```python
import pdb
import torch
import torchvision.transforms as transforms
import torch.utils.data as data
import os
import pickle
import numpy as np
import nltk
from PIL import Image
from build_vocab import Vocabulary
from pycocotools.coco import COCO


class CocoCaptionDemo(data.Dataset):
    """COCO Custom Dataset compatible with torch.utils.data.DataLoader."""
    def __init__(self, root, json, vocab, transform=None):
        """Set the path for images, captions and vocabulary wrapper.

        Args:
            root: image directory.
            json: coco annotation file path.
            vocab: vocabulary wrapper.
            transform: image transformer.
        """
        super(CocoCaptionDemo, self).__init__()
        self.root = root
        self.coco = COCO(json)
        self.ids = list(self.coco.anns.keys())
        self.vocab = vocab
        self.transform = transform

    def __getitem__(self, index):
        """Returns one data pair (image and caption)."""
        coco = self.coco
        vocab = self.vocab
        ann_id = self.ids[index]
        caption = coco.anns[ann_id]['caption']
        img_id = coco.anns[ann_id]['image_id']
        path = coco.loadImgs(img_id)[0]['file_name']

        image = Image.open(os.path.join(self.root, path)).convert('RGB')
        if self.transform is not None:
            image = self.transform(image)

        # Convert caption (string) to word ids.
        cap_string = str(caption).lower()
        tokens = nltk.tokenize.word_tokenize(cap_string)
        caption = []
        caption.append(vocab('<start>'))
        caption.extend([vocab(token) for token in tokens])
        caption.append(vocab('<end>'))
        target = torch.Tensor(caption)
        return image, target, cap_string

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


def caption_collate_fn(data):
    """Creates mini-batch tensors from the list of tuples (image, caption).
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61
62      We should build custom collate_fn rather than using default
    collate_fn,
63      because merging caption (including padding) is not supported in
    default.
64
65      Args:
66          data: list of tuple (image, caption).
67              - image: torch tensor of shape (3, 256, 256).
68              - caption: torch tensor of shape (?); variable length.
69
70      Returns:
71          images: torch tensor of shape (batch_size, 3, 256, 256).
72          targets: torch tensor of shape (batch_size, padded_length).
73          lengths: list; valid length for each padded caption.
74      """
75      # Sort a data list by caption length (descending order).
76      data.sort(key=lambda x: len(x[1]), reverse=True)
77      images, captions, cap_string = zip(*data)
78
79      # Merge images (from tuple of 3D tensor to 4D tensor).
80      images = torch.stack(images, 0)
81
82      # Merge captions (from tuple of 1D tensor to 2D tensor).
83      lengths = [len(cap) for cap in captions]
84      targets = torch.zeros(len(captions), max(lengths)).long()
85      for i, cap in enumerate(captions):
86          end = lengths[i]
87          targets[i, :end] = cap[:end]
88      return images, targets, lengths, cap_string
89
90  def get_loader(root, json, vocab, transform, batch_size, shuffle,
    num_workers):
91      """Returns torch.utils.data.DataLoader for custom coco dataset."""
92      # COCO caption dataset
93      coco = CocoDataset(root=root,
94                         json=json,
95                         vocab=vocab,
96                         transform=transform)
97
98      # Data loader for COCO dataset
99      # This will return (images, captions, lengths) for each iteration.
100     # images: a tensor of shape (batch_size, 3, 224, 224).
101     # captions: a tensor of shape (batch_size, padded_length).
102     # lengths: a list indicating valid length for each caption. length is
    (batch_size).
103     data_loader = torch.utils.data.DataLoader(dataset=coco,
104                                               batch_size=batch_size,
105                                               shuffle=shuffle,
106                                               num_workers=num_workers,
107                                               collate_fn=collate_fn)
108     return data_loader
```