Mads Hermansen x Daniel Hansen

NOVEMBER 13. 2024

AI Sudoku Solver

Marine AI Practice in English Mid-term Report

SUDOKU SOLVER

MAIN PROBLEM

Sometimes, Sudoku is too hard...

Let’s make it a bit easier

Use Image recognition to recognize written digits

Select the sudoku problem contours from an image map the numbers and solve the problem

Create an easy interface to use the program

NOVEMBER 13. 2024

SUDOKU SOLVER

PROJECT SETUP / BACKGROUND

What tools are we using (so far)

Python
- Tensorflow (Keras)
- Cv2
- Numpy
- MatPlotLib

Information

Kaggle
- Deep Learning Course
- Computer Vision Course

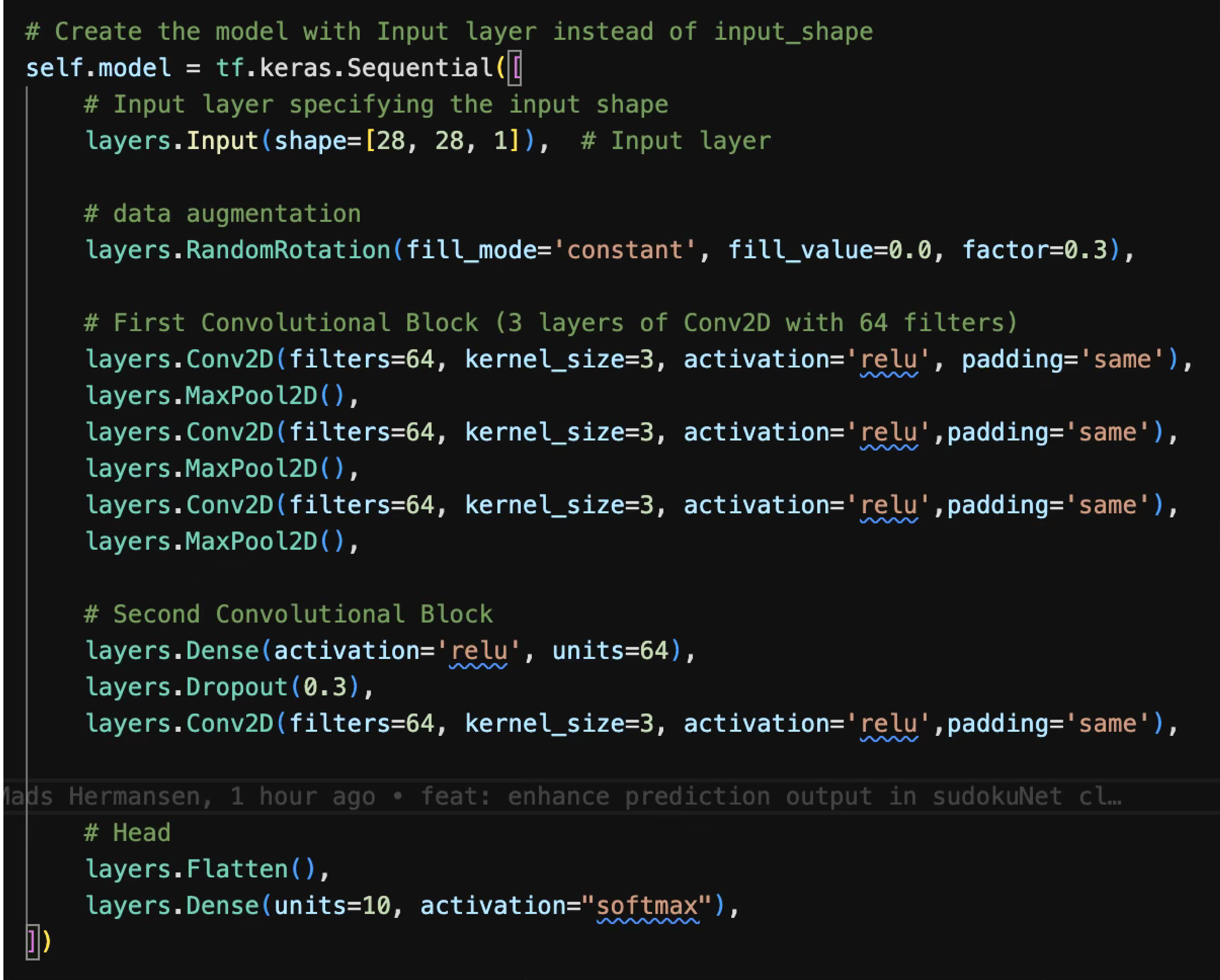
Research
- No Routing Needed Between Capsules (Adam Byerly, Tatiana Kalganova, Ian Kear)
- Sudo OpenCV Blog
- Tensorflow Documentation

