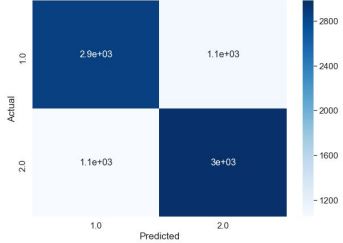
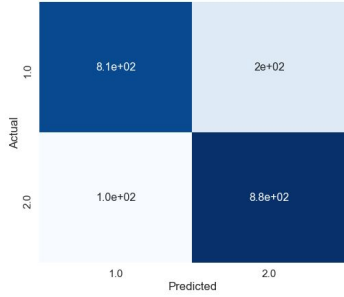
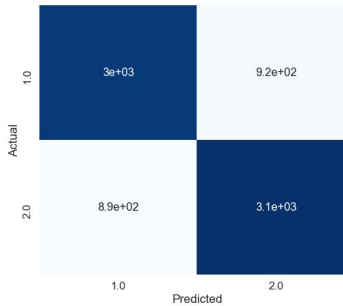
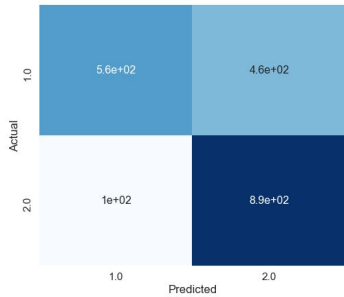
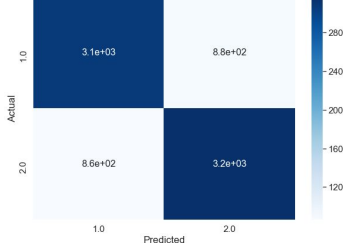
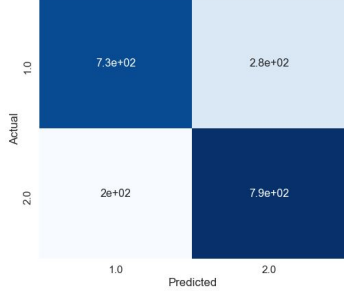
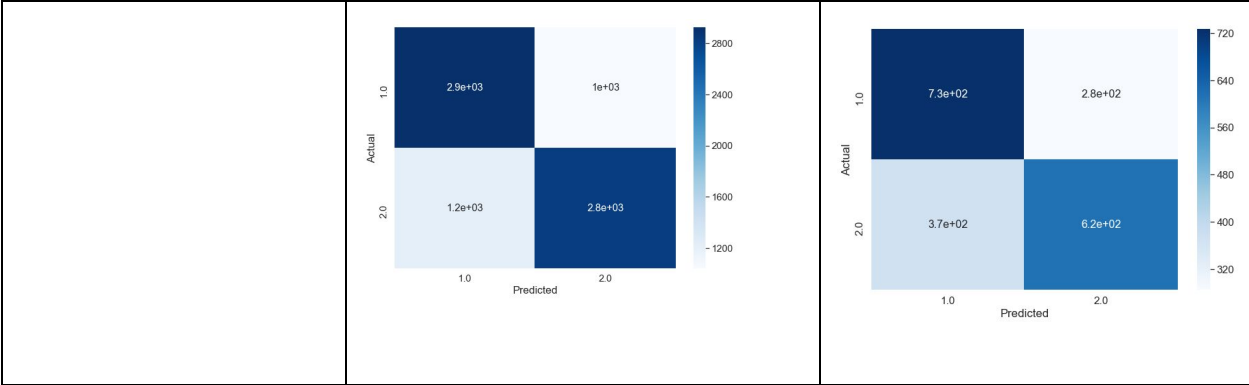


