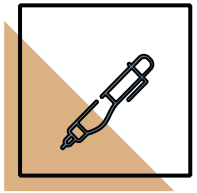
Signature Verification



Capstone Project: XiuTing

PROBLEM STATEMENT

Handwritten signatures are frequently used for personal identification and verification.

Challenges of detecting forged signatures:

- “No two signatures of the same person are exactly the same”
- Variability in pens used
- Noisy background

METHODOLOGY

01
DATASET
Look for usable dataset

02
PROCESS
Pre-process data
Create Lists of Signatures and binary Labels

03
EDA
Create lists of Signatures and binary labels

04
MODEL
View and explore images

05
TUNE
Tune optimizers and model parameters

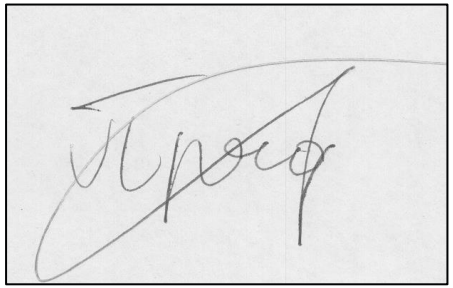
05
EVALUATE
Evaluate models

55 sets of
20 forged and 20 signatures
per person

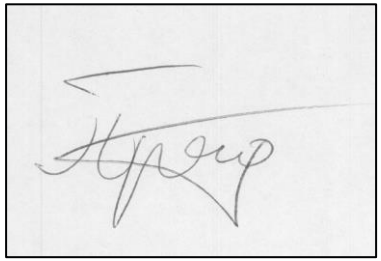
DATASET

GENUINE / FORGED SIGNATURES ?

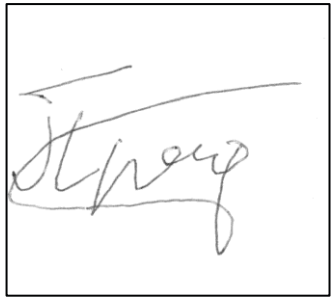
01



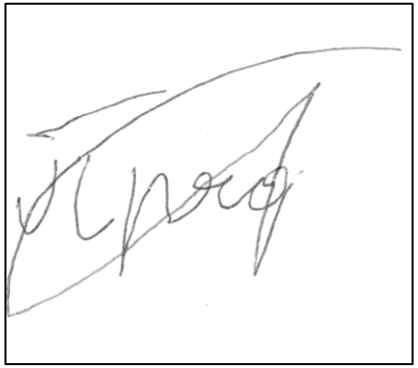
03



02



04

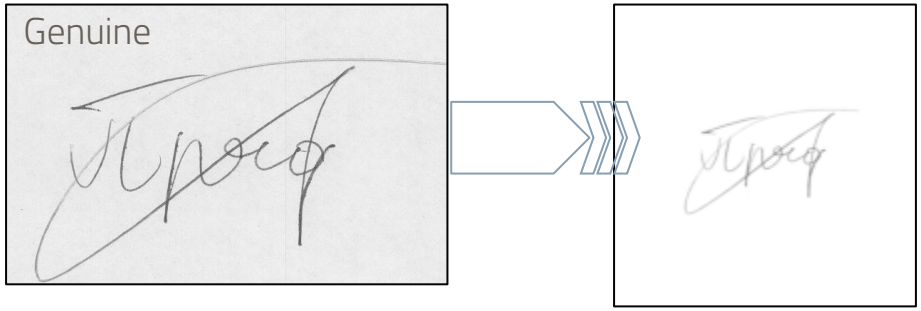


Why pre-processing is required:

- Not centered
- Background noise
- Variability in image size
- Noisy background

IMAGE PRE-PROCESSING

01



02

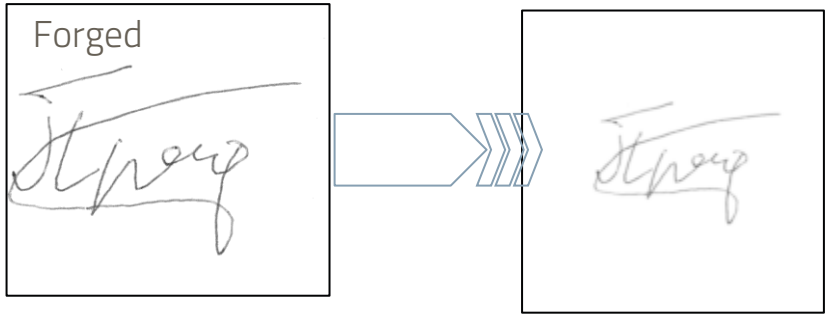
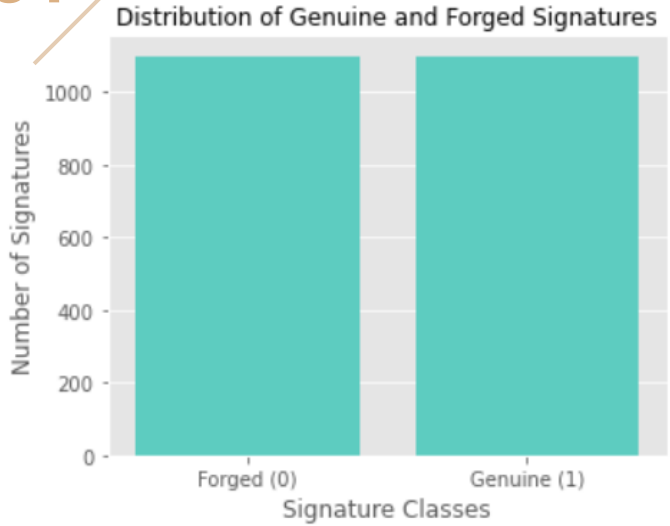


Image pre-processing steps

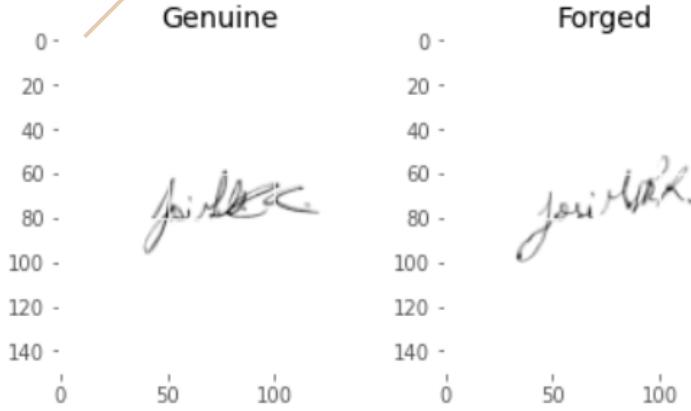
- Image changed to grayscale / single channel.
- Background is removed
- Gaussian filter applied
- Centralized image
- Image is cropped and resized

EDA

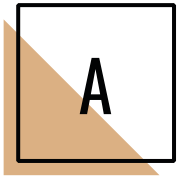
01 DATA DISTRIBUTION



02 VISUALIZE SIGNATURES

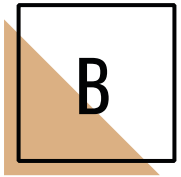


MODELING: NEURAL NETWORK



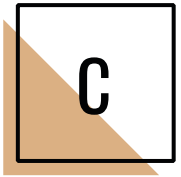
CNN

Covolutional Neural Network
Insufficient data is likely to cause over fitting of the model