MNIST dataset

Our current model

Current Accuracy: **98.53%**

Current Loss: **4.61%**



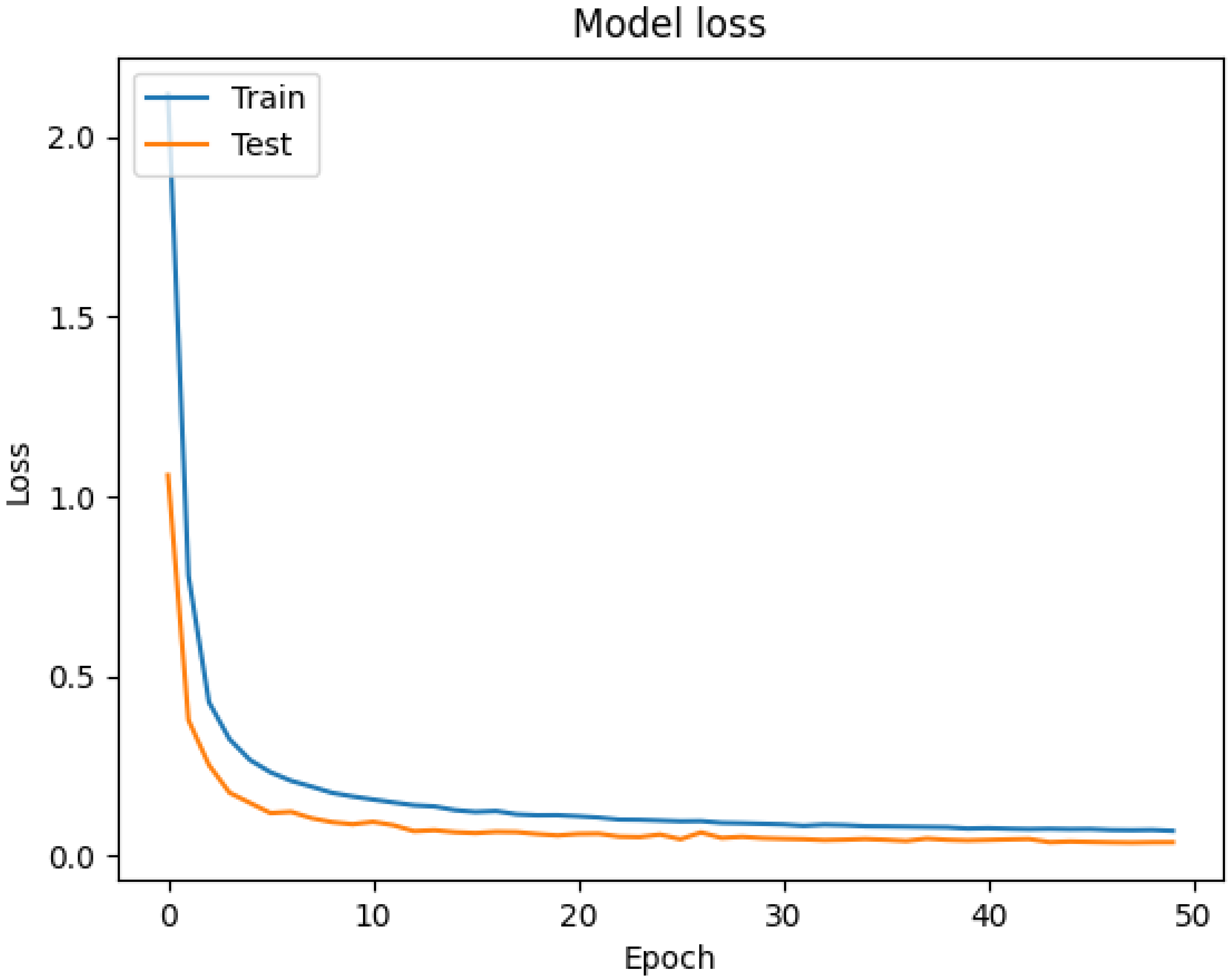
```
# Create the model with Input layer instead of input_shape
self.model = tf.keras.Sequential([
    # Input layer specifying the input shape
    layers.Input(shape=[28, 28, 1]),  # Input layer

    # data augmentation
    layers.RandomRotation(fill_mode='constant', fill_value=0.0, factor=0.3),

    # First Convolutional Block (3 layers of Conv2D with 64 filters)
    layers.Conv2D(filters=64, kernel_size=3, activation='relu', padding='same'),
    layers.MaxPool2D(),
    layers.Conv2D(filters=64, kernel_size=3, activation='relu',padding='same'),
    layers.MaxPool2D(),
    layers.Conv2D(filters=64, kernel_size=3, activation='relu',padding='same'),
    layers.MaxPool2D(),

    # Second Convolutional Block
    layers.Dense(activation='relu', units=64),
    layers.Dropout(0.3),
    layers.Conv2D(filters=64, kernel_size=3, activation='relu',padding='same'),
ads Hermansen, 1 hour ago • feat: enhance prediction output in sudokuNet cl…
    # Head
    layers.Flatten(),
    layers.Dense(units=10, activation="softmax"),
])
```

