Sudoku Solver with Digit Recognition - Interview Task

Goal

Implement a Python-based system that:

- Loads an image of a Sudoku puzzle
- Detects and extracts the Sudoku grid
- Recognizes digits in the grid using a neural network you trained
- Solves the puzzle using backtracking
- Outputs the solved board

Requirements

Your solution should:

- Load an input image (file path or image array)
- Preprocess the image: denoise, threshold, perspective transform
- Detect and divide the grid into 9×9 cells
- Train a digit recognition model (you may use MNIST or a custom dataset)
- Use the trained model to classify digits from the extracted cells
- Solve the Sudoku puzzle using a backtracking algorithm
- Log or print the puzzle before and after solving

Technical Constraints

- Use OpenCV for image processing
- Use PyTorch (or TensorFlow) for model training and digit classification
- Code should be modular: separate classes or functions for processing, model training, classification, solving
- Include a logging mechanism for debug and info messages
- Code should be clean, well-organized, and commented

Deliverables

- Python source code implementing the solution
- Code for training the digit recognition model
- A README explaining:
    - How to run the solution
    - How to train the model
    - Dependencies
    - Example input and output
- Optional: unit tests or sample input images

Expected Output

The program should log or print:

```
Original Board:
5 3 0 | 0 7 0 | 0 0 0
6 0 0 | 1 9 5 | 0 0 0
0 9 8 | 0 0 0 | 0 6 0
- - - - - - - - - - - -
8 0 0 | 0 6 0 | 0 0 3
4 0 0 | 8 0 3 | 0 0 1
7 0 0 | 0 2 0 | 0 0 6
- - - - - - - - - - - -
0 6 0 | 0 0 0 | 2 8 0
0 0 0 | 4 1 9 | 0 0 5
0 0 0 | 0 8 0 | 0 7 9

Solved board:
5 3 4 | 6 7 8 | 9 1 2
6 7 2 | 1 9 5 | 3 4 8
1 9 8 | 3 4 2 | 5 6 7
- - - - - - - - - - - -
8 5 9 | 7 6 1 | 4 2 3
4 2 6 | 8 5 3 | 7 9 1
7 1 3 | 9 2 4 | 8 5 6
- - - - - - - - - - - -
9 6 1 | 5 3 7 | 2 8 4
2 8 7 | 4 1 9 | 6 3 5
3 4 5 | 2 8 6 | 1 7 9
```

p.s. please do not use ChatGPT or any AI for this coding task