# EARLY MAIZE DISEASES DETECTOR

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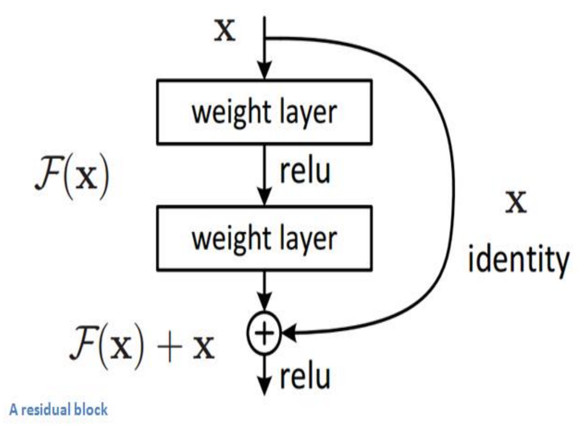
## Introduction

Agriculture has always been the mainstay in economy of most of the developing countries like Tanzania. The large amount of maize plants are being affected by diseases. Tanzania is a major maize producer in Sub-Saharan Africa. In the last four decades, Tanzania has ranked among the top 25 maize producing countries in the world
But maize like many other crops is vulnerable to virus and other diseases. These diseases can affect maize yield, cost famers money, and threaten food security in sub-Saharan Africa.

Farmers find it difficult to keep an eye on each and every maize plant in the cultivation area to detect manifestation of any infection.
Therefore, there is a need to come up with the solution that could automatically detect disease at early stage, accurately and timely locate maize diseases throughout the cultivation field, using continuous image capturing.

## Methodology




The formulation of F(**x**)+**x** can be realized by feedforward neural networks with "shortcut connections". In our case, the shortcut connections simply perform *identity* mapping,

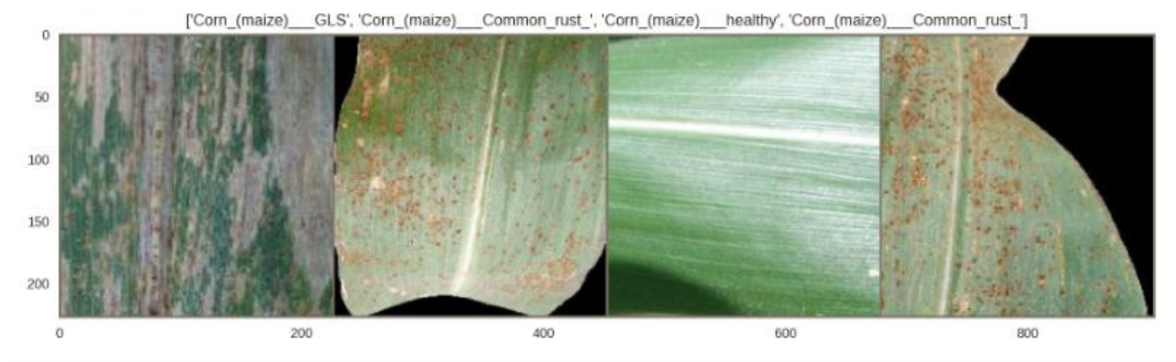
and their outputs are added to the outputs of the stacked layers. Identity shortcut connections add neither extra parameter nor computational complexity. The entire network can still be trained end-to-end by SGD with backpropagation. We adopt residual learning to every few stacked layers

$$\mathbf{y} = \mathrm{F}(\mathbf{x},\{W_i\}) + \mathbf{x}.$$

Here **x** and **y** are the input and output vectors of the layers considered. The function $\mathrm{F}(\mathbf{x},\{W_i\})$ represents the residual mapping to be learned.

if F has only a single layer, Eqn.(1) is similar to a linear layer: $\mathbf{y} = W_1\mathbf{x}+\mathbf{x}$, for which we have not observed advantages.
We also note that although the above notations are about fully-connected layers for simplicity, they are applicable to convolutional layers. The function $\mathrm{F}(\mathbf{x},\{W_i\})$ can represent multiple convolutional layers. The element-wise addition is performed on two feature maps, channel by channel.