NUMBERS / STATS



Key Problems and Current Solutions

Data preprocessing

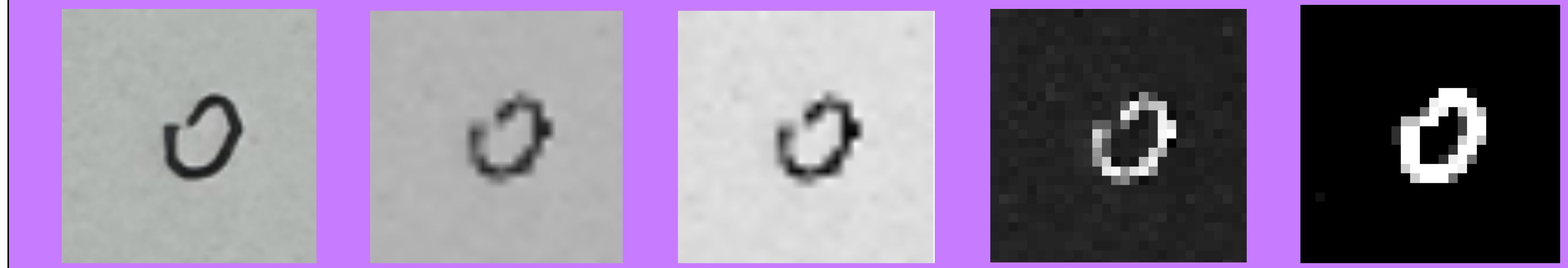
Finding a good way to process our own images of handwritten numbers

