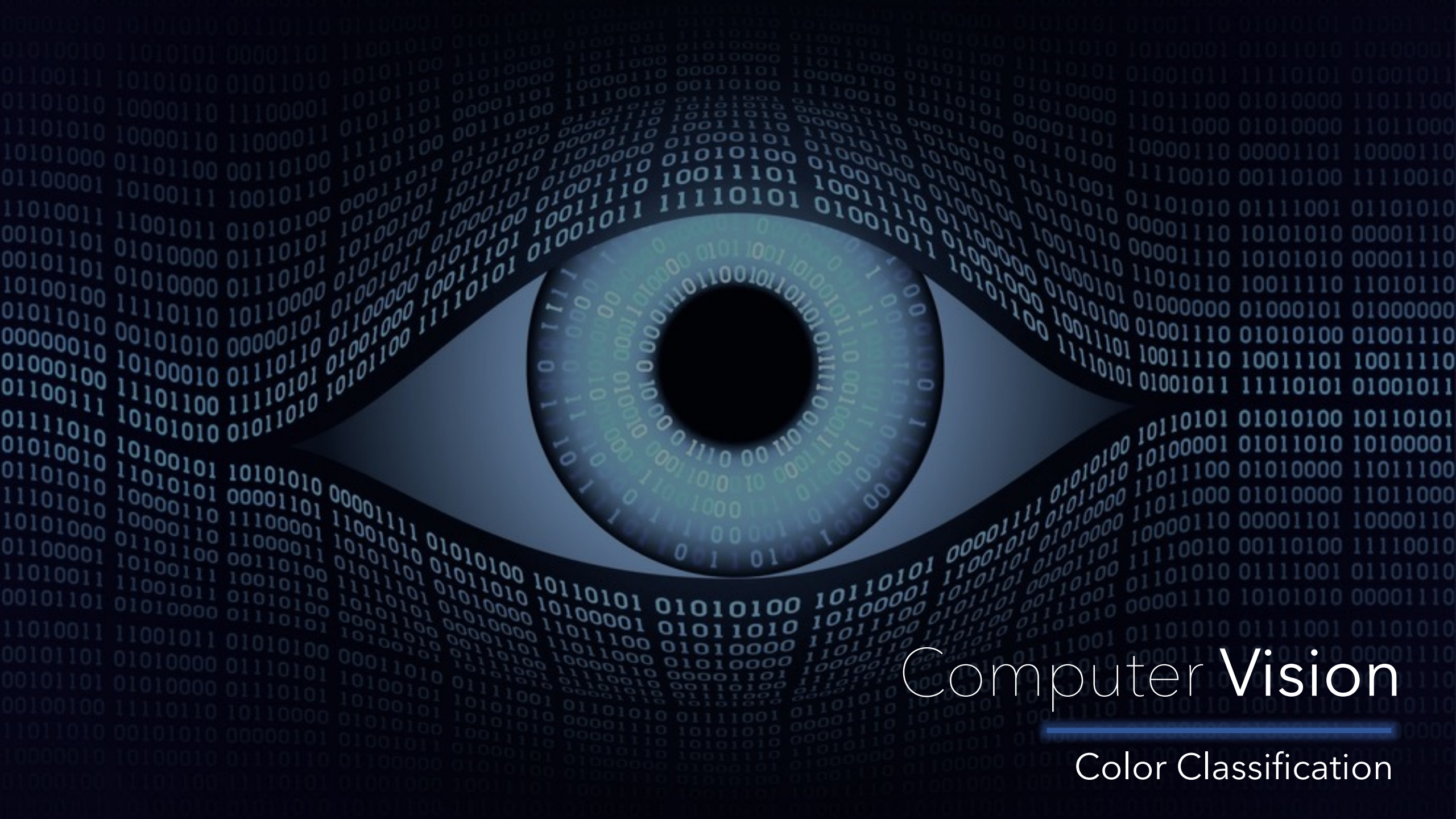


Computer Vision

Color Classification

Project Objectives

Data Collection

Data Preparation

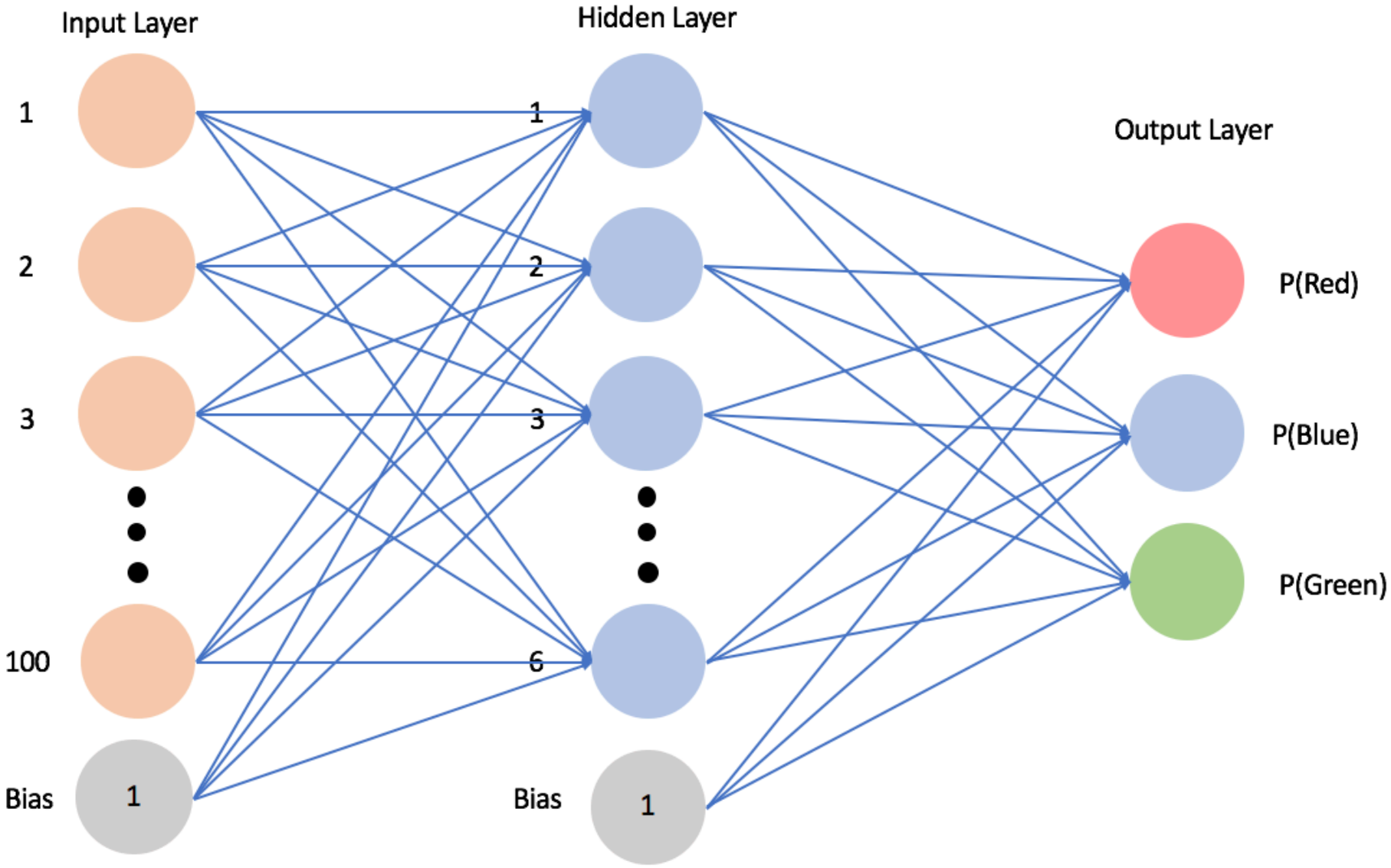
OpenCV

0	0	30	45	90	0	30	0	0	0
0	150	116	115	115	114	114	115	0	0
0	90	116	116	116	116	116	115	0	0
0	0	116	115	165	116	115	114	0	0
0	0	115	115	114	43	115	113	0	0
0	0	114	115	115	115	115	113	0	0
0	0	114	115	115	115	115	114	0	0
0	0	115	115	115	115	115	98	0	0
0	0	114	115	115	115	115	150	0	0
0	0	0	90	0	90	30	0	0	0

