Sugar Cane Grading from photos

USING MACHINE LEARNING

STUDENT: PHUONG PHAM
ADVISOR: DR. SALLY GOLDIN

BANGKOK
25 NOV '16

CONTENTS

1 Problem overview

2 Background and theories

3 Design and methodologies

4 Current results

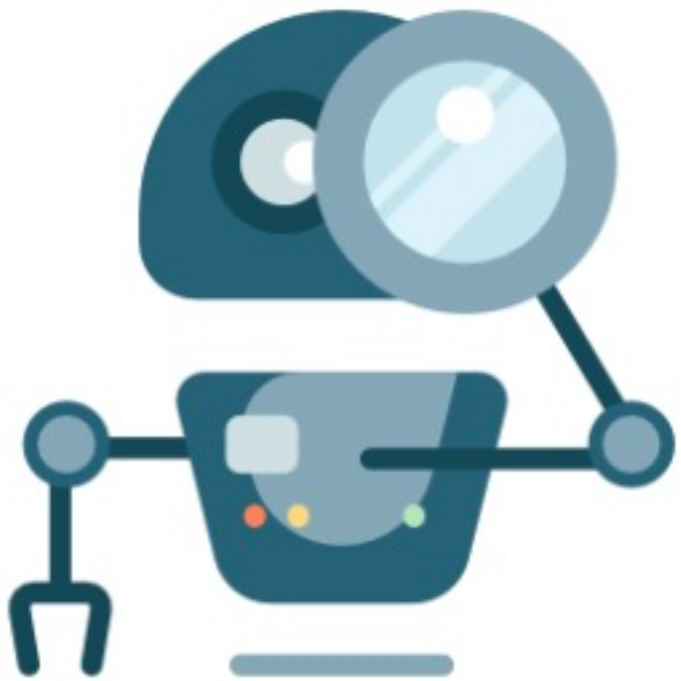
PROBLEM OVERVIEW NEED

The ability to grade sugarcane quality **quickly** and with high **accuracy**.

