Volume xx (20yy), Number z, pp. 1–5

Supplementary materials

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What follows includes comprehensive tables from the paper, featuring additional samples experiments. The best results for each metric are highlighted in bold. In addition, the deep learning plots for each dataset have been represented as bar plots instead of line charts to improve the readability.

1. Deep learning plots

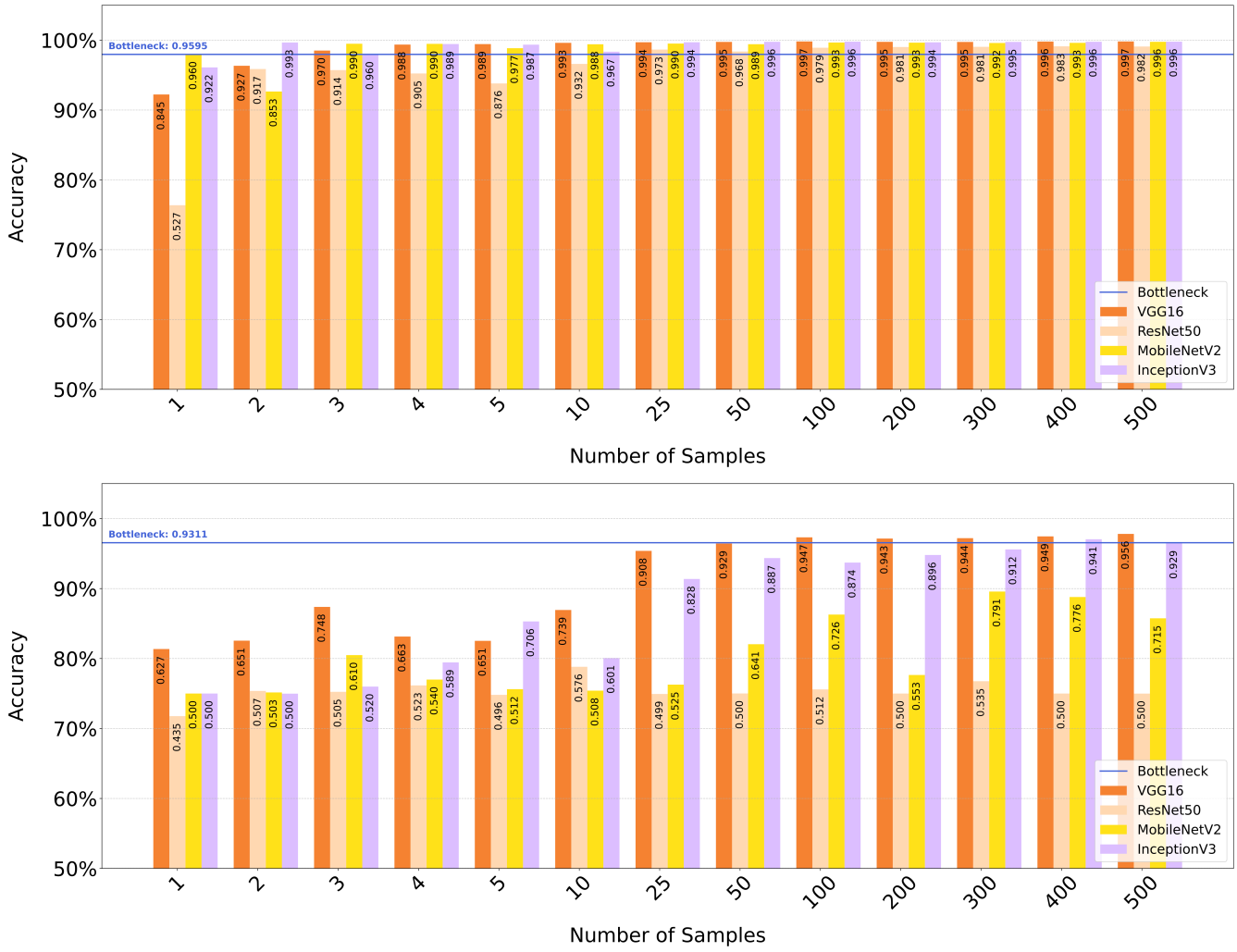

Figure 1: Bar chart illustrating the accuracy comparison between the Bottleneck method and deep learning models across varying numbers of training samples.Above is the Cracks dataset, and below is the Malaria dataset.

2. Deep learning performances for both Cracks and Malaria dataset

Samples	Method	Cracks dataset				Malaria dataset			
		Acc.	**Prec.**	**Rec.**	**F1**	**Acc.**	**Prec.**	**Rec.**	**F1**
1	VGG16	0.8446	0.9975	0.6910	0.8164	**0.6272**	**0.7203**	**0.4158**	**0.5273**
	ResNet50	0.5274	0.9294	0.0592	0.1114	0.4354	0.3976	0.2507	0.3075
	MobileNetV2	**0.9596**	0.9952	**0.9238**	**0.9581**	0.5000	0.0000	0.0000	0.0000
	InceptionV3	0.9221	**0.9994**	0.8448	0.9156	0.5000	0.5000	0.0004	0.0007
2	VGG16	0.9268	0.9991	0.8542	0.9210	**0.6511**	**0.7198**	0.4949	0.5865
	ResNet50	0.9175	**0.9997**	0.8352	0.9101	0.5074	0.5040	**0.9380**	**0.6557**
	MobileNetV2	0.8531	0.9982	0.7075	0.8281	0.5031	0.5044	0.3520	0.4146
	InceptionV3	**0.9934**	0.9972	**0.9895**	**0.9933**	0.4996	0.4706	0.0058	0.0115
3	VGG16	0.9704	0.9813	0.9590	0.9700	**0.7476**	**0.8794**	0.5740	**0.6946**
	ResNet50	0.9144	**1.0000**	0.8288	0.9064	0.5049	0.5616	0.0446	0.0827
	MobileNetV2	**0.9899**	0.9905	**0.9892**	**0.9899**	0.6098	0.6120	0.5998	0.6058
	InceptionV3	0.9595	0.9984	0.9205	0.9579	0.5198	0.5126	**0.8030**	0.6258
4	VGG16	0.9875	0.9947	0.9802	0.9874	**0.6629**	0.6061	**0.9303**	**0.7340**
	ResNet50	0.9048	**1.0000**	0.8095	0.8947	0.5232	0.6151	0.1241	0.2065
	MobileNetV2	**0.9896**	0.9868	**0.9925**	**0.9897**	0.5399	0.5915	0.2580	0.3593
	InceptionV3	0.9891	0.9895	0.9888	0.9891	0.5889	**0.6259**	0.4419	0.5181
5	VGG16	**0.9889**	0.9952	0.9825	**0.9888**	0.6506	0.6123	0.8211	**0.7015**
	ResNet50	0.8762	**1.0000**	0.7525	0.8588	0.4962	0.4981	**0.9844**	0.6615
	MobileNetV2	0.9771	0.9704	**0.9842**	0.9773	0.5125	0.7226	0.0406	0.0769
	InceptionV3	0.9872	0.9974	0.9770	0.9871	**0.7061**	**0.7363**	0.6422	0.6860
10	VGG16	**0.9925**	0.9982	0.9868	**0.9925**	**0.7388**	**0.8142**	0.6187	**0.7031**
	ResNet50	0.9321	**0.9997**	0.8645	0.9272	0.5764	0.5619	**0.6930**	0.6206
	MobileNetV2	0.9884	0.9853	0.9915	0.9884	0.5082	0.7922	0.0221	0.0431
	InceptionV3	0.9671	0.9387	**0.9995**	0.9682	0.6014	0.6206	0.5218	0.5669
25	VGG16	**0.9942**	**0.9992**	0.9892	**0.9942**	**0.9078**	**0.9599**	**0.8512**	**0.9023**
	ResNet50	0.9732	0.9971	0.9492	0.9726	0.4987	0.4720	0.0214	0.0410
	MobileNetV2	0.9904	0.9871	**0.9938**	0.9904	0.5254	0.7134	0.0849	0.1518
	InceptionV3	**0.9942**	0.9952	0.9932	**0.9942**	0.8275	0.8302	0.8233	0.8267

Table 1: Performance metrics for deep learning models for the Cracks and Malaria datasets across various number of samples per class ranging from 1 to 25.

Samples	Method	Cracks dataset				Malaria dataset			
		Acc.	**Prec.**	**Rec.**	**F1**	**Acc.**	**Prec.**	**Rec.**	**F1**
50	VGG16	0.9952	0.9965	0.9940	0.9952	**0.9287**	**0.9084**	0.9536	**0.9304**
	ResNet50	0.9676	**0.9973**	0.9378	0.9666	0.5002	0.5001	**0.9989**	0.6665
	MobileNetV2	0.9886	0.9897	0.9875	0.9886	0.6410	0.6462	0.6230	0.6344
	InceptionV3	**0.9955**	0.9945	**0.9965**	**0.9955**	0.8872	0.8949	0.8774	0.8860
100	VGG16	**0.9965**	**0.9985**	0.9945	**0.9965**	**0.9465**	**0.9624**	**0.9292**	**0.9455**
	ResNet50	0.9785	0.9948	0.9620	0.9781	0.5118	0.5337	0.1869	0.2768
	MobileNetV2	0.9934	0.9920	0.9948	0.9934	0.7257	0.9430	0.4804	0.6365
	InceptionV3	0.9959	0.9955	**0.9962**	0.9959	0.8743	0.8799	0.8668	0.8733
200	VGG16	**0.9954**	**0.9945**	0.9962	**0.9954**	**0.9430**	0.9685	0.9158	**0.9414**
	ResNet50	0.9806	0.9921	0.9690	0.9804	0.5000	0.5000	**1.0000**	0.6667
	MobileNetV2	0.9930	0.9893	**0.9968**	0.9930	0.5530	**0.9966**	0.1063	0.1921
	InceptionV3	0.9940	0.9933	0.9948	0.9940	0.8960	0.8905	0.9031	0.8968
300	VGG16	0.9951	**0.9945**	0.9958	0.9951	0.9441	0.9356	**0.9539**	0.9447
	ResNet50	0.9811	0.9931	0.9690	0.9809	0.5352	0.6054	0.2021	0.3030
	MobileNetV2	0.9921	0.9886	0.9958	0.9922	0.7915	**0.9763**	0.5976	0.7414
	InceptionV3	**0.9952**	0.9918	**0.9988**	**0.9953**	**0.9120**	0.9192	0.9035	**0.9113**
400	VGG16	**0.9962**	0.9940	**0.9985**	**0.9963**	**0.9492**	0.9602	**0.9372**	**0.9486**
	ResNet50	0.9825	0.9906	0.9742	0.9824	0.5000	0.0000	0.0000	0.0000
	MobileNetV2	0.9925	0.9920	0.9930	0.9925	0.7759	**0.9929**	0.5559	0.7127
	InceptionV3	0.9956	**0.9945**	0.9968	0.9956	0.9410	0.9606	0.9198	0.9398
500	VGG16	**0.9965**	0.9955	**0.9975**	**0.9965**	**0.9563**	0.9708	0.9409	**0.9556**
	ResNet50	0.9820	0.9876	0.9762	0.9819	0.4998	0.4999	**0.9996**	0.6665
	MobileNetV2	0.9955	0.9935	**0.9975**	0.9955	0.7150	**0.9837**	0.4372	0.6054
	InceptionV3	0.9959	**0.9958**	0.9960	0.9959	0.9291	0.9368	0.9202	0.9284

Table 2: Performance metrics for deep learning models for the Cracks and Malaria datasets across various number of samples per class ranging from 50 to 500.

3. Machine learning (w/wo Persistent homology) for the Cracks dataset

Samples	Method	Cracks dataset							
		ML				persIm ML			
		Acc.	**Prec.**	**Rec.**	**F1**	**Acc.**	**Prec.**	**Rec.**	**F1**
1	Log Reg	**0.6940**	**0.6999**	**0.6792**	**0.6894**	**0.9140**	0.9952	**0.8320**	**0.9063**
	SVM	**0.6940**	**0.6999**	**0.6792**	**0.6894**	**0.9140**	0.9952	**0.8320**	**0.9063**
	RF	0.5919	0.6284	0.4498	0.5243	0.7220	**1.0000**	0.4440	0.6150
5	Log Reg	0.7522	**0.8171**	0.6500	0.7240	0.9440	0.9625	0.9240	0.9429
	SVM	**0.7704**	0.7299	**0.8585**	**0.7890**	**0.9600**	0.9528	**0.9680**	**0.9603**
	RF	0.6738	0.7395	0.5365	0.6218	0.8800	**0.9750**	0.7800	0.8667
10	Log Reg	0.7492	0.7726	0.7065	0.7381	0.9280	**0.9908**	0.8640	0.9231
	SVM	**0.8080**	**0.8596**	**0.7362**	**0.7932**	**0.9780**	0.9723	0.9840	**0.9781**
	RF	0.7151	0.7318	0.6792	0.7045	0.4960	0.4980	**0.9880**	0.6622
25	Log Reg	0.7562	0.7889	0.6998	0.7417	0.9540	**0.9595**	0.9480	0.9537
	SVM	**0.8635**	**0.8444**	**0.8912**	**0.8672**	0.9620	0.9358	**0.9920**	0.9631
	RF	0.7061	0.6917	0.7438	0.7168	**0.9660**	0.9569	0.9760	**0.9663**
50	Log Reg	0.8028	0.8421	0.7452	0.7907	0.9680	0.9570	0.9800	0.9684
	SVM	**0.8966**	**0.8959**	**0.8975**	**0.8967**	**0.972**	**0.9574**	**0.988**	**0.9724**
	RF	0.7569	0.7510	0.7685	0.7597	0.9680	0.9570	0.9800	0.9684
100	Log Reg	0.8336	0.8919	0.7592	0.8203	0.9680	**0.9606**	0.9760	0.9683
	SVM	**0.9430**	**0.9847**	**0.9000**	**0.9404**	**0.9700**	0.9572	**0.9840**	**0.9704**
	RF	0.8934	0.9319	0.8488	0.8884	0.9680	0.9570	0.9800	0.9684
200	Log Reg	0.8669	0.9467	0.7775	0.8538	0.9740	**0.9798**	0.9680	0.9738
	SVM	**0.9559**	0.9810	**0.9298**	**0.9547**	**0.9760**	**0.9798**	0.9720	0.9759
	RF	0.9461	**0.9832**	0.9078	0.9440	**0.9760**	0.9648	**0.9880**	**0.9763**
300	Log Reg	0.8459	0.8918	0.7872	0.8363	0.9576	**0.9607**	0.9542	0.9575
	SVM	**0.9549**	**0.9822**	0.9265	**0.9536**	**0.9654**	0.9600	0.9712	**0.9656**
	RF	0.9296	0.9280	**0.9315**	0.9298	0.9648	0.9523	**0.9785**	0.9652
400	Log Reg	0.8721	0.9288	0.8060	0.8631	0.9616	**0.9622**	0.9610	0.9616
	SVM	0.9586	**0.9784**	0.9380	0.9578	**0.9674**	0.9574	**0.9782**	**0.9677**
	RF	**0.9596**	0.9698	**0.9488**	**0.9592**	0.9620	0.9538	0.9710	0.9623
500	Log Reg	0.8734	0.9290	0.8085	0.8646	0.9614	**0.9547**	0.9688	0.9617
	SVM	0.9582	**0.9801**	0.9355	0.9573	**0.9670**	0.9532	**0.9822**	**0.9675**
	RF	**0.9668**	0.9799	**0.9530**	**0.9663**	0.9585	0.9526	0.9650	0.9588

Table 3: Performance metrics for machine learning models for the Cracks dataset across various number of samples per class, applied to raw and persistence images.

4. Machine learning performances for the Malaria dataset

Samples	Method	Malaria dataset							
		ML				persIm ML			
		Acc.	**Prec.**	**Rec.**	**F1**	**Acc.**	**Prec.**	**Rec.**	**F1**
1	Log Reg	0.3881	0.4007	0.4517	0.4247	0.9087	**0.9581**	0.8549	0.9035
	SVM	0.3881	0.4007	0.4517	0.4247	**0.9089**	0.9574	**0.8560**	**0.9038**
	RF	**0.3975**	**0.4087**	**0.4590**	**0.4324**	0.6063	0.9508	0.2242	0.3629
5	Log Reg	0.6020	**0.6200**	0.5269	0.5696	0.8959	0.9576	0.8284	0.8883
	SVM	0.6009	0.6161	0.5352	0.5728	**0.9272**	0.9308	**0.9231**	**0.9269**
	RF	**0.6216**	0.6144	**0.6528**	**0.6330**	0.8641	**0.9593**	0.7605	0.8484
10	Log Reg	0.5709	0.5821	0.5029	0.5396	0.9082	0.9518	0.8599	0.9035
	SVM	0.5776	**0.6192**	0.4035	0.4886	**0.9311**	0.9314	**0.9307**	**0.931**
	RF	**0.5923**	0.5900	**0.6052**	**0.5975**	0.9151	**0.9525**	0.8737	0.9114
25	Log Reg	0.5847	0.5888	0.5617	0.5749	0.8988	**0.9541**	0.8378	0.8922
	SVM	0.6272	0.6699	0.5015	0.5736	**0.9311**	0.9314	**0.9307**	**0.931**
	RF	**0.6477**	**0.6709**	**0.5798**	**0.6220**	0.9156	0.9540	0.8734	0.9119
50	Log Reg	0.6054	0.6097	0.5860	0.5976	0.9231	0.9397	0.9042	0.9216
	SVM	0.5971	**0.6322**	0.4641	0.5353	**0.9311**	0.9314	**0.9307**	**0.9310**
	RF	**0.6139**	0.6098	**0.6328**	**0.6211**	0.9111	**0.9572**	0.8607	0.9064
100	Log Reg	0.6306	0.6343	0.6168	0.6255	0.9066	0.9491	0.8592	0.9019
	SVM	0.6549	0.6545	**0.6564**	0.6554	**0.9311**	0.9314	**0.9307**	**0.931**
	RF	**0.6798**	**0.6981**	0.6335	**0.6643**	0.9165	**0.9505**	0.8788	0.9133
200	Log Reg	0.6179	0.6270	0.5824	0.6038	0.9142	**0.9499**	0.8745	0.9106
	SVM	0.6646	0.6679	**0.6546**	0.6612	**0.9307**	0.9332	**0.9278**	**0.9305**
	RF	**0.6856**	**0.7007**	0.6480	**0.6733**	0.9260	0.9437	0.9060	0.9245
300	Log Reg	0.6226	0.6327	0.5849	0.6078	0.9242	0.9452	0.9006	0.9223
	SVM	0.6704	0.6667	**0.6814**	0.6740	**0.9309**	0.9317	**0.9300**	**0.9308**
	RF	**0.6836**	**0.6869**	0.6749	**0.6808**	0.9251	**0.9483**	0.8991	0.9231
400	Log Reg	0.6313	0.6360	0.6143	0.6250	0.9189	0.9415	0.8933	0.9168
	SVM	0.6782	0.6783	**0.6777**	**0.6780**	**0.9312**	0.9325	**0.9282**	**0.9304**
	RF	**0.6877**	**0.6935**	0.6628	0.6778	0.9244	**0.9479**	0.8985	0.9222
500	Log Reg	0.6136	0.6220	0.5791	0.5998	0.9224	**0.9429**	0.8991	0.9205
	SVM	0.6711	0.6597	**0.7068**	0.6824	**0.9300**	0.9322	**0.9274**	**0.9298**
	RF	**0.7037**	**0.7032**	0.7050	**0.7041**	0.9276	0.9416	0.9118	0.9265

Table 4: Performance metrics for machine learning models for the Malaria dataset across various number of samples per class, applied to raw and persistence images.