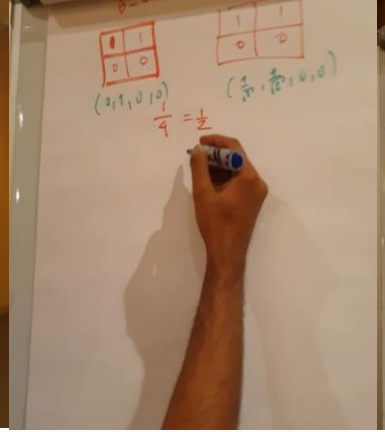
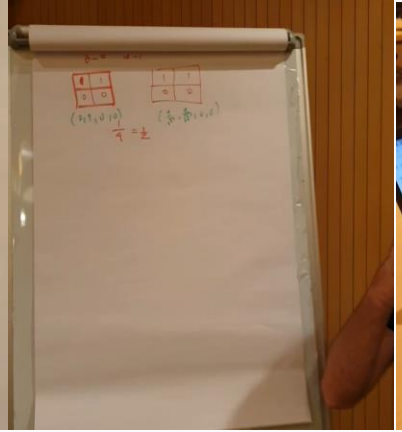
الجمعية السعودية الخيرية لمرض الزهايمر

SAUDI ALZHEIMER'S DISEASE ASSOCIATION

Saudi German Hospital

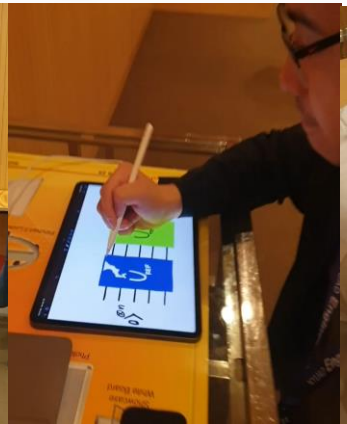
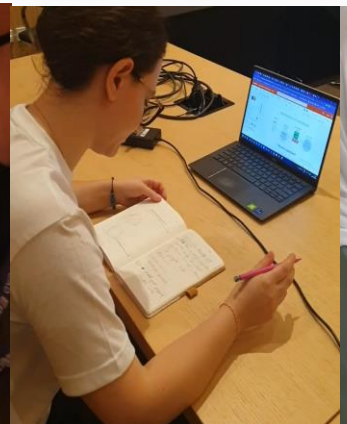
ALZHEIMER'S ASSOCIATION