PROBLEM OVERVIEW - SOLUTION

Hiring staffs

Slow, inefficient

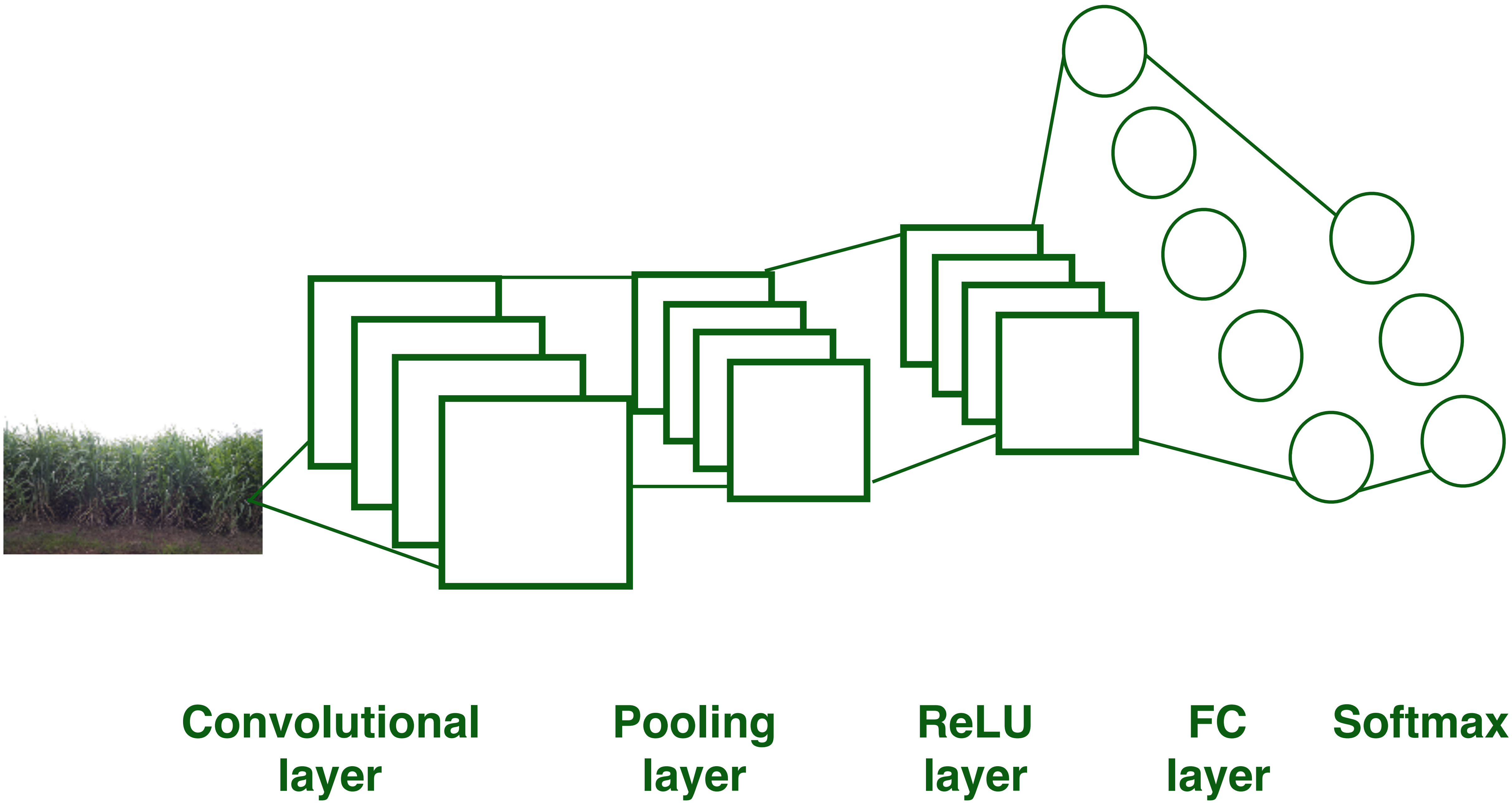


System automatically grade cane quality

Fast, efficient

BACKGROUND AND THEORIES

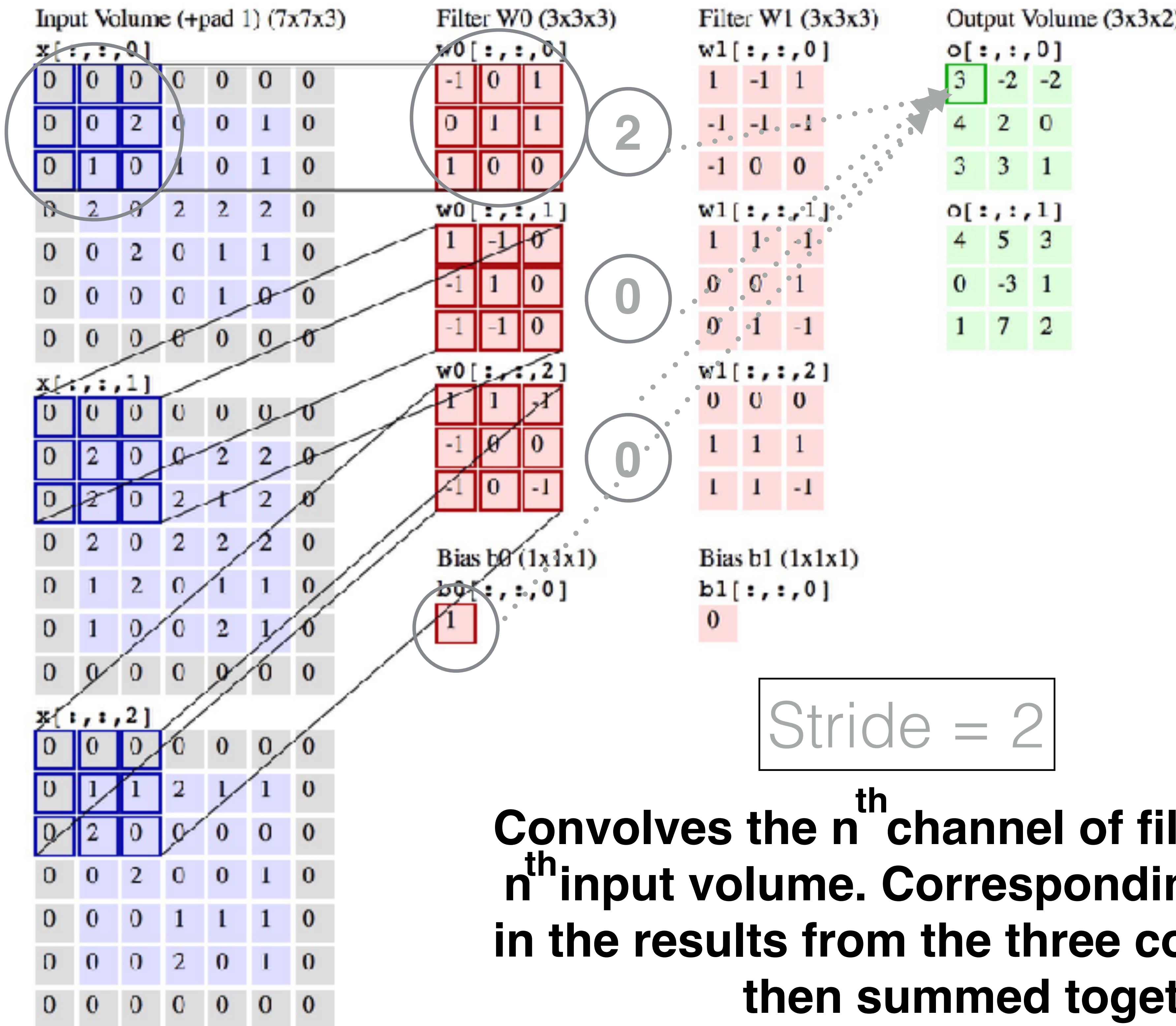
CNN - OVERVIEWS



BACKGROUND AND THEORIES

CNN - FORWARD PROPAGATION

CONVOLUTIONAL LAYER

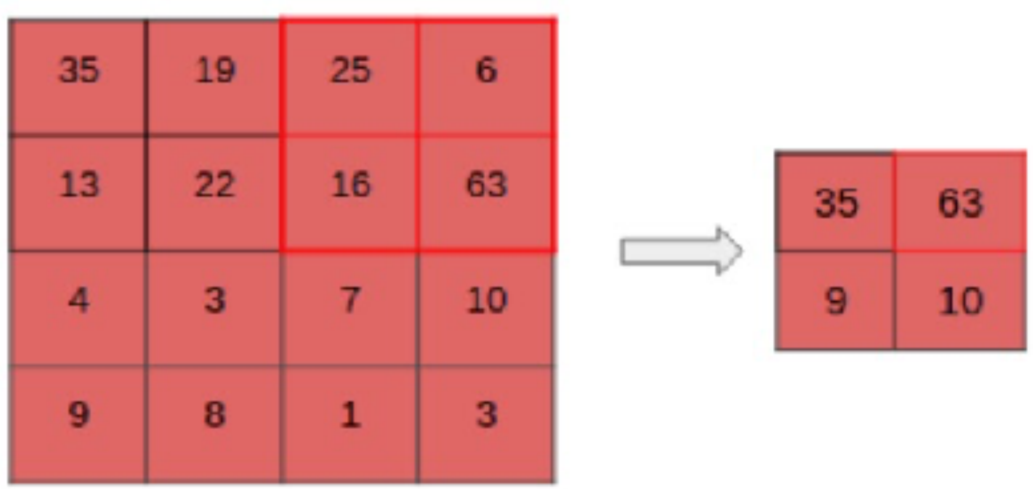


Convolves the n^{th} channel of filter W0 with the n^{th} input volume. Corresponding pixel values in the results from the three convolutions are then summed together.

