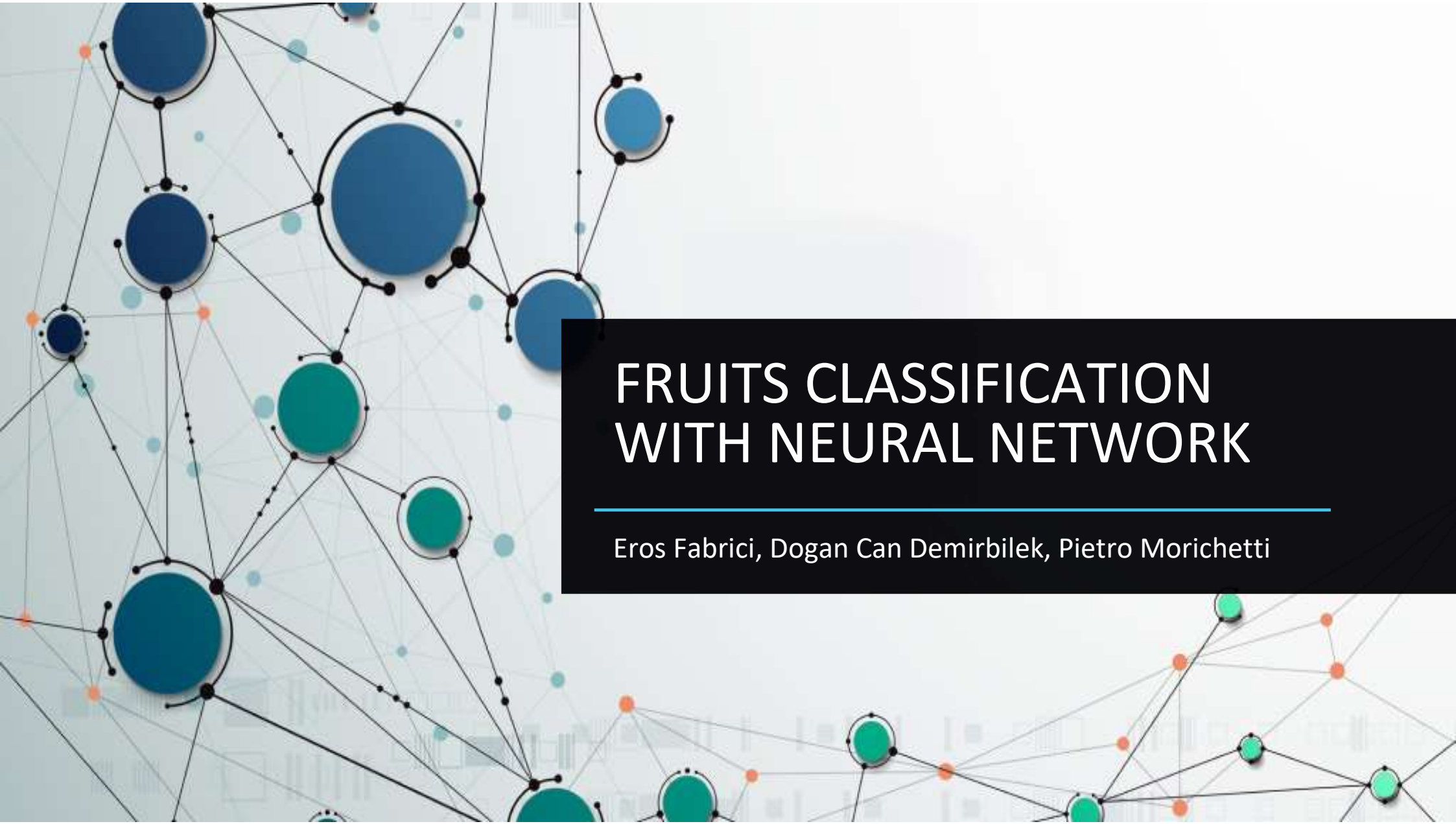
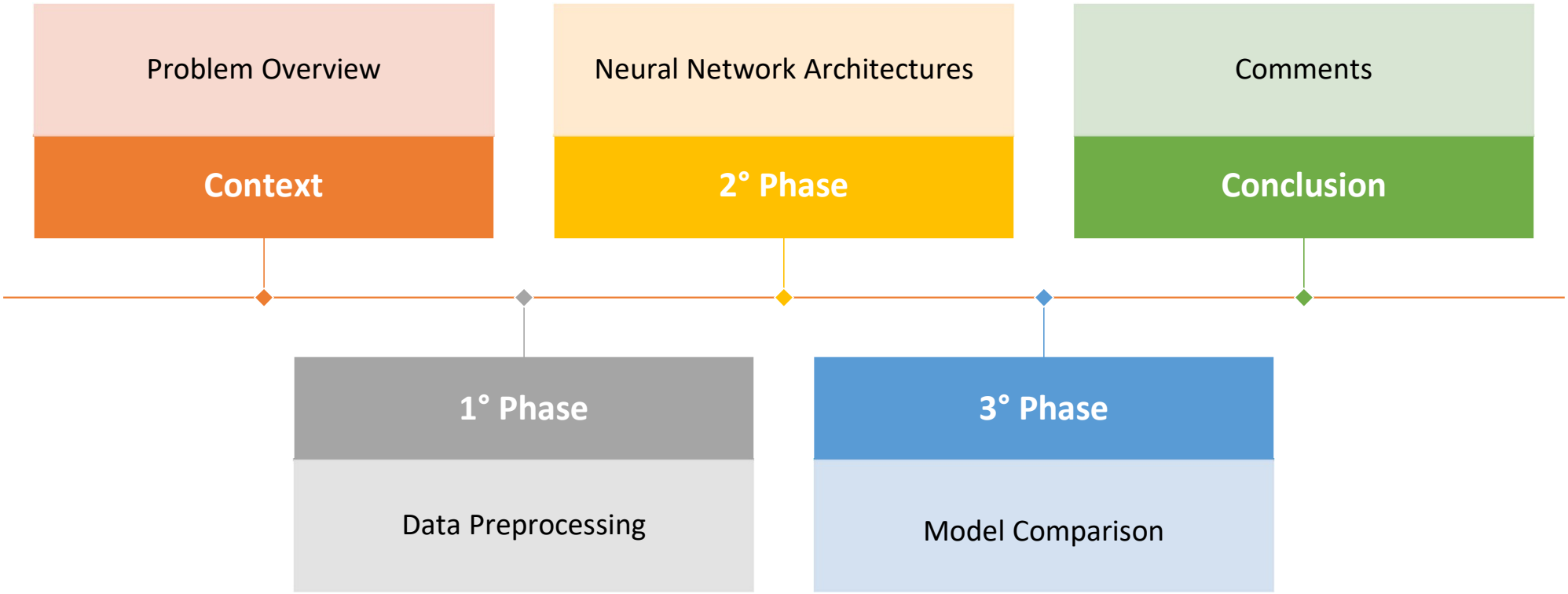


