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."

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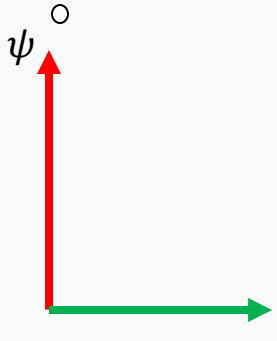
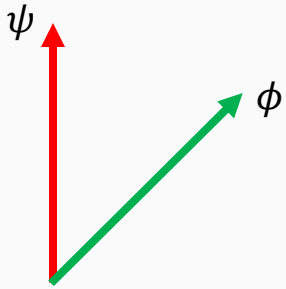
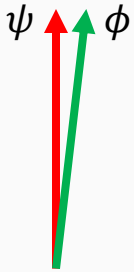


Not At All Similar
$Score: 0$



Somewhat Similar
$Score: 0.5$

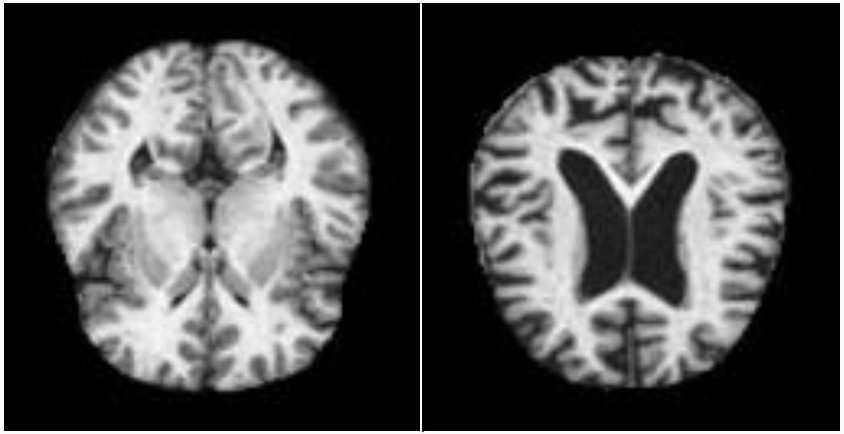


Very Similar
$Score: 0.9$

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

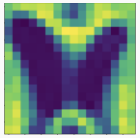
Non-Demented

Demented



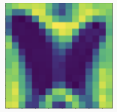
$$\langle \quad | \quad \rangle$$

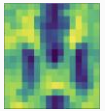