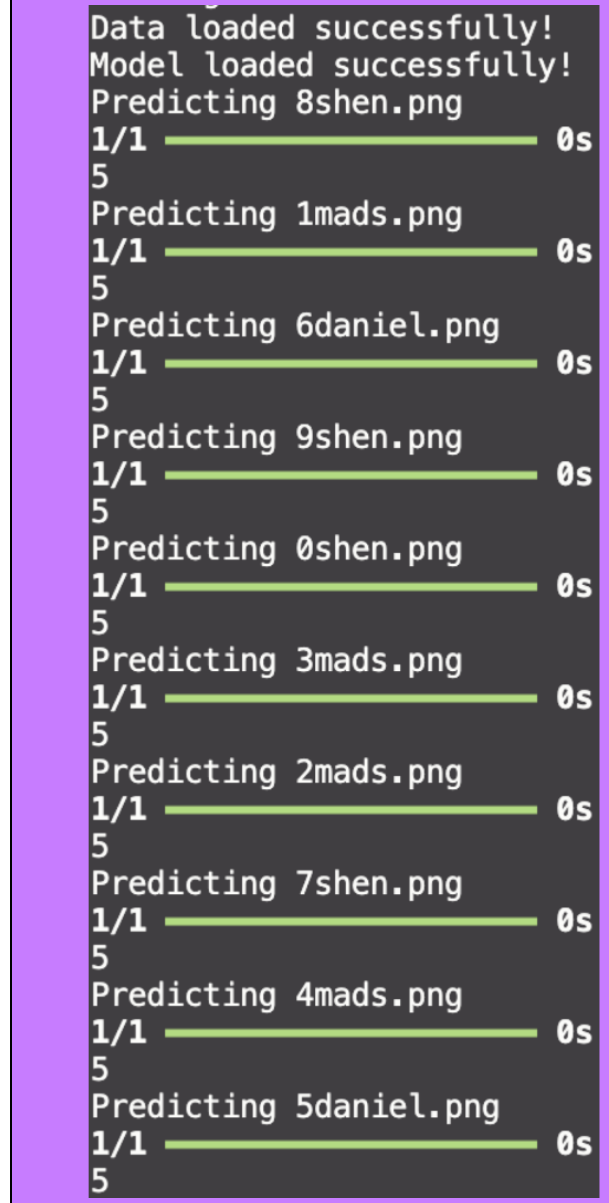
Problematic Numbers

Since you'll say more in a bit, you can keep these short.