FRUITS CLASSIFICATION WITH NEURAL NETWORK

Eros Fabrici, Dogan Can Demirbilek, Pietro Morichetti

Road Map of our Project



CONTEXT

- Problem Overview

Context

Problem Overview

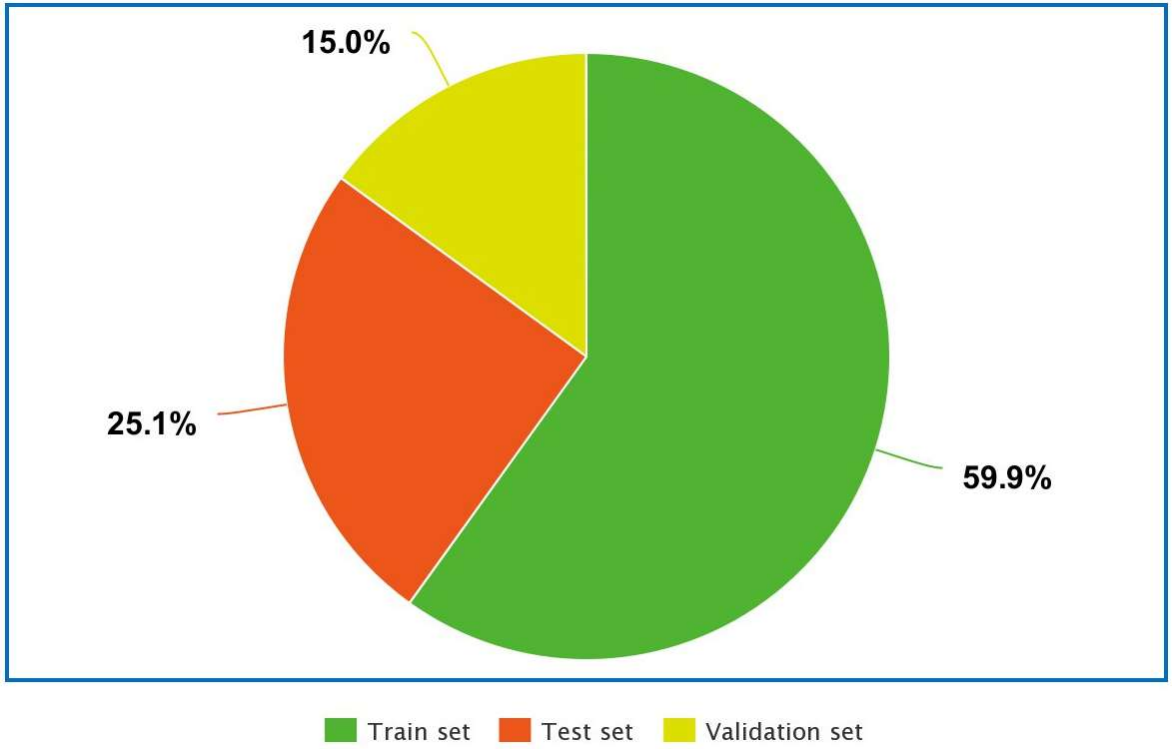
- Focus on dataset of fruits images
- Build a multi-class classification model over the set of 131 fruit species
- Build and test different NN architectures

1° PHASE

- Data Preprocessing

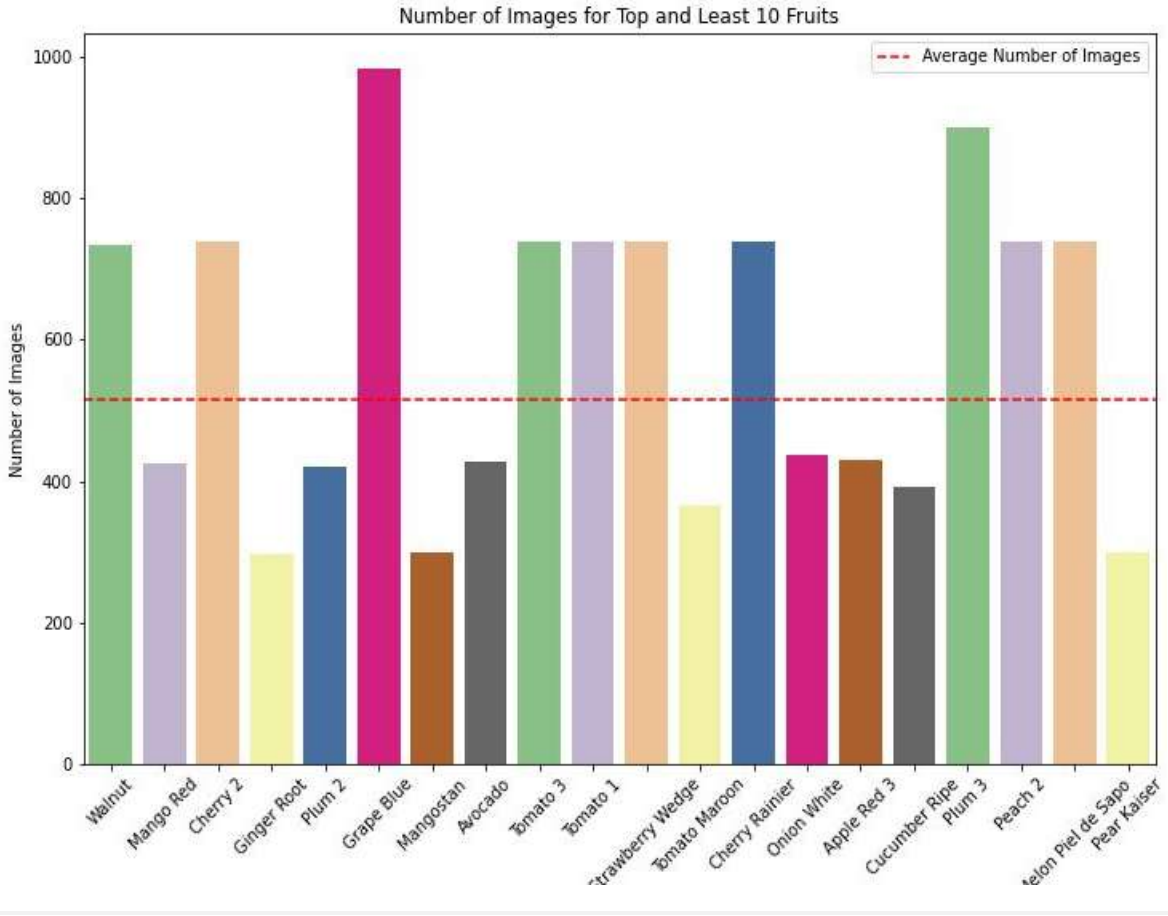
1° Phase: Data visualization

- Train set size: 54154
- Test set size: 22688
- Validation set size: 13538
- Each epoch we are shuffling data