FRQI and Fidelity Estimation



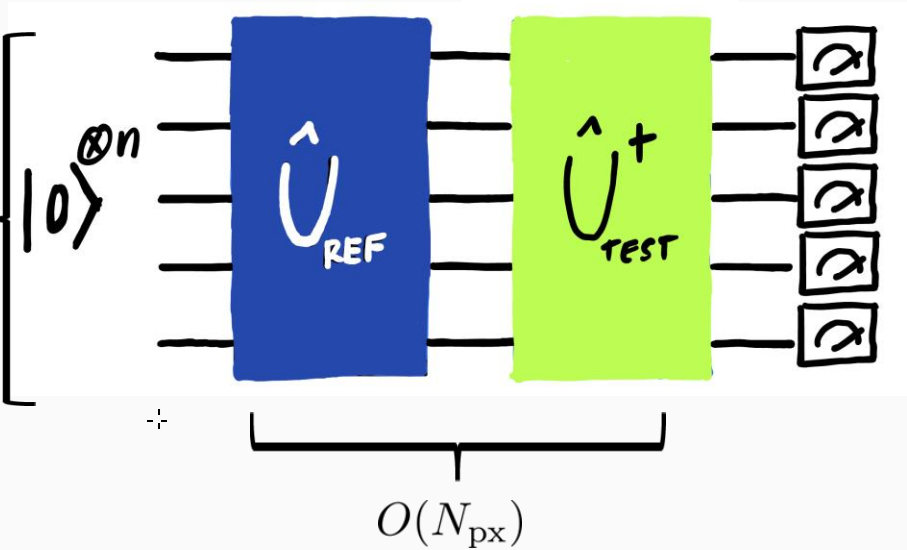
$\Rightarrow |\psi\rangle$

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

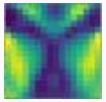
$|\psi_{ref}\rangle =$ 

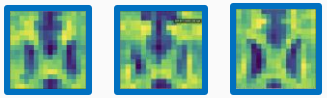
$|\psi_{test}\rangle =$ 

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

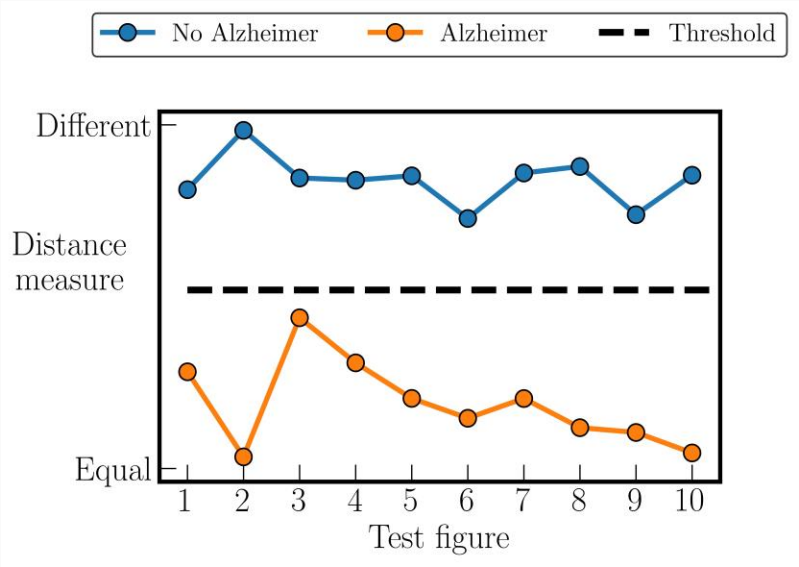


Results

$|\psi_{ref}\rangle =$ 

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

 , ... }



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

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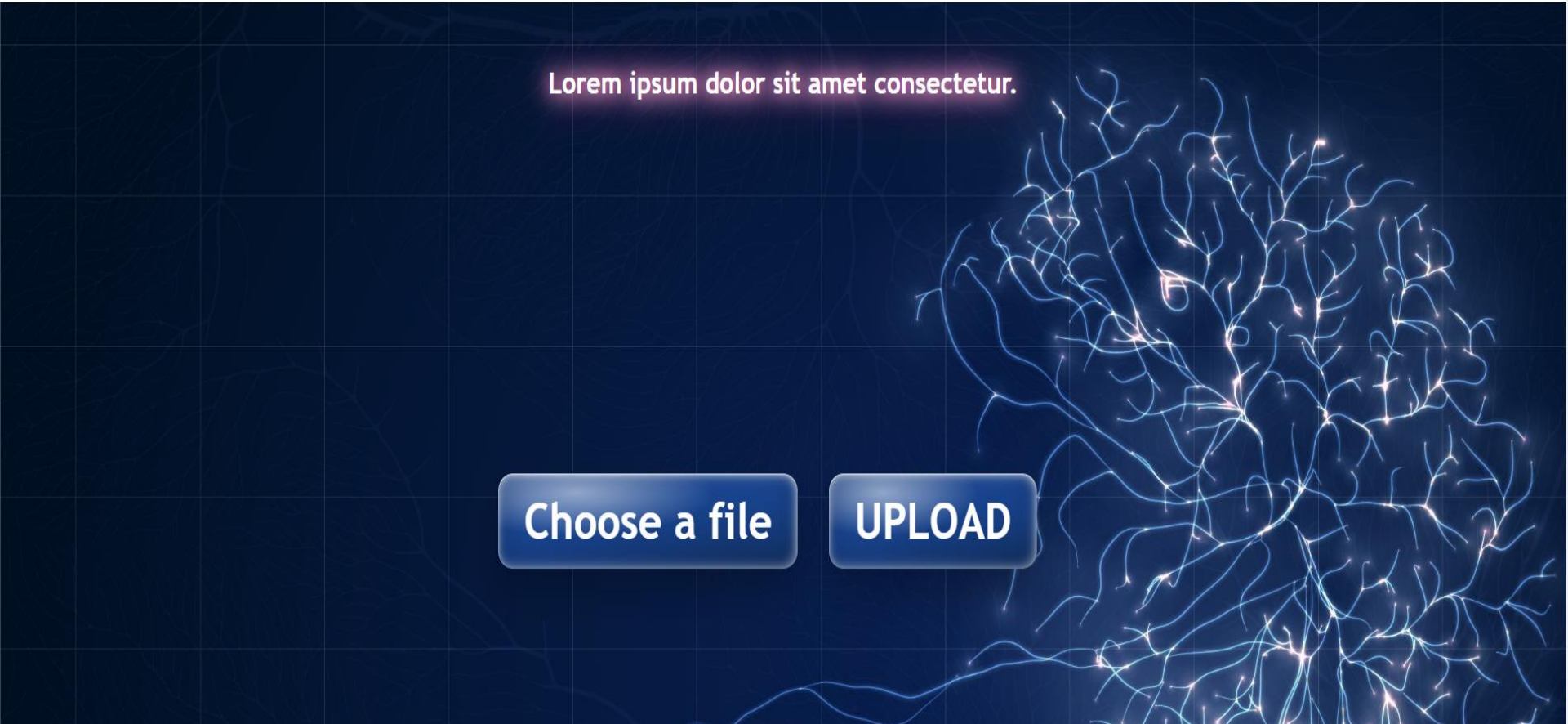