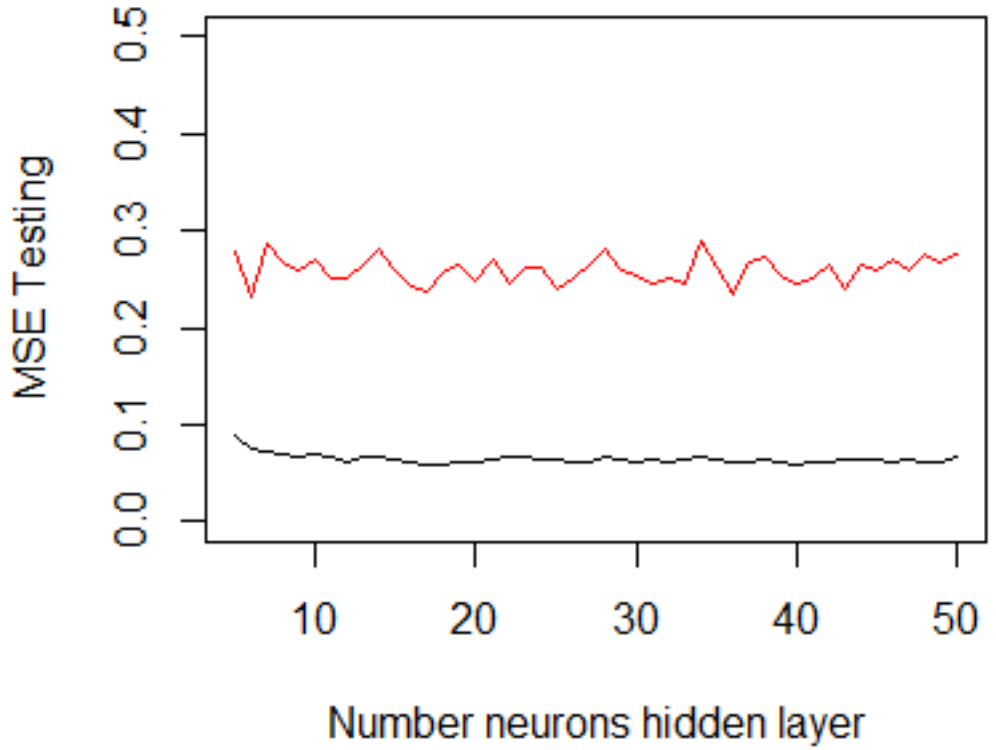
0 179

Hue Scale for Open CV

Architecture: Neural Network



Selection: Neural Network



s=0.7	s=0.8	s=0.9
0.4315504	0.3413741	0.2597338

Analysis: Neural Network

Training Data

Table 3: Neural Network Confusion Matrix - Training data. **Accuracy 98.05%**

		Predicted		
		Blue	*Red*	*Green*
Actual	*Blue*	211	0	5
	Red	1	201	2
	Green	3	1	192

Table 4: Neuronal Network results - Training data. **Accuracy 98.05%**

		Predicted		
		Blue	*Red*	*Green*
Actual	*Blue*	97.68%	0%	2.31%
	Red	0.49%	98.53%	0.98%
	Green	1.53%	0.51%	97.96%

