```python
import pandas as pd
import numpy as np
import torch
import torchvision
import random
from PIL import Image
import cv2
import os
device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
```

```
!pip install evaluate jiwer
```

```
Collecting evaluate
  Downloading evaluate-0.4.0-py3-none-any.whl (81 kB)
━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 81.4/81.4 kB 2.9 MB/s eta
0:00:00
ent already satisfied: huggingface-hub>=0.7.0 in
/opt/conda/lib/python3.7/site-packages (from evaluate) (0.10.1)
Requirement already satisfied: requests>=2.19.0 in
/opt/conda/lib/python3.7/site-packages (from evaluate) (2.28.1)
Requirement already satisfied: xxhash in
/opt/conda/lib/python3.7/site-packages (from evaluate) (3.0.0)
Requirement already satisfied: packaging in
/opt/conda/lib/python3.7/site-packages (from evaluate) (21.3)
Requirement already satisfied: numpy>=1.17 in
/opt/conda/lib/python3.7/site-packages (from evaluate) (1.21.6)
Requirement already satisfied: dill in /opt/conda/lib/python3.7/site-
packages (from evaluate) (0.3.5.1)
Requirement already satisfied: importlib-metadata in
/opt/conda/lib/python3.7/site-packages (from evaluate) (4.13.0)
Requirement already satisfied: responses<0.19 in
/opt/conda/lib/python3.7/site-packages (from evaluate) (0.18.0)
Requirement already satisfied: fsspec[http]>=2021.05.0 in
/opt/conda/lib/python3.7/site-packages (from evaluate) (2022.8.2)
Requirement already satisfied: datasets>=2.0.0 in
/opt/conda/lib/python3.7/site-packages (from evaluate) (2.1.0)
Requirement already satisfied: multiprocess in
/opt/conda/lib/python3.7/site-packages (from evaluate) (0.70.13)
Requirement already satisfied: tqdm>=4.62.1 in
/opt/conda/lib/python3.7/site-packages (from evaluate) (4.64.0)
Requirement already satisfied: pandas in
/opt/conda/lib/python3.7/site-packages (from evaluate) (1.3.5)
Collecting levenshtein==0.20.2
  Downloading Levenshtein-0.20.2-cp37-cp37m-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (1.4 MB)
━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 1.4/1.4 MB 24.1 MB/s eta
0:00:00a 0:00:01
ent already satisfied: rapidfuzz<3.0.0,>=2.3.0 in
/opt/conda/lib/python3.7/site-packages (from levenshtein==0.20.2-
>jiwer) (2.11.1)
Requirement already satisfied: pyarrow>=5.0.0 in
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```
/opt/conda/lib/python3.7/site-packages (from datasets>=2.0.0-
>evaluate) (5.0.0)
Requirement already satisfied: aiohttp in
/opt/conda/lib/python3.7/site-packages (from datasets>=2.0.0-
>evaluate) (3.8.1)
Requirement already satisfied: typing-extensions>=3.7.4.3 in
/opt/conda/lib/python3.7/site-packages (from huggingface-hub>=0.7.0-
>evaluate) (4.1.1)
Requirement already satisfied: pyyaml>=5.1 in
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>evaluate) (6.0)
Requirement already satisfied: filelock in
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>evaluate) (3.7.1)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in
/opt/conda/lib/python3.7/site-packages (from packaging->evaluate)
(3.0.9)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in