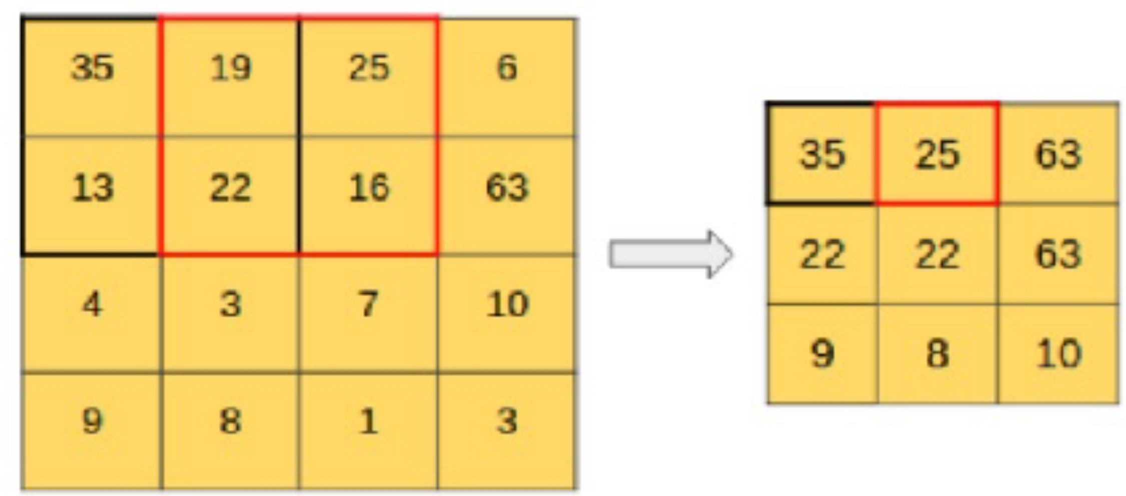
BACKGROUND AND THEORIES

CNN - FORWARD PROPAGATION

POOLING LAYER



Ordinary Pooling



Overlap Pooling

In max pooling, the largest value in the local receptive region will become the ‘representative’ for that region!

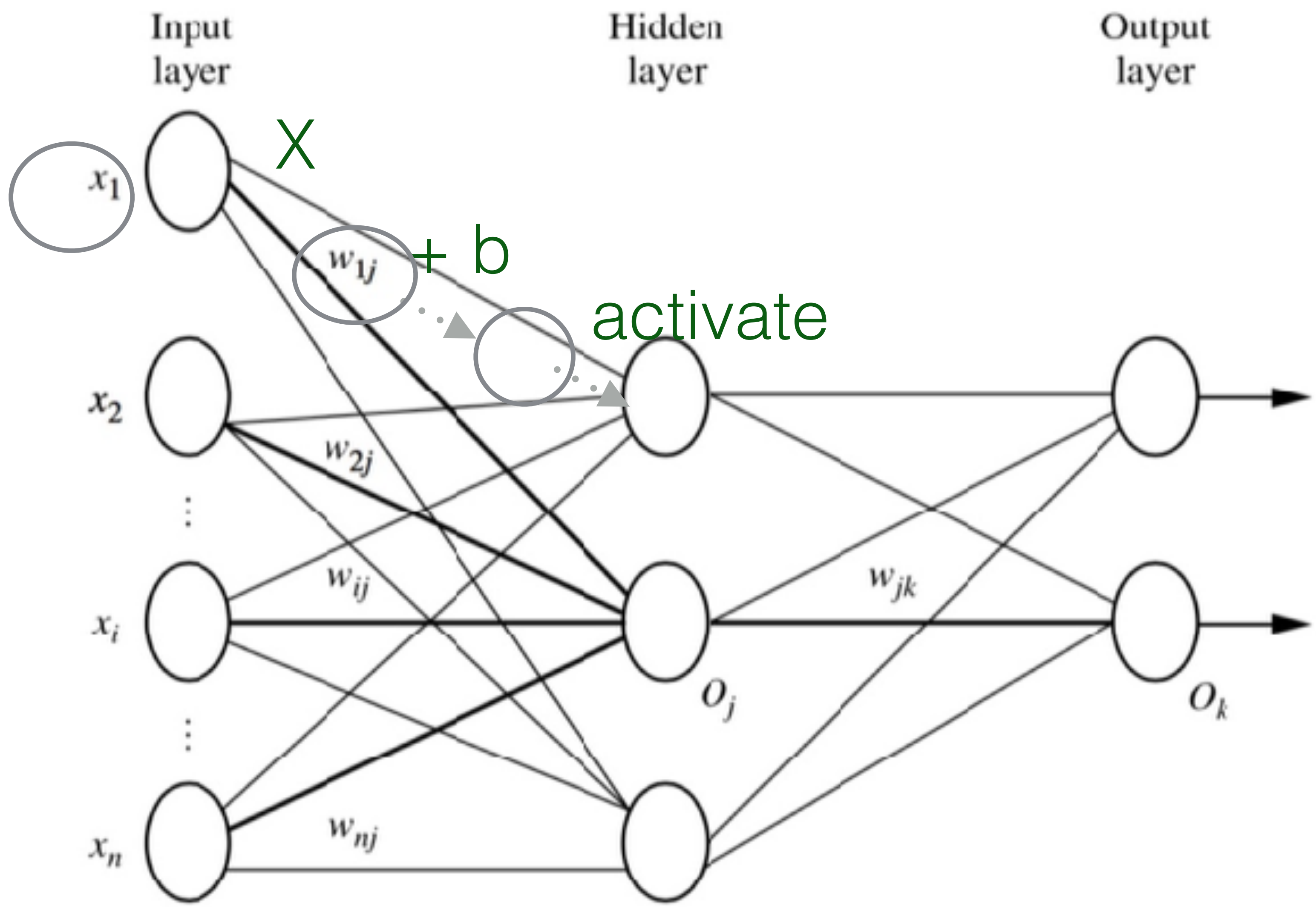
$$\boxed{a_j^{l} = \max\left(0, a_i^{l-1}\right)}$$

The output is 0 when the input is less than 0.

