

Table of Contents

1. Introduction	1
1.1. Motivation	1
1.2. Hypothesis	2
1.3. Objectives	2
1.3.1. General Objectives	2
1.3.2. Specific Objectives	2
1.4. Problem	2
1.5. Contribution	3
1.6. Methodology	3
1.6.1. Related Work Survey	3
1.6.2. Design and Implementation of Algorithms	3
1.6.3. Experimentation	4
1.6.4. Technologies	4
1.7. Summary of Results	4
1.8. Work Structure	4
2. Background	6
2.1. Digital Image Processing	6
2.1.1. RGB Model	6
2.1.2. Pixel	6
2.1.3. Raster graphics	7
2.1.4. Resolution	7
2.1.5. Compression	7
2.1.5.1. Lossy Compression	7
2.1.5.2. Lossless Compression	7
2.1.6. Digital Image	7
2.1.7. Spatial Filtering	8
2.1.7.1. Correlation Filtering	8
2.1.7.2. Convolution Filtering	8
2.2. Probability and Statistics	9
2.2.1. Probability Axioms	9
2.2.2. Random Variable	9
2.2.3. Probability Distribution	9
2.2.3.1. Normal Distribution	9
2.2.4. Statistical Inference	9
2.2.5. Maximum Likelihood Estimation	9
2.2.6. Loss Function	10

2.3.	Information Theory	10
2.3.1.	Entropy	10
2.3.2.	Kullback–Leibler Divergence	10
2.4.	Optimization Methods	11
2.4.1.	Stochastic Gradient Descent	11
2.4.2.	Powell’s Method	11
2.5.	Machine Learning	12
2.5.1.	Supervised Learning	12
2.5.2.	Performance Metrics	12
2.6.	Neural Networks	12
2.6.1.	Neural Network Training	13
2.6.1.1.	Forward	13
2.6.1.1.1.	Activation Functions	13
2.6.1.2.	Softmax	13
2.6.1.3.	Backward	14
2.6.1.3.1.	Backpropagation	14
2.6.1.3.2.	Loss function	14
2.6.1.3.3.	Optimizer	14
2.6.2.	Regularization Methods	14
2.6.2.1.	Weight Decay	14
2.6.2.2.	Early Stopping	15
2.6.2.3.	Data Augmentation	15
2.6.3.	Hardware and Libraries	15
2.6.3.1.	GPU	15
2.6.3.2.	Pytorch	15
2.7.	Image Classification	15
2.7.1.	Dataset	16
2.7.2.	Training Methodologies	16
2.7.2.1.	Generative Adversarial Networks	16
2.7.2.2.	Masked Autoencoders	16
2.7.3.	Convolutional Neural Network	17
3.	Related Work	19
3.1.	Image Classification	19
3.2.	Data Augmentation Techniques	19
3.3.	Robustness of Image Classification	20
3.4.	Laconic Image Classification	20
4.	Proposal	22
4.1.	Image Quality Reductions	22
4.1.1.	Mathematical Framework	22
4.1.2.	Image Reductions	23
4.1.2.1.	Atomic Reductions	23
4.1.2.2.	Quantization	23
4.1.2.3.	Downsampling	24
4.1.2.4.	Crop	24
4.1.2.5.	Combined	25

4.1.3.	Composed Reductions	25
4.1.3.1.	Slice	25
4.1.3.2.	Combined	26
4.2.	Training Methodologies	26
4.2.1.	Standard Methodology	27
4.2.2.	Fixed Reduction Methodology	27
4.2.3.	Linear Reduction Methodology	27
4.2.4.	Adaptive Reduction Methodology	28
4.3.	Linear and Adaptive Variants	30
4.3.1.	Paired Epochs	30
4.3.2.	Paired Rounds	31
5.	Experimental Design	33
5.1.	Training with Quality-Reduced Examples	33
5.2.	Experimental Setting	33
5.2.1.	Hardware	33
5.2.2.	Datasets	34
5.2.3.	Neural Networks	35
5.2.3.1.	SqueezeNet	35
5.2.3.2.	ResNet	35
5.2.3.3.	EfficientNet	35
5.2.3.4.	Network Hyperparameters	35
5.2.3.5.	Adjustment	36
5.3.	Training Methodologies Tested	36
5.3.1.	Exploratory Analysis	36
5.3.2.	Start Point	36
5.3.3.	Baseline	36
5.3.4.	Fixed Reductions	37
5.3.5.	Linear Reductions	37
5.3.6.	Adaptive Reductions	37
5.4.	MEPIs Calculation	37
6.	Results	38
6.1.	HumaNet	38
6.1.1.	Start Point	38
6.1.2.	Fixed Reduction	40
6.1.3.	Linear Reduction	41
6.1.3.1.	Paired Epochs	41
6.1.3.2.	Paired Rounds	43
6.1.4.	Adaptive Reduction	45
6.1.4.1.	Paired Epochs	45
6.1.4.2.	Paired Rounds	47
6.1.5.	Test Results	49
6.1.6.	Entropy Proportion	50
6.2.	ImageNet	52
6.2.1.	Training Methodology Tested	53
6.2.2.	Entropy Proportion	54

7. Conclusions	56
7.1. Summary	56
7.2. Review of Hypothesis	56
7.3. Review of Objectives	57
7.4. Challenges and Limitations	57
7.5. Future Work	58
Bibliography	59
ANNEXES	61
A. Methodologies Comparison	61
A.1. SqueezeNet	61
A.2. ResNet	64
A.3. EfficientNet	67
B. Performance and Significance	70
C. ImageNet Entropy-Ratio Central Tendency Measures	71