OHN1 — OHN1 TASK 1: NEURAL NETWORKS

ADVANCED ANALYTICS — D604
PRFA — OHN1

COMPETENCIES

4164.1.1 : Applies Neural Networks

The learner applies neural networks to solve a business problem.

4164.1.2 : Applies Natural Language Processing

The learner applies natural language processing to solve a business problem.

INTRODUCTION

Throughout your career in data analytics, you will assess continuous data sources for their relevance to specific research questions. Organizations use datasets to analyze their operations. Organizations may use these datasets in many ways to support their decision-making processes.

In your previous work, you explored a variety of supervised and unsupervised data mining models. You have seen the power of using data analysis techniques to help organizations make data-driven decisions, and you will now extend these models into areas of machine learning and artificial intelligence.

In this task, you will explore the use of neural networks to solve a business problem. You will choose between three different datasets and associated scenarios. You will build a neural network that is designed to learn data in the form of images, audio, or video using computer vision techniques. You will provide visualizations and a report, and you will build your network in an interactive development environment.

SCENARIO

As a data scientist, you will assess various types of data sources for their relevance to specific research questions throughout your career. The organizations related to the given datasets seek to analyze their operations and have collected variables of possible use to support decision-making processes.

For this task, choose **one** of the scenarios provided in the attachments: "Audio Scenario," "Image Scenario," or "Video Scenario." Each scenario has associated CSV files. You will complete this performance assessment in the provided WGU virtual lab environment provided by Cloud Academy. Your submission will be a design document that includes screenshots of your work in the virtual lab environment.

Artifacts must be submitted as a report generated using an industry-relevant interactive development environment (e.g., an R Markdown document, a Jupyter Notebook). Inc

the PDF or HTML document of your executed notebook presentation.

Note: The virtual IDE for this assessment is either Anaconda or RStudio, depending on which language you decide to use to complete the task. Please use the "WGU Virtual Lab Environment" web link below.

REQUIREMENTS

Your submission must represent your original work and understanding of the course material. Most performance assessment submissions are automatically scanned through the WGU similarity checker. Students are strongly encouraged to wait for the similarity report to generate after uploading their work and then review it to ensure Academic Authenticity guidelines are met before submitting the file for evaluation. See Understanding Similarity Reports for more information.

Grammarly Note:
Professional Communication will be automatically assessed through Grammarly for Education in most performance assessments before a student submits work for evaluation. Students are strongly encouraged to review the Grammarly for Education feedback prior to submitting work for evaluation, as the overall submission will not pass without this aspect passing. See Use Grammarly for Education Effectively for more information.

Microsoft Files Note:
Write your paper in Microsoft Word (.doc or .docx) unless another Microsoft product, or pdf, is specified in the task directions. Tasks may not be submitted as cloud links, such as links to Google Docs, Google Slides, OneDrive, etc. All supporting documentation, such as screenshots and proof of experience, should be collected in a pdf file and submitted separately from the main file. For more information, please see Computer System and Technology Requirements.

You must use the rubric to direct the creation of your submission because it provides detailed criteria that will be used to evaluate your work. Each requirement below may be evaluated by more than one rubric aspect. The rubric aspect titles may contain hyperlinks to relevant portions of the course.

Refer to the data provided in the attachments to inform your work.

Note: Written responses need to be submitted through EMA.

Part I: Research Question

Note: Your responses to the task prompts must be provided in a document file. Unless otherwise specified, responses to PA requirements that are included in a Python or RStudio notebook will not be accepted.

A. Select **one** of the scenarios and describe the purpose of this data analysis by doing the following:
   1. Provide **one** research question that you will answer using neural network models and computer vision techniques. Be sure the research question is relevant to a real-world organizational situation related to the images, video, and audio captured in your chosen dataset.
   2. Define the objectives or goals of the data analysis. Be sure *each* objective or goal is reasonable within the scope of the research question and is represented in the available data.

3. Identify an industry-relevant type of neural network capable of performing an image, audio, or video classification task that can be trained to produce useful predictions on image sequences on the selected dataset.
4. Justify your choice of neural network in part A3.

Part II: Data Preparation

Note: You may use Python or R for implementing your coding solutions, manipulating the data, and creating visual representations. However, your responses to the task prompts must be provided in a document file. Unless otherwise specified, responses to PA requirements that are included in a Python or RStudio notebook will not be accepted.

If you selected the Image Dataset:

B. Describe the data preparation process by doing the following:
   1. Perform exploratory data analysis on the chosen image dataset and provide screenshots of the following:
      a. visualization for the distribution of the different classes
      b. sample images with associated labels
   2. Perform data augmentation and justify the steps taken to augment the images.
   3. Normalize the images and discuss the steps taken for normalization.
   4. Perform a train-validation-test split and justify your selection of the proportions for the split.
   5. Encode the target feature appropriately for all your datasets and discuss the steps taken.
   6. Provide a copy of all your datasets.