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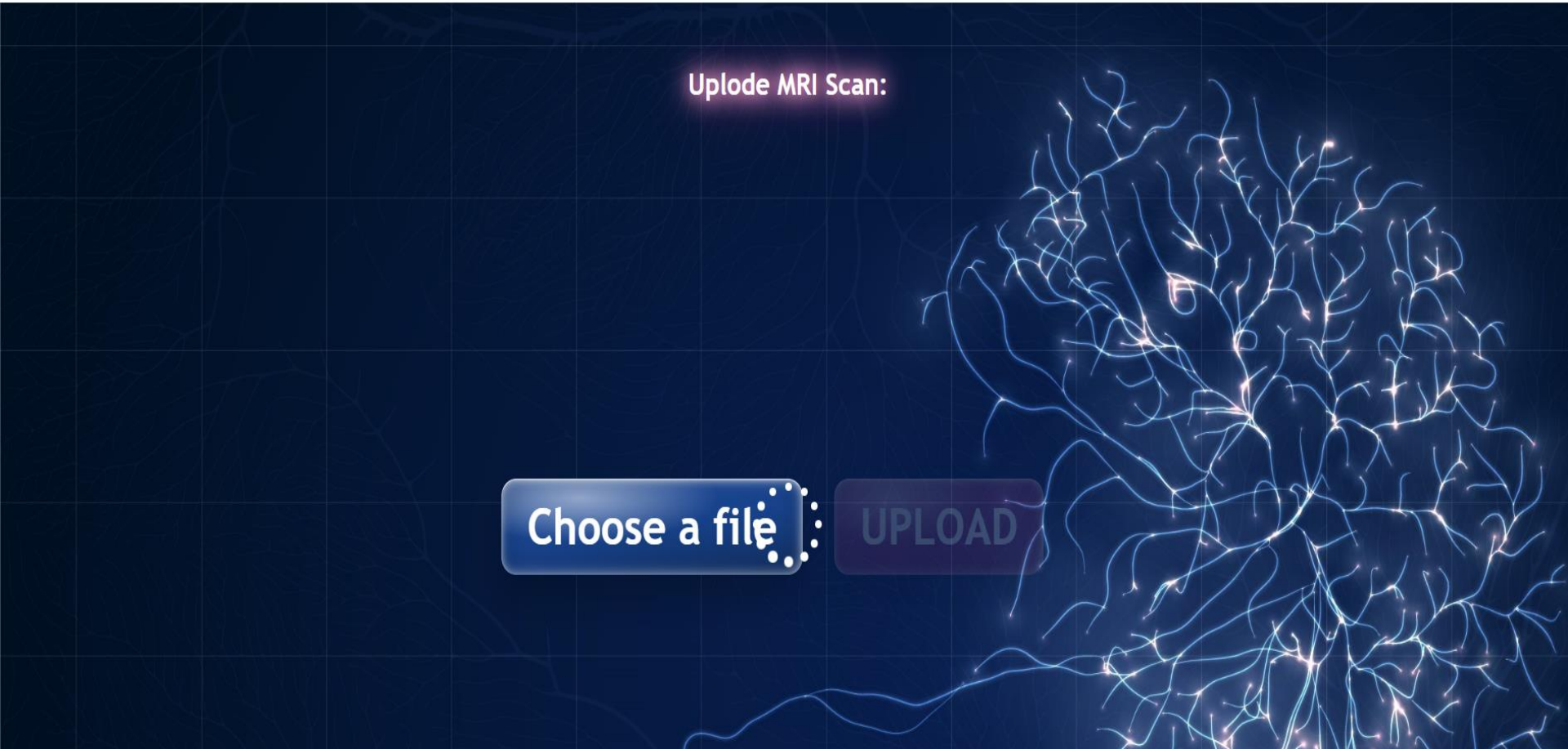
Uplode MRI Scan:



