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Report

SVM

Kernel	Max iterations	Degree	Gamma	Accuracy (%)	Error Rate(%)
Polynomial	10	2	-	55.46	44.54
Polynomial	25	2	-	71.64	28.36
Polynomial	50	2	-	84.87	15.13
Polynomial	10	5	-	28.43	71.57
Polynomial	10	4	-	32.54	67.46
Polynomial	10	3	-	42.26	57.74
Polynomial	100	2	-	92.55	7.45
RBF	10	-	0.1	10.09	89.91
RBF	25	-	0.1	10.09	89.91
RBF	10	-	0.001	88.62	11.38
RBF	50	-	0.1	10.09	89.91
RBF	100	-	0.1	10.09	89.91
RBF	10	-	1	10.09	89.91
Linear	10	-	-	59.34	40.65

We get the best error rate using Polynomial Kernel of degree 2 with 100 iterations. RBF and Linear kernel seem to be a very bad choice for our data.

MLP

Activation	Hidden Layer Size	Solver	alpha	Learning rate	Accuracy	Error Rate
Relu	5	sgd	0.5	constant	11.35	88.65
Relu	5	sgd	0.5	adaptive	11.35	88.65
Relu	20	sgd	0.5	constant	52.42	47.58
Relu	10	sgd	0.1	adaptive	11.35	88.65
Relu	50	sgd	0.1	adaptive	90.95	9.05
Relu	50	adam	0.1	adaptive	95.17	4.83
Relu	50	lbfgs	0.1	adaptive	91.21	8.78
Tanh	50	sgd	0.1	adaptive	95.73	4.26
Tanh	50	adam	0.1	adaptive	93.68	6.32
Tanh	50	lbfgs	0.1	adaptive	93.14	6.86
Logistic	50	sgd	0.1	adaptive	95.27	4.73
Logistic	50	adam	0.1	adaptive	94.63	53.69
Logistic	50	lbfgs	0.1	adaptive	93.4	6.59

We get the best error Rate with Tanh using sgd Solver. It has been observed that with 10 or lesser number of hidden layers, the rate rate comes to be quite high, whereas with 50 hidden layers we get a quite lesser error rate.

Gradient Boosting

Loss	No of Estimators	Learning Rate	Max features	Max Depth	Accuracy	Error Rate
Deviance	20	0.1	2	2	68.99	31.01
Deviance	30	0.5	4	4	91.41	8.58
Deviance	40	0.01	4	4	83.70	16.30
Deviance	40	0.25	4	4	91.73	8.27
Deviance	40	0.25	4	4	91.73	8.27
Deviance	70	0.6	4	4	92.97	9.03
Deviance	60	0.6	4	4	93.26	6.74
Deviance	60	0.5	10	10	95.5	4.50
Deviance	60	0.6	15	15	92.93	7.07
Deviance	60	0.6	12	12	93.86	6.14
Deviance	60	0.6	13	13	93.59	6.41
Deviance	70	0.6	12	12	93.89	6.11

We get the best error rate with 70 estimators having a learning rate of 0.6 and max features and depth of 12.

Kmeans

Image name	K	Centroids	Size after compression	Compression Ratio	No. of epochs
Koala	2	[[148, 81, 14], [60, 241, 133]]	66.3kB	0.915	34
Koala	2	[[254, 232, 38], [43, 225, 182]]	66.3kB	0.915	34
Koala	2	[[175, 103, 161], [180, 54, 103]]	66.2kB	0.906	20
Koala	5	[[181, 69, 107], [223, 226, 70], [253, 107, 62], [253, 208, 151], [65, 124, 217]]	167.5 kB	0.785	76
Koala	5	[[120, 45, 61], [193, 161, 8], [129, 177, 67], [1, 49, 230], [178, 177, 151]]	167.5 kB	0.785	108
Koala	5	[[193, 20, 166], [157, 125, 158], [31, 24, 3], [104, 195, 59], [164, 44, 17]]	103.6 kB	0.867	500
Koala	10	[[223, 144, 209], [224, 117, 254], [37, 55, 208], [95, 24, 22], [85, 154, 240], [210, 137, 156], [225, 76, 175], [243, 200, 247], [241, 234, 68], [226, 20, 115]]	303.3 kB	0.611	180
Koala	10	[[31, 82, 61], [69, 55,	188.3 kB	0.759	500

