MSDA Capstone Topic Approval Form

Student Name: Brittany Kozura

Capstone Project Name: Image & Video Frame Classification - Identifying Hand Shape In American Sign Language Interactions

Project Topic: Image Classification using Convolutional Neural Networks

Research Question: To what extent can hand shape be accurately classified from images?

Hypothesis: Images can be classified with 90% accuracy using Convolutional Neural Networks.

Context: A company that owns a video streaming platform wants to create closed captioning from ASL videos. In pursuit of an application that can apply NLP techniques to sign language, the first step in the process is to classify hand shape in an individual video frame/image. We are to create a model that classifies hand shapes as a proof-of-concept for such a system.

Data : 27,000 images of hands displaying ASL alphabet shapes. This is a synthesized set of images created by Lexset (https://www.lexset.ai/), which has been released under a CC BY-NC (Creative Commons Attribution-NonCommercial 4.0 International) license in order to promote their synthetic data generation software platform product "Seahaven" which was used to create the data set.

Data Gathering: Data will be obtained from an open source repository. Data will be split into Training and Testing sets, with images divided into folders of their classifications.

Data Analytics Tools and Techniques: The data analysis technique that will be used to classify the images is a Convolutional Neural Network using Keras/Tensorflow.

Justification of Tools/Techniques: CNNs are an industry standard in image classification analyses because they perform "phenomenally well on computer vision tasks" (Rizvi, 2022). Instead of the analyst identifying the key features of the classes of images, CNNs break down image data into a three-dimensional matrix representing color components per pixel and "'learns' how to extract these features, and ultimately infer what object they constitute" (Google Developers, 2022). Because the network learns from the raw data rather than be interpreted by the analyst, the network is capable of determining which features are most important and even identify features a human analyst could not.

Application type (select one: Mobile, Web, Stand-alone **):** **Stand-alone**
Analysis can be accessed on desktop via download to run in RStudio or viewed on the web as html R Notebook.

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Programming/development language(s) you will use:
R version 4.2.1,
Python v3.8.13 (through R's Reticulate library)

Operating System(s)/Platform(s) you will use:
Windows 11 (Via Azure Virtual Machine)
RStudio Desktop
Anaconda/Miniconda

Database Management System you will use: Data consists of images, held on SSD and accessed through RStudio and Windows File Explorer

Project Outcomes:
The goal of this project is to demonstrate the feasibility of identifying hand shape using a CNN that can be used in natural language processing of ASL and other applications.
The following deliverables should be achieved by this project:
1) Image data set divided into training and test set, which are further sorted into folders based on class
2) A complete CNN model that predicts an image's class
3) The training plot for model loss-accuracy over time
4) An analysis on the accuracy of the CNN model
5) An example of the CNN model's predictions
6) A detailed report outlining the analysis steps and outcomes
7) A presentation of the analysis
8) An executive summary of analysis

Projected Project End Date: Sept 28th

Sources:
   Chollet François, Kalinowski, T., & Allaire, J. J. (2022). *Deep learning with R*. Manning.

   Google Developers. (2022, July 18). *ML Practicum: Image Classification | machine learning | google developers*. Google Developers. Retrieved August 2, 2022, from https://developers.google.com/machine-learning/practica/image-classification/convolutional-neural-networks

   Rizvi, M. S. Z. (2020, October 19). *CNN image classification: Image Classification using CNN*. Analytics Vidhya. Retrieved August 23, 2022, from https://www.analyticsvidhya.com/blog/2020/02/learn-image-classification-cnn-convolutional-neural-networks-3-datasets/

INFORM INSTRUCTOR OF:
Potential use of human subjects (Y/N): **No**
Potential use of proprietary company information (Y/N): **No**

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