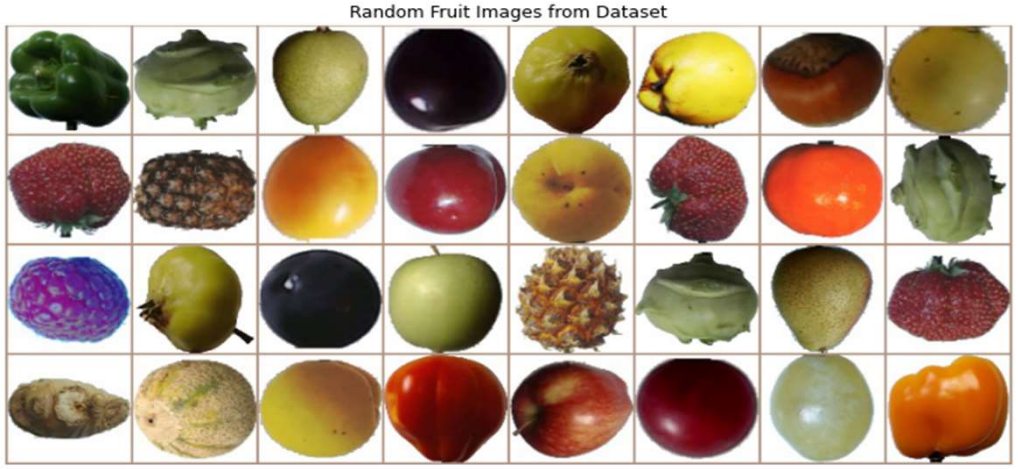
1° Phase: Data visualization

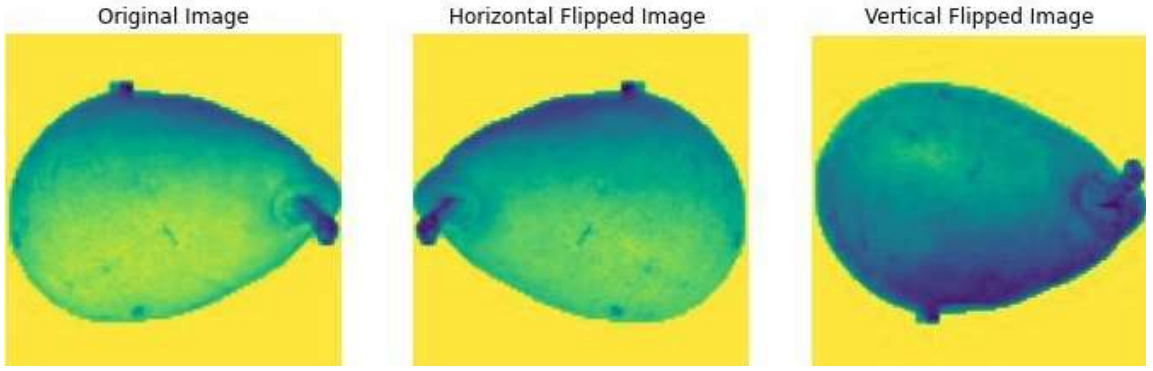
- Barplot of fruit classes
- Check balance of dataset by counting the number of images for each class
- Image size 100x100x3



1° Phase: Pre-processing data

- Shuffle and set 32 images as batch size
- Estimated mean and std of the population of each RGB channel
- Data normalization
- Data augmentation by using vertical and horizontal flip

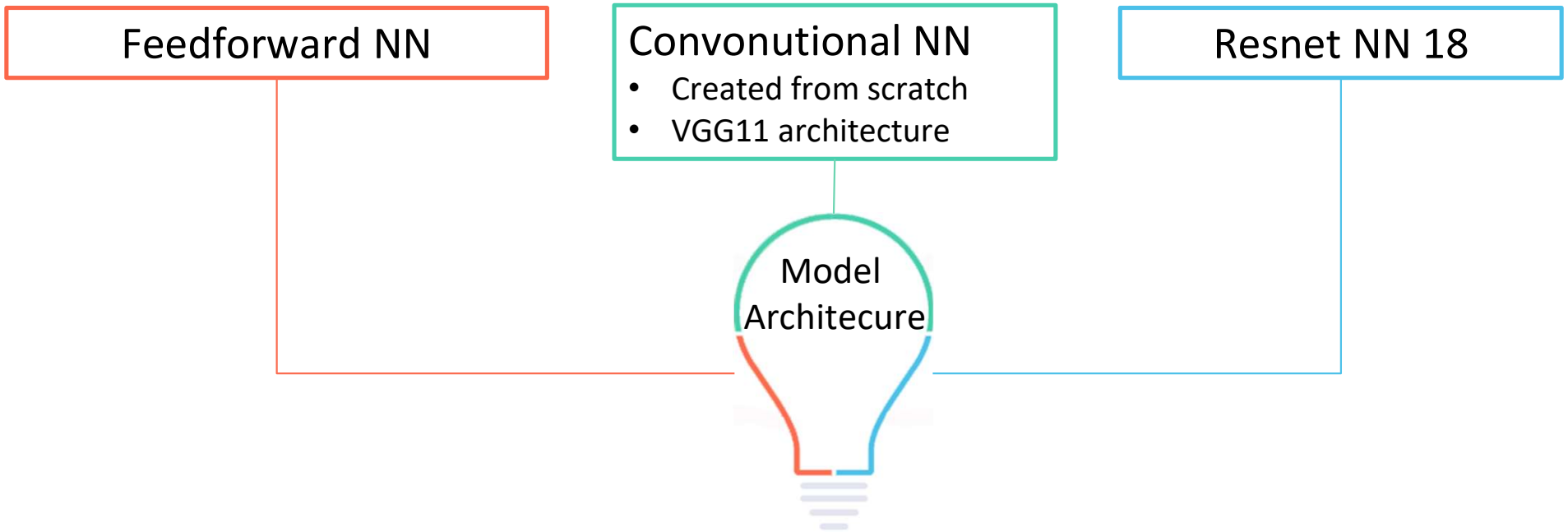




2° PHASE

- Neural Network Architectures

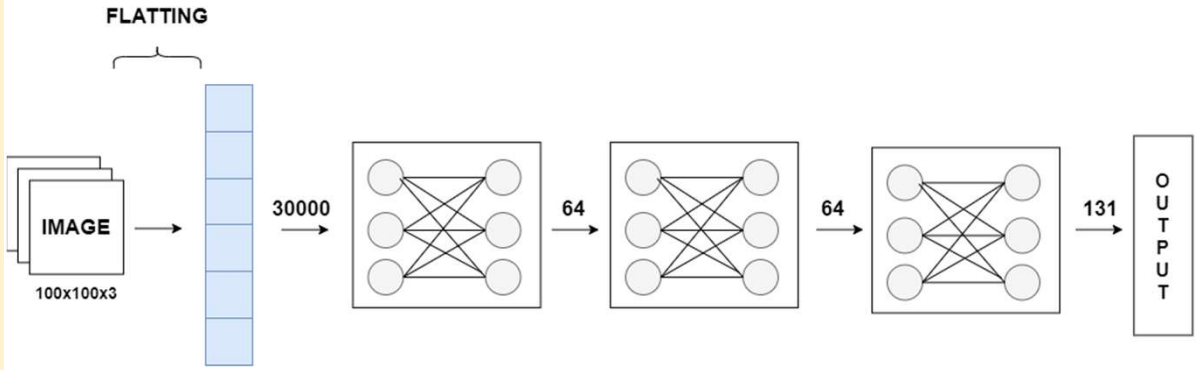
2° Phase: Model Building



2° Phase: Model Assessment

Model 1 (FNN) - Architecture

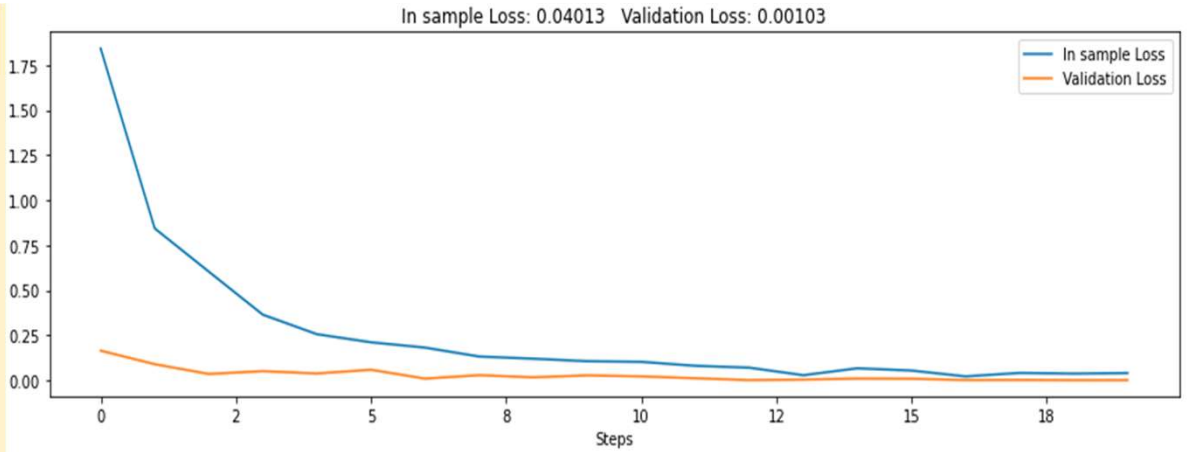
- Input network 100x100x3 and 131 output network
- We have 64 middle input/output among FNN
- Relu is used as non linear activation function
- Optimizer is SGD and Loss function is Cross Entropy