BACKGROUND AND THEORIES

CNN - FORWARD PROPAGATION

FULLY CONNECTED LAYER



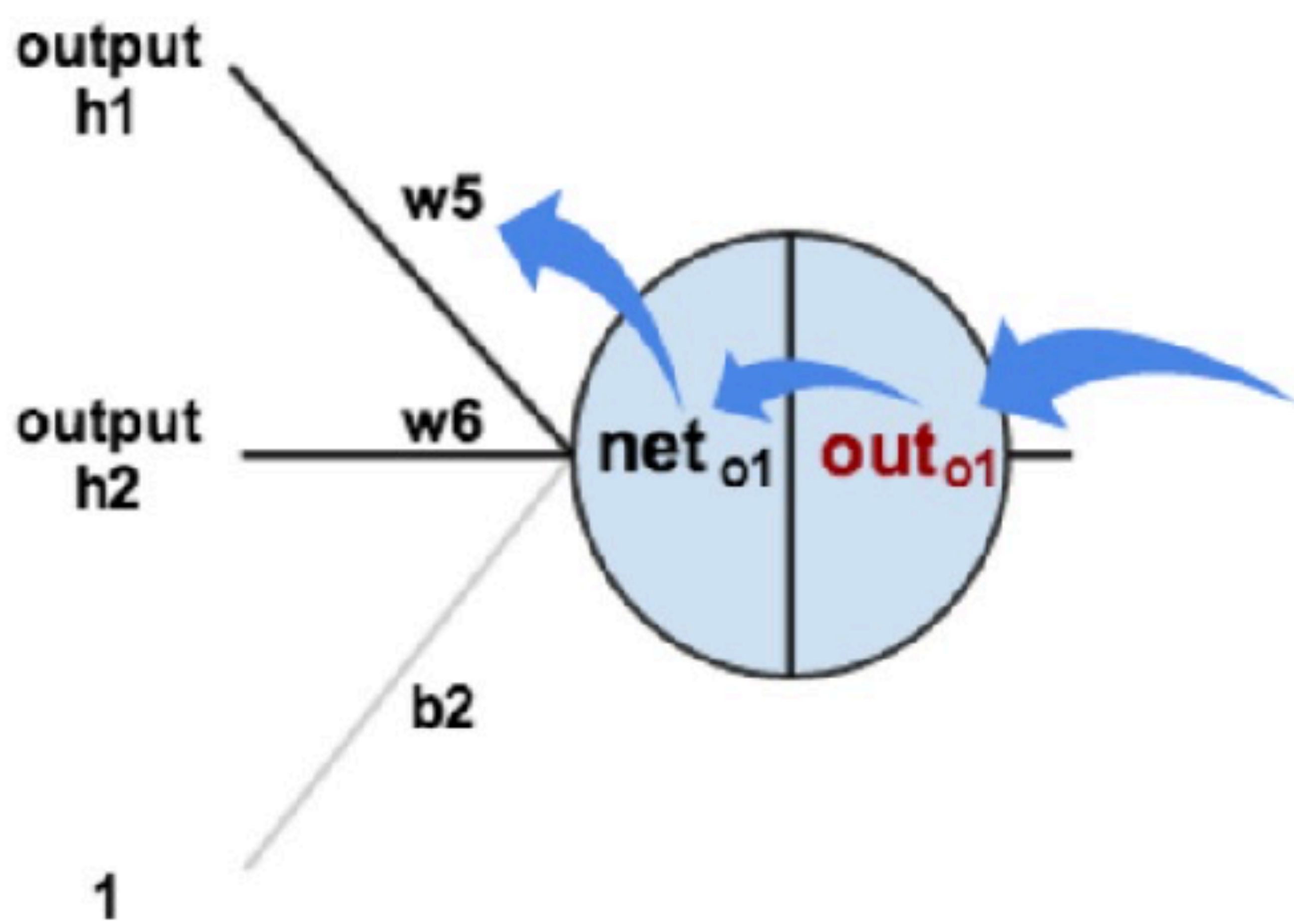
Multiply **activation** from each neuron in **level L-1** by **weight** on the connection to **level L**, sum across all incoming connections, add bias.

So, **higher weights** mean an incoming connection **has more effect** on the output

BACKGROUND AND THEORIES

CNN - BACK PROPAGATION

FULLY CONNECTED LAYER

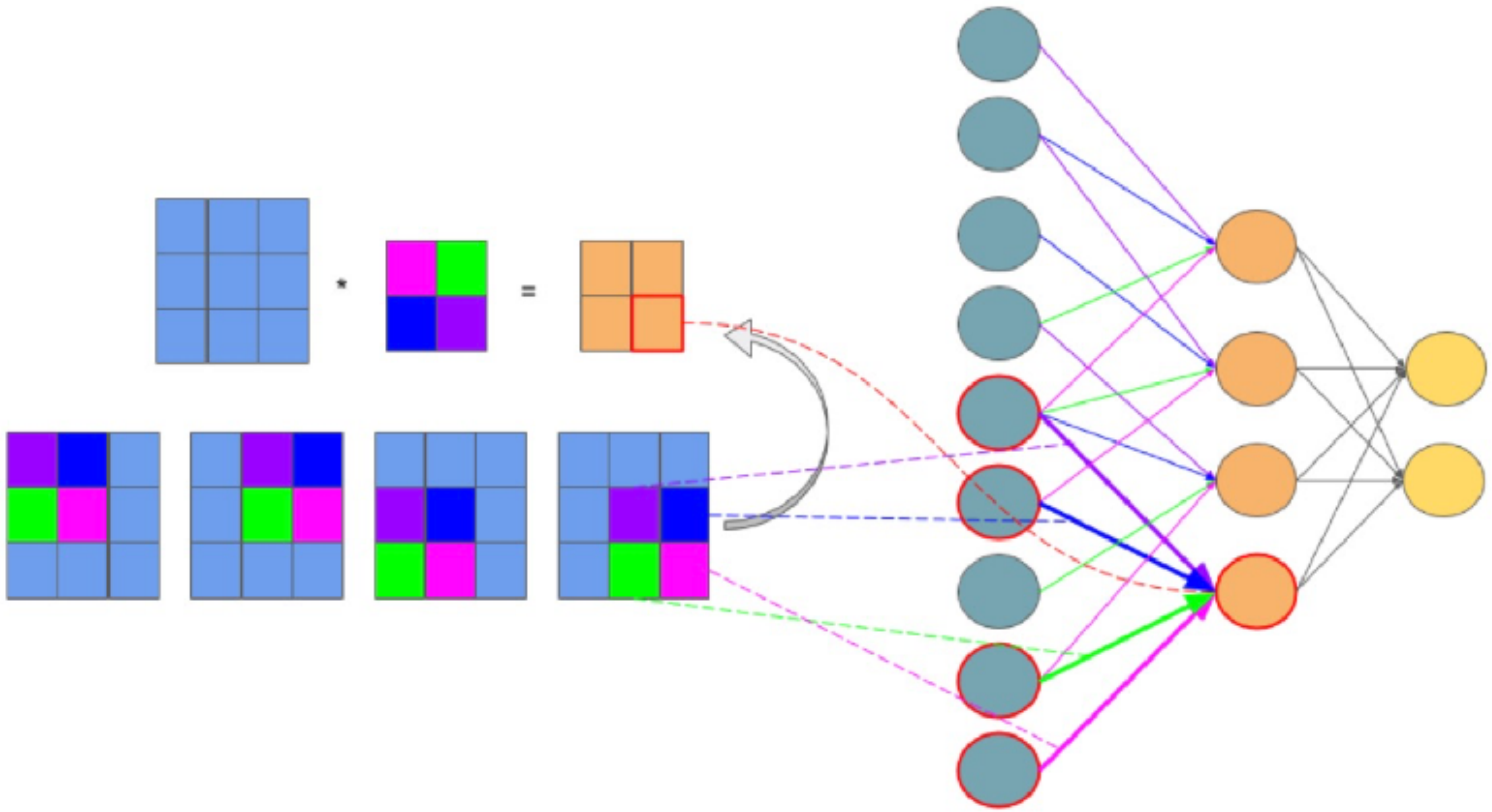


Use the error between predicted **output of each final neuron and the actual, correct output** to **raise** weights on connections that contributed to **correct output**, **lower** weights on connections that contributed to **erroneous output**.