/opt/conda/lib/python3.7/site-packages (from requests>=2.19.0-
>evaluate) (1.26.12)
Requirement already satisfied: charset-normalizer<3,>=2 in
/opt/conda/lib/python3.7/site-packages (from requests>=2.19.0-
>evaluate) (2.1.0)
Requirement already satisfied: idna<4,>=2.5 in
/opt/conda/lib/python3.7/site-packages (from requests>=2.19.0-
>evaluate) (3.3)
Requirement already satisfied: certifi>=2017.4.17 in
/opt/conda/lib/python3.7/site-packages (from requests>=2.19.0-
>evaluate) (2022.9.24)
Requirement already satisfied: zipp>=0.5 in
/opt/conda/lib/python3.7/site-packages (from importlib-metadata-
>evaluate) (3.8.0)
Requirement already satisfied: python-dateutil>=2.7.3 in
/opt/conda/lib/python3.7/site-packages (from pandas->evaluate) (2.8.2)
Requirement already satisfied: pytz>=2017.3 in
/opt/conda/lib/python3.7/site-packages (from pandas->evaluate)
(2022.1)
Requirement already satisfied: multidict<7.0,>=4.5 in
/opt/conda/lib/python3.7/site-packages (from aiohttp->datasets>=2.0.0-
>evaluate) (6.0.2)
Requirement already satisfied: async-timeout<5.0,>=4.0.0a3 in
/opt/conda/lib/python3.7/site-packages (from aiohttp->datasets>=2.0.0-
>evaluate) (4.0.2)
Requirement already satisfied: frozenlist>=1.1.1 in
/opt/conda/lib/python3.7/site-packages (from aiohttp->datasets>=2.0.0-
>evaluate) (1.3.0)
Requirement already satisfied: yarl<2.0,>=1.0 in
/opt/conda/lib/python3.7/site-packages (from aiohttp->datasets>=2.0.0-
>evaluate) (1.7.2)
Requirement already satisfied: asynctest==0.13.0 in
```

```
/opt/conda/lib/python3.7/site-packages (from aiohttp->datasets>=2.0.0-
>evaluate) (0.13.0)
Requirement already satisfied: aiosignal>=1.1.2 in
/opt/conda/lib/python3.7/site-packages (from aiohttp->datasets>=2.0.0-
>evaluate) (1.2.0)
Requirement already satisfied: attrs>=17.3.0 in
/opt/conda/lib/python3.7/site-packages (from aiohttp->datasets>=2.0.0-
>evaluate) (21.4.0)
Requirement already satisfied: six>=1.5 in
/opt/conda/lib/python3.7/site-packages (from python-dateutil>=2.7.3-
>pandas->evaluate) (1.15.0)
Installing collected packages: levenshtein, jiwer, evaluate
  Attempting uninstall: levenshtein
    Found existing installation: Levenshtein 0.20.7
    Uninstalling Levenshtein-0.20.7:
      Successfully uninstalled Levenshtein-0.20.7
ERROR: pip's dependency resolver does not currently take into account
all the packages that are installed. This behaviour is the source of
the following dependency conflicts.
python-levenshtein 0.20.7 requires Levenshtein==0.20.7, but you have
levenshtein 0.20.2 which is incompatible.
Successfully installed evaluate-0.4.0 jiwer-2.5.1 levenshtein-0.20.2
WARNING: Running pip as the 'root' user can result in broken
permissions and conflicting behaviour with the system package manager.
It is recommended to use a virtual environment instead:
https://pip.pypa.io/warnings/venv
```

```python
"""Seed everything!"""
random.seed(42)
os.environ['PYTHONHASHSEED'] = str(42)
np.random.seed(42)
torch.manual_seed(42)
torch.cuda.manual_seed(42)
torch.backends.cudnn.deterministic = True
torch.backends.cudnn.benchmark = True
```

