#### Abstract

This project aims at building a Chinese car-plate recognition system using deep neural networks. The project is divided into three parts: car-plate detection, character segmentation and character recognition. Firstly, we customize the YOLOv5 object detection model to locate the bounding box coordinates and take the sub-image containing the car-plate. Secondly, we conduct preprocessing on the sub-image: we will pre-scale the images, transform to grayscale images, and draw contours of each character in the car-plate. Lastly, we perform a modified version of LeNet 5 CNN to recognize the Chinese character and apply pytesseract to recognize the numerals and alphabets.

#### Introduction

* More history on CNN: YOLO, pytesseract and LeNet

Cars have become one of the most popular means of transportation in China. However, with the surging number of cars on the road, problems regarding traffic control also emerge, such as the increasing traffic violation rates. A single CCTV camera takes over 40,000 pictures per day. In order to increase the efficiency of vehicle regulation, it is necessary to implement a Machine Learning model that can extract and recognize car-plate information from images taken by the CCTV cameras. This project aims at developing an end-to-end Chinese car-plate recognition system, and the model accuracy is at the center of the project.

For the task of detecting car-plates from images, we implement object detection model YOLOv5 proposed by Redmon et al. (2016). YOLOv5 is the fifth version of You Only Look Once, a neural network that predicts bounding boxes and class probabilities directly from full images in one evaluation. The model outputs the coordinates of a bounding box around the target object and it would be suitable for extracting a sub-image of the car-plate as car-plates are mostly in rectangular shape unless largely skewed. We can further implement text recognition tasks on the sub-image of the car-plate.

完整车牌的照片

A standard Chinese car-plate consist of a Chinese character indicating the province (e.g. the character “沪” stands for the city of Shanghai), and a string combination of both numerals and alphabets. In order to achieve both high accuracy and efficiency, we divide the text recognition task into two sub-tasks, Chinese character recognition and numeral/alphabet recognition. The car-plate character is in a specialized font developed by the Ministry of Public Security, and therefore unmatched in common computer systems, so the Chinese character recognition is equivalent to handwritten character recognition rather than machine-printed character recognition.

Preliminary research shows that LeNet-5 convolutional neural network proposed by Yann LeCun et al. achieves high accuracy in handwritten character recognition. And we would apply a modified version of LeNet-5 based on Yann LeCun et al.’s paper from 1998 to recognize the Chinese character.

For numeral and alphabet recognition, we work with the Python package pytesseract which is based on tesseract, a command-line optical character recognition (OCR) program that can read the text contained in pictures.

#### Data preprocessing and augmentation