

CLASSIFICATION WITH VARIATIONAL QUANTUM CLASSIFIER

Group 9 (Topic 3)

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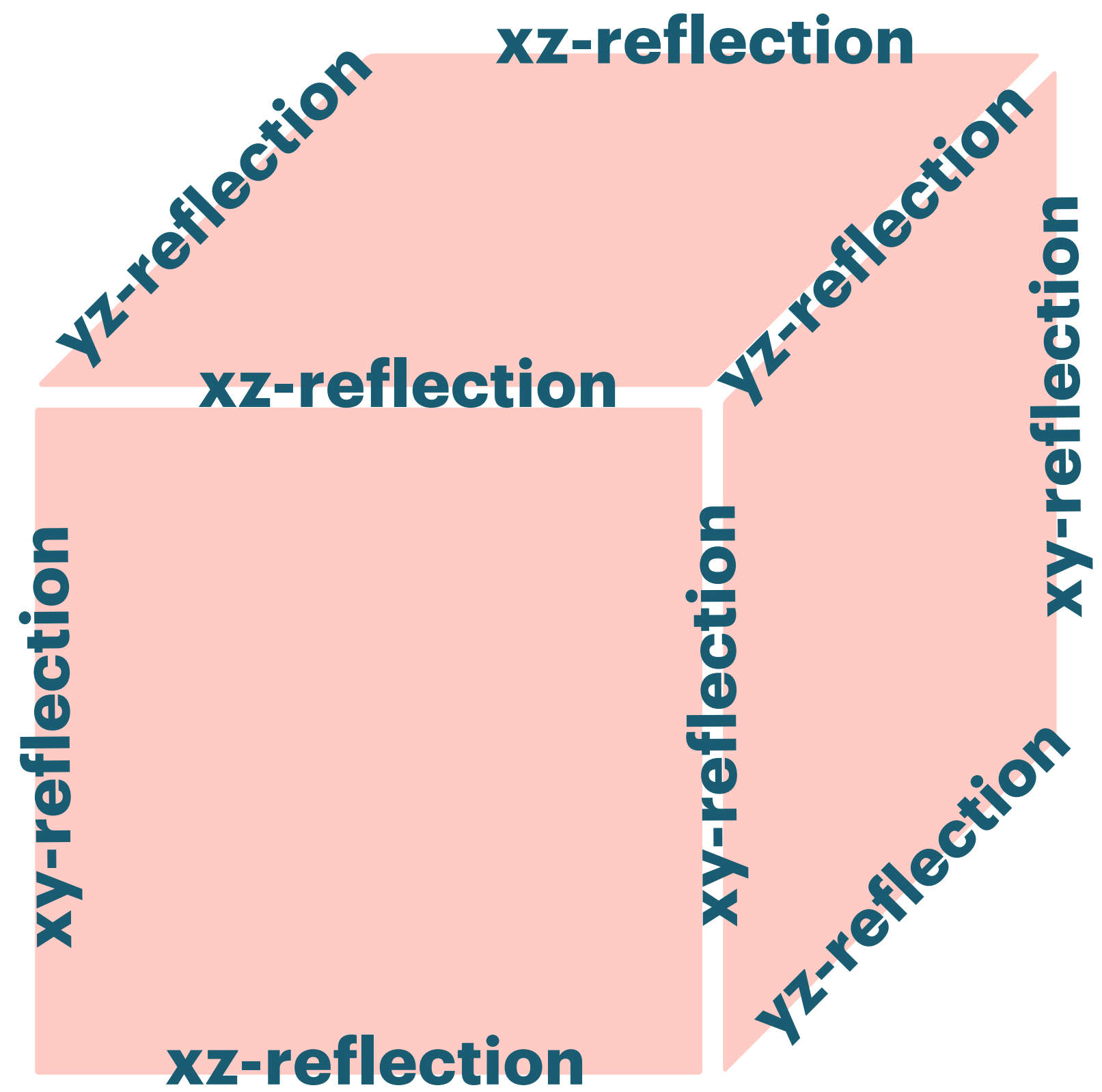
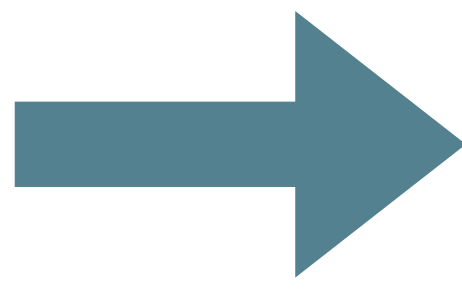
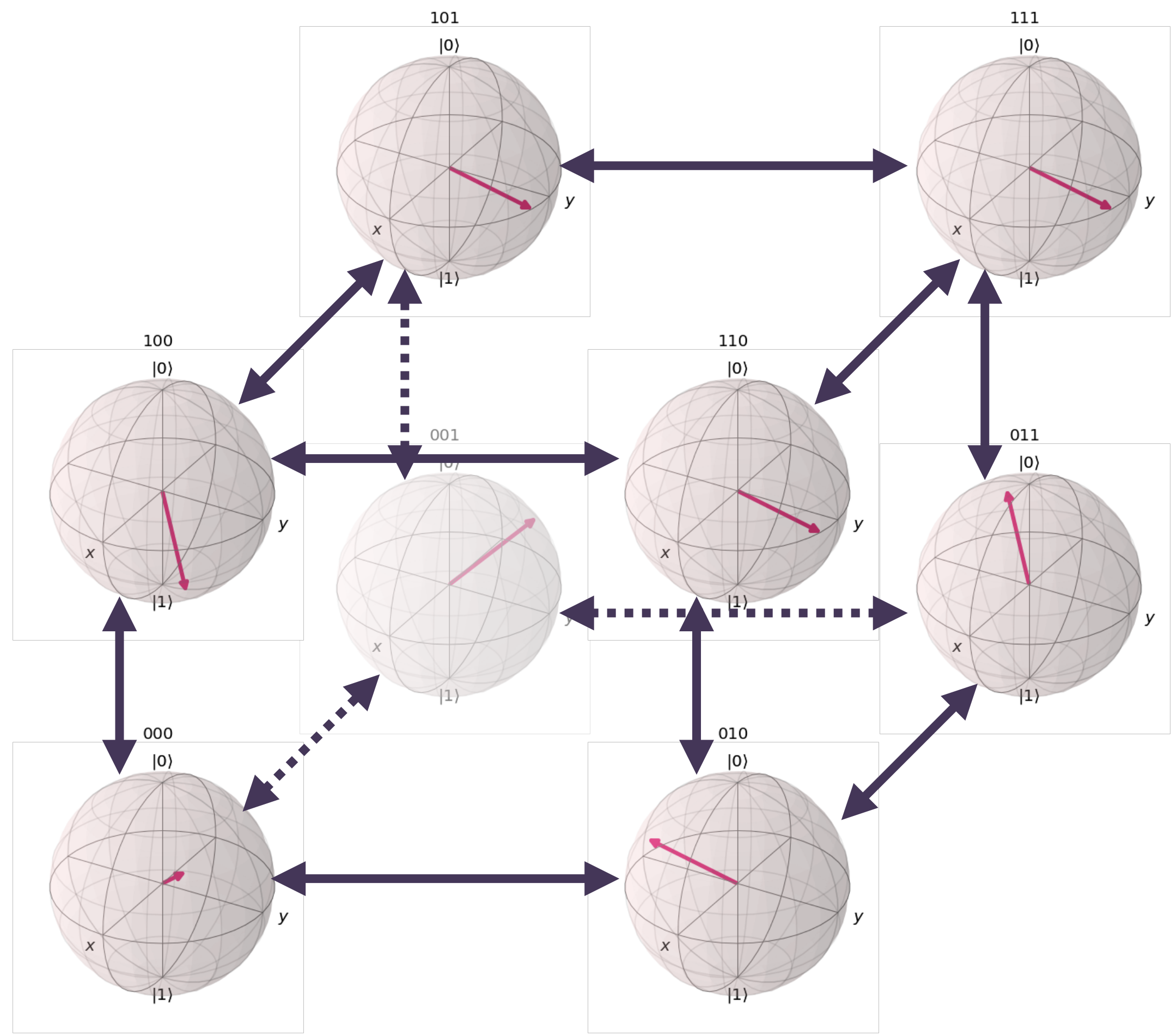