Load dataset

Tokenize car numbers

```python
# Get the list of car numbers
def exec_text(path):
    return path[path.find('-') + 1:path.find('.')]

input_dir_train = '/kaggle/input/labtinkoff/CCPD2019-dl1/train'

car_numbers = [exec_text(path) for  path in
os.listdir(input_dir_train)]
```

```python
# Get the alphabet of symbols from all car numbers
seq = ''
for car_number in car_numbers:
    seq += car_number
alphabet = ''
for symbol in sorted(set(seq)):
    alphabet += symbol
alphabet
```

```
'0123456789ABCDEFGHJKLMNOPQRSTUVWXYZ云京冀吉宁川新晋桂沪津浙渝湘琼甘皖粤苏蒙藏豫贵赣辽鄂闽陕青鲁黑'
```

```python
OOV_TOKEN = '<OOV>' # out of vocabulary token
CTC_BLANK = '<BLANK>' # token for ctc matrix
PAD_TOKEN = '<PAD>' # padding token


def get_char_map(alphabet):
    """Make from string alphabet character2int dict.
    Add BLANK char for CTC loss and OOV char for out of vocabulary symbols."""
    char_map = {value: idx + 3 for (idx, value) in enumerate(alphabet)}
    char_map[CTC_BLANK] = 0
    char_map[OOV_TOKEN] = 1
    char_map[PAD_TOKEN] = 2
    return char_map


class Tokenizer:
    """Class for encoding and decoding string word to sequence of int
    (and vice versa) using alphabet."""

    def __init__(self, alphabet):
        self.char_map = get_char_map(alphabet)
        self.rev_char_map = {val: key for key, val in self.char_map.items()}

    def encode(self, word_list):
        enc_words = []
        for word in word_list:
            enc_words.append(
                [self.char_map[char] if char in self.char_map
                 else self.char_map[OOV_TOKEN]
                 for char in word]
            )
        return enc_words

    def get_num_chars(self):
        return len(self.char_map)
    def decode(self, enc_word_list):
        dec_words = []
        for word in enc_word_list:
            word_chars = ''
            for idx, char_enc in enumerate(word):
                if (
                    char_enc != self.char_map[OOV_TOKEN]
                    and char_enc != self.char_map[CTC_BLANK]
                    and not (idx > 0 and char_enc == word[idx - 1])
                ):
                    word_chars += self.rev_char_map[char_enc]
            dec_words.append(word_chars)
        return dec_words

tokenizer = Tokenizer(alphabet)

class Laba_dataset(torch.utils.data.Dataset):
    def __init__(self, root, tokenizer, transform=None):
        self.root = root
        self.transform = transform
        self.tokenizer = tokenizer
        self.img_paths = [os.path.join(self.root, img_path) for
img_path in os.listdir(self.root)]
        self.text = [exec_text(path) for path in
os.listdir(self.root)]
        self.enc_text = self.tokenizer.encode(self.text)

    def __getitem__(self, ind):
        img = Image.open(self.img_paths[ind]) # resize
        if self.transform is not None:
            img = self.transform(img) # make some augmentations
        # return image, encoded_text, source_text
        return (img, torch.LongTensor(self.enc_text[ind]),
self.text[ind])

    def __len__(self):
        return len(self.img_paths)

def collate_fn(batch):
    images, enc_texts, texts = zip(*batch)
    images = torch.stack(images, 0)
