EEEM071 Advanced Topics in Computer Vision and Deep Learning Coursework Assignment (Spring 2024)

Vehicle Re-identification

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Deadline: 4:00PM, Wednesday 1st May 2024 (Week 10)

What to submit: You should submit a single PDF-format report, along with the running evidence, *e.g.*, the log file. You must format your submission using the provided `template` (see SurreyLearn) and convert the final report to the PDF format for submission.

This coursework is worth **25%** of overall mark for EEEM071

1 Introduction

Vehicle re-identification (Re-ID) is a challenging computer vision task that aims to match vehicle images captured from non-overlapping camera views. The goal is to identify the same vehicle instance across multiple camera views, which can be useful for traffic management and law enforcement applications. Vehicle Re-ID has several challenges, including variations in viewpoint, illumination, occlusion, and camera hardware differences. Researchers have proposed various approaches to tackle these challenges, including deep learning-based methods that leverage powerful feature representations to match similar vehicles. The performance of vehicle Re-ID has improved significantly in recent years, but it remains an active area of research due to its practical importance and technical difficulty.

The purpose of this coursework is to gain real-world development experience in design, training, and evaluation of a Convolution Neural Network (CNN) for vehicle Re-ID. This will be achieved through the Google Colab with PyTorch as the framework.

1.1 Required Resources for this Coursework

To do this coursework you will need to connect to Google Colab. Please refer to your lab sheets of **W5-W10** for more tutorials.

1.2 Getting Started

To better understand the motivation, definition, basic methods, and evaluation metrics of Re-ID, we suggest reading these two surveys before you start:

- Deep Learning for Person Re-Identification: A Survey and Outlook [3] (In particular, Sec.1 Introduction and Sec.2 Closed-World Person Re-Identification)
- Trends in Vehicle Re-Identification Past, Present, and Future: A Comprehensive Review [1] (In particular, Sec.1.3 Re-Identification, Sec.2.4 Vision-Based Vehicle Re-Identification and Sec.3 Vision-Based State-of-the-Art Vehicle Re-Identification Approaches)

We have lab sessions provided on the tutorial of PyTorch to train and test CNNs for image classification, coupled with knowledge from the associated lectures. The PyTorch Introductory lab sheet and the lecture slides from these sessions remain available on SurreyLearn in case you missed any classes. All these are helpful for this coursework assignment.

1.3 Support for Coursework Starting

We have provided a reference code base in this Github repo and a Colab demo to show how to start. For any problems, please feel free to open an issue.

1.4 Lab Support

Lab sessions on Monday and Tuesday afternoons are there to assist you with the coursework. The labs are in-person and run by Dr. Eddy Zhu (xiatian.zhu@surrey.ac.uk) with the help of four lab demonstrators Al-Hussein Abutaleb (a.abutaleb@surrey.ac.uk), Swapnil Bhosale (s.bhosale@surrey.ac.uk), Anindya Mondal (a.mondal@surrey.ac.uk), Haosen Yang (h.yang@surrey.ac.uk).

Again, you may find detailed schedule for these labs in your timetable - you only need to attend one of the two scheduled labs per week.

2 Deliverables

You must run your project in the Colab to undertake the task in this coursework. For the report, you must document the experiments performed using your software; You should detail the method used and the numerical and qualitative results (**including the running evidence**). The University has moved to **electronic submission of the coursework on SurreyLearn**.

3 Learning Outcomes

After completing this coursework along with the designated lectures, you should be able to:

1. **Design** and **implement** a convolutional neural network for vehicle Re-ID.
2. **Apply** appropriate training strategies to learn a discriminative CNN for representation learning.
3. **Conduct** a scientific investigation into fine-grained image retrieval systems in general.

4 Plagiarism

You must complete this coursework individually. If you copy code or text from the web, or another student, and include it in your project without clear attribution, then you have committed plagiarism. Undetected plagiarism degrades the quality of your degree, as it interferes with our ability to assess you and prevents you learning through properly attempting the coursework. Consequently if we suspect plagiarism you will referred to an Academic Misconduct Panel which may carry with it academic sanctions.

5 Main Assignment Tasks

During this project, we will walk you through a series of experiments in the use of CNNs for an image retrieval (e.g., vehicle re-identification) problem. Some of the main tasks are:

1. First, you need to run the demo code successfully without error and make sure fully understand every line of code.
2. You should experiment with different CNN architectures to see which gives you the highest performance. This might include the use of existing architectures (like ResNet) or modified versions of those architectures (*optional*).
3. You should experiment with different hyper-parameters, *e.g.*, those parameters such as the learning rate, weight decay, optimizer and etc. you vary for model training.

6 Dataset Choice

We provide a dataset (VeRi) for this coursework [2]. It contains over 50,000 images of 776 vehicles captured by 20 cameras covering a 1.0 km^2 area in 24 hours, which makes the dataset scalable enough for vehicle Re-ID research.

6.1 Dataset Access

Cloud link: https://drive.google.com/file/d/1TfGT84sEv-KBXOwi735_ECr7gjTyCJNz/view?usp=sharing

Please don't distribute this dataset or use it for any other purposes.

7 Starting Early!

It takes quite time to train a CNN model. Training a ResNet will take time depending on the GPU resource. You should start this coursework early to reduce stress level for making the deadline.

8 Submission Guidance

To format your report submission, please strictly follow the provided word report template. To make the structure of report clear, you are suggested to cover the marking points one by one.

Except the report, **the log file** for model training and evaluation (as mentioned in each question) is needed for submission. Note, the code base we provide can generate the log file.

You need to convert your final report into the **PDF** format for submission.

9 Feedback

In line with University regulations, you will receive feedback within 3 teaching weeks of the deadline for this coursework. This will comprise an overall mark and some written feedback against each of the criteria in Section 8.

10 Extensions

No extensions will be granted to this coursework unless in exceptional circumstances. Even then, extension requests must be made via the Extenuating Circumstances (ECs) process as your lecturer is not permitted to grant adhoc extension requests whatever the reason.

References

[1] Jianhua Deng, Yang Hao, Muhammad Saddam Khokhar, Rajesh Kumar, Jingye Cai, Jay Kumar, and Muhammad Umar Aftab. Trends in vehicle re-identification past, present, and future: A comprehensive review. *Mathematics*, 9(24):3162, 2021. 2

[2] Xinchen Liu, Wu Liu, Huadong Ma, and Huiyuan Fu. Large-scale vehicle re-identification in urban surveillance videos. In *International Conference on Multimedia and Expo (ICME)*. IEEE, 2016. 3

[3] Mang Ye, Jianbing Shen, Gaojie Lin, Tao Xiang, Ling Shao, and Steven CH Hoi. Deep learning for person re-identification: A survey and outlook. *IEEE transactions on pattern analysis and machine intelligence*, 44(6):2872–2893, 2021. 2