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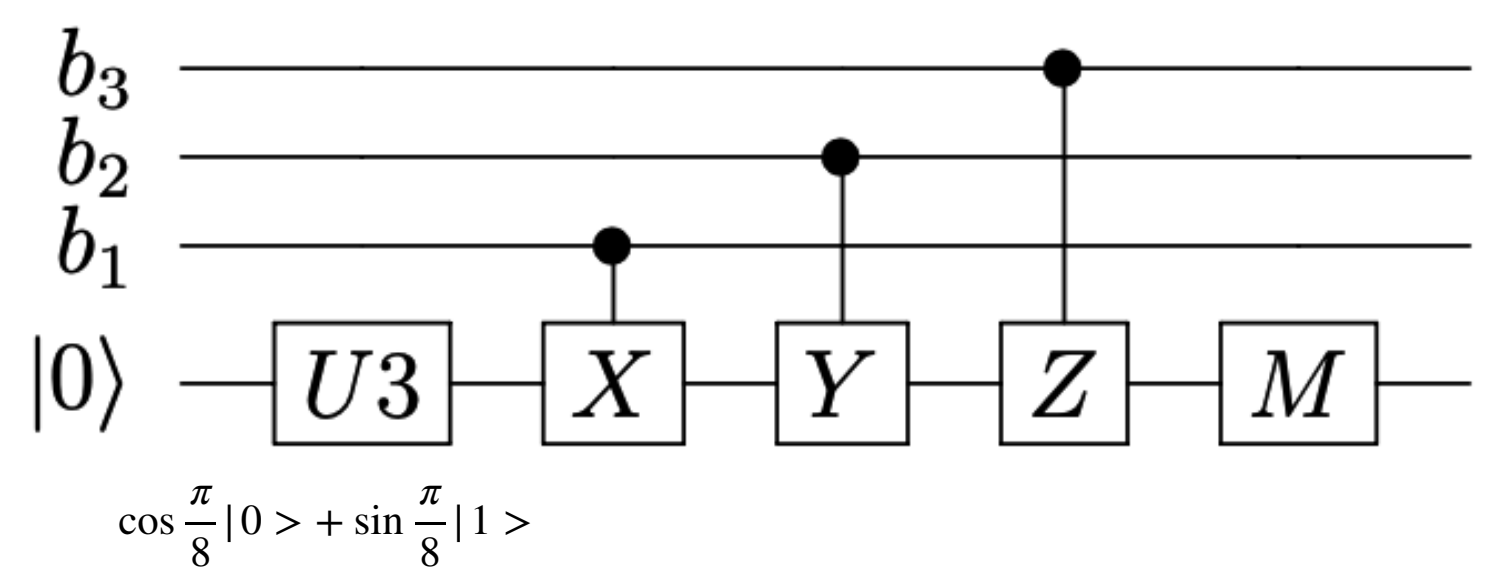
Questions:

- 1. Encode classical bits into Quantum State**
 - 2. Classify discrete-feature dataset (Breast Cancer)**
 - 3. Predict non-discrete-feature dataset (Titanic Passengers)**
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ENCODE BITS



$$(b_1, b_2, b_3) \rightarrow (r_x, r_y, r_z) = \frac{1}{\sqrt{3}}((-1)^{b_1}, (-1)^{b_2}, (-1)^{b_3})$$



$$\cos \frac{\pi}{8} |0\rangle + \sin \frac{\pi}{8} |1\rangle$$

ENCODE BITS

1. **We could encode maximum 3 classical bits into 1 qubit.**
2. **U3 gate is not unique, we could use any U3 (except for a few gates that cannot distinguish digits)**

For example, U3=I is invalid

3. **Measurement to different bases will indicate different classical bits**

For example, measure in

$$\left\{ \cos \frac{\pi}{8} |0\rangle + \sin \frac{\pi}{8} |1\rangle, \sin \frac{\pi}{8} |0\rangle + \cos \frac{\pi}{8} |1\rangle \right\}$$

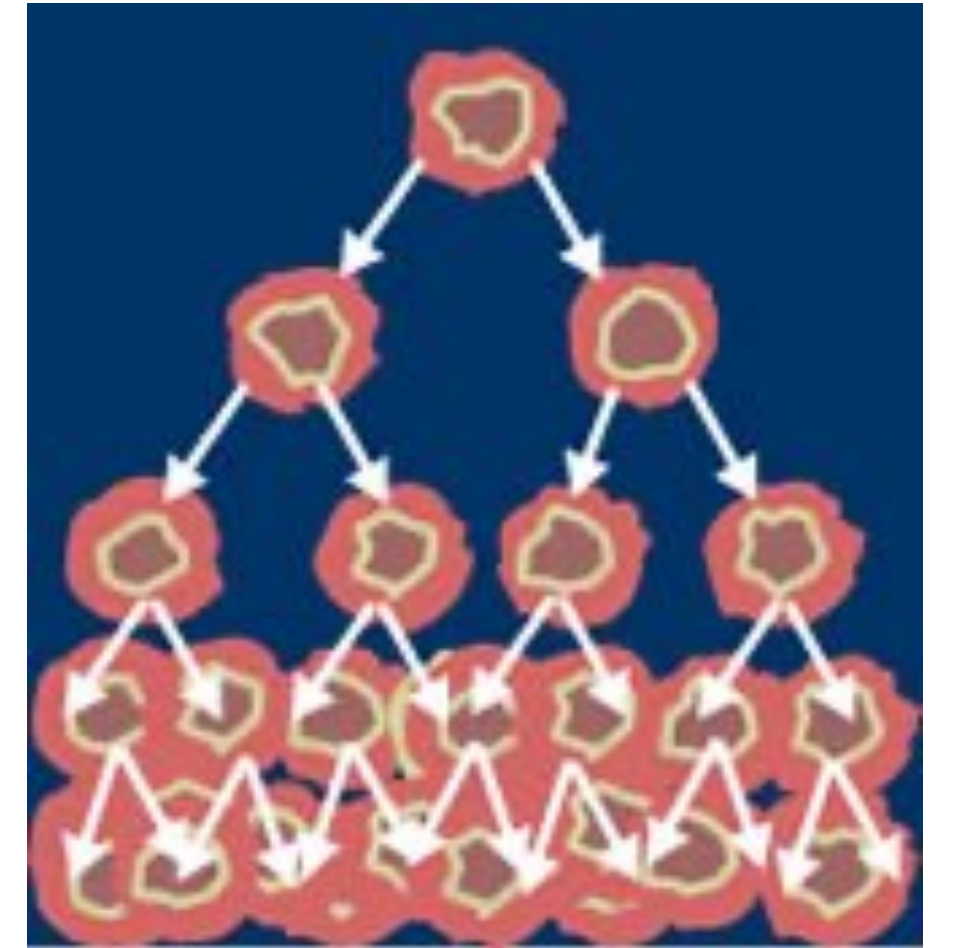
will indicate value of b_1 for this U3

CLASSIFY BREAST CANCER

We have labelled dataset with **9 discrete features**

Because feature dimension is high, we may want to use **Principal Components Analysis (PCA)** or just drop some unimportant features to lower computing cost.

Use **Variational Quantum Classifier (VQC)** is one feasible way to classify.



<https://archive.ics.uci.edu/ml/datasets/breast+cancer>

<https://github.com/bijing02/Group9/blob/master/breastcancer%2B1.ipynb>

PREDICT SURVIVER



Getting Started Prediction Competition

Titanic: Machine Learning from Disaster

Start here! Predict survival on the Titanic and get familiar with ML basics

<https://www.kaggle.com/c/titanic>

In Titanic data set, we have non-digit/over-ranged-digit/missing-data/useless-date.

Firstly, we should deal with these.

Then, the rest steps are same as before.

<https://github.com/bijing02/Group9/blob/master/titanic%2B1.ipynb>

SUMMARY

- 1. Machine Learning methods are many. In our class, Quantum machine learning, VQC, is specially addressed.**
 - 2. However, the running time of experiments on simulator (qiskit) is much slower than classical methods. It is a pity that we have not tested on real machine.**
 - 3. Our method of dealing last two questions is straight. Definitely, not the best solution. There are many things need to be improved.**
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THANK YOU