    enc_pad_texts = torch.nn.utils.rnn.pad_sequence(enc_texts,
batch_first=True, padding_value=tokenizer.char_map[PAD_TOKEN])
    return images, enc_pad_texts, texts

from sklearn.model_selection import train_test_split
batch_size = 128
transform = torchvision.transforms.Compose([
    torchvision.transforms.Resize((32, 128)),
    torchvision.transforms.RandomRotation(5),
    torchvision.transforms.ColorJitter(),
    torchvision.transforms.GaussianBlur(3),
    torchvision.transforms.ToTensor()
        ])
dataset_full = Laba_dataset(input_dir_train, tokenizer,
transform=transform)
# split full dataset
train_idx, valid_idx =
train_test_split(list(range(len(dataset_full))), train_size=0.9)
dataset = {
    'train': torch.utils.data.Subset(dataset_full, train_idx),
    'valid': torch.utils.data.Subset(dataset_full, valid_idx)
}

dataset_size = {ds: len(dataset[ds]) for ds in ['train', 'valid']}

dataloader = {
    'train': torch.utils.data.DataLoader(
        dataset=dataset['train'], batch_size=batch_size, shuffle=True,
collate_fn=collate_fn
    ),
    'valid': torch.utils.data.DataLoader(
        dataset=dataset['valid'], batch_size=batch_size,
shuffle=False, collate_fn=collate_fn
    ),
}

input_dir_test = '/kaggle/input/labtinkoff/CCPD2019-dl1/test'
batch_size = 128
transform_test = torchvision.transforms.Compose([
    torchvision.transforms.Resize((32, 128)),
    torchvision.transforms.ToTensor()
        ])
dataset_test = Laba_dataset(input_dir_test, tokenizer,
transform=transform_test)
dataloader_test = torch.utils.data.DataLoader(
        dataset=dataset_test, batch_size=batch_size, shuffle=False,
collate_fn=collate_fn
    )
```

```
next(iter(dataloader['train']))[0].shape
```

```
torch.Size([128, 3, 32, 128])
```

```
img = torchvision.transforms.ToPILImage()(dataset_full[173]
[0].squeeze(0))
```

```
img
```

```
dataset_test[122]
```

```
(tensor([[[0.5451, 0.5529, 0.5608,  ..., 0.4157, 0.4118, 0.4706],
          [0.4431, 0.4039, 0.4039,  ..., 0.4157, 0.5020, 0.5647],
          [0.3333, 0.2980, 0.3059,  ..., 0.2353, 0.3137, 0.4353],
          ...,
          [0.3333, 0.3137, 0.2667,  ..., 0.1608, 0.1490, 0.1843],
          [0.3216, 0.3176, 0.3098,  ..., 0.4471, 0.4706, 0.5020],
          [0.3255, 0.3333, 0.3529,  ..., 0.3922, 0.4314, 0.4471]],

         [[0.5059, 0.5059, 0.5059,  ..., 0.4745, 0.4706, 0.5373],
          [0.4275, 0.3686, 0.3608,  ..., 0.5216, 0.6000, 0.6627],
          [0.3569, 0.3020, 0.2980,  ..., 0.3804, 0.4431, 0.5490],
          ...,
          [0.4431, 0.4235, 0.3725,  ..., 0.2353, 0.2392, 0.2824],
          [0.4157, 0.4157, 0.4078,  ..., 0.5255, 0.5647, 0.6000],
          [0.4157, 0.4235, 0.4431,  ..., 0.4784, 0.5255, 0.5412]],

         [[0.6275, 0.6353, 0.6431,  ..., 0.5451, 0.5176, 0.5333],
          [0.5961, 0.5765, 0.6000,  ..., 0.6000, 0.6353, 0.6471],
          [0.5490, 0.5725, 0.6471,  ..., 0.5059, 0.4902, 0.5294],
          ...,
          [0.4314, 0.4471, 0.4510,  ..., 0.2980, 0.2039, 0.2000],
          [0.3882, 0.3922, 0.3922,  ..., 0.5529, 0.5216, 0.5294],
          [0.3922, 0.3961, 0.4118,  ..., 0.4784, 0.4863, 0.4941]]]),
 tensor([54, 13,  5,  8, 33,  8, 12]),
 '皖A25V59')
```