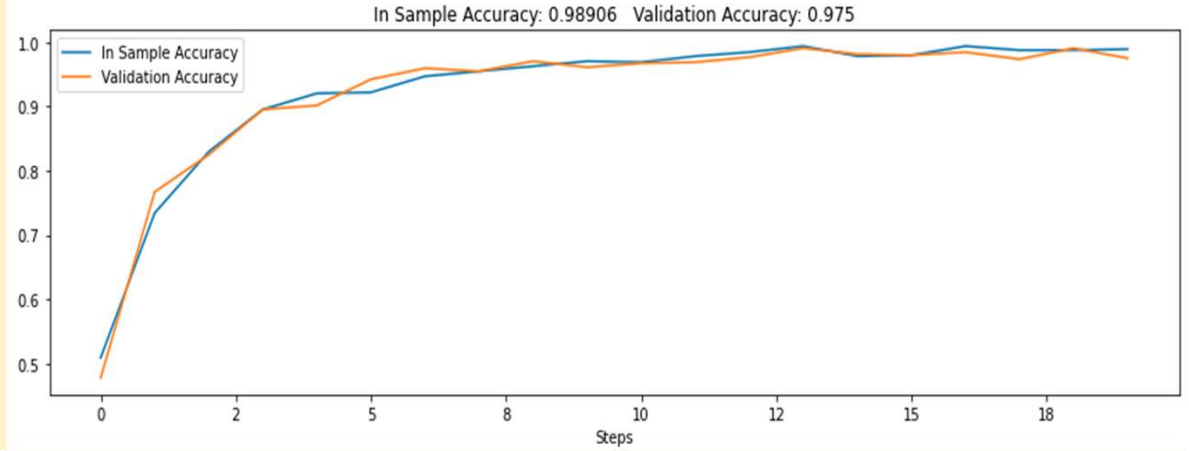


2° Phase: Model Assessment

Model 1 (FNN) - Analysis

- Number of epochs is 20
- Number of parameters 1936899
- Train phase took 15 minutes on GPU (Colab env)
- Validation and train accuracy increase together
- Test accuracy is 91%

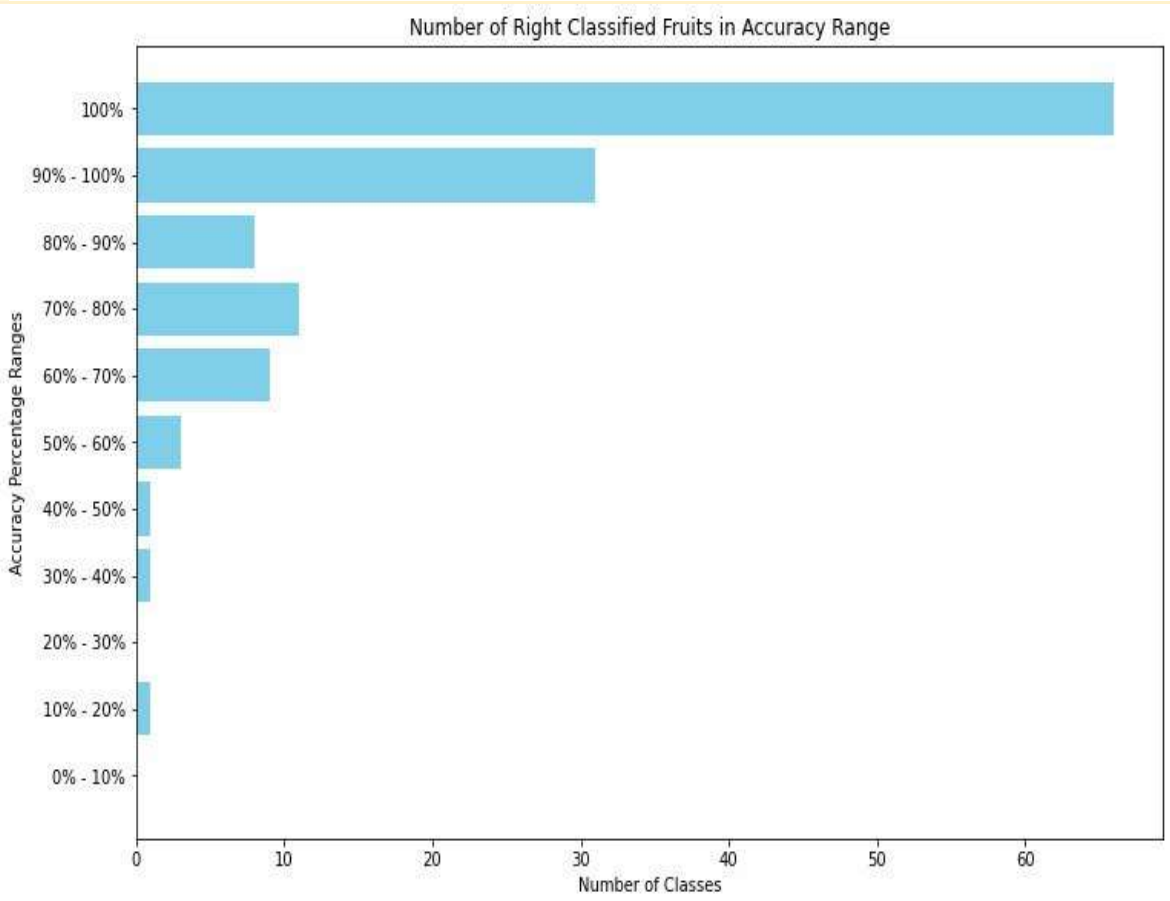




2° Phase: Model Assessment

Model 1 (FNN) - Analysis

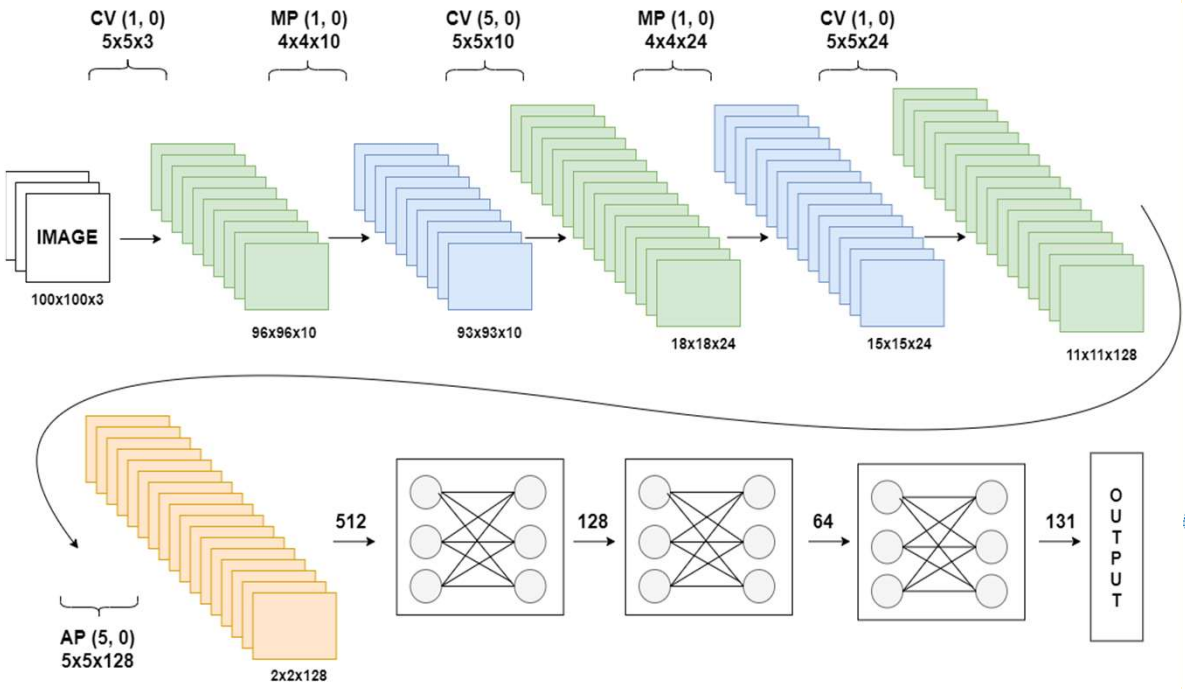
- Horizontal barplot about accuracy for each class
- Most of the classes have an accuracy over 50%
- Few fruits are not well classified