## Results



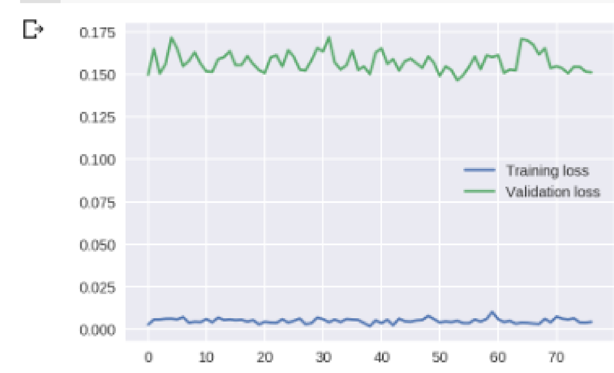

We are using a dataset created from taking pictures of maize plant in a field. Image in the dataset were then annotated by a domain expert. The dataset includes 4 category labels which 3 are leaf diseases and 1 are health leaf. We use the resnet50 model (Resnet50), to extract the features from the earlier layer  and train a classifier on top of that

```
[20] aug = iaa.Affine(rotate=(-40, 40), mode='symmetric')
     imgs = [np.asarray(dataset[0][0]) for _ in range(6)]
     aug.augment_images(imgs)
     plt.imshow(np.hstack(imgs))

<matplotlib.image.AxesImage at 0x7f083ecc1e48>
```


To achieve  this, First, we have to freeze the pre-trained layers, so we don't backprop through them during training. Then, we re-define the final fully-connected the layer, the one that we'll train with our images. We have designed and developed a model which predict maize diseases with accuracy of **0.95077**

```
[19]
Epoch 14/20
----------
train Loss: 0.3649 Acc: 0.8646
valid Loss: 0.1529 Acc: 0.9443

Epoch 15/20
----------
train Loss: 0.3809 Acc: 0.8455
valid Loss: 0.1774 Acc: 0.9275

Epoch 16/20
----------
train Loss: 0.3731 Acc: 0.8494
valid Loss: 0.1615 Acc: 0.9378

Epoch 17/20
----------
train Loss: 0.3516 Acc: 0.8636
valid Loss: 0.1618 Acc: 0.9391

Epoch 18/20
----------
train Loss: 0.3720 Acc: 0.8581
valid Loss: 0.1574 Acc: 0.9417

Epoch 19/20
----------
train Loss: 0.3539 Acc: 0.8581
valid Loss: 0.1491 Acc: 0.9365

Epoch 20/20
----------
train Loss: 0.3794 Acc: 0.8536
valid Loss: 0.1581 Acc: 0.9378

Training complete in 14m 48s
Best valid accuracy: 0.950777
```

```
tensor([[ 238.,    0.,    1.,    0.],
        [   0.,   78.,   24.,    1.],
        [   1.,   14.,  182.,    0.],
        [   0.,    1.,    0.,  232.]])
```




## Conclusion and Recommendations

This project will be used for the detection, diagnosis and recognition of maize plant leaf diseases. The proposed project has great potential to be applied in real world because helps farmer to detect disease at an early stage hence the system will reduce the destruction of crops in the farm so it will increase the production of the crops at the maximum. As it is a work in progress, we aim to collect more dataset, apply image processing techniques and try different tunings to observe how the model improves toward better results.

## References

1. Kaiming He  Xiangyu Zhang   Shaoqing Ren     Jian Sun  Microsoft Research
2. Aarju Dixit et al, International Journal of Computer Science and Mobile Computing, Vol.7 Issue.5, May 2018,    pg. 124-129
3. http://arxiv.org/abs/1511.08060
4. https://www.researchgate.net/publication/280611424_CURRENT_MAIZE_PRODUCTION_POSTHARVEST_LOSSES_AND_THE_RISK_OF_MYCOTOXINS_CONTAMINATION_IN_TANZANIA