Define model

```
from torch import nn

# To solve the problem, I used the standard CRNN structure

class ResNetBlock(nn.Module):
    def __init__(self, in_channels, out_channels, kernel_size=3,
stride=1, padding=0, dropout=0.15):
        super().__init__()
        self.conv = nn.Conv2d(in_channels, out_channels, kernel_size,
stride, padding, bias=False)
        self.bn = nn.BatchNorm2d(out_channels)
        self.relu = nn.LeakyReLU()
        self.dropout = nn.Dropout(dropout)
        self.downsample = None
        if in_channels != out_channels:
            self.downsample = nn.Conv2d(in_channels, out_channels, 1,
stride=2)

    def forward(self, x, identity=True):
        out = self.dropout(self.bn(self.conv(x)))
        if identity:
            if self.downsample is not None:
                x = self.downsample(x)
            return self.relu(out + x)
        else:
            return self.relu(out)

class CNN(nn.Module):
    def __init__(self, in_channels=1, num_layers=2, dropout=0.1):
        super().__init__()
        """
        As feature extractor i use resnet, passing through the cut the 
images are
        transformed from the dimension tensor (C: 1, W: 128, H: 32) to 
the
        dimension tensor (C: 1, W: 4, H: 1)
        """
        self.start = ResNetBlock(3, 64, 7, 1, 0, 0.0)
        self.maxpool = nn.MaxPool2d(3, 2, 1)
        self.blocks1 = nn.ModuleList([ResNetBlock(64, 64, padding=1) 
for _ in range(num_layers)])
        self.blocks2 = nn.ModuleList([ResNetBlock(64, 128, padding=1, 
stride=2)] + [ResNetBlock(128, 128, padding=1) for _ in 
range(num_layers)])
        self.blocks3 = nn.ModuleList([ResNetBlock(128, 256, padding=1, 
stride=2)] + [ResNetBlock(256, 256, padding=1) for _ in 
range(num_layers)])
        self.blocks4 = nn.ModuleList([ResNetBlock(256, 512, padding=1, 
stride=2)] + [ResNetBlock(512, 512, padding=1) for _ in 
range(num_layers)])
        self.blocks5 = nn.ModuleList([ResNetBlock(512, 1024, 
padding=1, stride=2)] + [ResNetBlock(1024, 1024, padding=1) for _ in 
range(num_layers)])
        self.blocks = [self.blocks1, self.blocks2, self.blocks3, 
self.blocks4, self.blocks5]

    def forward(self, x):
        out = self.maxpool(self.start(x, identity=False))
        for blocks in self.blocks:
            for block in blocks:
                out = block(out)

        return out

class BiLSTM(nn.Module):
    def __init__(self, input_size, hidden_size, num_layers, 
dropout=0.1):
        super().__init__()
        self.lstm = nn.LSTM(
            input_size, hidden_size, num_layers,
            dropout=dropout, batch_first=True, bidirectional=True)
    def forward(self, x):
        out, _ = self.lstm(x)
        return out


class CRNN(nn.Module):
    def __init__(
        self, number_class_symbols, time_feature_count=256,
lstm_hidden=256,
        lstm_len=3,
    ):
        super().__init__()
        self.feature_extractor = CNN(dropout=0.15)
        self.avg_pool = nn.AdaptiveAvgPool2d(
            (time_feature_count, time_feature_count))
        self.bilstm = BiLSTM(time_feature_count, lstm_hidden,
lstm_len, dropout=0.15)
        self.classifier = nn.Sequential(
            nn.Linear(lstm_hidden * 2, time_feature_count),
            nn.GELU(),
            nn.Dropout(0.15),
            nn.Linear(time_feature_count, number_class_symbols)
        )

    def forward(self, x):
        x = self.feature_extractor(x)
        b, c, h, w = x.size()
        x = x.view(b, c * h, w)
        x = self.avg_pool(x)
        x = x.transpose(1, 2)
        x = self.bilstm(x)
        x = self.classifier(x)
        x = nn.functional.log_softmax(x, dim=2).permute(1, 0, 2)
        return x
```

