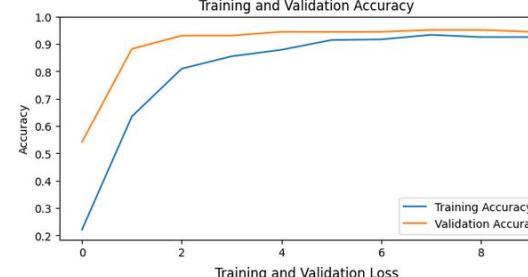
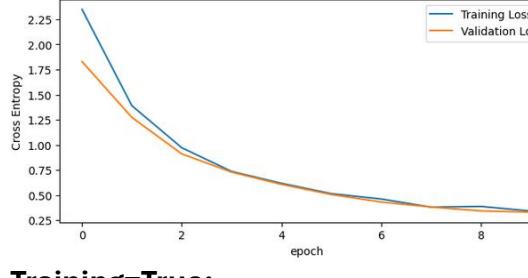
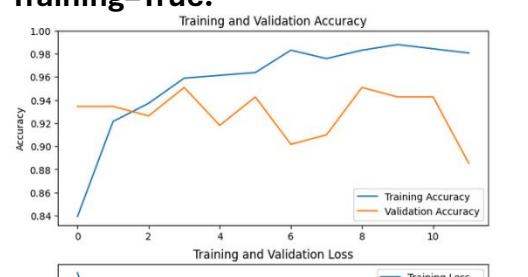
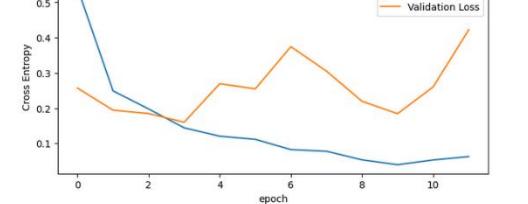


## Assignment 3 Parameter History

Iteration	Parameters	Test/Train Accuracy	History Plot Graphs
1	<b>PREPROCESSING:</b> <code>batch = 32</code> <code>seed = 1337</code> <code>flip = "horizontal"</code> <code>rotation = 0.5</code> <code>zoom = 0.1</code>  <b>MODEL:</b> <code>alpha_val = 1.0</code> <code>include_top_val = False</code> <code>dropout_rate_val = 0.2</code> <code>optimizer_val =</code> <code>tf.keras.optimizers.Adam()</code> <code>optimizer_val_tuning =</code> <code>tf.keras.optimizers.Adam(1e-4)</code> <code>global_average_layer_parameter =</code> <code>tf.keras.layers.GlobalAveragePooling2D()</code> <code>loss_val =</code> <code>"sparse_categorical_crossentropy"</code> <code>base_learning_rate = 0.0001</code> <code>initial_epochs = 10</code> <code>fine_tune_layers = 30</code> <code>fine_tune_epochs = 10</code>	<b>Training = False:</b> Train Acc: 0.9251 Train Loss: 0.3416 Validation Acc: 0.9444 Validation Loss: 0.3313  <b>Training = True:</b> Train Acc: 1.000 Train Loss: 0.9444 Validation Acc: 0.9444 Validation Loss: 0.9444  <b>Test:</b> Test Acc: 0.9829 Test Loss: 0.0521	<p><b>Training = False:</b></p>  <p><b>Training = True:</b></p>  <p><b>Training=True:</b></p>  

## Assignment 3 Parameter History

			<p><b>Training and Validation Accuracy:</b></p> <table border="1"> <thead> <tr> <th>Epoch</th> <th>Training Accuracy</th> <th>Validation Accuracy</th> </tr> </thead> <tbody> <tr><td>0</td><td>0.86</td><td>0.92</td></tr> <tr><td>1</td><td>0.96</td><td>0.97</td></tr> <tr><td>2</td><td>0.98</td><td>0.94</td></tr> <tr><td>3</td><td>0.98</td><td>0.95</td></tr> <tr><td>4</td><td>0.99</td><td>0.96</td></tr> <tr><td>5</td><td>0.99</td><td>0.98</td></tr> <tr><td>6</td><td>0.99</td><td>0.96</td></tr> <tr><td>7</td><td>0.99</td><td>0.98</td></tr> <tr><td>8</td><td>0.99</td><td>0.94</td></tr> <tr><td>9</td><td>1.00</td><td>0.97</td></tr> </tbody> </table> <p><b>Training and Validation Loss:</b></p> <table border="1"> <thead> <tr> <th>Epoch</th> <th>Training Loss</th> <th>Validation Loss</th> </tr> </thead> <tbody> <tr><td>0</td><td>0.50</td><td>0.20</td></tr> <tr><td>1</td><td>0.15</td><td>0.12</td></tr> <tr><td>2</td><td>0.08</td><td>0.10</td></tr> <tr><td>3</td><td>0.05</td><td>0.10</td></tr> <tr><td>4</td><td>0.03</td><td>0.08</td></tr> <tr><td>5</td><td>0.02</td><td>0.07</td></tr> <tr><td>6</td><td>0.01</td><td>0.07</td></tr> <tr><td>7</td><td>0.01</td><td>0.08</td></tr> <tr><td>8</td><td>0.01</td><td>0.09</td></tr> <tr><td>9</td><td>0.01</td><td>0.08</td></tr> </tbody> </table>	Epoch	Training Accuracy	Validation Accuracy	0	0.86	0.92	1	0.96	0.97	2	0.98	0.94	3	0.98	0.95	4	0.99	0.96	5	0.99	0.98	6	0.99	0.96	7	0.99	0.98	8	0.99	0.94	9	1.00	0.97	Epoch	Training Loss	Validation Loss	0	0.50	0.20	1	0.15	0.12	2	0.08	0.10	3	0.05	0.10	4	0.03	0.08	5	0.02	0.07	6	0.01	0.07	7	0.01	0.08	8	0.01	0.09	9	0.01	0.08
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## Assignment 3 Parameter History