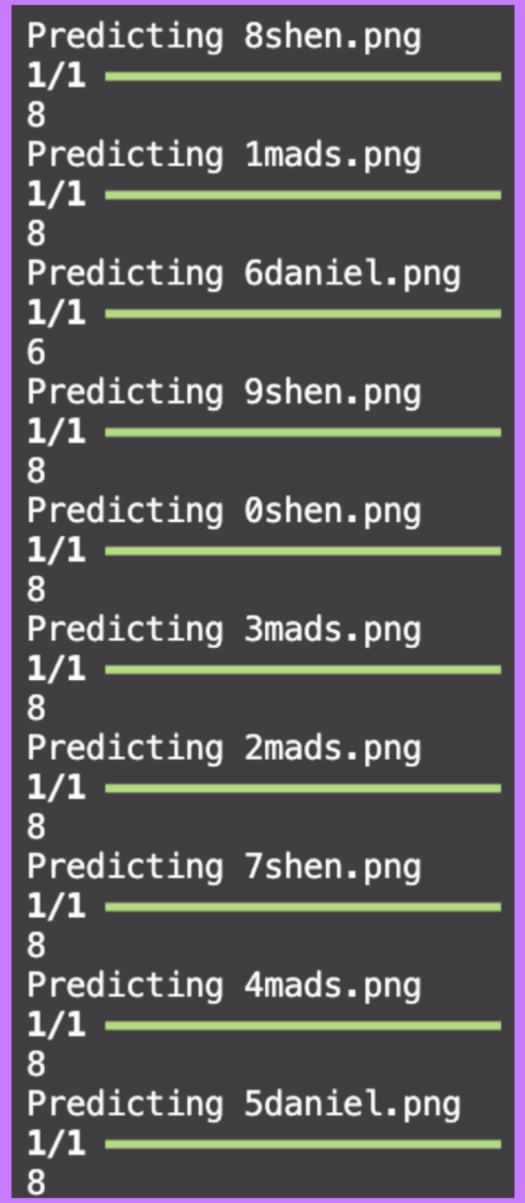
DATA PREPROCESSING

Finding good ways to process our handwritten data

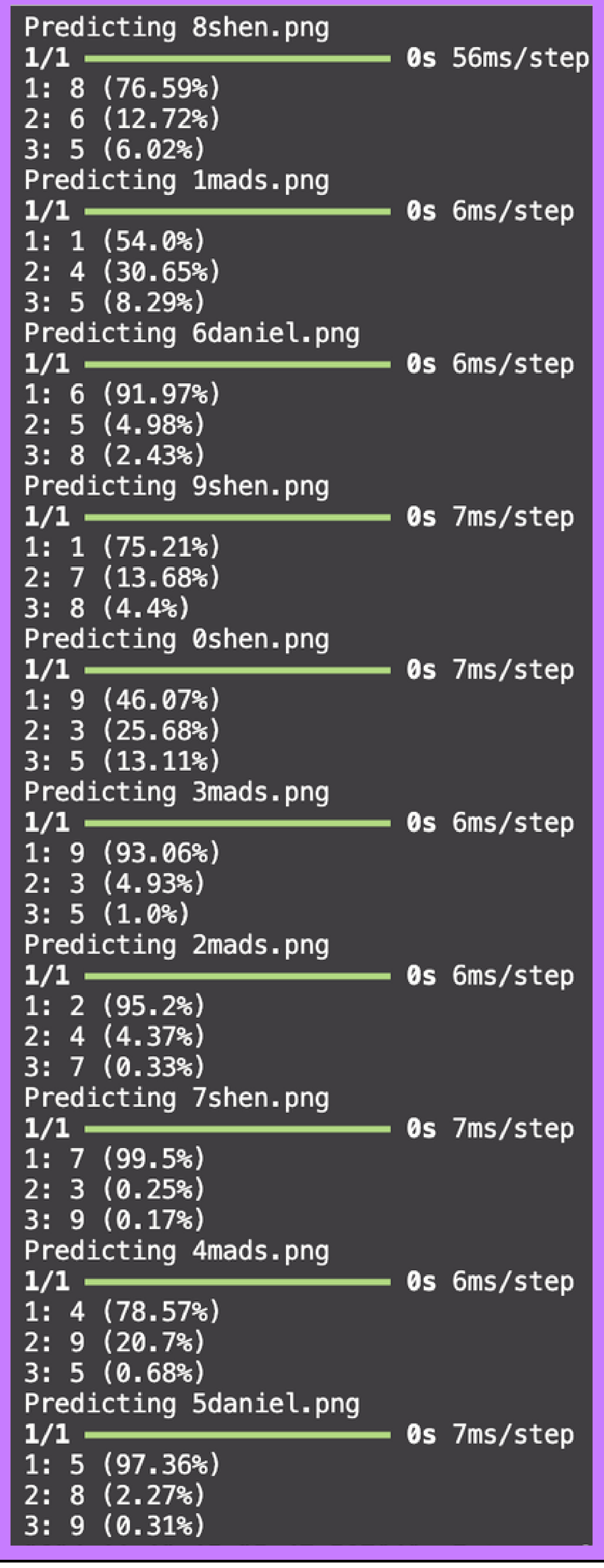




```
Data loaded successfully!
Model loaded successfully!
Predicting 8shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s
5
Predicting 1mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s
5
Predicting 6daniel.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s
5
Predicting 9shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s
5
Predicting 0shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s
5
Predicting 3mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s
5
Predicting 2mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s
5
Predicting 7shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s
5
Predicting 4mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s
5
Predicting 5daniel.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s
5
```