Define accuracy metric for evaluate validation dataset

```
class AverageMeter:
    def __init__(self):
        self.reset()

    def reset(self):
        self.avg = 0
        self.sum = 0
        self.count = 0

    def update(self, val, n=1):
        self.sum += val * n
        self.count += n
        self.avg = self.sum / self.count
```

```
def get_accuracy(y_true, y_pred):
    scores = []
    for true, pred in zip(y_true, y_pred):
        scores.append(true == pred)
    avg_score = np.mean(scores)
    return avg_score
```

Training loop

```
import pickle as pkl

def safe(obj, filename):
    with open(filename, 'wb') as outp:
        pkl.dump(obj, outp)

def read(filename):
    with open(filename, 'rb') as inp:
        return pkl.load(inp)

def weights_init(m):
    classname = m.__class__.__name__
    if type(m) in [nn.Linear, nn.Conv2d, nn.Conv1d]:
        torch.nn.init.xavier_uniform_(m.weight)
        if m.bias is not None:
            m.bias.data.fill_(0.01)
    elif classname.find('BatchNorm') != -1:
        m.weight.data.normal_(1.0, 0.02)
        m.bias.data.fill_(0)

def val_loop(data_loader, model, tokenizer, device):
    acc_avg = AverageMeter()
    for images, enc_texts, texts in data_loader:
        batch_size = len(texts)
        text_preds = predict(images, model, tokenizer, device)
        acc_avg.update(get_accuracy(texts, text_preds), batch_size)
    print(f'Validation, acc: {acc_avg.avg:.4f}')
    return acc_avg.avg

def predict(images, model, tokenizer, device):
    model.eval()
    images = images.to(device)
    with torch.no_grad():
        output = model(images)
    pred = torch.argmax(output.detach().cpu(), -1).permute(1,
0).numpy()
    text_preds = tokenizer.decode(pred)
    return text_preds

def val_loop_ensemble(data_loader, models, tokenizer, device):
    acc_avg = AverageMeter()
    for images, enc_texts, texts in data_loader:
        batch_size = len(texts)
        text_preds = predict_ensemble(images, models, tokenizer,
device)
        acc_avg.update(get_accuracy(texts, text_preds), batch_size)
    print(f'Validation, acc: {acc_avg.avg:.4f}')
    return acc_avg.avg

def predict_ensemble(images, models, tokenizer, device):
    [model.eval() for model in models]
    images = images.to(device)
    with torch.no_grad():
        output = sum([model(images) for model in models]) /
len(models)
    pred = torch.argmax(output.detach().cpu(), -1).permute(1,
0).numpy()
    text_preds = tokenizer.decode(pred)
    return text_preds

def train_loop(data_loader, model, criterion, optimizer, epoch):
    loss_avg = AverageMeter()
    model.train()
    for images, enc_texts, texts in data_loader:
        model.zero_grad()
        images = images.to(device)
        batch_size = len(texts)
        output = model(images)
        output_lenghts = torch.full(
            size=(output.size(1),),
            fill_value=output.size(0),
            dtype=torch.long
        )
        text_lens = torch.LongTensor([len(text) for text in texts])
        loss = criterion(output, enc_texts, output_lenghts, text_lens)
        loss_avg.update(loss.item(), batch_size)
        loss.backward()
        torch.nn.utils.clip_grad_norm_(model.parameters(), 2)
        optimizer.step()
    for param_group in optimizer.param_groups:
        lr = param_group['lr']
    print(f'\nEpoch {epoch}, Loss: {loss_avg.avg:.5f}, LR: {lr:.7f}')
    return loss_avg.avg

def train(dataloader, epochs):
    train_loader, val_loader = dataloader['train'],
dataloader['valid']
    model = CRNN(number_class_symbols=tokenizer.get_num_chars())
    model.apply(weights_init)
    model.to(device)
    criterion = torch.nn.CTCLoss(blank=0, reduction='mean',
zero_infinity=True)
    optimizer = torch.optim.AdamW(model.parameters(), lr=0.001,
                                  weight_decay=0.01)
    scheduler = torch.optim.lr_scheduler.ReduceLROnPlateau(
        optimizer=optimizer, mode='max', factor=0.5, patience=5)
    best_acc = -np.inf
    acc_avg = val_loop(val_loader, model, tokenizer, device)
    for epoch in range(epochs):
        loss_avg = train_loop(train_loader, model, criterion,
optimizer, epoch)
        acc_avg = val_loop(val_loader, model, tokenizer, device)
        scheduler.step(acc_avg)
        if acc_avg > best_acc:
            best_acc = acc_avg
        safe(model, f'model_{epoch}')
```

```
train(dataloader, 8)
```

```
Validation, acc: 0.0000

Epoch 0, Loss: 1.52695, LR: 0.0010000
Validation, acc: 0.8252

Epoch 1, Loss: 0.08662, LR: 0.0010000
Validation, acc: 0.9335

Epoch 2, Loss: 0.05117, LR: 0.0010000
Validation, acc: 0.9433

Epoch 3, Loss: 0.03628, LR: 0.0010000
Validation, acc: 0.9570

Epoch 4, Loss: 0.03567, LR: 0.0010000
Validation, acc: 0.9253

Epoch 5, Loss: 0.03618, LR: 0.0010000
Validation, acc: 0.9701

Epoch 6, Loss: 0.02495, LR: 0.0010000
Validation, acc: 0.9591

Epoch 7, Loss: 0.02684, LR: 0.0010000
Validation, acc: 0.9676
```

```
model = read('/kaggle/working/model_5') # load model with best acc on
validation
```

```
img, enc_label, label = dataset_full[2001]
```

```
pred = predict(img.unsqueeze(0).to(device), model, tokenizer, device)
# sample pred
pred
```

```
['皖KLJ029']
```

```
real_img = torchvision.transforms.ToPILImage()(img)
real_img
```

