

## Course Project: Date Fruit Image Classification

There are many date fruit types in Saudi Arabia such as Ajwa, Medjoo, Nabtat Ali, etc. Your task in this project is to design and build a machine learning-based image classification system based on a provided image of a date.

You can work in a team of two students at most, and of course, you can work alone if you prefer.

### Task Details

Design and implement a Convolutional Neural Network (CNN) to tackle this problem. Take the following instructions into accounts:

- Your model accuracy on the provided test data **must be at least 75%** (0.75/1)
- You should use **TensorFlow** for this task
- You can build your own architecture for the CNN, or you can utilize an existing CNN architecture
- You can train your model from scratch, or you can utilize Transfer Learning by fine tuning an existing model trained on a different dataset
- You should train your models only on the provided training set. **Do not use the test set for training!**
- You should **evaluate** your models **only** on **all** the provided **test** dataset.
- Include and discuss the following details in your report:
  - Dataset samples counts per label charts for both training and test sets (check provided examples)
  - Any data preprocessing steps you used
  - Augmentation details if used
  - CNN full design
  - Used optimizer and its hyperparameter
  - Number of epochs used to train your model
  - Plots of loss and accuracy on the training and validation sets per epoch (check provided example)
  - Evaluation results using classification report and confusion matrix (check provided examples)
- You need to write the corresponding Python code to generate the required charts (Dataset sample counts per label, loss and accuracy per epoch, classification report and confusion matrix).

**Dataset Information:**

The dataset consists of data fruit images corresponding to 9 types of fruit dates as the following: Ajwa, Galaxy, Medjool, Meneifi, NabtatAli, Rutab, Shaishe, Sokari, Sugaey.

| Dataset  | Number of images | Download             |
|----------|------------------|----------------------|
| Training | 1156             | <a href="#">Link</a> |
| Test     | 502              | <a href="#">Link</a> |

**Data Samples****Helpful Resources**

- Image classification Example in TensorFlow
  - <https://www.tensorflow.org/tutorials/images/classification>

## Project Submission Information

Submit **two** files in the LMS (a **PDF** report & a **ZIP** archive for the source code) as the following:

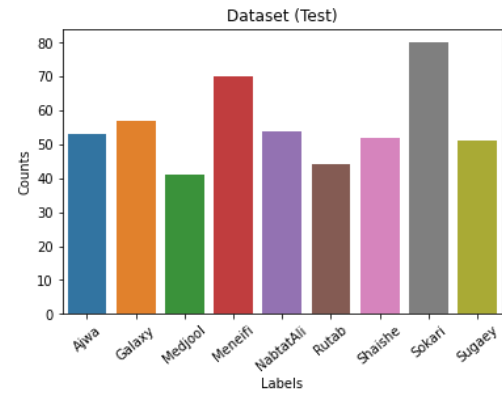
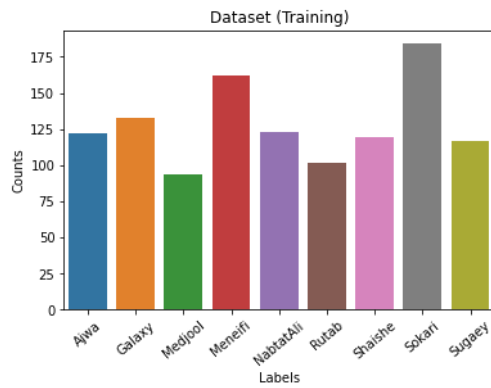
1. A **PDF** report that describes all the steps you took to design and implement your model along with the following information:
  - Team names and student IDs
  - Problem description and its importance.
  - Description of the roles and responsibilities of each student in the project (if the team consists of more than one student)
  - The platform you used to train your model
  - Include and discuss the following details in your report:
    1. Dataset samples counts per label charts for both training and test sets.
    2. Any data preprocessing you applied to the provided dataset
    3. Augmentation details if used
    4. Detailed description of your CNN including all the layers you used. If you opted for an existing CNN architecture, name it and discuss its details
    5. Description of the used optimizer and its hyperparameters
    6. Number of epochs used to train your model
    7. Plots of loss and accuracy on the training and validation sets per epoch
  - Evaluation results of your model on the provided test set. Include the following:
    1. Full Classification Report
    2. Confusion Matrix
  - Screenshots for the following:
    1. All the source code
    2. Evaluation results of your models
2. A **ZIP** compressed file containing all the source code of your system

### Important Notes:

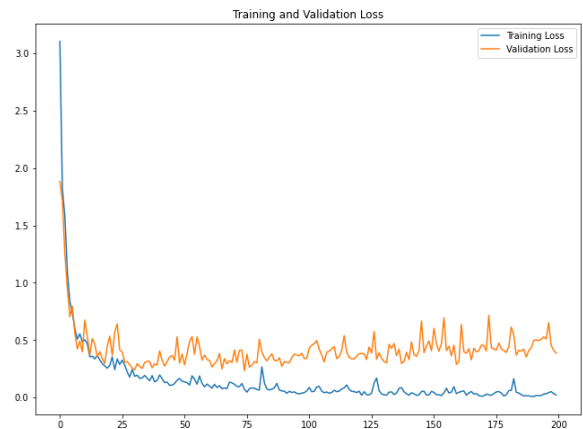
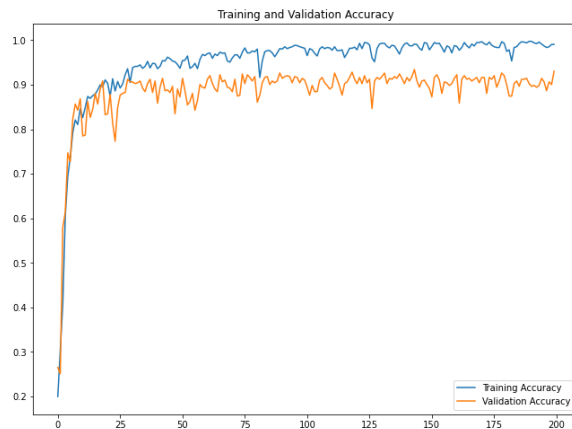
1. Make sure to submit the two files **separately** (do not include the **PDF** report inside the **ZIP** archive).
2. The report file must be in **PDF** format. Don't use other formats such as doc, docx, odt, or txt.
3. The compressed file containing your source code must be in **ZIP** format. Don't use other formats such as RAR, 7s, or tar.
4. Provide screenshots all the code, not just some parts.

## Results Examples

Dataset samples counts per label charts for both training and test sets.



Plots of loss and accuracy on the training and validation sets per epoch (Example)



## Classification Report (Example)

|              | precision | recall | f1-score | support |
|--------------|-----------|--------|----------|---------|
| Ajwa         | 1.00      | 1.00   | 1.00     | 53      |
| Galaxy       | 0.94      | 0.84   | 0.89     | 57      |
| Medjool      | 0.89      | 0.98   | 0.93     | 41      |
| Meneifi      | 0.87      | 0.94   | 0.90     | 70      |
| NabtatAli    | 0.94      | 0.87   | 0.90     | 54      |
| Rutab        | 0.98      | 1.00   | 0.99     | 44      |
| Shaishe      | 0.94      | 0.98   | 0.96     | 52      |
| Sokari       | 0.94      | 0.94   | 0.94     | 80      |
| Sugaey       | 0.90      | 0.84   | 0.87     | 51      |
| accuracy     |           |        | 0.93     | 502     |
| macro avg    | 0.93      | 0.93   | 0.93     | 502     |
| weighted avg | 0.93      | 0.93   | 0.93     | 502     |

## Confusion Matrix (Example)