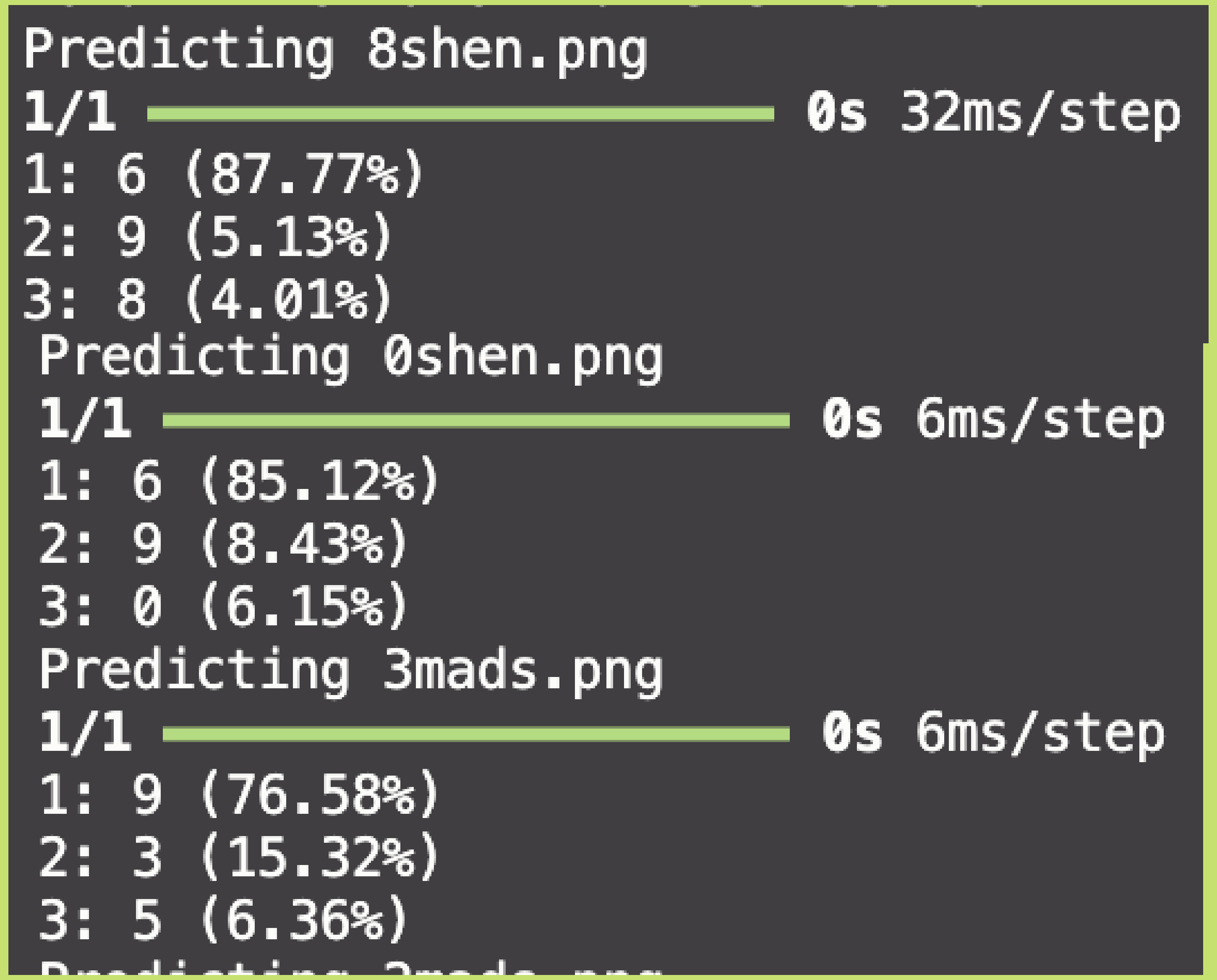
```
Predicting 8shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━
8
Predicting 1mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━
8
Predicting 6daniel.png
1/1 ━━━━━━━━━━━━━━━━━━━━
6
Predicting 9shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━
8
Predicting 0shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━
8
Predicting 3mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━
8
Predicting 2mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━
8
Predicting 7shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━
8
Predicting 4mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━
8
Predicting 5daniel.png
1/1 ━━━━━━━━━━━━━━━━━━━━
8
```