		229], [231, 147, 153], [51, 81, 168], [117, 53, 126], [216, 142, 162], [114, 198, 112], [190, 112, 195], [236, 21, 232], [113, 253, 204]]			
Koala	10	[[48, 243, 188], [23, 216, 224], [23, 33, 76], [142, 175, 235], [121, 170, 100], [199, 2, 75], [188, 114, 21], [128, 245, 79], [152, 165, 156], [219, 133, 160]]	303.3 kB	0.611	182
Koala	15	[[127, 89, 197], [101, 96, 98], [192, 68, 166], [247, 251, 111], [125, 66, 130], [145, 102, 234], [83, 206, 234], [35, 70, 220], [218, 29, 241], [156, 37, 90], [245, 213, 143], [141, 225, 78], [57, 230, 33], [242, 119, 233], [249, 95, 21]]	406.9 kB	0.479	81
Koala	15	[[163, 205, 162], [229, 52, 166], [63, 1, 28], [164, 191, 54], [93, 70, 1], [173, 3, 131], [102, 130, 176], [198, 227, 104], [91, 107, 146], [179, 37, 55], [169, 215, 220], [229, 114, 206], [70, 118, 189], [73, 210, 50], [82, 36, 211]]	399.7 kB	0.488	178
Koala	15	[[44, 58, 92], [175, 163, 128], [46, 51, 8],	399.7 kB	0.488	158

		[153, 34, 45], [5, 123, 179], [230, 147, 96], [60, 170, 118], [181, 190, 132], [219, 98, 64], [29, 220, 188], [177, 183, 137], [31, 52, 215], [58, 113, 49], [153, 157, 251], [25, 238, 22]]			
Koala	15	[[211, 21, 247], [193, 22, 138], [93, 69, 236], [115, 154, 247], [84, 225, 149], [250, 41, 211], [100, 78, 51], [225, 46, 144], [221, 7, 7], [99, 85, 121], [109, 141, 111], [198, 209, 248], [102, 96, 14], [78, 214, 9], [95, 128, 123]]	399.7 kB	0.488	206
Koala	20	[[110, 253, 236], [233, 81, 92], [221, 50, 81], [137, 198, 228], [204, 112, 4], [16, 19, 94], [96, 80, 121], [139, 11, 139], [81, 78, 187], [122, 175, 233], [234, 107, 120], [167, 243, 153], [168, 209, 38], [235, 93, 107], [235, 83, 94], [51, 199, 11], [204, 178, 138], [208, 253, 201], [201, 31, 183], [59, 54, 71]]	496.8 kB	0.398	376
Koala	20	[[30, 65, 146], [205, 26, 134], [28, 130, 109], [15, 110, 51], [126, 201, 92], [175, 65, 186], [39, 197,	496.8 kB	0.398	416

		38], [202, 201, 184], [77, 181, 3], [86, 2, 154], [114, 238, 25], [8, 108, 113], [119, 18, 20], [74, 87, 178], [67, 202, 254], [38, 174, 95], [35, 70, 168], [158, 144, 222], [236, 211, 93], [102, 185, 67]]			
Koala	20	[[142, 212, 70], [23, 162, 147], [21, 43, 132], [34, 158, 165], [26, 76, 133], [118, 148, 158], [165, 227, 212], [245, 203, 189], [127, 254, 190], [4, 87, 225], [199, 229, 224], [239, 174, 216], [222, 166, 238], [20, 248, 157], [241, 222, 87], [119, 86, 70], [95, 222, 161], [93, 108, 89], [63, 20, 164], [117, 208, 244]] 50th epoch	496.8 kB	0.398	407
Penguin	2	[[69, 86, 121], [106, 140, 116]]	35.2 kB	0.955	10
Penguin	2	[[174, 103, 113], [117, 134, 210]]	35.2 kB	0.955	11
Penguin	2	[[69, 189, 86], [30, 164, 250]]	35.2 kB	0.955	13
Penguin	5	[[196, 132, 12], [159, 32, 31], [125, 178, 21], [109, 235, 247], [87, 142, 5]]	65.4 kB	0.916	48
Penguin	5	[[65, 182, 6], [150, 154, 69], [218, 59, 74], [1, 97, 233],	65.4 kB	0.916	30