If you selected the Video Dataset:

C. Describe the data preparation steps by doing the following:
   1. Perform exploratory data analysis on the chosen video dataset. Include an explanation of *each* of the following steps:
      a. Train-validation-test split (you will determine the split size)
      b. Split the videos into smaller segments or frames on specific activities.
      c. Remove irrelevant or noisy frames from video segments.
      d. Adjust video frames to a consistent format, such as resizing or converting to grayscale.
      e. Extract meaningful features from video frames reducing data dimensionality for easier processing.
      f. Consider the sequence of video frames to help the model learn to recognize and differentiate between activities more effectively.
   2. Provide a copy of the prepared video dataset.
   3. Justify *each* of your data preparation steps from part C1.

If you selected the Audio Dataset:

D. Describe the data preparation steps by doing the following:
   1. Perform exploratory data analysis on the chosen ESC-50 audio dataset. Include an explanation of *each* of the following elements:
      a. spectrogram
      b. audio tagging
   2. Extract the spectrogram.
   3. Create an audio signal.
   4. Explain the signal padding process used to standardize the audio signal. Include a screenshot of the padded sequence.
   5. Normalize the spectrogram.
   6. Extract features from the audio for sound classification.

7. Explain the steps used to prepare the data for analysis.
8. Perform a train-validation-test split and justify your selection of the proportions for the split.
9. Provide a copy of the prepared audio dataset.
10. Justify *each* of your data preparation steps for your chosen audio dataset.

Part III: Network Architecture

Note: Your responses to the task prompts must be provided in a document file. Unless otherwise specified, responses to PA requirements that are included in a Python or RStudio notebook will not be accepted.

E. Describe the type of network used by doing the following:
1. Provide the output of the model summary.
2. Discuss components of your neural network architecture and justify the choice of the following:
    a. number of layers
    b. types of layers
    c. number of nodes per layer
    d. total number of parameters (weights, bias)
    e. activation functions (hidden layers, output layer)
3. Discuss the backpropagation process and justify the choice of the following hyperparameters:
    a. loss function
    b. optimizer
    c. learning rate
    d. stopping criteria
4. Create, explain, and provide a screenshot of your confusion matrix.

Part IV: Model Evaluation

Note: Your responses to the task prompts must be provided in a document file. Unless otherwise specified, responses to PA requirements that are included in a Python or RStudio notebook will not be accepted.

F. Analyze the model by doing the following:
1. Evaluate the model training process and its relevant outcomes by doing the following:
    a. Discuss the impact of using stopping criteria to include defining the number of epochs, including a screenshot showing the final training epoch.
    b. Compare the training data to the validation dataset using an evaluation metric such as loss, accuracy, F1, or mean absolute error (MAE) to assess model performance. Include an explanation.
    c. Provide a visualization comparing the model's training versus validation loss. Include a screenshot.
2. Assess the fitness of the model and *any* actions taken to address overfitting or underfitting.
3. Discuss the predictive accuracy of the trained network using the test set and the chosen evaluation metric from part F1b.

Part V: Summary and Recommendations

Note: Your responses to the task prompts must be provided in a document file. Unless otherwise specified, responses to PA requirements that are included in a Python or RStudio

notebook will not be accepted.

G. Summarize results by doing the following:

1. Provide the code you used to save the trained network within the neural network.
2. Discuss the functionality of your neural network, including the impact of the network architecture.
3. Discuss the effectiveness of the model in addressing the business problem you identified in part A1.
4. Discuss lessons learned including how the model might be improved (i.e., if you were to deploy this model in a real-life scenario).
5. Recommend a course of action based on your results as they relate to the research question.

Part VI: Reporting

Note: Your responses to the task prompts must be provided in a document file. Unless otherwise specified, responses to PA requirements that are included in a Python or RStudio notebook will not be accepted.

H. Submit a copy of your code used to save the trained network within the neural network and output in a PDF or HTML format.

I. Submit a list of *all* the specific web sources you used to acquire segments of third-party code to support the application.

J. Acknowledge sources, using in-text citations and references, for content that is quoted, paraphrased, or summarized.

K. Demonstrate professional communication in the content and presentation of your submission.

File Restrictions

File name may contain only letters, numbers, spaces, and these symbols: ! - _ . * ' ( )
File size limit: 200 MB
File types allowed: doc, docx, rtf, xls, xlsx, ppt, pptx, odt, pdf, csv, txt, qt, mov, mpg, avi, mp3, wav, mp4, wma, flv, asf, mpeg, wmv, m4v, svg, tif, tiff, jpeg, jpg, gif, png, zip, rar, tar, 7z

RUBRIC

A1:RESEARCH QUESTION

NOT EVIDENT	APPROACHING COMPETENCE	COMPETENT
A research question is not provided in a document file.	The submission does not provide a question that can be addressed through analysis, or the question is not relevant to a realistic organizational need or situation represented in the dataset.	The submission provides a question that can be addressed through analysis of the dataset. The question is relevant to a realistic organizational need or situation represented in the dataset.

A2:OBJECTIVES OR GOALS