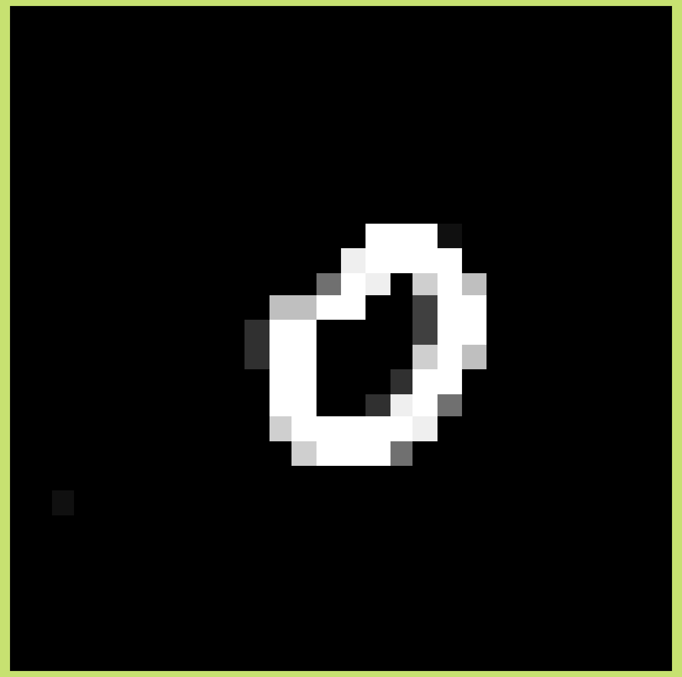
```
Predicting 8shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step
1: 8 (76.59%)
2: 6 (12.72%)
3: 5 (6.02%)
Predicting 1mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step
1: 1 (54.0%)
2: 4 (30.65%)
3: 5 (8.29%)
Predicting 6daniel.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step
1: 6 (91.97%)
2: 5 (4.98%)
3: 8 (2.43%)
Predicting 9shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 7ms/step
1: 1 (75.21%)
2: 7 (13.68%)
3: 8 (4.4%)
Predicting 0shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 7ms/step
1: 9 (46.07%)
2: 3 (25.68%)
3: 5 (13.11%)
Predicting 3mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step
1: 9 (93.06%)
2: 3 (4.93%)
3: 5 (1.0%)
Predicting 2mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step
1: 2 (95.2%)
2: 4 (4.37%)
3: 7 (0.33%)
Predicting 7shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 7ms/step
1: 7 (99.5%)
2: 3 (0.25%)
3: 9 (0.17%)
Predicting 4mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step
1: 4 (78.57%)
2: 9 (20.7%)
3: 5 (0.68%)
Predicting 5daniel.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 7ms/step
1: 5 (97.36%)
2: 8 (2.27%)
3: 9 (0.31%)
```