2° Phase: Model Assessment

Model 2 (CNN) - Architecture

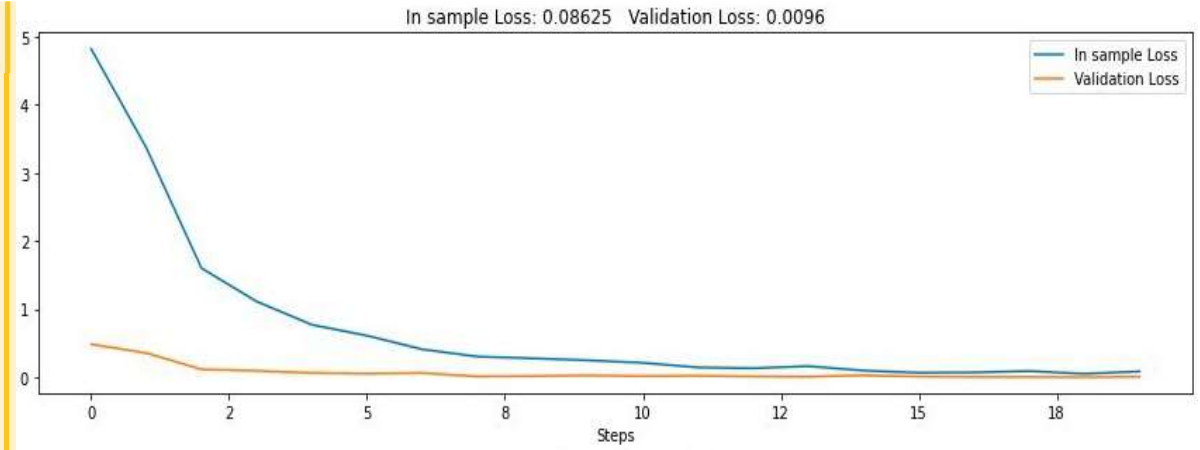
- Input network 3 channels and 131 output network
- We have different sizes of middle input/output
- Relu is used as non linear activation function
- Optimizer is SGD and Loss function is Cross Entropy

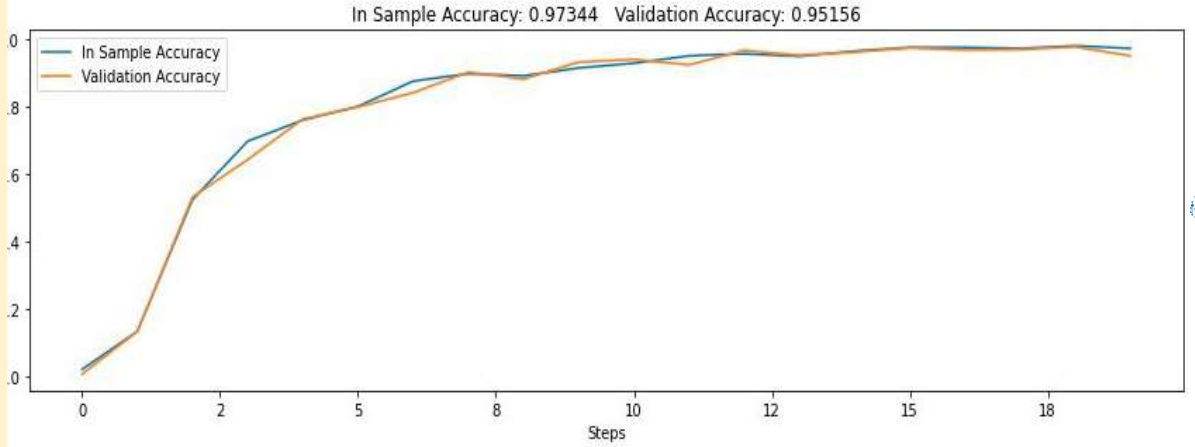


2° Phase: Model Assessment

Model 2 (CNN) - Analysis

- Number of epochs is 20
- Number of parameters 166147
- Train phase took 18 minutes on GPU (Colab env)
- Validation and train accuracy increase together
- Test accuracy is 90%