Testing Data

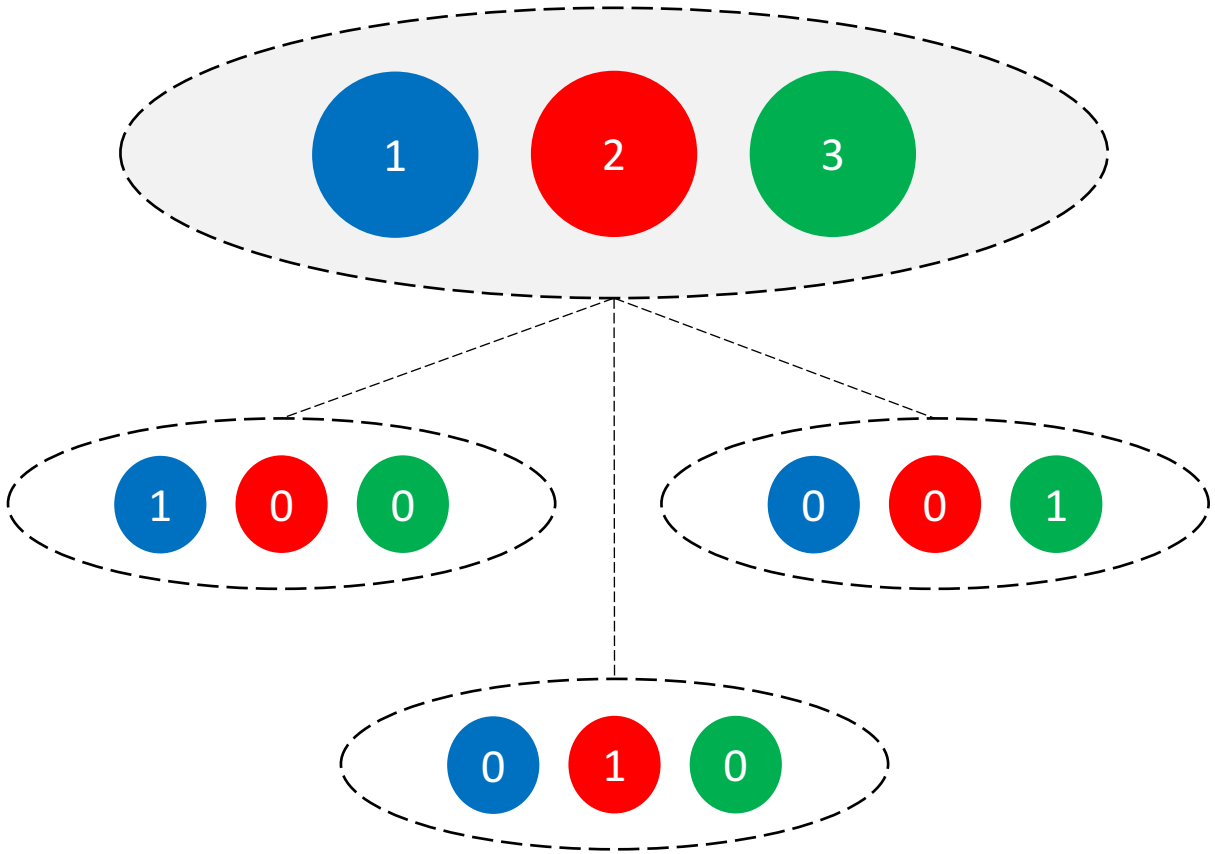
Table 1: Neural Network Confusion Matrix - Testing data. **Accuracy 82.61%**

		Predicted		
		Blue	*Red*	*Green*
Actual	*Blue*	23	0	1
	Red	4	13	6
	Green	0	1	21

Table 2: Neural Network results - Testing data. **Accuracy 82.61%**

		Predicted		
		Blue	*Red*	*Green*
Actual	*Blue*	95.83%	0%	4.17%
	Red	17.39%	56.52%	26.09%
	Green	0%	4.54%	95.45%

Benchmark: Logistic Regression



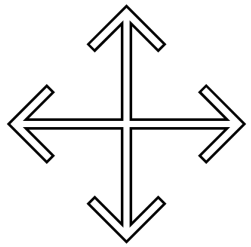
One-vs-all logistic regression model

- Non-binary classification problem
- Exclusive classes (red, blue and green)

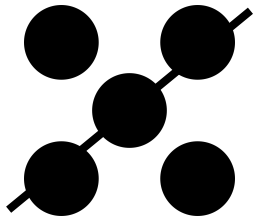
One-vs-all logistic regression is done by creating three separate binary classification problems

The chosen classifier is the one that maximizes the probability

Limitations: Logistic Regression



Logistic Regression has unstable parameters when classes are well separated.



Not well adapted to multiclass classification

Logistic regression is better suited to identify the objects that depend on the place

