# 2020 Hackathon

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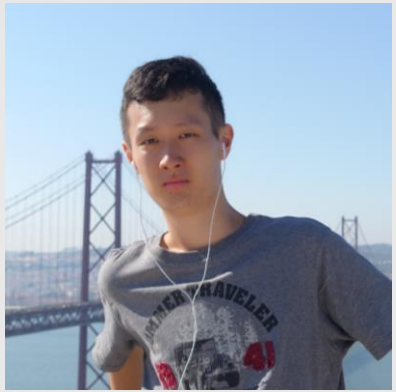
# 01

# Who are we?



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# 02

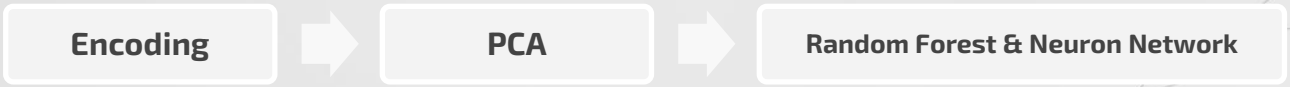
# What we did?

# 01 VERIFICATION

## IDEA

- Using synthetic data, train a model to predict readmission.
- Check the performance of this model on synthetic data and on real data.

## MODEL



# 01 VERIFICATION

## RESULT

| Synthetic data (Train set) | Synthetic data (Val set) | Real data |
|---|---|---|
| 71% | 68% | 53% |

- There is a **significant difference** between 2 datasets.
- Real data is **harder** to make prediction. Using this set of synthetic data to do data analysis is **risky**.

# 02 CLASSIFICATION

## MODEL

Encoding → PCA → Neuron Network

## RESULT

| | Training set | Validation set |
|---|---|---|
| **Accuracy** | 90% | 88% |

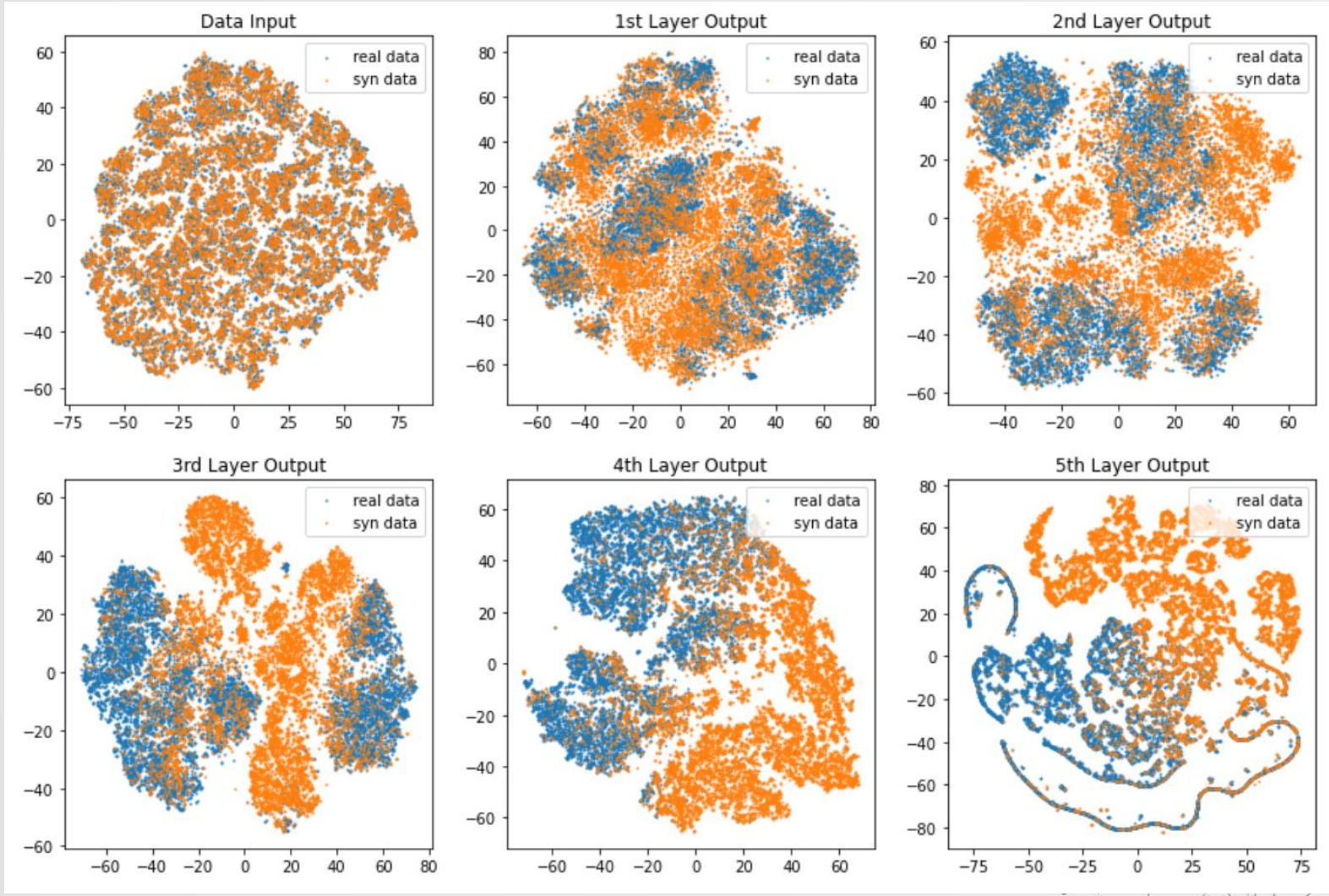
# 03 ANALYSIS

- Low dimensional embedding
- Check hidden-layer activation
- Re-train the model using combination of dimensions
- Analyze crucial dimensions

## 3.1 Low dimension embedding

- Embedding and visualization by t-SNE

- Check the decoupling of each layer in neuron network


Data Input
real data
syn data
1st Layer Output
real data
syn data
2nd Layer Output
real data
syn data
3rd Layer Output
real data
syn data
4th Layer Output
real data
syn data
5th Layer Output
real data
syn data

# 3.2 Check hidden layer activation

- Try to find which features the first layer detects

**Find the samples that mostly activate the first layer** → **Recover the input by taking pseudo-inverse** → **Compare the difference**

$$A = relu(W \cdot X + b)$$
$$X \approx W^{-1} \cdot (A - b)$$

The inspiration comes from
Zeiler M.D., Fergus R. (2014) Visualizing and Understanding Convolutional Networks.

## 3.2 Check hidden layer activation

- By comparing the result, we teased out dimensions not used in decoupling.
- Remain 22 dimensions.

## 3.3 Train model with combination of dimensions

- To check the most important dimensions among the 22 dimension.
- Find 3 most important dimensions:

“insulin”
“change”
“diabetesMed”

# 3.3 Train model with combination of dimensions

| | All features | Only 3 features | All other features |
|---|---|---|---|
| Accuracy | 88% | 72% | 74% |

# 3.4 Understand the difference

- Compare the correlation coefficient of this 3 dimensions.

**Real data**

| Corrs | insulin | change | diabetesMed |
|---|---|---|---|
| **insulin** | 1.0 | -0.14 | 0.26 |
| **change** | -0.14 | 1.0 | -0.51 |
| **diabetesMed** | 0.26 | -0.51 | 1.0 |

**Synthetic data**

| Corrs | insulin | change | diabetesMed |
|---|---|---|---|
| **insulin** | 1.0 | -0.02 | 0.01 |
| **change** | -0.02 | 1.0 | 0.02 |
| **diabetesMed** | 0.01 | 0.02 | 1.0 |

# Conclusion

- The mainly difference between real data and synthetic data are dimensions “**insulin**”, “**change**” and “**diabetesMed**”;

- In real data, these three dimensions are **highly related**;

- while in synthetic data, these three dimensions seems to be generated **independently**.

# Future Plan

- Re-sampling these 3 dimensions to generate a better synthetic data

- Use this new set of synthetic data to train a model predicting re-admission, then check if this model works well on real data

# Thank you for listening