	<pre><b>global_average_layer_parameter =</b> tf.keras.layers.GlobalAveragePooling2D() <b>loss_val =</b> "sparse_categorical_crossentropy" <b>base_learning_rate =</b> 0.0005 <b>initial_epochs =</b> 10 <b>fine_tune_layers =</b> 40 <b>fine_tune_epochs =</b> 10</pre>		<p>Training and Validation Accuracy</p> <table border="1"> <thead> <tr> <th>Epoch</th> <th>Training Accuracy</th> <th>Validation Accuracy</th> </tr> </thead> <tbody> <tr><td>0</td><td>0.84</td><td>0.94</td></tr> <tr><td>1</td><td>0.94</td><td>0.93</td></tr> <tr><td>2</td><td>0.97</td><td>0.93</td></tr> <tr><td>3</td><td>0.98</td><td>0.98</td></tr> <tr><td>4</td><td>0.98</td><td>0.97</td></tr> <tr><td>5</td><td>0.99</td><td>0.98</td></tr> <tr><td>6</td><td>0.99</td><td>0.98</td></tr> <tr><td>7</td><td>0.99</td><td>0.98</td></tr> <tr><td>8</td><td>0.99</td><td>0.98</td></tr> </tbody> </table> <p>Cross Entropy</p> <table border="1"> <thead> <tr> <th>Epoch</th> <th>Training Loss</th> <th>Validation Loss</th> </tr> </thead> <tbody> <tr><td>0</td><td>0.5</td><td>0.22</td></tr> <tr><td>1</td><td>0.15</td><td>0.15</td></tr> <tr><td>2</td><td>0.1</td><td>0.22</td></tr> <tr><td>3</td><td>0.08</td><td>0.08</td></tr> <tr><td>4</td><td>0.06</td><td>0.07</td></tr> <tr><td>5</td><td>0.05</td><td>0.07</td></tr> <tr><td>6</td><td>0.04</td><td>0.06</td></tr> <tr><td>7</td><td>0.03</td><td>0.06</td></tr> <tr><td>8</td><td>0.02</td><td>0.06</td></tr> </tbody> </table>	Epoch	Training Accuracy	Validation Accuracy	0	0.84	0.94	1	0.94	0.93	2	0.97	0.93	3	0.98	0.98	4	0.98	0.97	5	0.99	0.98	6	0.99	0.98	7	0.99	0.98	8	0.99	0.98	Epoch	Training Loss	Validation Loss	0	0.5	0.22	1	0.15	0.15	2	0.1	0.22	3	0.08	0.08	4	0.06	0.07	5	0.05	0.07	6	0.04	0.06	7	0.03	0.06	8	0.02	0.06
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	<pre><b>loss_val</b> = "sparse_categorical_crossentropy" <b>base_learning_rate</b> = 0.001 <b>initial_epochs</b> = 10 <b>fine_tune_layers</b> = 50 <b>fine_tune_epochs</b> = 15</pre>		<p>Training and Validation Accuracy</p> <table border="1"> <thead> <tr> <th>Epoch</th> <th>Training Accuracy</th> <th>Validation Accuracy</th> </tr> </thead> <tbody> <tr><td>0</td><td>0.45</td><td>0.90</td></tr> <tr><td>2</td><td>0.72</td><td>0.92</td></tr> <tr><td>4</td><td>0.85</td><td>0.94</td></tr> <tr><td>6</td><td>0.88</td><td>0.94</td></tr> <tr><td>8</td><td>0.90</td><td>0.95</td></tr> <tr><td>10</td><td>0.94</td><td>0.96</td></tr> <tr><td>12</td><td>0.92</td><td>0.96</td></tr> <tr><td>14</td><td>0.94</td><td>0.96</td></tr> </tbody> </table> <p>Training and Validation Loss</p> <table border="1"> <thead> <tr> <th>Epoch</th> <th>Training Loss</th> <th>Validation Loss</th> </tr> </thead> <tbody> <tr><td>0</td><td>3.0</td><td>0.45</td></tr> <tr><td>2</td><td>1.2</td><td>0.45</td></tr> <tr><td>4</td><td>0.8</td><td>0.45</td></tr> <tr><td>6</td><td>0.6</td><td>0.45</td></tr> <tr><td>8</td><td>0.45</td><td>0.45</td></tr> <tr><td>10</td><td>0.35</td><td>0.45</td></tr> <tr><td>12</td><td>0.38</td><td>0.45</td></tr> <tr><td>14</td><td>0.35</td><td>0.45</td></tr> </tbody> </table>	Epoch	Training Accuracy	Validation Accuracy	0	0.45	0.90	2	0.72	0.92	4	0.85	0.94	6	0.88	0.94	8	0.90	0.95	10	0.94	0.96	12	0.92	0.96	14	0.94	0.96	Epoch	Training Loss	Validation Loss	0	3.0	0.45	2	1.2	0.45	4	0.8	0.45	6	0.6	0.45	8	0.45	0.45	10	0.35	0.45	12	0.38	0.45	14	0.35	0.45
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4	<p><b>PREPROCESSING:</b></p> <pre><b>batch</b> = 32 <b>seed</b> = 1337 <b>flip</b> = "horizontal" <b>rotation</b> = 0.8 <b>zoom</b> = 0.5</pre> <p><b>MODEL:</b></p> <pre><b>alpha_val</b> = 1.0 <b>include_top_val</b> = False <b>dropout_rate_val</b> = 0.25 <b>optimizer_val</b> = tf.keras.optimizers.Adam() <b>optimizer_val_tuning</b> = tf.keras.optimizers.Adam(1e-4) <b>global_average_layer_parameter</b> = tf.keras.layers.GlobalMaxPooling2D()</pre>	<p><b>Training = False:</b></p> <p>Train Acc: 0.7146 Train Loss: 1.3420 Validation Acc: 0.9167 Validation Loss: 0.2968</p> <p><b>Training = True:</b></p> <p>Train Acc: 0.9239 Train Loss: 0.3158 Validation Acc: 0.9236 Validation Loss: 0.2660</p> <p><b>Test:</b></p> <p>Test Acc: 0.9261 Test Loss: 0.3809</p>	<p><b>Training = False:</b></p> <p>Training and Validation Accuracy</p> <table border="1"> <thead> <tr> <th>Epoch</th> <th>Training Accuracy</th> <th>Validation Accuracy</th> </tr> </thead> <tbody> <tr><td>0</td><td>0.15</td><td>0.35</td></tr> <tr><td>2</td><td>0.38</td><td>0.62</td></tr> <tr><td>4</td><td>0.55</td><td>0.82</td></tr> <tr><td>6</td><td>0.62</td><td>0.88</td></tr> <tr><td>8</td><td>0.68</td><td>0.92</td></tr> <tr><td>10</td><td>0.72</td><td>0.93</td></tr> <tr><td>12</td><td>0.75</td><td>0.94</td></tr> <tr><td>14</td><td>0.75</td><td>0.94</td></tr> </tbody> </table> <p>Training and Validation Loss</p> <table border="1"> <thead> <tr> <th>Epoch</th> <th>Training Loss</th> <th>Validation Loss</th> </tr> </thead> <tbody> <tr><td>0</td><td>7.0</td><td>3.5</td></tr> <tr><td>2</td><td>4.5</td><td>1.5</td></tr> <tr><td>4</td><td>2.5</td><td>0.8</td></tr> <tr><td>6</td><td>2.0</td><td>0.6</td></tr> <tr><td>8</td><td>1.8</td><td>0.4</td></tr> <tr><td>10</td><td>1.5</td><td>0.3</td></tr> <tr><td>12</td><td>1.4</td><td>0.2</td></tr> <tr><td>14</td><td>1.4</td><td>0.2</td></tr> </tbody> </table> <p><b>Training=True:</b></p>	Epoch	Training Accuracy	Validation Accuracy	0	0.15	0.35	2	0.38	0.62	4	0.55	0.82	6	0.62	0.88	8	0.68	0.92	10	0.72	0.93	12	0.75	0.94	14	0.75	0.94	Epoch	Training Loss	Validation Loss	0	7.0	3.5	2	4.5	1.5	4	2.5	0.8	6	2.0	0.6	8	1.8	0.4	10	1.5	0.3	12	1.4	0.2	14	1.4	0.2
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## Assignment 3 Parameter History