# RL\_Project\_Results

Using cifar 10 Accuracy and Confusion Matrix

Classifier	Accuracy(Oversampling)	Accuracy(Undersampling)																		
<b>GB</b>	<b>73.16</b>  <table border="1"> <thead> <tr> <th>Actual \ Predicted</th> <th>1.0</th> <th>2.0</th> </tr> </thead> <tbody> <tr> <th>1.0</th> <td>2.9e+03</td> <td>1.1e+03</td> </tr> <tr> <th>2.0</th> <td>1.1e+03</td> <td>3e+03</td> </tr> </tbody> </table>	Actual \ Predicted	1.0	2.0	1.0	2.9e+03	1.1e+03	2.0	1.1e+03	3e+03	<b>84.6</b>  <table border="1"> <thead> <tr> <th>Actual \ Predicted</th> <th>1.0</th> <th>2.0</th> </tr> </thead> <tbody> <tr> <th>1.0</th> <td>8.1e+02</td> <td>2e+02</td> </tr> <tr> <th>2.0</th> <td>1.0e+02</td> <td>8.8e+02</td> </tr> </tbody> </table>	Actual \ Predicted	1.0	2.0	1.0	8.1e+02	2e+02	2.0	1.0e+02	8.8e+02
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<b>SVM</b>	<b>77.33</b>  <table border="1"> <thead> <tr> <th>Actual \ Predicted</th> <th>1.0</th> <th>2.0</th> </tr> </thead> <tbody> <tr> <th>1.0</th> <td>3e+03</td> <td>9.2e+02</td> </tr> <tr> <th>2.0</th> <td>8.9e+02</td> <td>3.1e+03</td> </tr> </tbody> </table>	Actual \ Predicted	1.0	2.0	1.0	3e+03	9.2e+02	2.0	8.9e+02	3.1e+03	<b>72.05</b>  <table border="1"> <thead> <tr> <th>Actual \ Predicted</th> <th>1.0</th> <th>2.0</th> </tr> </thead> <tbody> <tr> <th>1.0</th> <td>5.6e+02</td> <td>4.6e+02</td> </tr> <tr> <th>2.0</th> <td>1e+02</td> <td>8.9e+02</td> </tr> </tbody> </table>	Actual \ Predicted	1.0	2.0	1.0	5.6e+02	4.6e+02	2.0	1e+02	8.9e+02
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<b>Logistic</b>	<b>78.225</b>  <table border="1"> <thead> <tr> <th>Actual \ Predicted</th> <th>1.0</th> <th>2.0</th> </tr> </thead> <tbody> <tr> <th>1.0</th> <td>3.1e+03</td> <td>8.8e+02</td> </tr> <tr> <th>2.0</th> <td>8.6e+02</td> <td>3.2e+03</td> </tr> </tbody> </table>	Actual \ Predicted	1.0	2.0	1.0	3.1e+03	8.8e+02	2.0	8.6e+02	3.2e+03	<b>75.9</b>  <table border="1"> <thead> <tr> <th>Actual \ Predicted</th> <th>1.0</th> <th>2.0</th> </tr> </thead> <tbody> <tr> <th>1.0</th> <td>7.3e+02</td> <td>2.8e+02</td> </tr> <tr> <th>2.0</th> <td>2e+02</td> <td>7.9e+02</td> </tr> </tbody> </table>	Actual \ Predicted	1.0	2.0	1.0	7.3e+02	2.8e+02	2.0	2e+02	7.9e+02
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<b>Random Forest</b>	<b>71.775</b>	<b>67.15</b>																		

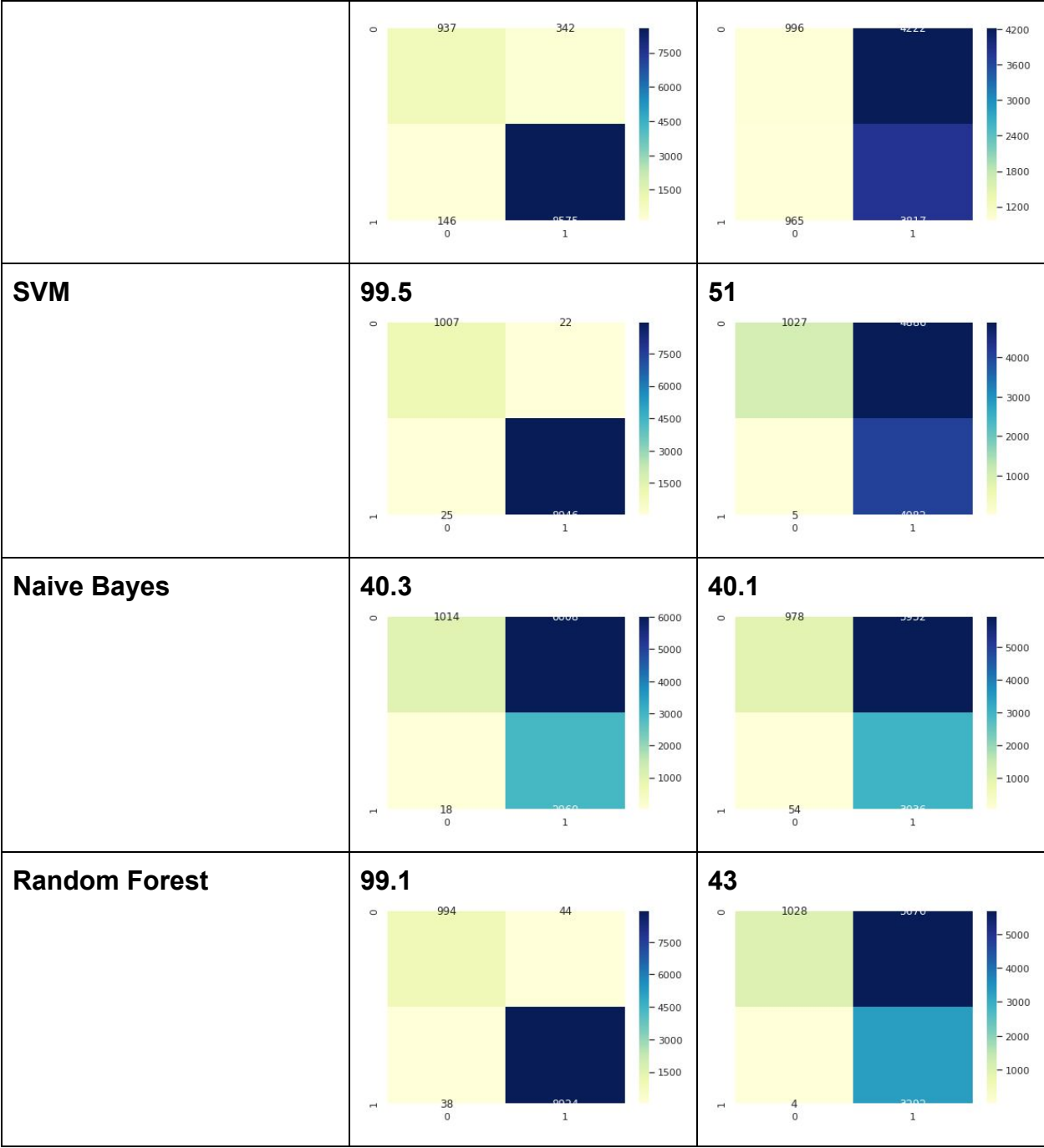


Ensemble Learning (Boosting and Bagging)

Method	Accuracy(Oversampling)	Accuracy(Undersampling)
Boosting	<b>76.1</b>	<b>85.1</b>
Bagging	<b>77.225</b>	<b>80.45</b>

MNIST

Classifier	OverSampling	UnderSampling
Logistic Regression	95.27	48.13



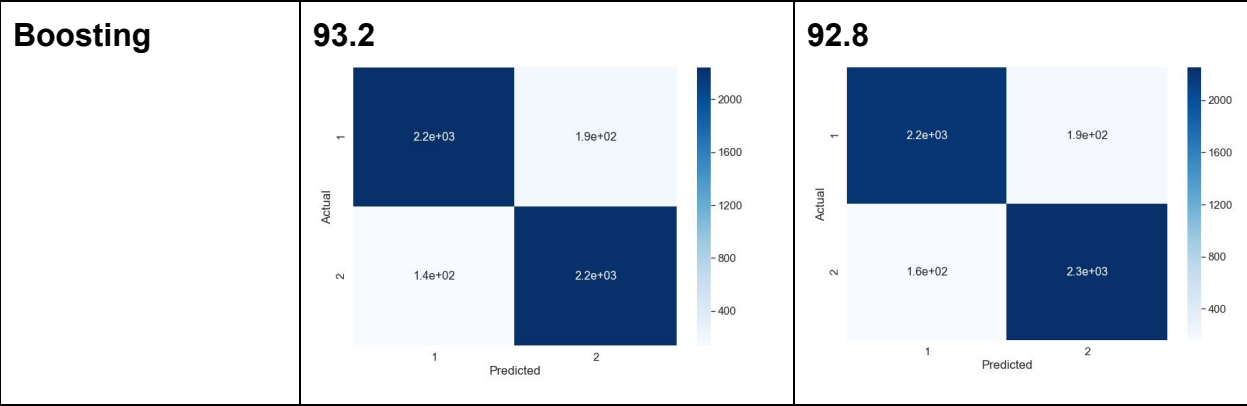
	<b>OverSampling</b>	<b>UnderSampling</b>
<b>Bagging</b>	<b>90.4</b>	<b>42.7</b>

	<p>Confusion matrix for baseline model. The color scale ranges from 1500 to 7500. The matrix shows counts for predicted classes 0 and 1 against actual classes 0 and 1.</p> <table border="1"> <thead> <tr> <th></th> <th>Actual 0</th> <th>Actual 1</th> </tr> </thead> <tbody> <tr> <th>Predicted 0</th> <td>937</td> <td>146</td> </tr> <tr> <th>Predicted 1</th> <td>342</td> <td>9575</td> </tr> </tbody> </table>		Actual 0	Actual 1	Predicted 0	937	146	Predicted 1	342	9575	<p>Confusion matrix for baseline model. The color scale ranges from 1200 to 4200. The matrix shows counts for predicted classes 0 and 1 against actual classes 0 and 1.</p> <table border="1"> <thead> <tr> <th></th> <th>Actual 0</th> <th>Actual 1</th> </tr> </thead> <tbody> <tr> <th>Predicted 0</th> <td>996</td> <td>965</td> </tr> <tr> <th>Predicted 1</th> <td>4222</td> <td>3017</td> </tr> </tbody> </table>		Actual 0	Actual 1	Predicted 0	996	965	Predicted 1	4222	3017
	Actual 0	Actual 1																		
Predicted 0	937	146																		
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Predicted 1	4222	3017																		
<b>Boosting</b>	<b>91.8</b> <p>Confusion matrix for Boosting model. The color scale ranges from 1500 to 7500. The matrix shows counts for predicted classes 0 and 1 against actual classes 0 and 1.</p> <table border="1"> <thead> <tr> <th></th> <th>Actual 0</th> <th>Actual 1</th> </tr> </thead> <tbody> <tr> <th>Predicted 0</th> <td>839</td> <td>193</td> </tr> <tr> <th>Predicted 1</th> <td>624</td> <td>9344</td> </tr> </tbody> </table>		Actual 0	Actual 1	Predicted 0	839	193	Predicted 1	624	9344	<b>40.7</b> <p>Confusion matrix for Boosting model. The color scale ranges from 1000 to 5000. The matrix shows counts for predicted classes 0 and 1 against actual classes 0 and 1.</p> <table border="1"> <thead> <tr> <th></th> <th>Actual 0</th> <th>Actual 1</th> </tr> </thead> <tbody> <tr> <th>Predicted 0</th> <td>993</td> <td>39</td> </tr> <tr> <th>Predicted 1</th> <td>3002</td> <td>3095</td> </tr> </tbody> </table>		Actual 0	Actual 1	Predicted 0	993	39	Predicted 1	3002	3095
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Predicted 0	993	39																		
Predicted 1	3002	3095																		

**FMNIST**

Methods	Accuracy(Oversampling)	Accuracy(Undersampling)																		
<b>GB</b>	<b>90.125</b> <p>Confusion matrix for GB model with oversampling. The color scale ranges from 400 to 2000. The matrix shows counts for predicted classes 1 and 2 against actual classes 1 and 2.</p> <table border="1"> <thead> <tr> <th></th> <th>Actual 1</th> <th>Actual 2</th> </tr> </thead> <tbody> <tr> <th>Predicted 1</th> <td>2.3e+03</td> <td>3.7e+02</td> </tr> <tr> <th>Predicted 2</th> <td>1e+02</td> <td>2e+03</td> </tr> </tbody> </table>		Actual 1	Actual 2	Predicted 1	2.3e+03	3.7e+02	Predicted 2	1e+02	2e+03	<b>90.02</b> <p>Confusion matrix for GB model with undersampling. The color scale ranges from 400 to 2000. The matrix shows counts for predicted classes 1 and 2 against actual classes 1 and 2.</p> <table border="1"> <thead> <tr> <th></th> <th>Actual 1</th> <th>Actual 2</th> </tr> </thead> <tbody> <tr> <th>Predicted 1</th> <td>2.3e+03</td> <td>3.9e+02</td> </tr> <tr> <th>Predicted 2</th> <td>90</td> <td>2e+03</td> </tr> </tbody> </table>		Actual 1	Actual 2	Predicted 1	2.3e+03	3.9e+02	Predicted 2	90	2e+03
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<b>SVM</b>	<b>93.375</b> <p>Confusion matrix for SVM model with oversampling. The color scale ranges from 400 to 2000. The matrix shows counts for predicted classes 1 and 2 against actual classes 1 and 2.</p> <table border="1"> <thead> <tr> <th></th> <th>Actual 1</th> <th>Actual 2</th> </tr> </thead> <tbody> <tr> <th>Predicted 1</th> <td>2.2e+03</td> <td>1.4e+02</td> </tr> <tr> <th>Predicted 2</th> <td>1.6e+02</td> <td>2.3e+03</td> </tr> </tbody> </table>		Actual 1	Actual 2	Predicted 1	2.2e+03	1.4e+02	Predicted 2	1.6e+02	2.3e+03	<b>93.79</b> <p>Confusion matrix for SVM model with undersampling. The color scale ranges from 400 to 2000. The matrix shows counts for predicted classes 1 and 2 against actual classes 1 and 2.</p> <table border="1"> <thead> <tr> <th></th> <th>Actual 1</th> <th>Actual 2</th> </tr> </thead> <tbody> <tr> <th>Predicted 1</th> <td>2.2e+03</td> <td>1.4e+02</td> </tr> <tr> <th>Predicted 2</th> <td>1.6e+02</td> <td>2.3e+03</td> </tr> </tbody> </table>		Actual 1	Actual 2	Predicted 1	2.2e+03	1.4e+02	Predicted 2	1.6e+02	2.3e+03
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Predicted 1	2.2e+03	1.4e+02																		
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	<p>A confusion matrix for a baseline model. The y-axis is labeled 'Actual' with values 1 and 2. The x-axis is labeled 'Predicted' with values 1 and 2. The matrix shows counts: (1,1) = 2.3e+03, (1,2) = 1.4e+02, (2,1) = 98, (2,2) = 2.3e+03. A color bar on the right ranges from 0 to 2000.</p> <table border="1"><thead><tr><th></th><th>Predicted 1</th><th>Predicted 2</th></tr></thead><tbody><tr><th>Actual 1</th><td>2.3e+03</td><td>1.4e+02</td></tr><tr><th>Actual 2</th><td>98</td><td>2.3e+03</td></tr></tbody></table>		Predicted 1	Predicted 2	Actual 1	2.3e+03	1.4e+02	Actual 2	98	2.3e+03										
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Logistic	<b>95.02</b> <p>A confusion matrix for a Logistic model. The y-axis is labeled 'Actual' with values 1 and 2. The x-axis is labeled 'Predicted' with values 1 and 2. The matrix shows counts: (1,1) = 2.3e+03, (1,2) = 1.4e+02, (2,1) = 98, (2,2) = 2.3e+03. A color bar on the right ranges from 0 to 2000.