From https://en.wikipedia.org/wiki/Vegetable

School Name	School of Computing
Semester	AY2023/24 Semester 2
Course Name	DAAA
Module Code	ST1504
Module Name	Deep Learning

Assignment 1 (CA1: 40%)

The objective of the assignment is to help you gain a better understanding of deep learning for image classification using Convolutional Neural Networks (CNN) and generating a word given some sequence of words using Recurrent Neural Networks (RNN).

There are two parts in this assignment, Parts A and B.

Guidelines

1. You are to work on the entire assignment individually.

2. In this assignment, you will:

    a. Create a CNN for image classification and evaluate the performance of the network. You must perform necessary steps to improve the model performance.
    b. Create an RNN to predict the next word, given a sequence of words. You must devise ways to improve model performance and to evaluate meaningful outputs.

3. For Parts A and B, you should prepare the following (one set of zipped files, for each part):

    a) Jupyter notebook including your code, comments and visualisations (.ipynb).
    b) In addition, please save a copy of the Jupyter notebook as a .html file.
    c) Include your best neural network weights (.h5 file).
    d) A deck of presentation slides (.pptx file) for your project.

    Submit all materials in a zipped file.

4. The normal SP's academic policies on Copyright and Plagiarism applies. Please note that you are to cite all sources. You may refer to the citation guide available at: https://sp-sg.libguides.com/citation

5. You need to submit your declaration of academic integrity. You may access this document on Brightspace. Without this, your submission is deemed incomplete.

Reminder: Please check that all files are valid, especially after zipping. If files cannot be opened, it would be considered as no submission. It is your responsibility as students to ensure this is properly carried out.

Submission Details

Deadline: 27 Nov 2023, 08:00 AM
Submit through: Brightspace

Late Submission

50% of the marks will be deducted for assignments that are received within ONE (1) calendar day after the submission deadline. No marks will be given thereafter. Exceptions to this policy will be given to students with valid LOA on medical or compassionate grounds. Students in such cases will need to inform the lecturer as soon as reasonably possible. Students are not to assume on their own that their deadline has been extended.

Neural network models

You must build your own neural network models, with explanations and justifications.

Your neural networks models can be improved upon with tweaks to your architectures.

If you wish to implement transfer learning, it is only acceptable after you have done the above (building your own models with justifications).

Otherwise, transfer learning is rejected.

Save the best weights of your neural networks. This is important for reproducibility without having to re-train over some extended duration.

PART A: CONVOLUTIONAL NEURAL NETWORK (50 marks)

Task

Implement an image classifier using a deep learning network. You are given colour images of 224 by 224 pixels, containing 15 types of vegetables.

You must convert the given images into grayscale (i.e. only 1 channel instead of 3). Consider two different input sizes:

a) 31 by 31 pixels
b) 128 by 128 pixels

Do not use the original size of 224 by 224 pixels.

Build two types of neural networks, one for each input size. Compare and discuss the classification accuracies for each input size.

Dataset

You must use the dataset that is provided.

You **cannot use any external data** to train your model.

Nevertheless, you are allowed to apply augmentation on the provided data, if you wish. If you choose to do so, you must concretely explain why you make such a choice, as well as investigate whether this is actually beneficial.

Submission requirements for Part A

1. Submit a zip file containing all the project files (source code, Jupyter notebook .ipynb file, .html file, and best neural network weights .h5, slides).
2. Submit online via the Assignment link.

Evaluation criteria:

Background research and exploratory data analysis	10 marks
Feature engineering or data augmentation	10 marks
Modelling and evaluation	10 marks
Model improvement	10 marks
Demo/Presentation and quality of report (Jupyter)	10 marks

PART B: RECURRENT NEURAL NETWORK (50 marks)

Task

Build a next-word predictor, given a sequence of words.

The `input` to your model is a sequence of words of any length (could be one word, could be five words, etc.).

The `output` of your model is a word that follows that sequence of words.

In principle, given an input to your model, you can ask your model to predict the next ten words, by asking your model to predict the next word ten times.

To test your model, you must apply the following ten example sequences of words as inputs:

```
seed_texts = ['embrace each day',
              'radiate some',
              'believe that',
              "life's actual purpose is",
              'dance through each and every',
              'let your time and energy',
              'every person is',
              'our country Singapore is',
              'planet earth is',
              'morning and evening would make it']
```

You can ask your model to predict the next ten words, given each input. For example:

```
Model 1:
embrace each day for morning's potential is a blank canvas seize it wit
h
radiate some gratitude and watch as the universe conspires to bring you
believe that yourself and let your heart's whispers guide you to your
life's actual purpose is a chance to learn to grow and to embrace the
dance through each and every one chapter of life to the next world your
nature
let your time and energy so brightly that it eclipses even the darkest
of days
every person is of kindness sends ripples of positivity throughout the
universe of
our country Singapore is through storms knowing that your steps create
the path to
planet earth is through challenges like a breeze through the trees leav
ing a
morning and evening would make it the chisels that sculpt you into a ma
sterpiece of strength
```

Your model (or collection of models) should be capable of producing different sequences of output texts, given the same input. For example, a second run with the same `seed_texts` may yield:

```
Model 2:
embrace each day they bring the thunder that clears the path to your
radiate some positivity illuminating the world with a light that banish
es darkness
believe that yourself and let your inner light outshine any darkness ar
ound
life's actual purpose is a wildflower spreading love's fragrance far an
d wide and majesty
dance through each and every from one chapter of life to the next next
hues
let your time and energy so hold mysteries waiting to be explored revea
ling hidden wonders
every person is you nurture blooms into a garden of meaningful relation
ships relationships
our country Singapore is is a testament to the city's ambition and resi
lience and
planet earth is sparkles a reflection of the city's ambition to reach n
ew
morning and evening would make it a tapestry of flavors weaving a story
of cultural fusion
```

You should devise ways to evaluate the generated sequence of words, how meaningful they are, or how creative they are, using the given `seed_texts` as a benchmark.

Incidentally, a model without any training (but took in the training dataset's tokenisation and embedding) may output nonsense like this:

```
embrace each day discover brilliance by mountains mountains days days f
or choreography choreography
radiate some wildflowers wildflowers yourself holds holds holds illumin
ated illuminated illuminated this
believe that by by days days delicate yourself not each each love
life's actual purpose is radiate not holds holds any any guide guide un
iverse's universe's
dance through each and every hues closely closely closely choice civili
zations civilizations civilizations story story
let your time and energy wonders blessings blessings and knowing knowin
g knowing knowing minds minds
every person is radiate radiate light holds nurturing nurturing arms ar
ms arms yourself
our country Singapore is radiate radiate holds holds holds light light
arms holds holds
planet earth is radiate radiate holds holds holds light light arms hold
s holds
morning and evening would make it so human grand grand grand soundtrack
soundtrack soundtrack soundtrack hues
```

Dataset

You must use the dataset that is provided.

You **cannot use any external data** to train your model.

You should consider ways to engineer the given data to produce suitable input and output pairs.

Submission requirements for Part B

1. Submit a zip file containing all the project files (source code, Jupyter notebook .ipynb file, .html file, and best neural network weights .h5, slides).
2. Submit online via the Assignment link.

Evaluation criteria:

Background research and exploratory data analysis	10 marks
Feature engineering	10 marks
Modelling and evaluation	10 marks
Model improvement	10 marks
Demo/Presentation and quality of report (Jupyter)	10 marks

— End of Assignment —