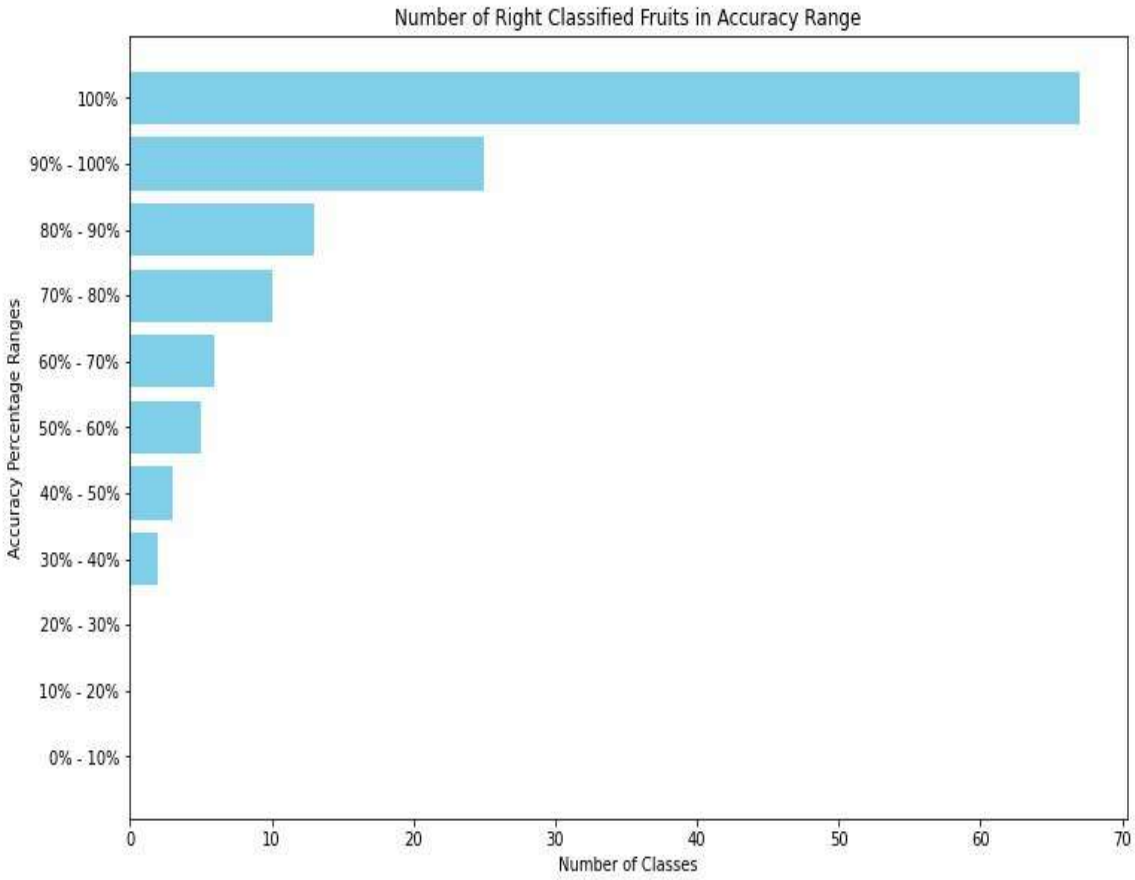




2° Phase: Model Assessment

Model 2 (CNN) - Analysis

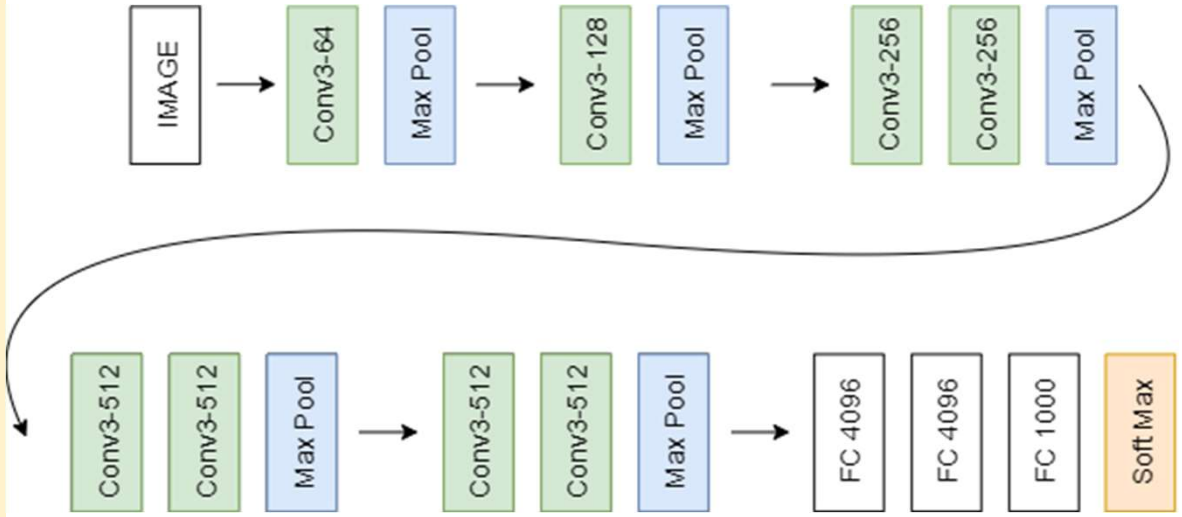
- Horizontal barplot about accuracy for each class
- Most of the classes have an accuracy over 50%
- Class-wise accuracy improved



2° Phase: Model Assessment

Model 2 (vgg11) - Architecture

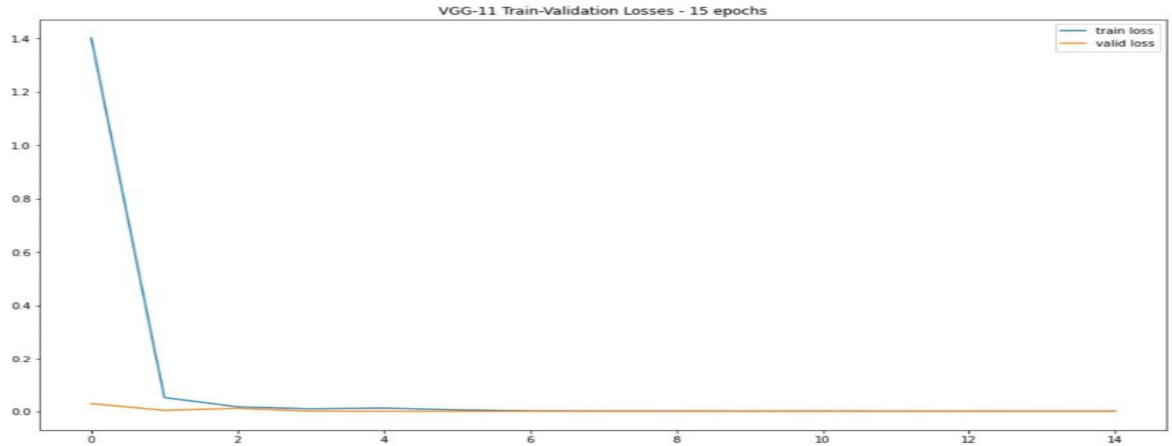
- Input network 3 channels and 131 output network
- Relu is used as non linear activation function
- Optimizer is SGD and Loss function is Cross Entropy

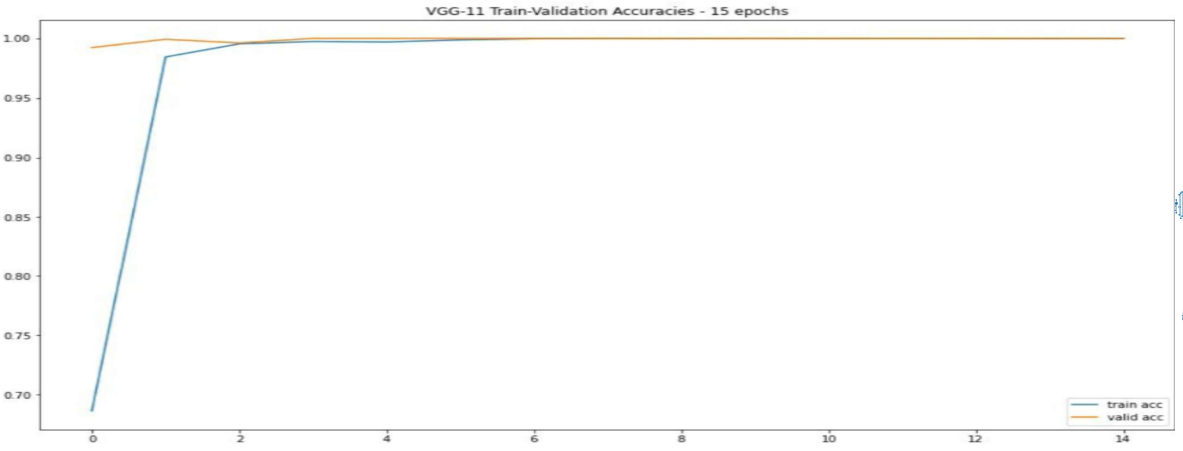


2° Phase: Model Assessment

Model 2 (vgg11) - Analysis

- Number of epochs is 15
- Number of parameters 133 million
- Train phase took 37 minutes on GPU (Colab env)
- Validation and Train accuracy increase together
- Test accuracy is 99%

