Course: 282772 Industrial System Design and Integration

Assessment: 02 Written Assignment

Course Learning Outcomes Assessed:

- Use a knowledge system development software.
- Represent industrial knowledge and understand inference principles.
- Develop a simple knowledge-based system.

Weighting: 40 %

Due Date: TBC

This is an individual-based assessment.

Academic Integrity

Massey University values academic integrity. This means that we expect all our staff and students to be completely honest about all aspects of academic work. This includes always saying where the ideas, information, images, code, or any other materials used in your work come from (attribution). It also means that we expect you to always submit your own work for assessment. When the assessment is a group task, we expect you to follow the rules set out by your lecturer. If you are unsure, ask. We are here to help you.

You can find out more about academic integrity at Massey University here: Academic integrity student guide (massey.ac.nz).

Introduction

Artificial Intelligence (AI) is becoming more widely used in both consumer- and industry-based applications. For example, AI is used in smart phones to predict the next word that will be typed into a message and to detect faces in a camera's frame.

Machine Learning (ML) is a subset of AI, which can be categorised into the following categories: 1) supervised learning; 2) unsupervised learning; and 3) reinforcement learning. Supervised ML involves training a neural network using input data and labelled output data, and minimising the difference between the labelled output data and the neural network's predicted output. Supervised ML can be used to classify data and detect objects in data. Figure 1 illustrates supervised ML being used to classify images as either a picture of a hotdog or something else.

Figure 1: Classification of an image into the Hotdog or Not Hotdog classes. See the following for a live demonstration: https://youtu.be/pqTntG1RXSY.

Consider the following situation:

- A Computer Numerical Controlled (CNC) mill is used to cut slots in a project box's lid as part of a manufacturing process.
- Sometimes the CNC mill doesn't cut the slots properly; sometimes the project box's lid shatters when the last slot is being milled.
- Once a project lid has been milled, it is visually inspected by the CNC mill's operator to see if there are any defects.

A key problem with this situation is:

- Milled project lids need to be manually inspected.

You are required to:

- Train a neural network to automatically determine whether the CNC mill cut the slots properly and that the project box's lid did not shatter.

Aims

The assessment's aims are to demonstrate proficiency in:

- Using a trained neural network to accurately categorise input data.

Objectives

The assessment's objectives are to:

- Prepare a dataset that will be used to train the neural network.
- Design the neural network's architecture and implement it in software using a ML framework.
- Choose appropriate hyperparameters and train the neural network.
- Use the trained neural network to accurately categorise input data.

The neural network should be able to:

- Use an image as its input.
- Categorise the input data into one or more categories.

Requirements

You are required to:

- Design and write a program that addresses the assessment's objectives.
- Write a report that describes what you did, how, and why.

Resources

You will be provided with the following:

- A set of images.

For reference:

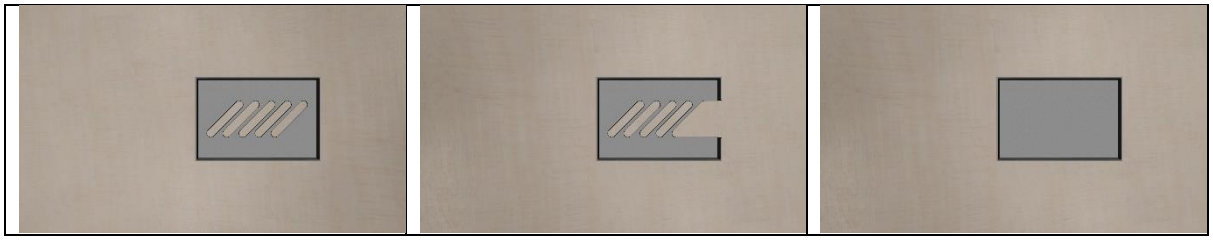

Figure: (Left) An example of a "good" part; (Middle) an example of a "bad" part; and (Right) another example of a "bad" part.

Submission Instructions

Add all of your assessment's software to a .zip archive and name it in the following format: FIRSTNAME_LASTNAME_ID.zip.

Upload your submission to Stream before the due date.

Frequently Asked Questions

Q. What ML framework should I use?

A. You can use whatever framework you want; however, I recommend using TensorFlow and its Keras Application Programming Interface (API).