	<pre><b>loss_val =</b> "sparse_categorical_crossentropy" <b>base_learning_rate</b> = 0.001 <b>initial_epochs</b> = 15 <b>fine_tune_layers</b> = 75 <b>fine_tune_epochs</b> = 12</pre>		<p>The top plot, titled "Training and Validation Accuracy", shows accuracy on the y-axis (0.0 to 1.0) against epoch on the x-axis (0 to 10). Training accuracy (blue line) starts at ~0.55 and rises steadily to ~0.92. Validation accuracy (orange line) starts at ~0.91 and remains relatively stable around 0.92.</p> <p>The bottom plot, titled "Training and Validation Loss", shows cross entropy on the y-axis (0.0 to 2.5) against epoch on the x-axis (0 to 10). Training loss (blue line) starts at ~2.5 and drops sharply to ~0.3 by epoch 4, then continues to decrease slowly to ~0.2. Validation loss (orange line) starts at ~0.45 and decreases steadily to ~0.25.</p>
5	<p><b>PREPROCESSING:</b></p> <pre><b>batch</b> = 32 <b>seed</b> = 1337 <b>flip</b> = "vertical" <b>rotation</b> = 0.8 <b>zoom</b> = 0.5</pre> <p><b>MODEL:</b></p> <pre><b>alpha_val</b> = 1 <b>include_top_val</b> = False <b>dropout_rate_val</b> = 0.35 <b>optimizer_val</b> = tf.keras.optimizers.Adam() <b>optimizer_val_tuning</b> = tf.keras.optimizers.Adam(1e-5)</pre>	<p><b>Training = False:</b></p> Train Acc: 0.7051 Train Loss: 1.6204 Validation Acc: 0.9236 Validation Loss: 0.3886 <p><b>Training = True:</b></p> Train Acc: 0.6266 Train Loss: 2.1800 Validation Acc: 0.9236 Validation Loss: 0.3919 <p><b>Test:</b></p> Test Acc: 0.9629 Test Loss: 0.2663	<p><b>Training = False:</b></p> <p>The top plot, titled "Training and Validation Accuracy", shows accuracy on the y-axis (0.0 to 1.0) against epoch on the x-axis (0 to 14). Training accuracy (blue line) starts at ~0.2 and rises steadily to ~0.7. Validation accuracy (orange line) starts at ~0.35 and rises steadily to ~0.9.</p> <p>The bottom plot, titled "Training and Validation Loss", shows cross entropy on the y-axis (0.0 to 7.0) against epoch on the x-axis (0 to 14). Training loss (blue line) starts at ~7.0 and drops sharply to ~2.0 by epoch 4, then continues to decrease slowly to ~1.5. Validation loss (orange line) starts at ~3.5 and decreases steadily to ~0.5.</p>

## Assignment 3 Parameter History

	<pre><b>global_average_layer_parameter =</b> tf.keras.layers.GlobalMaxPooling2D() <b>loss_val =</b> "sparse_categorical_crossentropy" <b>base_learning_rate =</b> 0.001 <b>initial_epochs =</b> 15 <b>fine_tune_layers =</b> 75 <b>fine_tune_epochs =</b> 12</pre>		<p><b>Training=True:</b></p>
6	<p><b>PREPROCESSING:</b></p> <pre><b>batch =</b> 30 <b>seed =</b> 1337 <b>flip =</b> "vertical" <b>rotation =</b> 0.8 <b>zoom =</b> 0.5</pre> <p><b>MODEL:</b></p> <pre><b>alpha_val =</b> 1 <b>include_top_val =</b> False <b>dropout_rate_val =</b> 0.30 <b>optimizer_val =</b> tf.keras.optimizers.AdamW() <b>optimizer_val_tuning =</b> tf.keras.optimizers.AdamW(1e-4)</pre>	<p><b>Training = False:</b></p> <p>Train Acc: 0.9045 Train Loss: 0.3633 Validation Acc: 0.9262 Validation Loss: 0.3386</p> <p><b>Training = True:</b></p> <p>Train Acc: 0.9807 Train Loss: 0.0624 Validation Acc: 0.8852 Validation Loss: 0.4223</p> <p><b>Test:</b></p> <p>Test Acc: 0.9367 Test Loss: 0.1942</p>	<p><b>Training = False:</b></p> <p><b>Training = True:</b></p>

## Assignment 3 Parameter History

```
global_average_layer_parameter =  
tf.keras.layers.GlobalAveragePooling2D()  
loss_val =  
"sparse_categorical_crossentropy"  
base_learning_rate = 0.001  
initial_epochs = 15  
fine_tune_layers = 75  
fine_tune_epochs = 12
```

**Training=True:**