SNN

Siamese Neural Networks
Good for training with insufficient data



PRE-TRAINED

InceptionV3
Experimented with it
Requires more tuning

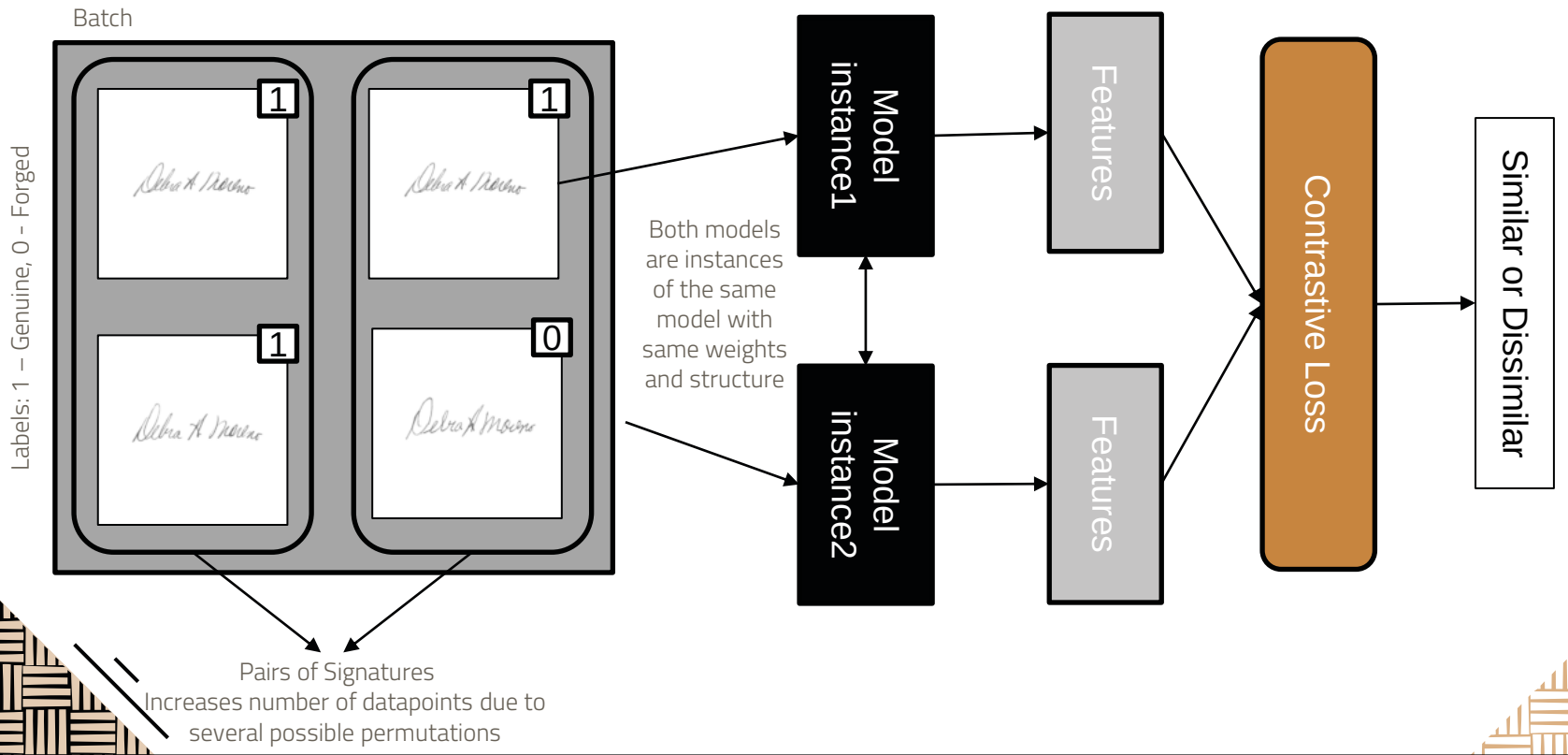
INCREASING DATAPOINTS

Genuine-Genuine Pairs
20 genuine signatures per pax:
20 choose 2 = 190 Genuine-Genuine image pairs for one person

Genuine-Forged Pairs
Pair every 1 genuine signature of a person with 20 randomly sampled Forged signatures of the same person.
20 * 20 = 400 Genuine-Forged image pairs per person

In all we have 55 person's data in the training data.
Total no. of Genuine-Genuine pairs = 55 * 190 = 10450
Total number of Genuine-Forged pairs = 55 * 400 = 22000
Total no. of data points = 10450 + 22000 = 32450