Q. What Integrated Development Environment (IDE) should I use?

A. You can use whatever IDE you want; however, I recommend using Microsoft's Visual Studio Code.

Q. What should I include in the report's Methodology section?

A. You should include relevant background information, a description of the framework you used, the tools you used, your neural network's architecture, how you implemented the neural network using your chosen framework, the hyperparameters you used, etc. Be sure to include code snippets, descriptions, and figures.

Q. How accurately should my neural network be able categorise the input data?

A. I have trained a neural network that can categorise the input data with an accuracy of 100 %.

Q. Can I use Keras' Applications' neural networks?

A. Yes; however, I expect you to implement a neural network yourself and compare its performance against the chosen neural network's performance.

Q. Can I get an extension?

A. Only in critical personal circumstances. Extensions will be granted at the offering coordinator's discretion. Last minute computer failure and loss of data/files is a very common excuse and generally not acceptable. Plan to complete the assessment a few days before the deadline. Start early! Do not underestimate the time it will take to get a working system and be able to demonstrate it working.

Report

The report is worth 100 % of the assessment's final grade.

	D Range (40 – 49.99)	C Range (50 – 64.99)	B Range (65 – 79.99)	A Range (80 – 100)	Weighting
	Doesn't Meet Expectations	*Below Expectations*	*Meets Expectations*	*Exceeds Expectations.*	
Introduction	The Introduction section is poor. It summarises the project; its aims and objectives.	The Introduction section is adequate. It presents the project; its aims and objectives; what was done; and the results.	The Introduction section is good. It describes the project; its aims and objectives; what was done; and the results.	The Introduction section is excellent. It discusses the project; its aims and objectives; what was done; and the results.	5 %
Methodology	The Methodology section is poor. It summarises the neural network. It summarises what was done.	The Methodology section is adequate. It presents the neural network. It presents what was done.	The Methodology section is good. It describes the neural network using a combination of block diagrams and code snippets. It describes what was done and how.	The Methodology section is excellent. It discusses the neural network using an appropriate combination of block diagrams, code snippets, and description. It discusses what was done, how, and why.	40 %
Results	The Results section is poor. The neural network's output are summarised. It shows images were categorised with an accuracy < 50%.	The Results section is adequate. The neural network's output are presented. It shows images were categorised with an accuracy >= 50% and < 65%. An attempt is made to discuss the limitations of the neural network.	The Results section is good. The neural network's output are analysed quantitatively and described. It shows images were categorised with an accuracy >= 65% and < 80%.. Assumptions within the neural network are identified and their impacts on the results identified.	The Results section is excellent. The neural network's output are analysed quantitatively and discussed; a table summarises the results. It shows images were categorised with an accuracy >= 80% and <= 100%. The discussion includes an analysis of the robustness of the neural network, and what is required to mitigate weak assumptions.	40 %
Conclusion	The Conclusion section is poor. It summarises the project; its aims and objectives.	The Conclusion section is adequate. It presents the project; its aims and objectives; what was done; and the results.	The Conclusion section is good. It describes the project; what was done; the results, and outlines whether the aims and objectives were achieved.	The Conclusion section is excellent. It discusses the project; what was done; the results; and clearly evaluates the extent to which the aims and objectives are achieved.	5 %
Presentation	The report's presentation poor. The report's structure is poor. No figures are used. The report's fluency is poor; spelling, punctuation, and grammatical issues impact the report's readability a lot.	The report's presentation is adequate. The report's structure is adequate. A few figures, e.g. illustrations, and code snippets, are used. The report's fluency is adequate; spelling, punctuation, and grammatical issues impact the report's readability a lot.	The report's presentation is good. The report's structure is good. Some figures, e.g. illustrations, and code snippets, are used; they are easy to read; a Title Page, a Table of Contents is used. The report's fluency is good; with minor spelling, punctuation, and grammatical issues.	The report's presentation is excellent. The report's structure is excellent. A lot of figures, e.g. illustrations, flow-charts, and code snippets, are used; they are easy to read; a Title Page, a Table of Contents is used. The report's fluency is excellent, with almost no spelling, punctuation, and grammatical issues.	10 %

Comments: