**Summary:** I attempted to classify a 100 class leaf dataset using two different inputs to neural networks; raw image and sift features. When I used SIFT I had to use the bag of words technique to utilize this information in a useful manner, this leads to an average accuracy of 0.72 and average F1 score of 0.7. When I fed the raw image (resized, flattened and normalized) to the neural network I got much worse results with all of the classes included, those results are shown below. I then completed this second method by reducing the number of classes used to produce somewhat acceptable results achieving an accuracy of 0.36 and average F1 score of 0.36.

**.png to .svg then train network on this also try normalizing your data before training (convert to grayscale, make sure they are all the same size)**

**Describe dataset ; multiclass, size of dataset show histogram showing distribution**

**Show an example of what you can and cannot classify well – explain why.**

**Make it a little more scientific formatting**

**Last question compare the two methods (Sift vs non-sift)**

**USING SIFT**

The loss curve is shown below.

A picture containing shape

Description automatically generated

The classification report is shown below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **class** | **precision** | **recall** | **f1-score** | **support** |
| 0 | 1.00 | 1 | 1 | 4 |
| 1 | 1.00 | 1 | 1 | 1 |
| 2 | 1.00 | 1 | 1 | 3 |
| 3 | 1.00 | 1 | 1 | 6 |
| 4 | 1.00 | 1 | 1 | 2 |
| 5 | 1.00 | 1 | 1 | 3 |
| 6 | 1.00 | 1 | 1 | 2 |
| 7 | 1.00 | 1 | 1 | 6 |
| 8 | 0.25 | 1 | 0.4 | 1 |
| 9 | 1.00 | 1 | 1 | 2 |
| 10 | 1.00 | 0.75 | 0.86 | 4 |
| 11 | 1.00 | 1 | 1 | 4 |
| 12 | 0.67 | 1 | 0.8 | 2 |
| 13 | 1.00 | 1 | 1 | 2 |
| 14 | 1.00 | 1 | 1 | 4 |
| 15 | 1.00 | 1 | 1 | 1 |
| 17 | 1.00 | 0.67 | 0.8 | 3 |
| 18 | 0.00 | 0 | 0 | 3 |
| 19 | 1.00 | 1 | 1 | 5 |
| 20 | 0.67 | 0.67 | 0.67 | 3 |
| 21 | 1.00 | 1 | 1 | 1 |
| 22 | 0.25 | 0.67 | 0.36 | 3 |
| 23 | 1.00 | 0.5 | 0.67 | 4 |
| 24 | 0.50 | 1 | 0.67 | 1 |
| 25 | 1.00 | 1 | 1 | 3 |
| 26 | 1.00 | 0.5 | 0.67 | 2 |
| 27 | 0.67 | 0.4 | 0.5 | 5 |
| 28 | 0.50 | 1 | 0.67 | 1 |
| 29 | 0.20 | 0.33 | 0.25 | 3 |
| 30 | 0.00 | 0 | 0 | 3 |
| 31 | 0.50 | 1 | 0.67 | 2 |
| 32 | 0.50 | 0.67 | 0.57 | 3 |
| 33 | 1.00 | 0.8 | 0.89 | 5 |
| 34 | 1.00 | 0.4 | 0.57 | 5 |
| 35 | 1.00 | 0.67 | 0.8 | 3 |
| 36 | 0.00 | 0 | 0 | 0 |
| 37 | 0.33 | 1 | 0.5 | 1 |
| 38 | 0.00 | 0 | 0 | 3 |
| 39 | 0.40 | 0.67 | 0.5 | 3 |
| 40 | 0.00 | 0 | 0 | 1 |
| 41 | 0.67 | 1 | 0.8 | 4 |
| 42 | 1.00 | 1 | 1 | 3 |
| 43 | 0.67 | 1 | 0.8 | 2 |
| 44 | 0.00 | 0 | 0 | 0 |
| 45 | 1.00 | 1 | 1 | 3 |
| 46 | 1.00 | 1 | 1 | 1 |
| 47 | 1.00 | 1 | 1 | 3 |
| 48 | 1.00 | 0.43 | 0.6 | 7 |
| 49 | 1.00 | 1 | 1 | 3 |
| 50 | 1.00 | 0.75 | 0.86 | 4 |
| 51 | 1.00 | 1 | 1 | 1 |
| 52 | 1.00 | 0.67 | 0.8 | 3 |
| 53 | 0.40 | 0.67 | 0.5 | 3 |
| 54 | 0.33 | 1 | 0.5 | 1 |
| 55 | 0.17 | 1 | 0.29 | 1 |
| 56 | 0.57 | 1 | 0.73 | 4 |
| 57 | 0.33 | 0.5 | 0.4 | 2 |
| 58 | 1.00 | 0.67 | 0.8 | 3 |
| 59 | 0.00 | 0 | 0 | 2 |
| 60 | 0.00 | 0 | 0 | 1 |
| 61 | 0.40 | 1 | 0.57 | 2 |
| 62 | 1.00 | 1 | 1 | 3 |
| 63 | 0.33 | 0.5 | 0.4 | 2 |
| 64 | 0.80 | 0.8 | 0.8 | 5 |
| 65 | 0.75 | 0.75 | 0.75 | 4 |
| 66 | 1.00 | 0.5 | 0.67 | 2 |
| 67 | 0.00 | 0 | 0 | 4 |
| 68 | 1.00 | 0.8 | 0.89 | 5 |
| 69 | 0.67 | 0.67 | 0.67 | 3 |
| 70 | 0.75 | 0.6 | 0.67 | 5 |
| 71 | 1.00 | 1 | 1 | 2 |
| 72 | 1.00 | 0.17 | 0.29 | 6 |
| 73 | 0.43 | 1 | 0.6 | 3 |
| 74 | 1.00 | 1 | 1 | 1 |
| 75 | 1.00 | 1 | 1 | 4 |
| 76 | 1.00 | 1 | 1 | 2 |
| 77 | 0.67 | 0.57 | 0.62 | 7 |
| 78 | 1.00 | 1 | 1 | 3 |
| 79 | 1.00 | 1 | 1 | 3 |
| 80 | 0.80 | 1 | 0.89 | 4 |
| 81 | 0.00 | 0 | 0 | 3 |
| 82 | 0.50 | 0.67 | 0.57 | 3 |
| 83 | 0.50 | 1 | 0.67 | 1 |
| 84 | 0.00 | 0 | 0 | 0 |
| 85 | 1.00 | 1 | 1 | 5 |
| 86 | 0.00 | 0 | 0 | 4 |
| 87 | 0.50 | 0.25 | 0.33 | 4 |
| 88 | 0.33 | 1 | 0.5 | 2 |
| 89 | 0.67 | 1 | 0.8 | 2 |
| 90 | 0.50 | 0.5 | 0.5 | 6 |
| 91 | 1.00 | 0.2 | 0.33 | 5 |
| 92 | 1.00 | 1 | 1 | 3 |
| 93 | 0.67 | 1 | 0.8 | 2 |
| 94 | 0.75 | 1 | 0.86 | 3 |
| 95 | 1.00 | 1 | 1 | 5 |
| 96 | 0.33 | 0.33 | 0.33 | 3 |
| 97 | 1.00 | 0.57 | 0.73 | 7 |
| 98 | 1.00 | 1 | 1 | 5 |
|  |  |  |  |  |
| accuracy |  |  | 0.72 | 297 |
| macro | avg | 0.69 | 0.73 | 0.67 |
| avg | 0.76 | 0.72 | 0.7 | 297 |

**USING RAW IMAGE**

The loss curve is shown below.

Shape

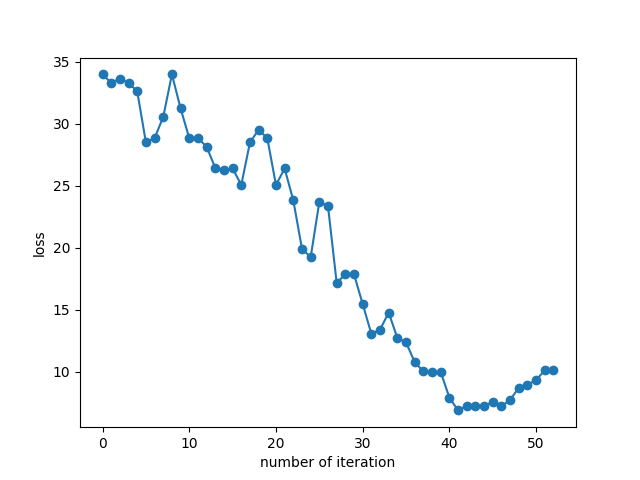
Description automatically generated

The classification report is shown below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **class** | **precision** | **Recall** | **f1-score** | **support** |
| 0 | 0 | 0 | 0 | 6 |
| 1 | 0 | 0 | 0 | 3 |
| 2 | 0 | 0 | 0 | 4 |
| 3 | 0 | 0 | 0 | 3 |
| 5 | 0 | 0 | 0 | 1 |
| 6 | 0 | 0 | 0 | 1 |
| 7 | 0 | 0 | 0 | 3 |
| 8 | 0 | 0 | 0 | 3 |
| 9 | 0 | 0 | 0 | 2 |
| 10 | 0 | 0 | 0 | 5 |
| 11 | 0 | 0 | 0 | 0 |
| 12 | 0 | 0 | 0 | 1 |
| 13 | 0 | 0 | 0 | 4 |
| 14 | 0 | 0 | 0 | 3 |
| 15 | 0 | 0 | 0 | 2 |
| 16 | 0 | 0 | 0 | 2 |
| 17 | 0 | 0 | 0 | 2 |
| 18 | 0 | 0 | 0 | 4 |
| 20 | 0.14 | 1 | 0.25 | 1 |
| 21 | 0 | 0 | 0 | 2 |
| 22 | 0 | 0 | 0 | 2 |
| 23 | 0 | 0 | 0 | 1 |
| 24 | 0 | 0 | 0 | 2 |
| 25 | 0 | 0 | 0 | 3 |
| 26 | 0 | 0 | 0 | 3 |
| 27 | 0 | 0 | 0 | 0 |
| 28 | 0 | 0 | 0 | 5 |
| 29 | 0 | 0 | 0 | 2 |
| 30 | 0 | 0 | 0 | 2 |
| 31 | 0.05 | 1 | 0.09 | 1 |
| 32 | 0 | 0 | 0 | 1 |
| 33 | 0 | 0 | 0 | 3 |
| 34 | 0 | 0 | 0 | 3 |
| 35 | 0 | 0 | 0 | 1 |
| 36 | 0 | 0 | 0 | 3 |
| 37 | 0 | 0 | 0 | 4 |
| 38 | 0 | 0 | 0 | 2 |
| 39 | 0 | 0 | 0 | 3 |
| 40 | 0 | 0 | 0 | 3 |
| 41 | 0 | 0 | 0 | 2 |
| 42 | 0 | 0 | 0 | 7 |
| 43 | 0 | 0 | 0 | 3 |
| 44 | 0 | 0 | 0 | 5 |
| 45 | 0 | 0 | 0 | 3 |
| 46 | 0 | 0 | 0 | 3 |
| 47 | 0 | 0 | 0 | 5 |
| 48 | 0 | 0 | 0 | 3 |
| 49 | 0 | 0 | 0 | 3 |
| 50 | 0 | 0 | 0 | 3 |
| 51 | 0 | 0 | 0 | 3 |
| 52 | 0 | 0 | 0 | 3 |
| 53 | 0 | 0 | 0 | 6 |
| 54 | 0 | 0 | 0 | 2 |
| 55 | 0 | 0 | 0 | 4 |
| 56 | 0 | 0 | 0 | 1 |
| 57 | 0 | 0 | 0 | 3 |
| 58 | 0 | 0 | 0 | 1 |
| 59 | 0 | 0 | 0 | 1 |
| 60 | 0 | 0 | 0 | 7 |
| 61 | 0 | 0 | 0 | 5 |
| 62 | 0.03 | 1 | 0.07 | 1 |
| 63 | 0 | 0 | 0 | 2 |
| 64 | 0 | 0 | 0 | 4 |
| 65 | 0 | 0 | 0 | 2 |
| 66 | 0 | 0 | 0 | 3 |
| 67 | 0 | 0 | 0 | 2 |
| 68 | 0 | 0 | 0 | 4 |
| 69 | 0 | 0 | 0 | 1 |
| 70 | 0 | 0 | 0 | 4 |
| 71 | 0 | 0 | 0 | 3 |
| 72 | 0 | 0 | 0 | 3 |
| 73 | 0 | 0 | 0 | 1 |
| 74 | 0 | 0 | 0 | 2 |
| 75 | 0 | 0 | 0 | 4 |
| 76 | 0 | 0 | 0 | 1 |
| 77 | 0 | 0 | 0 | 3 |
| 78 | 0 | 0 | 0 | 3 |
| 79 | 0 | 0 | 0 | 6 |
| 80 | 0 | 0 | 0 | 4 |
| 81 | 0 | 0 | 0 | 3 |
| 82 | 0 | 0 | 0 | 2 |
| 83 | 0 | 0 | 0 | 3 |
| 84 | 0 | 0 | 0 | 4 |
| 85 | 0 | 0 | 0 | 5 |
| 86 | 0 | 0 | 0 | 4 |
| 87 | 0 | 0 | 0 | 3 |
| 88 | 0 | 0 | 0 | 3 |
| 89 | 0 | 0 | 0 | 2 |
| 90 | 0 | 0 | 0 | 4 |
| 91 | 0 | 0 | 0 | 4 |
| 92 | 0 | 0 | 0 | 7 |
| 93 | 0 | 0 | 0 | 5 |
| 94 | 0 | 0 | 0 | 5 |
| 95 | 0 | 0 | 0 | 5 |
| 96 | 0 | 0 | 0 | 6 |
| 97 | 0 | 0 | 0 | 5 |
| 98 | 0 | 0 | 0 | 5 |
|  |  |  |  |  |
| accuracy |  |  | 0.01 | 297 |
| macro avg | 0 | 0.03 | 0 | 297 |
| weighted avg | 0 | 0.01 | 0 | 297 |

**USING RAW IMAGE WITH A REDUCED NUMBER OF CLASSES**

The loss curve is shown below.



The classification report is shown below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **class** | **precision** | **recall** | **f1-score** | **support** |
|  |  |  |  |  |
| 1 | 0.5 | 0.25 | 0.33 | 4 |
| 2 | 1 | 0.6 | 0.75 | 5 |
| 3 | 0.8 | 1 | 0.89 | 4 |
| 4 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 2 |
| 6 | 0 | 0 | 0 | 2 |
| 7 | 0 | 0 | 0 | 3 |
| 8 | 0.33 | 0.67 | 0.44 | 3 |
| 9 | 0.33 | 0.25 | 0.29 | 4 |
| 10 | 0.5 | 0.6 | 0.55 | 5 |
| 11 | 0 | 0 | 0 | 1 |
| 12 | 0 | 0 | 0 | 2 |
| 13 | 0.2 | 0.25 | 0.22 | 4 |
| 14 | 0 | 0 | 0 | 4 |
| 15 | 1 | 0.5 | 0.67 | 2 |
|  |  |  |  |  |
| accuracy |  |  | 0.36 | 45 |
| macro avg | 0.31 | 0.27 | 0.28 | 45 |
| weighted avg | 0.4 | 0.36 | 0.36 | 45 |