Backend Processing for the Image:

```python
from django.core.files.storage import default_storage
import numpy as np
import matplotlib.pyplot as plt
from PIL import Image, ImageEnhance

# load, normalize, and resize
def load_transform(filepath,
                   img_size=(16, 16),
                   contrast=1,
                   conv_to_theta=True,
                   flatten=True):

    img = Image.open(filepath)

    # change contrast
    #image brightness enhancer
    if contrast != 1:
        enhancer = ImageEnhance.Contrast(img)
        img = enhancer.enhance(contrast)

    # Assume that this is part of the image collection
    img = img.resize(img_size)
    img = np.array(img) / 255 # normalize

    if conv_to_theta:
        img = img * np.pi / 2 # convert to number between 0 and pi/2

    if flatten:
        img = img.flatten()

    return img
```

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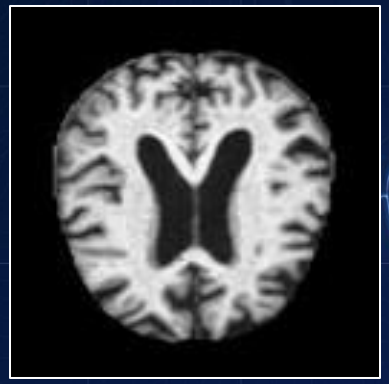
Uplode MRI Scan:

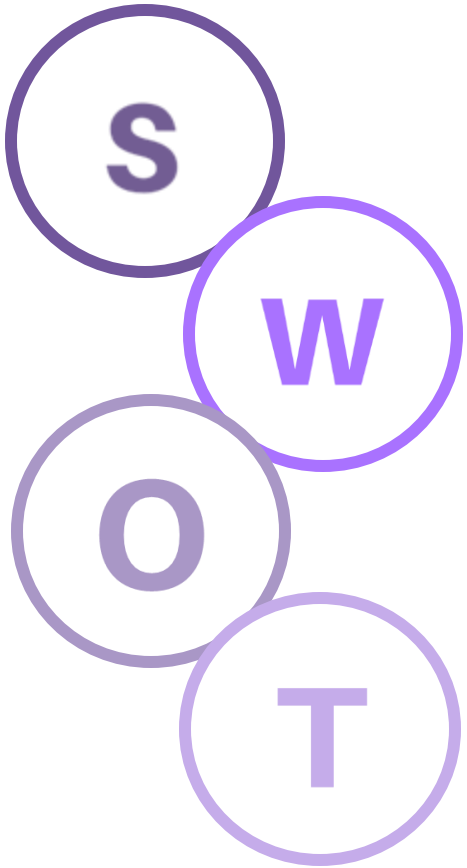


Choose a file UPLOAD

91% of early on-set Alzheimer detected

Resources

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

Early diagnosis

Experimental phase

Skepticism

Privacy

Business Sustainability

Neurological Institute

Cleveland Clinic

2016 Outcomes

Alzheimer's Disease International

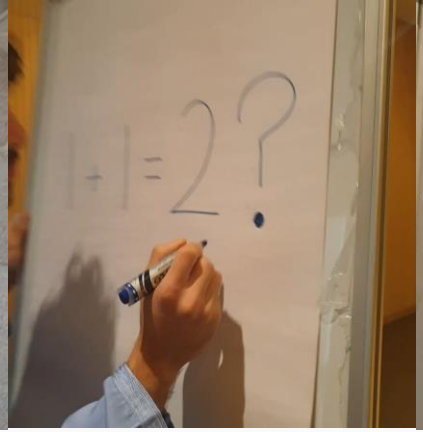
The global voice on dementia

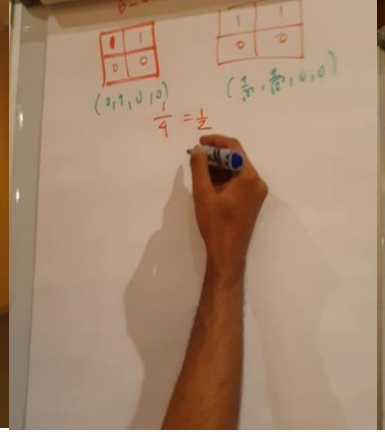
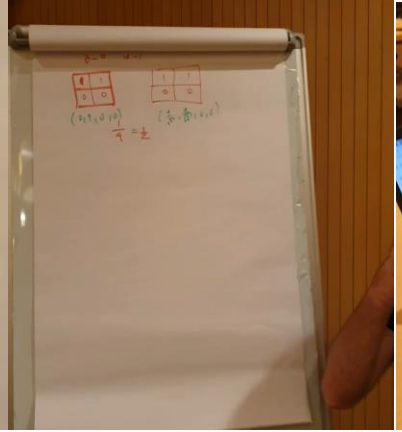
الجمعية السعودية الخيرية لمرض الزهايمر

SAUDI ALZHEIMER'S DISEASE ASSOCIATION

Saudi German Hospital

ALZHEIMER'S ASSOCIATION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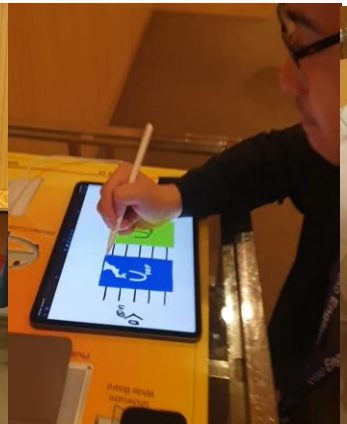
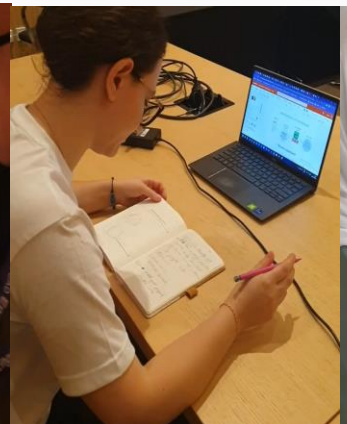
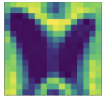
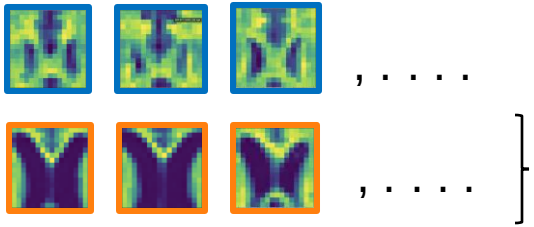
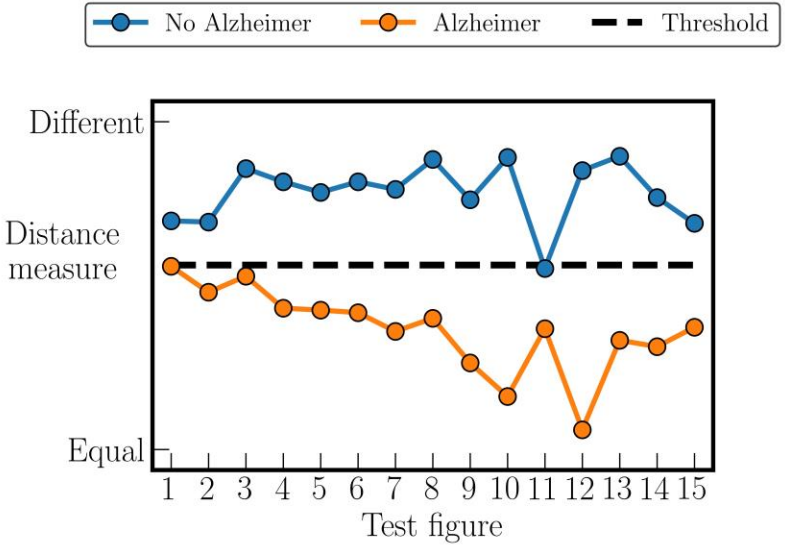