BACKGROUND AND THEORIES

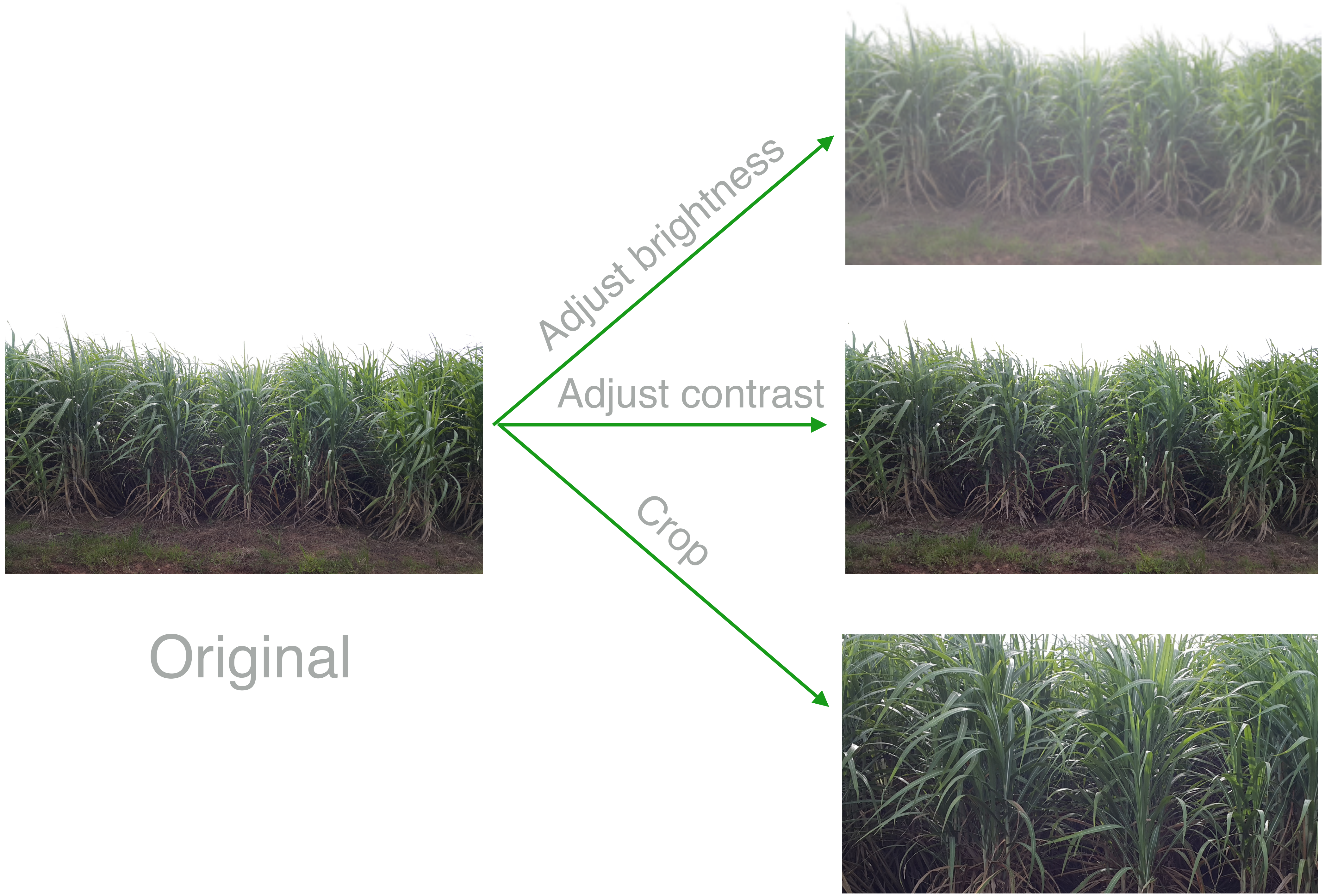
CNN - BACK PROPAGATION

CONVOLUTIONAL LAYER



BACKGROUND AND THEORIES

DATA AUGMENTATION



DESIGNS AND METHODOLOGIES

SET UP - DATA

Photos with labels

THE MORE THE MERRIER!