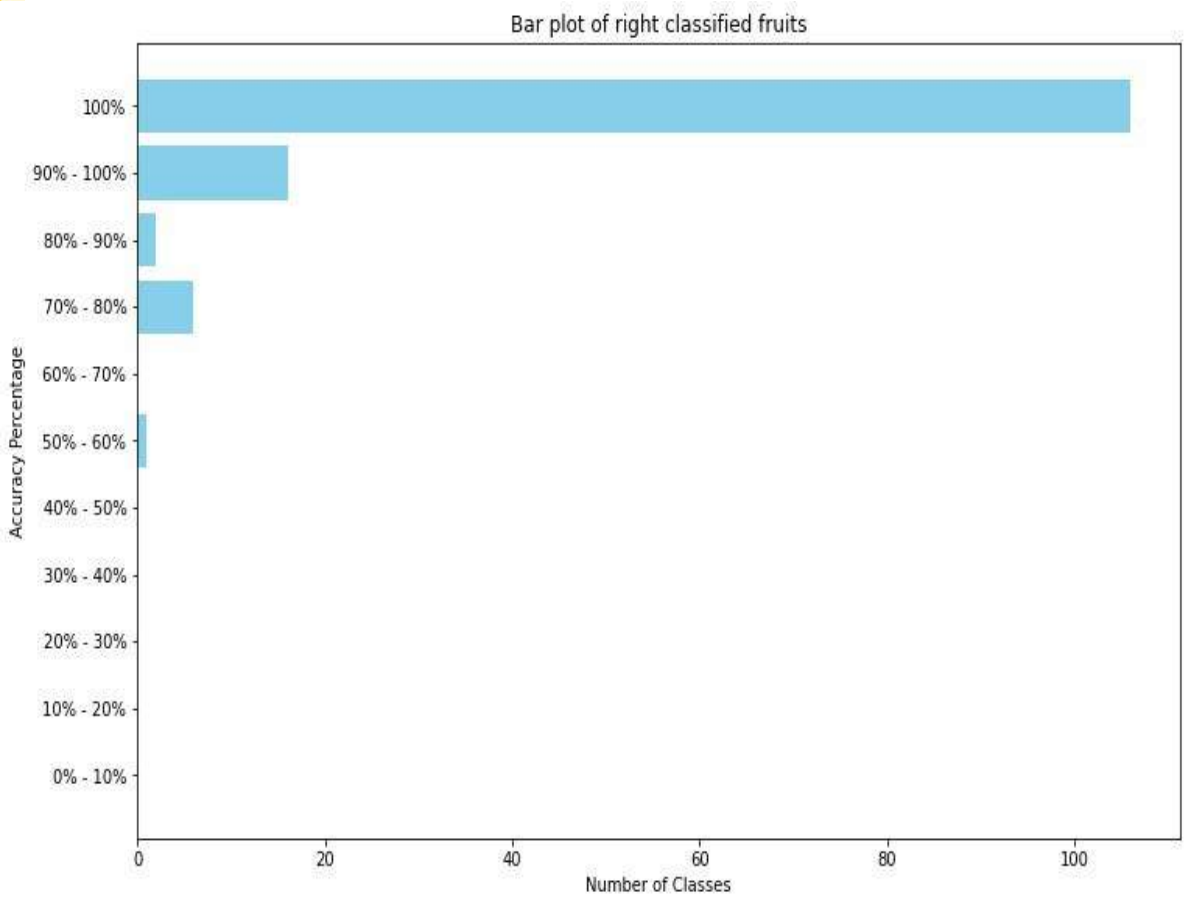




2° Phase: Model Assessment

Model 2 (vgg11) - Analysis

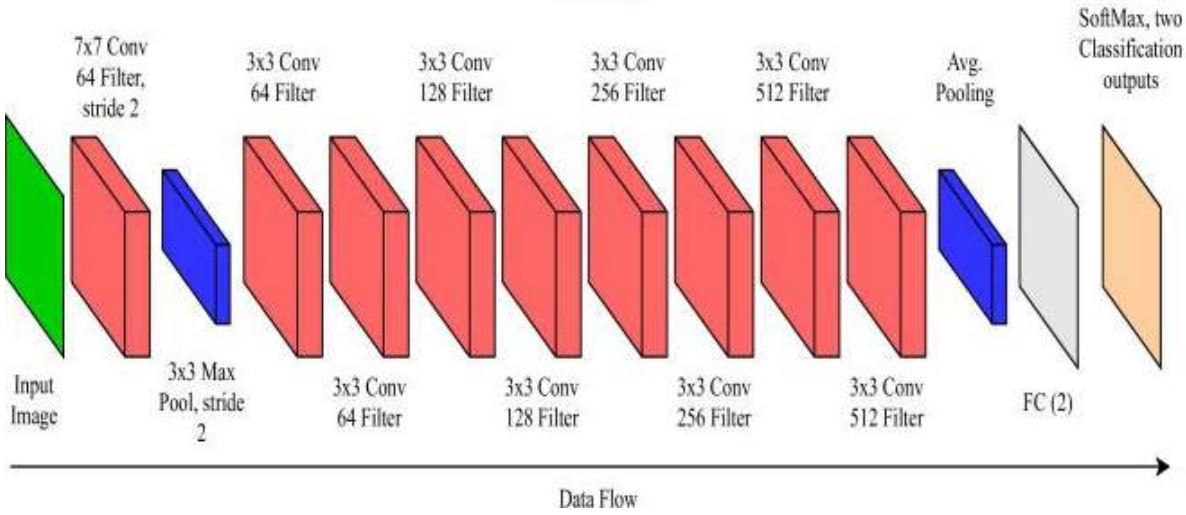
- Horizontal barplot about accuracy for each class
- Most of the classes have an accuracy over 80%
- Class-wise accuracy improved



2° Phase: Model Assessment

Model 3 (ResNet18) - Architecture

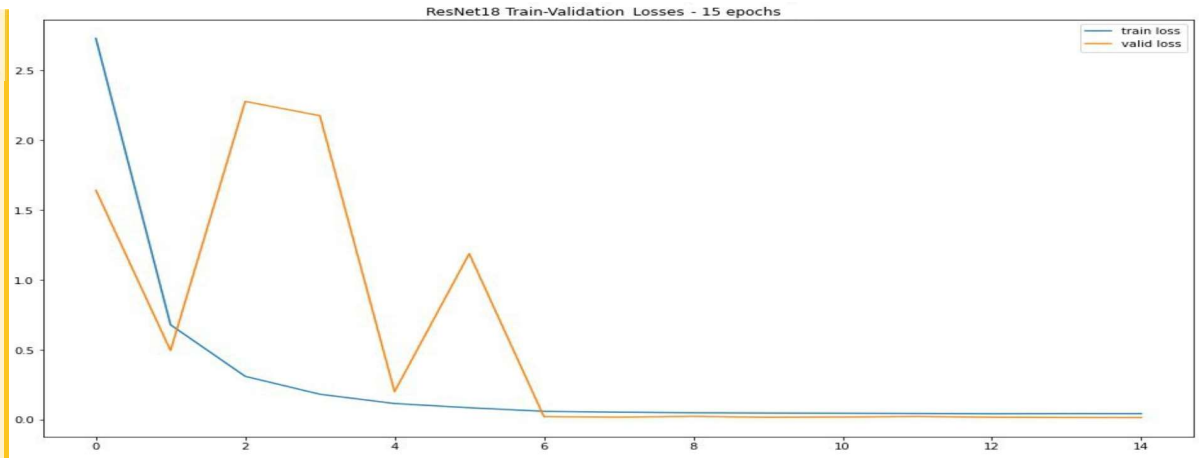
- Relu is used as non linear activation function
- Optimizer is SGD and Loss function is Cross Entropy

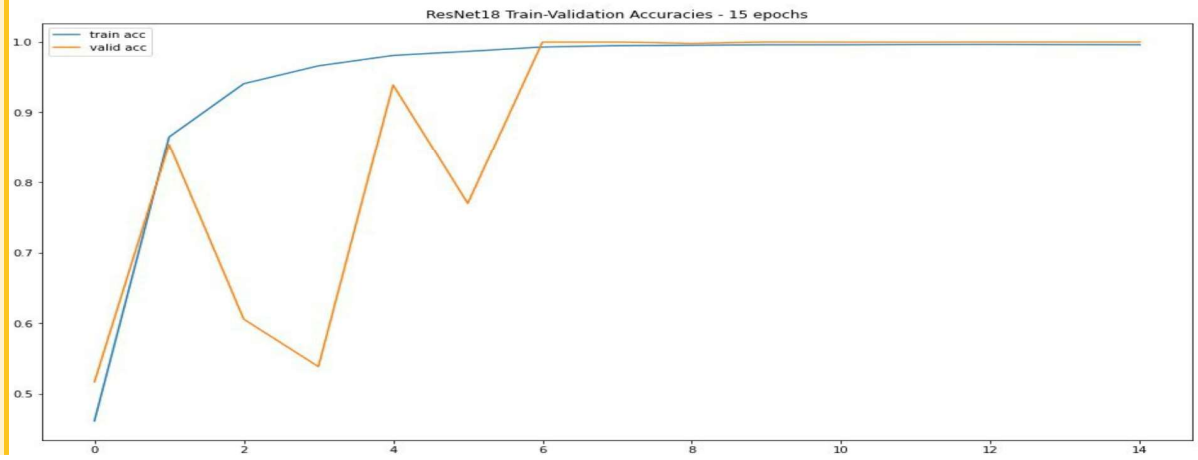


2° Phase: Model Assessment

Model 3 (ResNet18) - Analysis

- Number of epochs is 15
- Number of parameters 11,174 milion
- Train phase took 28 minutes on GPU (Colab env)
- Eventually, validation and train accuracies will stabilize
- Test accuracy is 98%