Compute metrics

```
from evaluate import load
cer = load("cer")
```

```
{"version_major":2,"version_minor":0,"model_id":"15cd030f4c6147509acee
f3bae3b6bf2"}
```

```
references = dataset_test.text
```

```
predictions = []
for imgs, enc_text, text in dataloader_test:
    predictions += predict(imgs, model, tokenizer, device)
```

```
cer.compute(predictions=predictions, references=references)
```

```
0.008486562942008486
```

```
len(references) == len(predictions)
```

```
True
```

```
errors = {} # dict of errors {predictions: references}
for pred, refer in zip(predictions, references):
    if cer.compute(predictions=[pred], references=[refer]) != 0.0:
        errors[pred] = refer
```

```
errors
```

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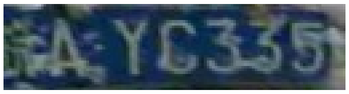
 '沪C7VV26': '浙C7VV26',
 '皖AF619': '皖ACF619',
 '粤S8Y585': '豫S8Y585',
 '浙EH4B78': '鄂EH4P78',
 '浙AM062J': '晋AM062J',
 '苏A3B5G5': '苏A3B8G5',
 '皖NA2S56': '皖NA2556',
 '皖AG838U': '皖AG838D',
 '皖A83927': '皖A83922',
 '赣GVY921': '豫GVY921',
 '皖AX442X': '皖AX447X',
 '皖A26': '皖ADD226',
 '沪C9HH82': '浙C9HH82',
 '鄂A0450D6': '苏D750D6',
 '皖AX83DR': '皖AX830R',
 '苏DB809J': '苏DR809J',
 '皖AAG490': '皖AAR490',
 '京N89N13': '豫N89N13',
 '苏E48F88': '赣E48F88',
 '皖A952D2': '皖A952U2',
 '苏DB7208': '苏DR7208',
 '浙DQ7222': '渝DQ7222',
 '皖CJ0001': '闽CJ0001',
 '浙G06B57': '浙C06BS7'}
```

As we can see, the model is most wrong on Chinese characters, I tried to fix it with augmentations, but still there are numbers on which the model is wrong

```
key_err_0 = list(errors.values())[0]
```

```
ind_err_0 = dataset_test.text.index(key_err_0)
```

```
torchvision.transforms.ToPILImage()(dataset_test[ind_err_0][0])
```



```
list(errors.keys())[0]
```

```
'苏AYC335'
```

```
key_err_0
```

```
'皖AYC335'
```

```
acc_avg = val_loop(dataloader_test, model, tokenizer, device)
```

```
Validation, acc: 0.9533
```

```
acc_avg
```

```
0.9532953295329533
```