SIAMESE NEURAL NETWORK



MODEL TUNING

01 OPTIMIZER

1. Adam
2. Adagrad
3. SGD
4. RMSprop

02 LEARNING RATE

1. 1e-4
2. 1e-5
3. 1e-6

03 BATCH SIZE

32, 64, 256

04 EPOCHS

EarlyStopping

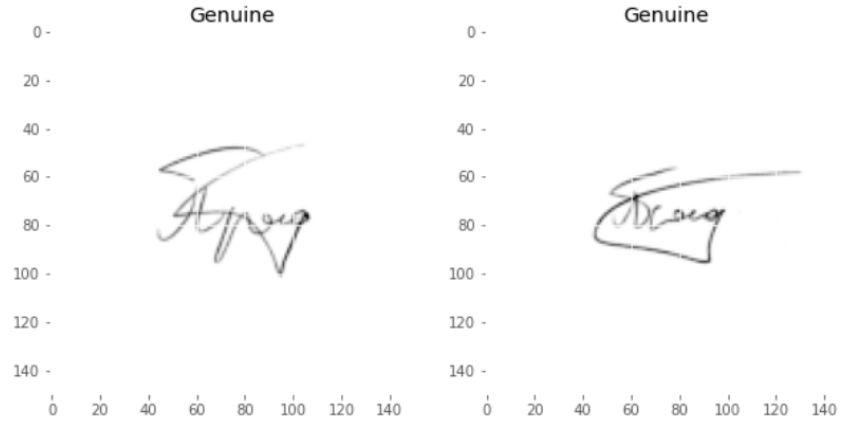
MODEL EVALUATION

Model No.	Optimizer	Batch Size	Learning Rate	Epoch Number	Accuracy (%)
1	Adam	32	0.0001	13	65.6
2	Adam	64	0.0001	24	69.3
3	Adam	256	0.0001	8	64.8
4	Adam	32	1e-05	7	65.9
5	Adam	64	1e-05	79	70.4
6	Adam	256	1e-05	2	71.4
7	RMSprop	32	0.0001	8	72.2
8	RMSprop	64	0.0001	11	69.2
9	RMSprop	256	0.0001	25	72.1
10	RMSprop	32	1e-05	3	69.9
11	RMSprop	64	1e-05	18	68.2
12	RMSprop	256	1e-05	0	70.7

Model 7 has the highest accuracy score.

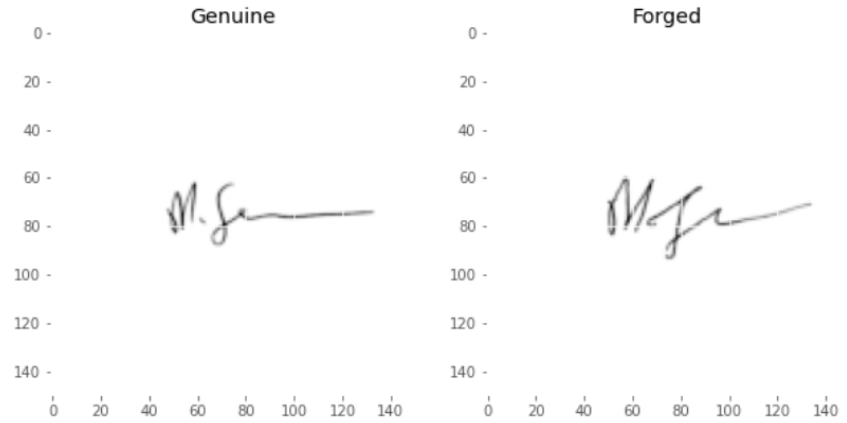
PREDICTIONS

```
1 verify_signature()
```




```
Difference Score =  0.0650725
The signature is genuine
```

```
1 verify_signature()
```




```
Difference Score =  0.55037856
The signature is forged
```

Accuracy: **72.2%,** Threshold: **0.1519**

FUTURE WORKS

1. Build model using triplet loss on Siamese Neural Networks (Current models built on contrastive loss)
2. Change metrics to precision
3. Look into pre-trained models and fine-tune the model more.
4. Deploy on web application

QUESTIONS