DESIGNS AND METHODOLOGIES

SET UP - FRAMEWORKS

Caffe TensorFlow torch Facebook AI Research

1. Install a framework and its dependencies
2. Build model by modifying example code
3. Evaluate

DESIGNS AND METHODOLOGIES

SET UP - FRAMEWORKS

Ease of installation

Good documentation

Ease of constructing the networks

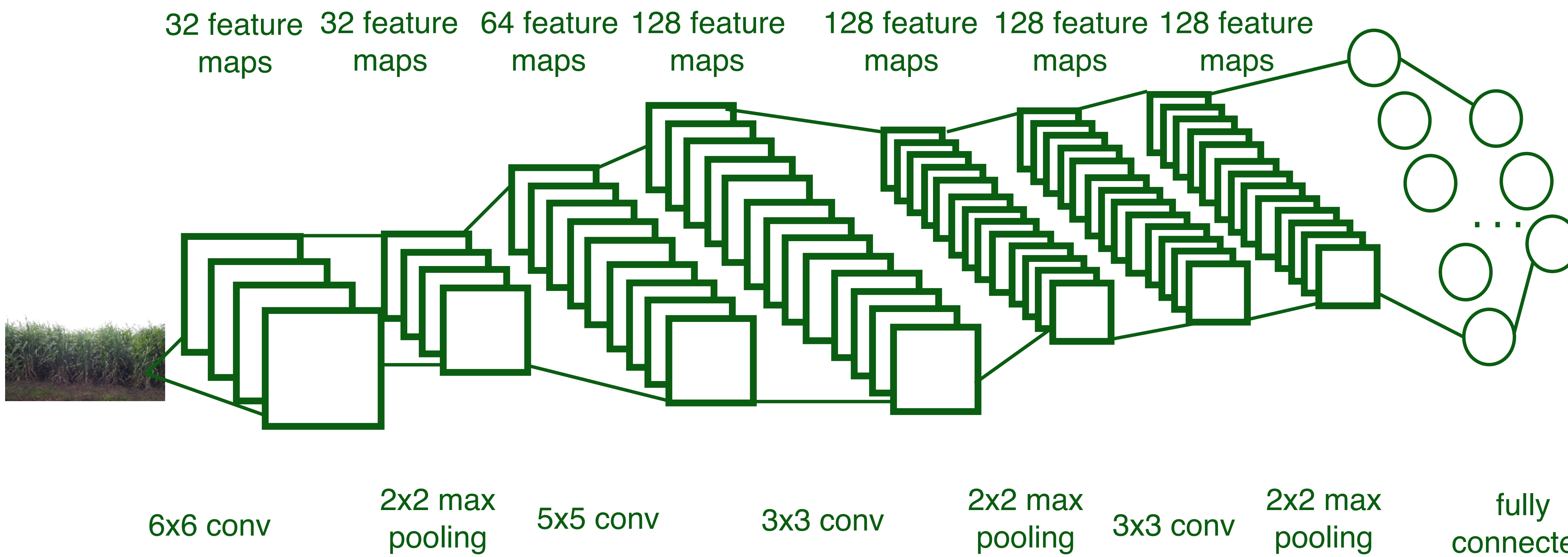
Performance

Sample code and tutorials

Error messages

DESIGNS AND METHODOLOGIES

MODEL DESIGN



* Adapted using the model from Sander et al.

