WEIJIA CAI

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Department of Civil and Environmental Engineering, Carnegie Mellon University

EDUCATION

Carnegie Mellon University Pittsburgh, Pennsylvania

Master of Science in *Civil and Environmental Engineering* Aug 2019 – Dec 2020

- GPA: 3.52/4.00
- Awards: Civil Engineering Department Scholarship (2019-2020)
- Related courses: Introduction to Machine learning(10601), Introduction to Deep learning(11785), Probabilistic and Mathematical Statistic(36700), Engineering Optimization(24785), Data Analytics for Engineered Systems(12709), BIM for Engineering, Construction and Facility Management(12711).

Jilin University Changchun, Jilin, China

Bachelor of Engineering in *Engineering Geology* Sept 2015 – Jul 2019

- Overall GPA: 3.41/4.00, 86.2/100.0

Taiwan National Central University Taoyuan, Taiwan, China

Exchange student in the *Civil Engineering Department* Sept 2017 – Jan 2018

- Overall GPA: 3.73/4.00, 87.6/100.0

PUBLICATION

XU Shubing, ZHANG Xiaopei, **CAI Weijia**. Application of Seismic Refraction Tomography and High Density Resistivity Method in Tunnel Exploration[J]. Subgrade Engineering, 2019, (1): 163-167. doi:10.13379/j.issn.1003-8825.2019.01.33

WANG Yan-long, DU Li-zhi, HE Sai, **CAI Wei-jia**,(2018). Application of logistic regression model in slope stability analysis[J]. Global Geology, 2018,37(03):945-951.

RESEARCH EXPERIENCE

Research Assistant in SWARM Lab Aug 2020 - present

with professor Pingbo Tang

A context-based framework for recognizing the criticalities of bridge components

- Analysed potential factors that influenced the importance measurement of the bridge components.
- Designed and performed experiments to exam the effectiveness of the potential factors including mechanical factors and geometric factors.
- Updated the self-built FEM library to be extensive to more structural models.

Research Assistant in the Summer Research Program, CEE, CMU Jun 2020 – Jul 2020

with Professor Pingbo Tang

Valuable Data Preservation of Drone-generated Data for bridge inspection

- Designed a framework for filtering the less important image data and for updating the historical defects records.
- Created an integrated system in Python for data preprocessing, simulation function, and data visualization.
- Built a Python library for 2D Finite Element Model (FEMpy), enabling customized mesh inputs and designed a suitable loss function for information loss evaluation.

PROFESSIONAL EXPERIENCES

Carnegie Mellon University Pittsburgh, PA, USA

Grader Sept 2020 - Dec 2020

- Discussed with the lecturer and TAs about the content of assignments and allocated every course assignment grading.

Guangdong Institute of Intelligent Manufacturing Guangzhou, Guangdong, China

Intern Jan 2018 – Mar 2018

- Developed an interface that can detect faces by catching dynamic images from a camera.
- Processed images using modules in OpenCV. Trained AdaBoost classifiers and cascade classifiers using HAAR-like features.

ACADEMIC PROJECTS

Course projects of Computer Vision (16720 at CMU) Sept 2020 - Dec 2020

- Scene classification: implemented Spatial Pyramid Matching using features extracted from four different tuned filters; used the bag-of-words strategy to categorize the classes.

- Augmented Reality: found corresponding points between two images using BRIEF descriptor; search the best homography between the images using RANSAC with fine-tuned parameters; replaced the original object in a video with another video.
- Object Tracking: implemented two versions of Lucas-Kanade tracking including forwarding additive using the previous frame as a template, inverse composition with templated correction; implemented subtraction motion tracking.
- 3D Reconstruction: estimated the fundamental matrix using eight-point corresponding and RANSAC; implemented triangulate and chose the best corresponding homography matrix for the second camera.

Course projects of *Introduction to Deep Learning* (11785 at CMU) Jan 2020 – Mar 2020

- Handwriting Number Recognition on MNIST: Implemented a Multi-Layer Perceptron (MLP) model based on the NumPy based library, including useful activations, loss criteria, and batch normalization; achieved a 95% accuracy.
- Frame-level Speech recognition on WSJ0 Dataset: built a six-layer MLP within AWS services platform; adjusted the hyperparameters of the network using techniques such as callback function, scheduling learning rate, and ensemble method; achieved an accuracy of 63.4 % ranked as A level among the class.
- Implemented distributed scanning MLP architecture using self-built 1D Convolutional layer function using Numpy.
- Face Recognition: Designed a CNN model based on ResNet34 to do classification a task with 2300 classes of the human face and achieved an accuracy of 79.4%, ranked 14/300 in Kaggle in-class competition.
- Face Verification: implemented an open-set protocol human face verification using Cosine Similarity; achieved an AUC score of 92.2%.
- Language generation on WikiText-two language modeling Dataset: built RNN cell and GRU cell as the basics of the language model; applied locked Dropout and weight tying to the model as regularization.
- Language Generation on WSJ0 Dataset: built a probabilistic language model based on the LAS model; implemented the QKV Attention mechanism with static Teacher Forcing; achieved an average Levenshtein distance of 9.81 which ranked A in the class.

Course Projects of *Introduction to Machine Learning* (10601 in CMU) Aug 2019 – Dec 2019

- Political party Identifier: Constructed a political party classifier by implementing a Decision Tree algorithm based on Mutual Information as a decision threshold in Python.
- Polarity analysis on Movie Review Polarity dataset challenge: combined Bag-of-Words Model and Binary Logistic Regression in Python to predict whether a comment of a movie is positive or negative; achieved an accuracy of 85%.
- Word Order Decoding: implemented a first-order Hidden Markov Model using the Viterbi algorithm as a decoding paradigm to predict tag sequences from word sequences.
- MountainCar-v0: built a Q-learning model with Q value approximated by linear regression; accomplished the challenge within 5 epochs.

Course Project of *Data Analytics in Engineered Systems* (12709) Aug 2019 – Dec 2019

Data Analysis and Interpretation of EMS Incident Dispatch Data in NYC Opendata

- Made an EDA of the million-level dataset and cleaned abnormal data such as NULL values and outliers using R module and Tableau Prep.
- Proposed three research questions one of which inferred the relationship between EMS response time and ineffective call.
- Used R square test to evaluate the dependency of EMS response time on ineffective calls.

Undergraduate Dissertation Mar 2019 – Jun 2019

Design of Genetic Algorithm applied to Analysis of Slope Stability

- Analyzed the Geological characteristics of a foundation of a high-rise building and extracted the related data.
- Designed a framework for the implementation of the Genetic Algorithm in the field of Slope Analysis.
- Combined the genetic algorithm with Limit Analysis which helps reduce 1.5 times of the cost estimation by confirming a more precise sliding plane.

Jilin University Open Innovation Experiment Project Apr 2017 – Jun 2017

Remote Control Car Model

- Designed a single-chip system (51 single chip) and assembled it into a car model.
- Implemented a decoding algorithm in C language to recognize the NEC IR Protocol for controlling the car's moving.

EXTRACURRICULAR ACTIVITIES

Education Without Barriers Oct 2018 – Oct 2019

Group Member at The Technical Team of the Publicity Department

- Designed a database management system using Access. Composed a technical manual about the use of DingTalk APP.
- Organized database of faculty information and donations. Registered new email addresses for Zoom VIP account for online teaching.