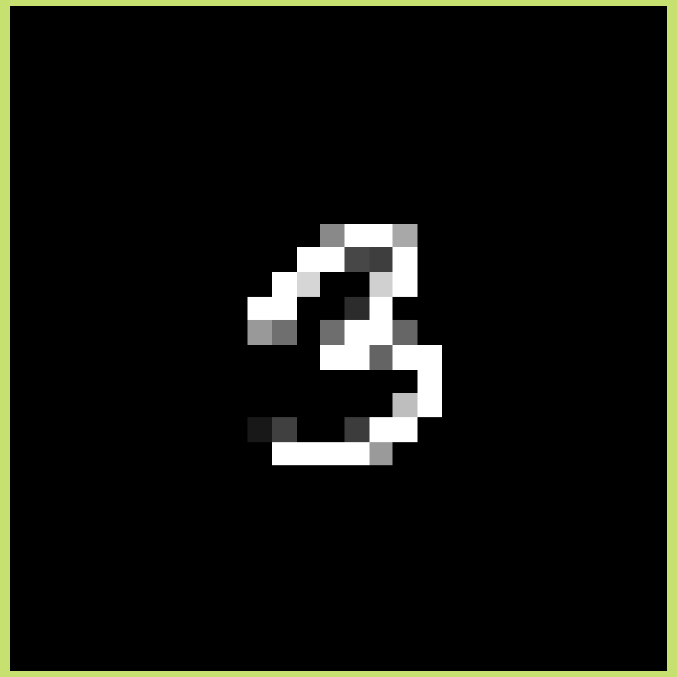
PROBLEMATIC NUMBERS

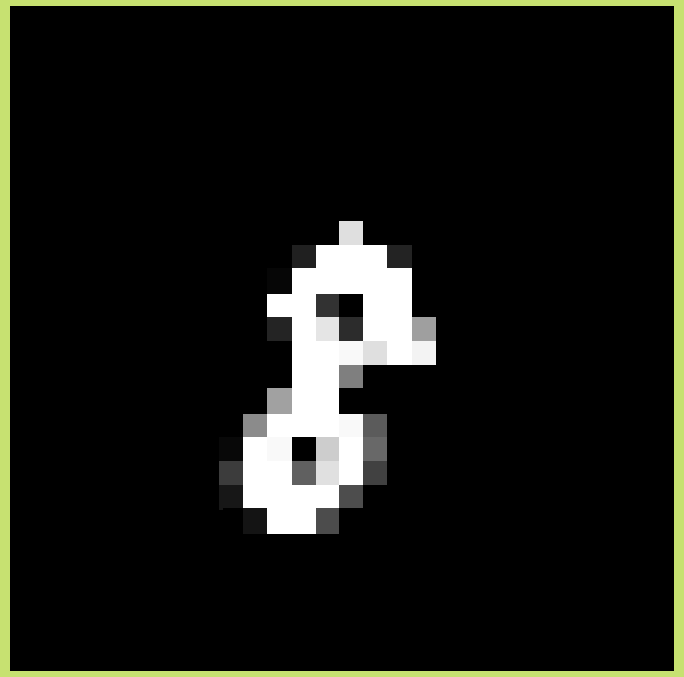
Some numbers are hard for our model to predict



```
Predicting 8shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step
1: 6 (87.77%)
2: 9 (5.13%)
3: 8 (4.01%)
Predicting 0shen.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step
1: 6 (85.12%)
2: 9 (8.43%)
3: 0 (6.15%)
Predicting 3mads.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step
1: 9 (76.58%)
2: 3 (15.32%)
3: 5 (6.36%)
```







DEMO

NOVEMBER 13. 2024

SUDOKU SOLVER

Live Demo & Showcase

PLAN MOVING FORWARD

TIMELINE

4 weeks

Week 1: Fine-tune our model to be able to identify problematic numbers

Week 2: Be able to scan and identify a sudoku board

Week 3: Pinpoint the position of numbers & solve the sudoku problem

Week 4: Create a mobile demo and web server to serve results

Goals

Solve a Sudoku Problem

Goal 1: We want to be able to take an image of a Sudoku board and solve it

Goal 2: We want to have a high accuracy of identifying handwritten numbers (90%?)

Optimistic Goals

Mobile Interface

If previous goal is achieved we want to expand into a simple mobile app to take a picture, upload image to our web server and produce the solution for the user

> “I love sudoku solver, it helped me bring joy to my family and friends”

Future Sudoku Solver User, North Korea