</p> <table border="1"><thead><tr><th></th><th>Predicted 1</th><th>Predicted 2</th></tr></thead><tbody><tr><th>Actual 1</th><td>2.3e+03</td><td>1.4e+02</td></tr><tr><th>Actual 2</th><td>98</td><td>2.3e+03</td></tr></tbody></table>		Predicted 1	Predicted 2	Actual 1	2.3e+03	1.4e+02	Actual 2	98	2.3e+03	<b>94.72</b> <p>A confusion matrix for another Logistic model. The y-axis is labeled 'Actual' with values 1 and 2. The x-axis is labeled 'Predicted' with values 1 and 2. The matrix shows counts: (1,1) = 2.2e+03, (1,2) = 1.5e+02, (2,1) = 1.1e+02, (2,2) = 2.3e+03. A color bar on the right ranges from 0 to 2000.</p> <table border="1"><thead><tr><th></th><th>Predicted 1</th><th>Predicted 2</th></tr></thead><tbody><tr><th>Actual 1</th><td>2.2e+03</td><td>1.5e+02</td></tr><tr><th>Actual 2</th><td>1.1e+02</td><td>2.3e+03</td></tr></tbody></table>		Predicted 1	Predicted 2	Actual 1	2.2e+03	1.5e+02	Actual 2	1.1e+02	2.3e+03
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Random Forest	<b>92.75</b> <p>A confusion matrix for a Random Forest model. The y-axis is labeled 'Actual' with values 1 and 2. The x-axis is labeled 'Predicted' with values 1 and 2. The matrix shows counts: (1,1) = 2.3e+03, (1,2) = 1e+02, (2,1) = 3.7e+02, (2,2) = 2e+03. A color bar on the right ranges from 0 to 2000.</p> <table border="1"><thead><tr><th></th><th>Predicted 1</th><th>Predicted 2</th></tr></thead><tbody><tr><th>Actual 1</th><td>2.3e+03</td><td>1e+02</td></tr><tr><th>Actual 2</th><td>3.7e+02</td><td>2e+03</td></tr></tbody></table>		Predicted 1	Predicted 2	Actual 1	2.3e+03	1e+02	Actual 2	3.7e+02	2e+03	<b>93.125</b> <p>A confusion matrix for another Random Forest model. The y-axis is labeled 'Actual' with values 1 and 2. The x-axis is labeled 'Predicted' with values 1 and 2. The matrix shows counts: (1,1) = 2.2e+03, (1,2) = 1.7e+02, (2,1) = 1.6e+02, (2,2) = 2.2e+03. A color bar on the right ranges from 0 to 2000.</p> <table border="1"><thead><tr><th></th><th>Predicted 1</th><th>Predicted 2</th></tr></thead><tbody><tr><th>Actual 1</th><td>2.2e+03</td><td>1.7e+02</td></tr><tr><th>Actual 2</th><td>1.6e+02</td><td>2.2e+03</td></tr></tbody></table>		Predicted 1	Predicted 2	Actual 1	2.2e+03	1.7e+02	Actual 2	1.6e+02	2.2e+03
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Bagging	<b>93.75</b> <p>A confusion matrix for a Bagging model. The y-axis is labeled 'Actual' with values 1 and 2. The x-axis is labeled 'Predicted' with values 1 and 2. The matrix shows counts: (1,1) = 2.3e+03, (1,2) = 1.2e+02, (2,1) = 1.8e+02, (2,2) = 2.2e+03. A color bar on the right ranges from 0 to 2000.</p> <table border="1"><thead><tr><th></th><th>Predicted 1</th><th>Predicted 2</th></tr></thead><tbody><tr><th>Actual 1</th><td>2.3e+03</td><td>1.2e+02</td></tr><tr><th>Actual 2</th><td>1.8e+02</td><td>2.2e+03</td></tr></tbody></table>		Predicted 1	Predicted 2	Actual 1	2.3e+03	1.2e+02	Actual 2	1.8e+02	2.2e+03	<b>93.89</b> <p>A confusion matrix for another Bagging model. The y-axis is labeled 'Actual' with values 1 and 2. The x-axis is labeled 'Predicted' with values 1 and 2. The matrix shows counts: (1,1) = 2.3e+03, (1,2) = 1e+02, (2,1) = 1.9e+02, (2,2) = 2.2e+03. A color bar on the right ranges from 0 to 2000.</p> <table border="1"><thead><tr><th></th><th>Predicted 1</th><th>Predicted 2</th></tr></thead><tbody><tr><th>Actual 1</th><td>2.3e+03</td><td>1e+02</td></tr><tr><th>Actual 2</th><td>1.9e+02</td><td>2.2e+03</td></tr></tbody></table>		Predicted 1	Predicted 2	Actual 1	2.3e+03	1e+02	Actual 2	1.9e+02	2.2e+03
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Actual 2	1.9e+02	2.2e+03																		



Dataset	Imbalance Ratio	DQNimb	DNN	Oversampling	Undersampling
Cifar10(1)	4%	0.932	0.815	0.7821	0.8464
	1%	0.899	0.718	0.7353	0.8287
FMNIST(1)	4%	0.964	0.903	0.9508	0.9455
	1%	0.938	0.851	0.9388	0.9199
MNIST	1%	0.989	0.955	0.9841	0.7241
	0.1%	0.955	0.843	0.9110	0.6589