We will experiment by modifying

Batch size & image size

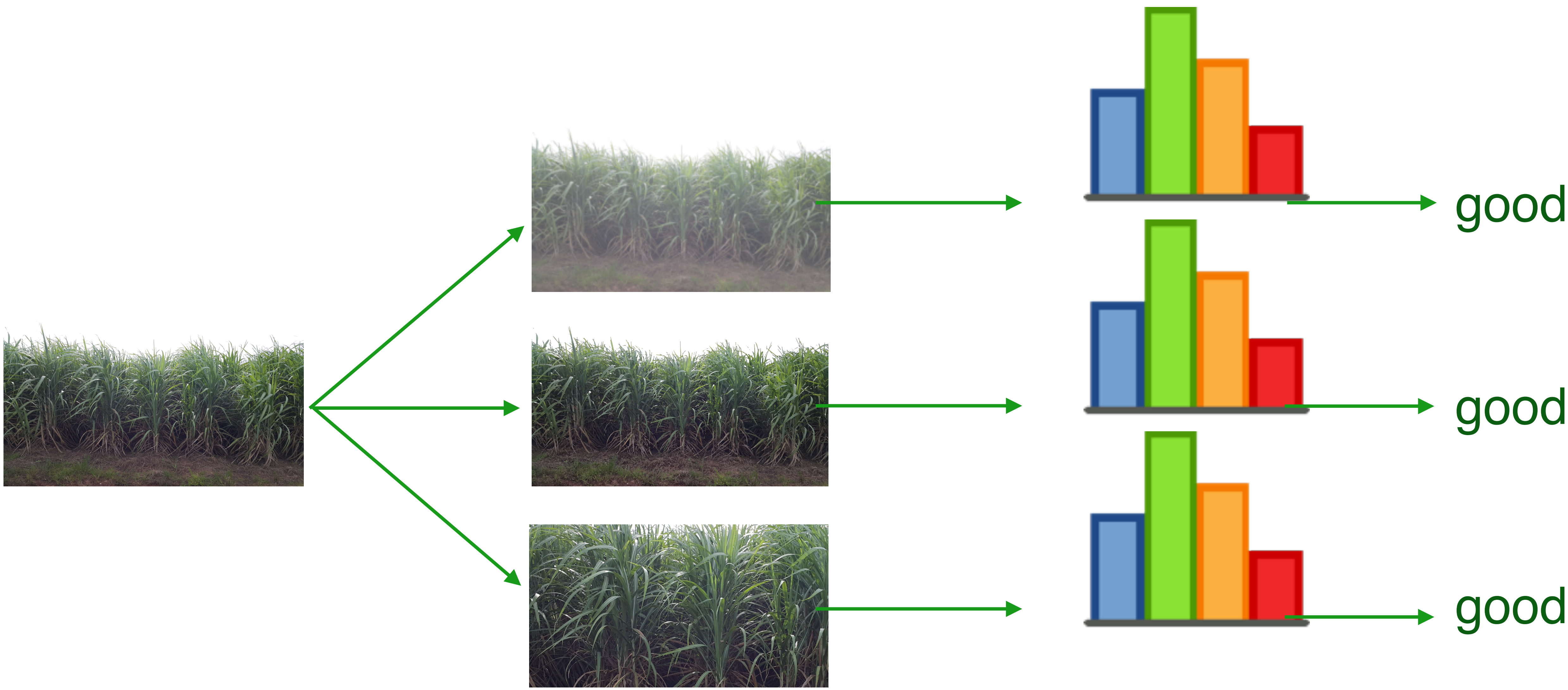
Number of convolutional layers

Pooling technique

Number of fully connected layers

DESIGNS AND METHODOLOGIES

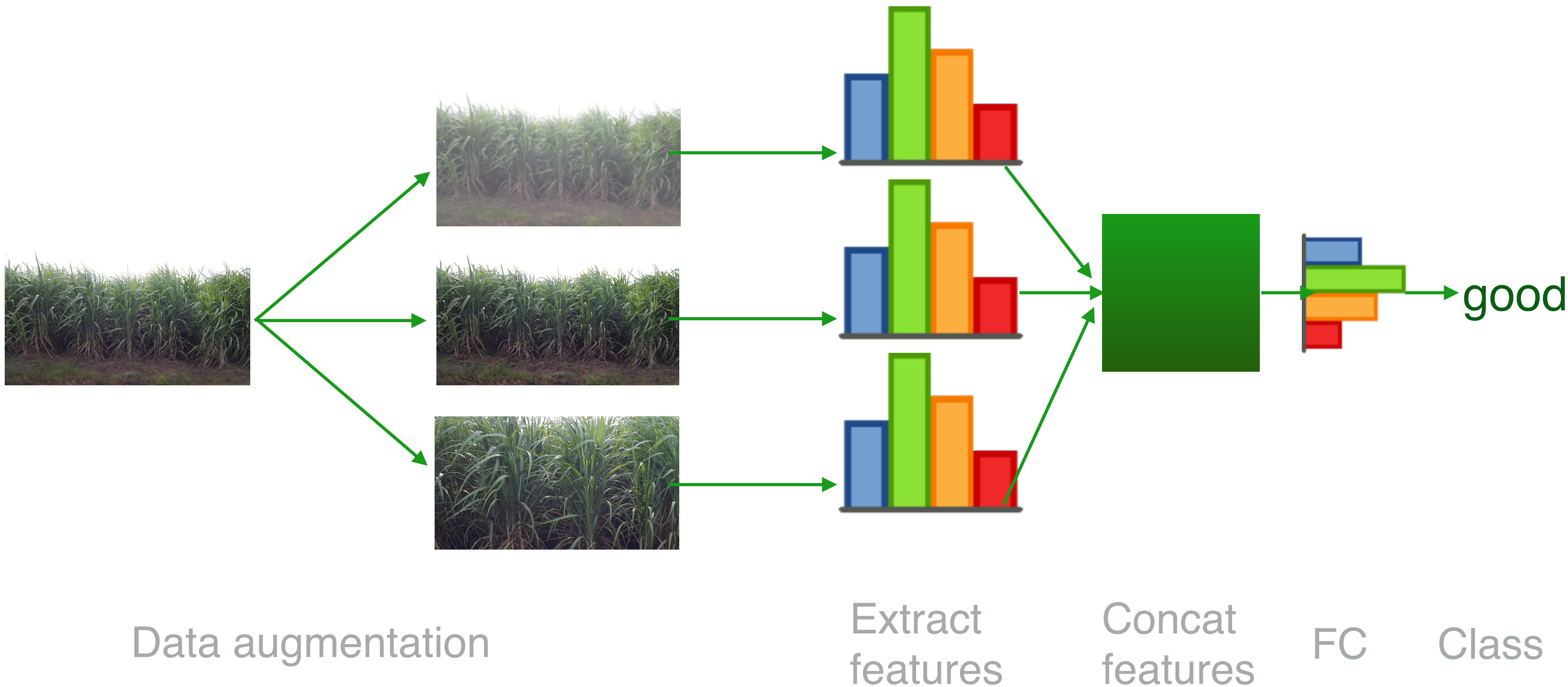
CNN DESIGN - WITHOUT VIEWPOINTS EXTRACTION