		[134, 135, 90]]			
Penguin	5	[[157, 8, 155], [143, 246, 73], [63, 202, 219], [203, 143, 157], [74, 167, 171]]	65.4 kB	0.916	48
Penguin	10	[[118, 12, 235], [199, 182, 85], [1, 222, 115], [180, 4, 113], [204, 248, 3], [127, 48, 106], [213, 13, 89], [62, 164, 136], [124, 156, 234], [36, 247, 62]]	406.9 kB	0.477	119
Penguin	10	[[211, 14, 187], [227, 82, 208], [55, 178, 244], [23, 99, 223], [243, 130, 164], [110, 172, 33], [216, 72, 142], [217, 199, 85], [139, 91, 186], [40, 229, 87]]	149.2 kB	0.808	73
Penguin	10	[[171, 27, 149], [31, 251, 100], [165, 253, 190], [118, 71, 114], [63, 224, 116], [151, 90, 200], [57, 35, 179], [162, 19, 18], [25, 40, 222], [154, 20, 113]] 50th epoch	181.0kB	0.767	128
Penguin	15	[[254, 68, 174], [34, 50, 9], [250, 254, 155], [14, 83, 157], [170, 104, 98], [222, 92, 74], [244, 127, 2], [44, 183, 56], [66, 43, 70], [146, 126, 74], [136, 113, 120], [244, 31, 166], [36, 147, 149], [246, 208, 45],	224.1 kB	0.712	183

		[25, 167, 40]]			
Penguin	15	[[101, 62, 59], [255, 96, 74], [61, 92, 86], [251, 217, 229], [252, 120, 10], [193, 78, 8], [57, 62, 221], [45, 54, 62], [174, 147, 136], [101, 253, 61], [85, 220, 44], [165, 101, 105], [146, 181, 142], [213, 47, 122], [184, 237, 77]]	224.1 kB	0.712	198
Penguin	15	[[98, 26, 160], [176, 98, 67], [177, 232, 177], [17, 180, 2], [212, 10, 99], [65, 49, 95], [217, 190, 180], [206, 97, 225], [30, 85, 248], [116, 164, 4], [177, 108, 164], [5, 196, 20], [11, 133, 246], [136, 212, 228], [142, 43, 180]]	209.9 kB	0.730	58
Penguin	20	[[213, 199, 74], [48, 119, 83], [132, 151, 78], [195, 88, 160], [137, 201, 48], [173, 165, 156], [120, 158, 63], [236, 180, 62], [239, 139, 3], [131, 86, 92], [86, 149, 80], [154, 145, 127], [186, 216, 0], [107, 44, 90], [121, 184, 254], [171, 1, 149], [9, 130, 118], [54, 217, 194], [158, 149, 90], [77, 155, 152]]	265.1 kB	0.6591	75
Penguin	20	[[249, 222, 157], [16, 102, 192], [18, 187,	273.2 kB	0.649	157

		24], [113, 123, 179], [247, 13, 131], [19, 31, 118], [222, 5, 7], [3, 140, 29], [242, 163, 23], [14, 57, 38], [161, 190, 124], [111, 222, 119], [235, 106, 98], [107, 93, 201], [137, 89, 110], [114, 202, 15], [212, 231, 223], [84, 124, 101], [6, 50, 64], [69, 236, 163]]			
Penguin	20	[[232, 14, 236], [10, 66, 104], [92, 153, 133], [157, 20, 184], [33, 176, 107], [204, 16, 84], [249, 103, 121], [19, 176, 30], [61, 24, 48], [5, 155, 1], [182, 184, 113], [108, 245, 249], [71, 109, 105], [198, 75, 129], [22, 195, 38], [212, 123, 89], [69, 192, 186], [27, 56, 141], [244, 189, 12], [100, 224, 77]]	289.0kB	0.628	216

Kmeans Analysis

Picture Name	K value	Average	Variance
Koala	2	0.912	1.79
Koala	5	0.812	0.001
Koala	10	0.66	0.004
Koala	15	0.488	0
Koala	20	0.398	0
Penguin	2	0.955	0
Penguin	5	0.916	0
Penguin	10	0.684	0.022
Penguin	15	0.718	7.19
Penguin	20	0.645	0.0001

Yes there is a trade off between image quality and and degree of compression. Degree of compression is more with lower K. With lower K we have lower number of clusters for the pixels and thus lesser number of colors are used to identify the shades and shadows in a picture, and thus picture quality decreases.

Good K:

Koala – 10
Penguins - 15