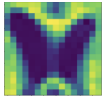

FUDAN

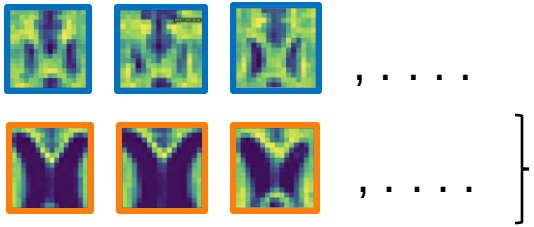


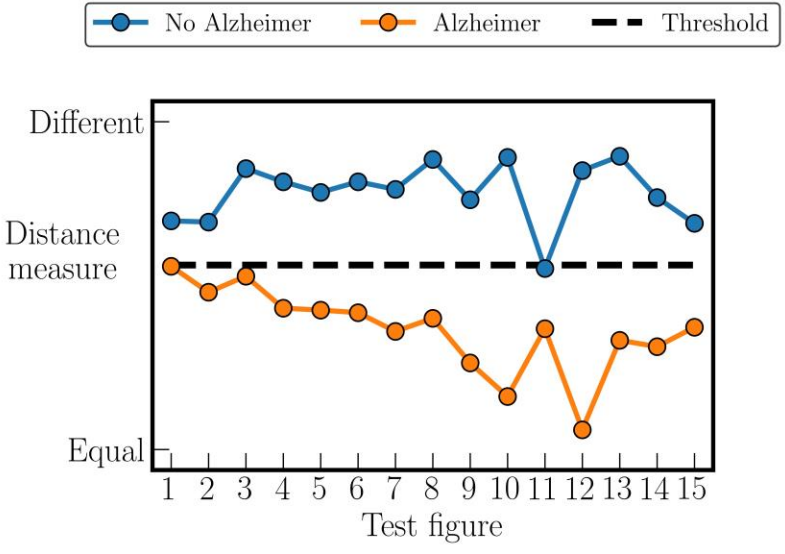



Additional details

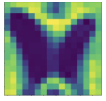
Results (with shot noise)

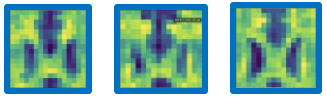
$|\psi_{ref}\rangle =$ 

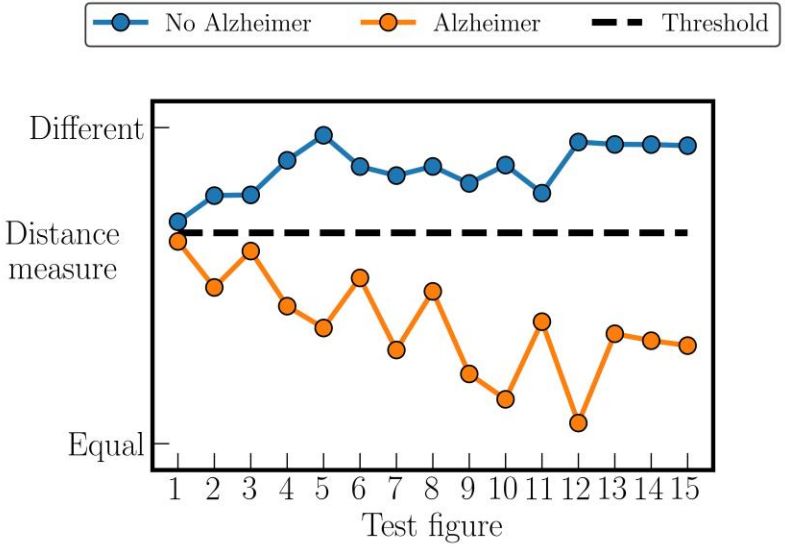
$|\psi_{test}\rangle =$ 



Results (classical classifier)

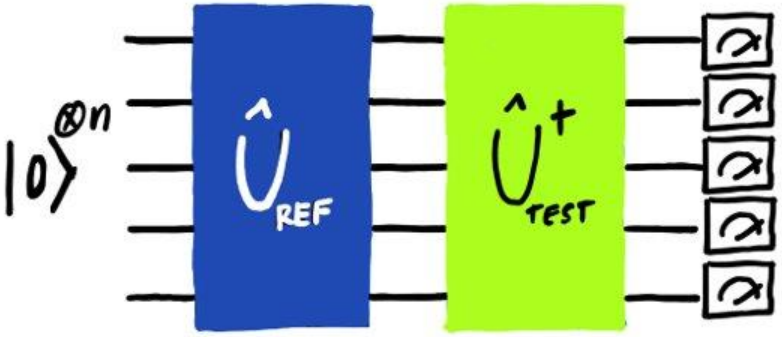
$ref =$ 

$test =$ {  , ...  , ... } .



Compute-Uncompute method

$$\text{Fidelity} = |\langle\psi_{ref}|\psi_{test}\rangle|^2$$



$$\text{Fidelity} = |\langle\psi_{\text{test}}|\psi_{\text{ref}}\rangle|^2 = |\langle 0|\hat{U}_{\text{test}}^{\dagger}\hat{U}_{\text{ref}}|0\rangle|^2 = |\langle 0|(\hat{U}_{\text{test}}^{\dagger}\hat{U}_{\text{ref}}|0\rangle)|^2 = |\langle 0|\psi_{\text{test-ref}}\rangle|^2$$

post-selection on ()