Data augmentation CNN Class

DESIGNS AND METHODOLOGIES

CNN DESIGN - WITH VIEWPOINTS EXTRACTION



CURRENT RESULTS

DATA

1700 samples

1 - 3 MONTHS

Poor

Medium

Good

CURRENT RESULTS

DATA

4 - 6 MONTHS

Poor

Medium

Good

CURRENT RESULTS

DATA

7 - 9 MONTHS

Poor

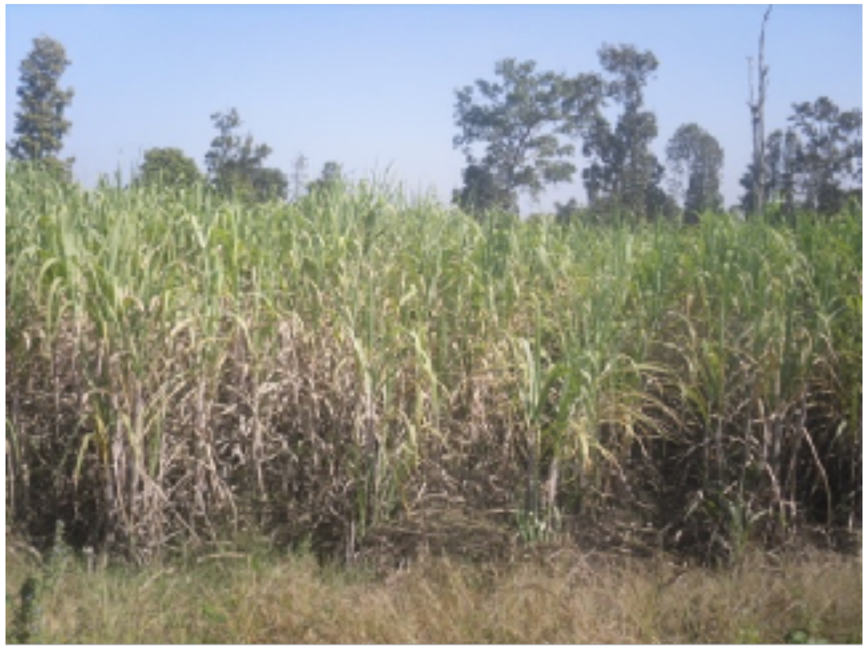
Medium

Good

CURRENT RESULTS

DATA

10- 12 MONTHS



Poor

Medium

Good

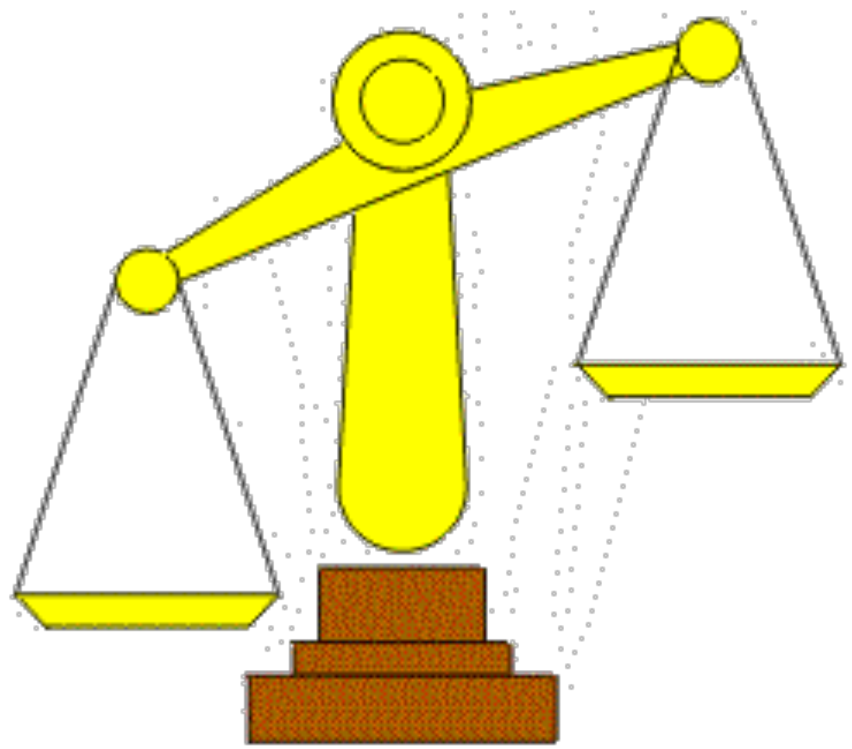
CURRENT RESULTS

EXPERIMENT - TENSORFLOW

TensorFlow

Pros

Easy to install
Good documentation
Tutorial available
Use Python



Cons

Long compute time
7 mins to train 24 images

Results

```
training accuracy: 0.25
training accuracy: 0.45
training accuracy: 0.4
training accuracy: 0.45
training accuracy: 0.25
```

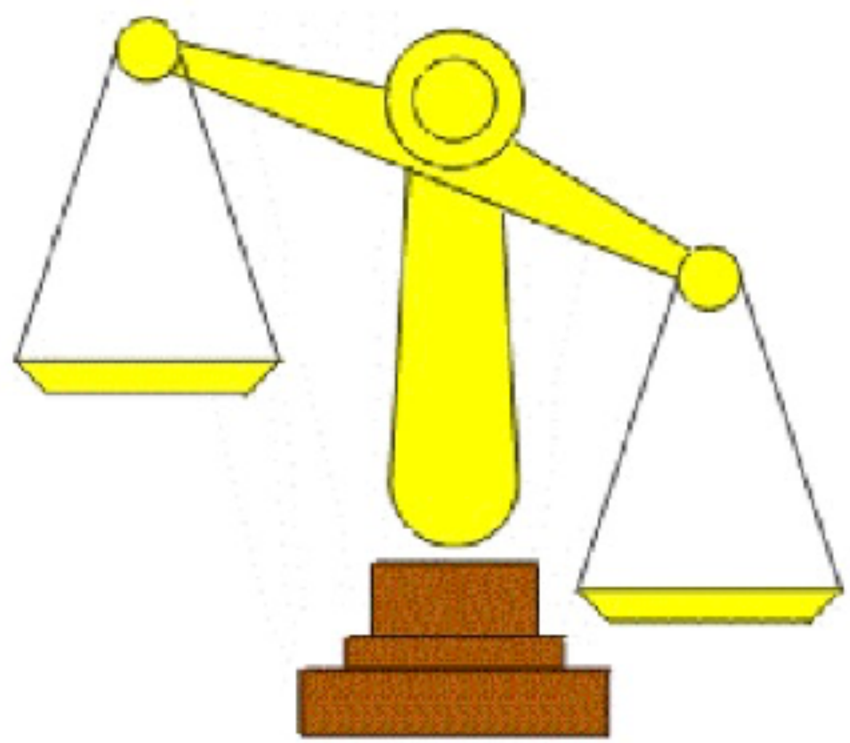
CURRENT RESULTS

EXPERIMENT - CAFFE

Caffe

Pros

Easy to modify
parameters
Use Python



Cons

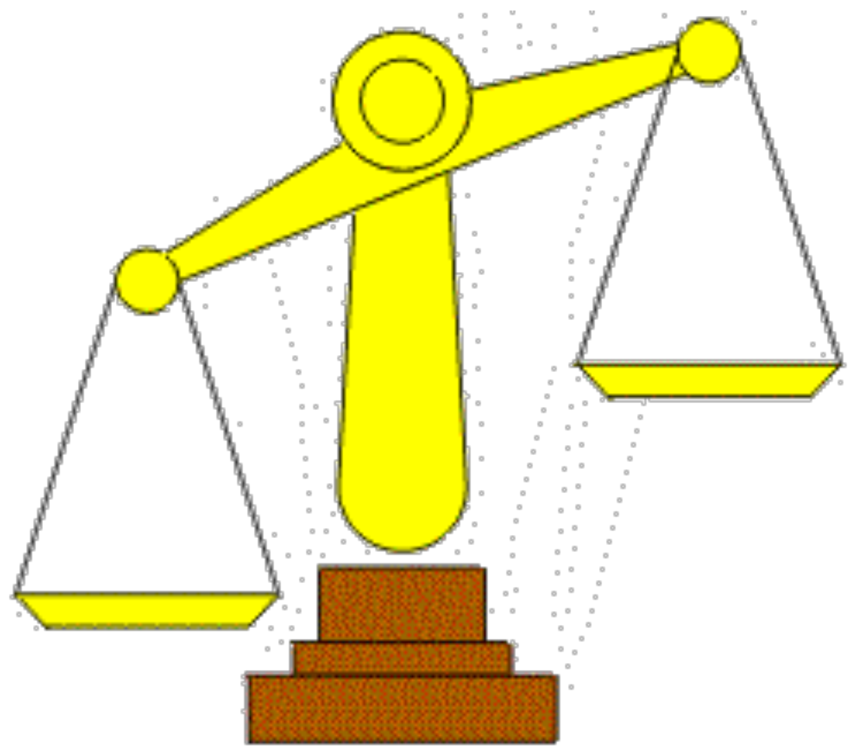
Has many
dependencies
Hard to install
Bad documentation

CURRENT RESULTS

EXPERIMENT - TORCH

Pros

Easy to install
Good documentation
Short compute time (40 second to train 24 images)
Easy to modify parameters



Cons

Use Lua
Few tutorial available

Results

```
# StochasticGradient: training
# current error = 1.0940228035297
# current error = 1.0927206600653
# current error = 1.0914983894763
# current error = 1.09033464861
# current error = 1.0891952305181
# StochasticGradient: you have reached the maximum number of iterations
# training error = 1.0891952305181
```

OUR NEXT STEP

WHAT WE WILL EXAMINE

Do we have enough training data for stable results?

1. The influence of separating by growing season on accuracy
2. The influence of network parameters on accuracy
3. The influence of pooling algorithm & viewpoints on accuracy
4. The best accuracy we can obtain

THANK YOU!