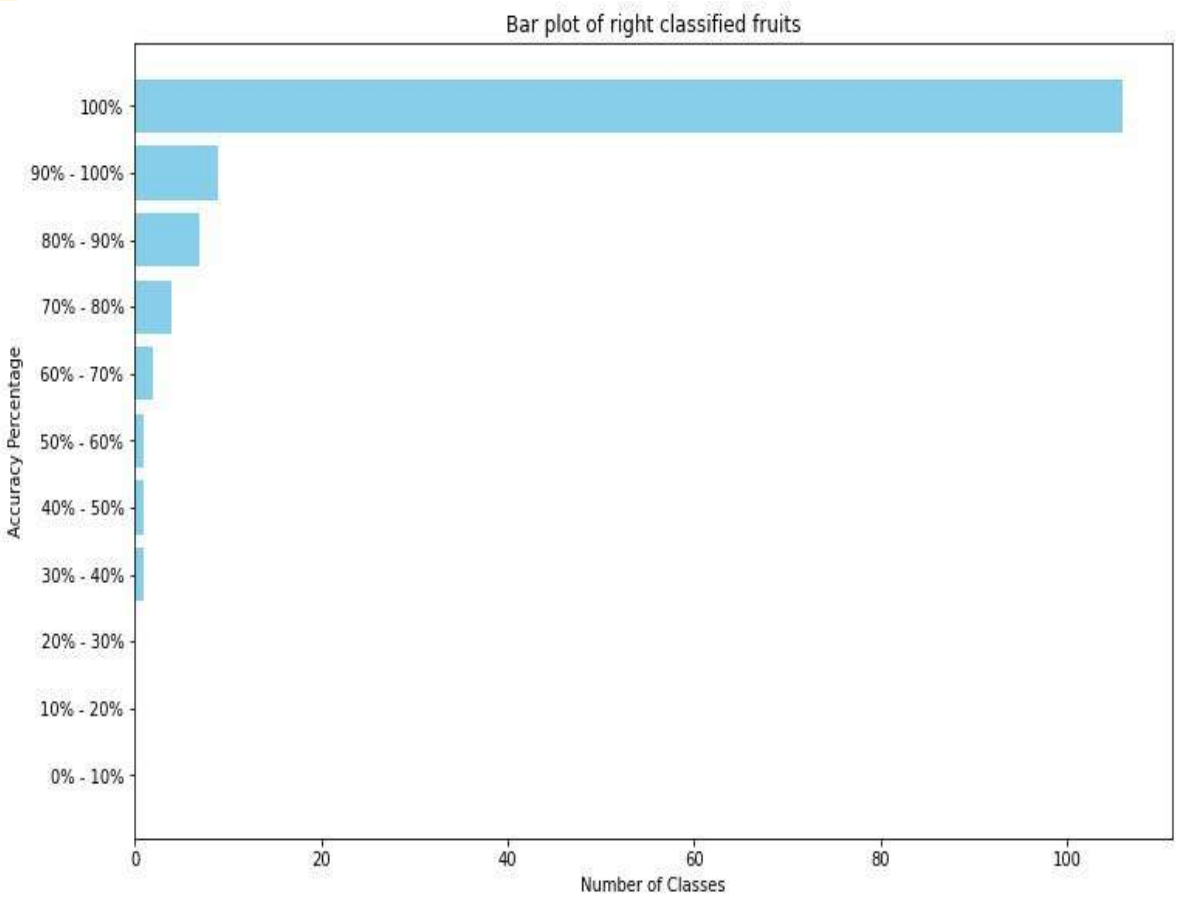




2° Phase: Model Assessment

Model 3 (ResNet18) - Analysis

- Horizontal barplot about accuracy for each class
- Most of the classes have an accuracy over 50%



3° PHASE

- Model Comparison

3° Phase: Model Comparison

MODELS		TEST ACC	TRAIN TIME	COMPLEXITY (n. par)
M1	Feedforward NN	91%	15 min	2 Million
M2	Convolutional NN	90%	18 min	0,16 Million
M3	VGG11 NN	99%	37 min	133 Million
M4	Resnet NN	98%	23 min	11 Million

CONCLUSION

- Comments

Conclusion: Comments

PROS

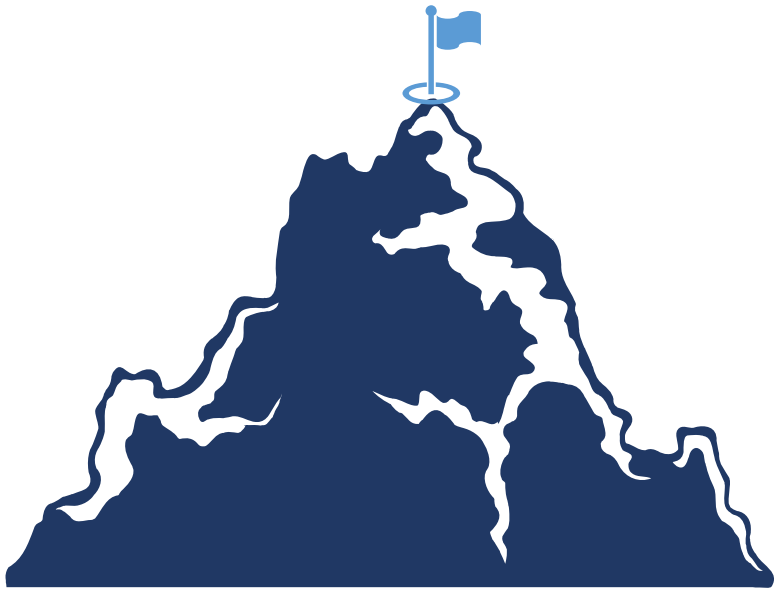
- Dataset are well prepared and clean
- All models are achieved good accuracy (over 90% of accuracy)

CONS

- Some fruit species have less accuracy

Conclusion: Next steps

- Make our models robust against adversarial attacks
- Use transfer learning



References

- Kaggle, “Fruits 360”, https://www.kaggle.com/moltean/fruits
- Github, “Fruit recognition learning”, https://github.com/Horea94/Fruit-Images-Dataset/blob/master/papers/fruit_recognition_deep_learning.pdf
- Kaggle, “CNN from scratch with pytorch”, https://www.kaggle.com/jessewheeler/my-first-kernel-cnn-from-scratch-with-pytorch
- Simonyan, Karen & Zisserman, Andrew. (2014). Very Deep Convolutional Networks for Large-Scale Image Recognition. arXiv 1409.1556
- Ghorakavi, Ram Srivatsav. (2019). TBNet:Pulmonary Tuberculosis Diagnosing System using Deep Neural Networks
- Github, “Fruits classification Neural Network”, https://github.com/demirbilek95/sml_project

THANK YOU FOR YOUR ATTENTION

Eros Fabrici, Dogan Demirbilek, Pietro Morichetti