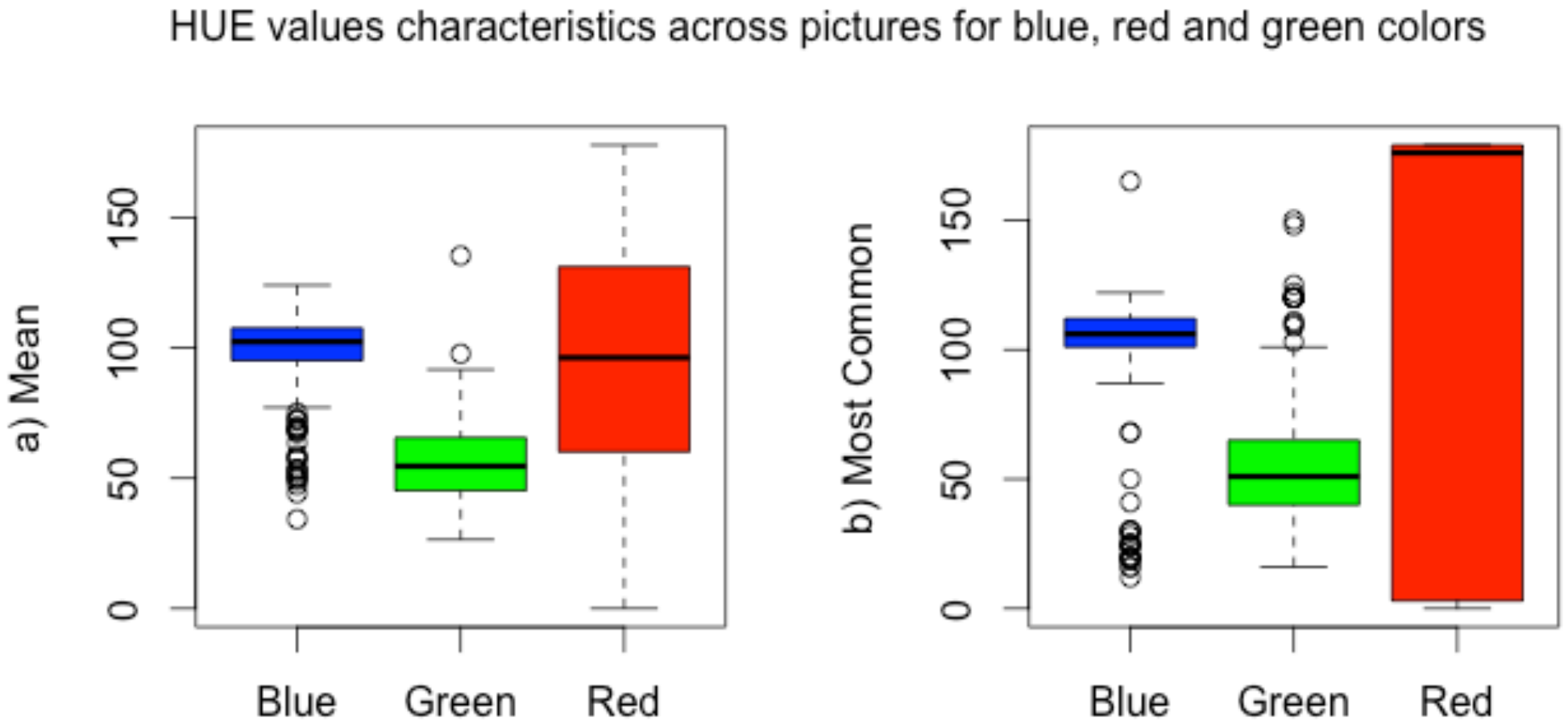
Running a logistic regression on the aggregated HUE value data

Limitations:

- Lack of scalability
- Eliminates the properties of the object
- Lack the applicability to identify more than one color in the picture
- Sensitive to aggregation measure

Analysis: Logistic Regression

Logistic Regression on aggregated HUE values measures



Mean aggregated measure is not suitable for the logistic regression due to red colour characteristics

Results: Logistic Regression

Training Data

Original

		Predicted		
		Blue	*Red*	*Green*
Actual	*Blue*	179	29	8
	Red	47	105	49
	Green	17	19	163

Accuracy: 72.56%

Aggregated

		Predicted		
		Blue	*Red*	*Green*
Actual	*Blue*	193	1	22
	Red	8	113	80
	Green	25	2	172

Accuracy: 77.60%

Testing Data

Original

		Predicted		
		Blue	*Red*	*Green*
Actual	*Blue*	21	1	2
	Red	7	8	11
	Green	1	4	14

Accuracy: 62.32%

Aggregated

		Predicted		
		Blue	*Red*	*Green*
Actual	*Blue*	22	0	2
	Red	3	11	12
	Green	1	0	18

Accuracy: 73.91%

Comparison: LR to NN

Training Data

NN

Actual \ Predicted	*Blue*	*Red*	*Green*
Blue	211	0	5
Red	1	201	2
Green	3	1	192

Accuracy: 98.05%

LR

Actual \ Predicted	*Blue*	*Red*	*Green*
Blue	179	29	8
Red	47	105	49
Green	17	19	163

Accuracy: 72.56%

Testing Data

Actual \ Predicted	*Blue*	*Red*	*Green*
Blue	23	0	1
Red	4	13	6
Green	0	1	21

Accuracy: 82.61%

Actual \ Predicted	*Blue*	*Red*	*Green*
Blue	21	1	2
Red	7	8	11
Green	1	4	14

Accuracy: 62.32%

Real-Time Demonstration

Code Repository: https://github.com/gabeleibo/color_recognition