Results (with shot noise)

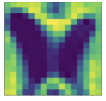
Results (with shot noise)

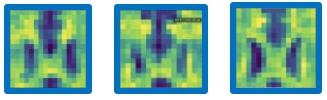
$|\psi_{ref}\rangle =$ 

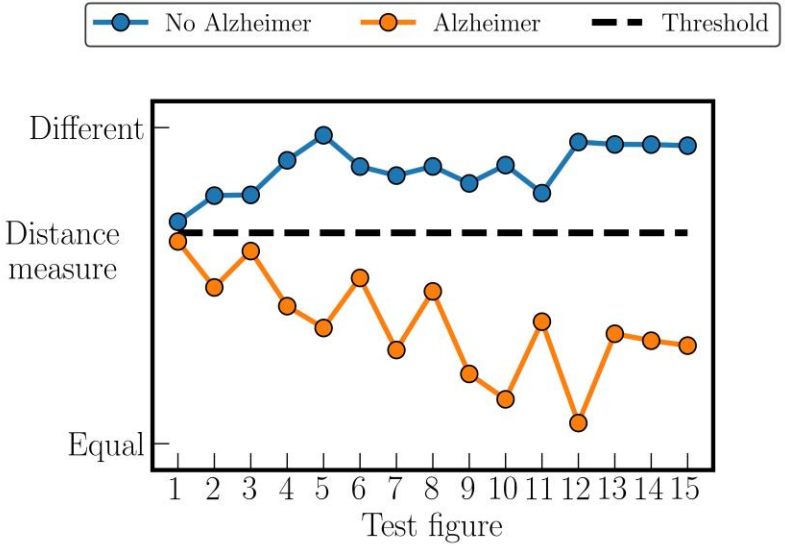
$|\psi_{test}\rangle =$ 



Results (classical classifier)

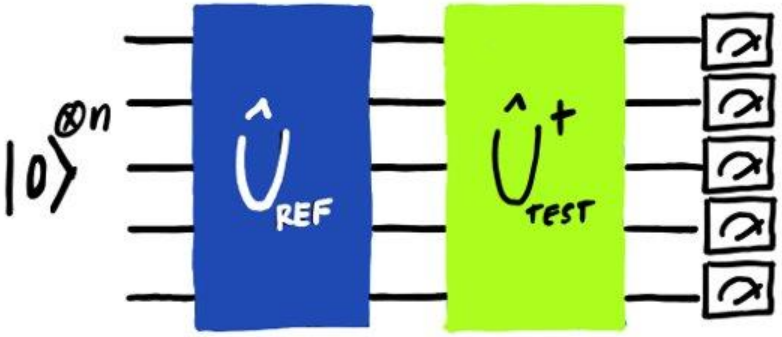
$ref =$ 

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



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 ()