ECE 720 Assignment Hands-on Project 2

Assignment 2 due on March 4, 2022, 11:59 PM MST.

Late Submission Policy: 3 free late days, then **10%** off per day late.

1 Introduction

In the last assignment, we've explored the automated testing method *Randoop* on traditional software. In this assignment, we will explore how to design testing method for deep learning models. Before working on the assignment, it is highly recommended to read two related work: DeepGauge [1] and DeepHunter [2]. Note that basic knowledge about Python programming is required for finishing this assignment.

2 Environment Setup

In this assignment, we **highly recommend** you to use Google Colaboratory, so that you don't have to install anything on your own PC or laptop. The DL framework used in this assignment is PyTorch.

To set up the environment for assignment 2, simply upload the given `HW2.ipynb` file to Google Colab, then run the notebook according to the given.

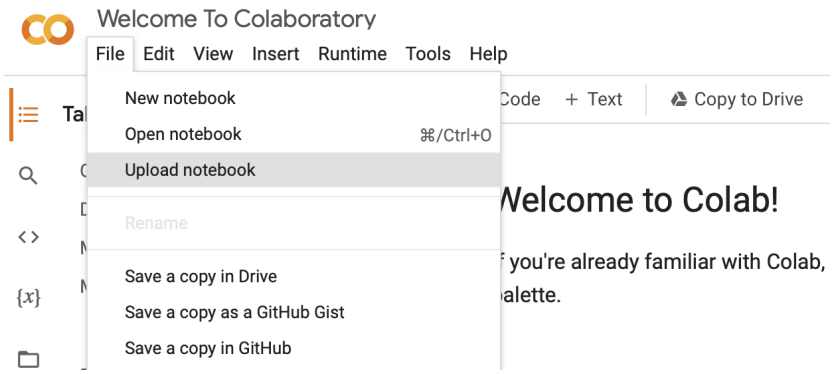

Figure 1: Upload a notebook to Google Colab

If you want to set up the environment on your own computers, here are the prerequisites (only these settings have been tested).

Python	≥ 3.7
opencv-python	4.1.2.30
PyTorch	1.10.0
torchvision	0.11.1

Table 1: Prerequisites

3 Assignment Objectives

Please follow the detailed requirements of each question in the notebook.

1. [4 points] The difference between traditional software and AI model
   - 1.1 [2 points] Please summarize the characteristics of traditional software and compare it to AI model
   - 1.2 [2 points] Please summarize the characteristics of AI model and compare it to traditional software
2. [13 points] Quality assurance of DL models
   - 2.1 [7 points] Testing metric
     - [3 points] Profile the DNN on training data
     - [4 points] Implement Neuron Boundary Coverage
   - 2.2 [6 points] Mutation
     - [2 points] Answer the question: For all images returned in Algorithm 2, how many mutations are applied for each image if the success flag is True ? How does sequential mutations done in DeepHunter?
     - [4 points] Complete Algorithm 2
3. [3 points] Experiments
   - 3.1 Set up experiments on mutation testing.

4 Submission Guidelines

You need to submit this assignment as a zip file (.zip) containing: 1) notebook (keep all output cells), and 2) project report via eClass. **In the project report, please screenshot all TODO code blocks.** The zip file's name should be `[First name]_[Student ID]_asg2.zip` . Please keep the exact same file structure as the following. For example,

```
zhijie_1234567_asg2.zip
├── HW2.ipynb
└── report.pdf
```

Please note that questions regard submission should first be directed to the TA.

References

[1] Ma, L., Juefei-Xu, F., Zhang, F., Sun, J., Xue, M., Li, B., Chen, C., Su, T., Li, L., Liu, Y., et al. Deepgauge: Multi-granularity testing criteria for deep learning systems. In *Proceedings of the 33rd ACM/IEEE International Conference on Automated Software Engineering* (2018), pp. 120–131.

[2] Xie, X., Ma, L., Juefei-Xu, F., Xue, M., Chen, H., Liu, Y., Zhao, J., Li, B., Yin, J., and See, S. Deephunter: a coverage-guided fuzz testing framework for deep neural networks. In *Proceedings of the 28th ACM SIGSOFT International Symposium on Software Testing and Analysis* (2019), pp. 146–157.

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"Integrity is doing the right thing, even when no one is watching"
C. S. Lewis

Engineering at Alberta