

# Contents

<b>1</b>	<b>Motivation</b>	<b>4</b>
1.1	Bibliographical Notes . . . . .	4
<b>2</b>	<b>Neural Networks and Deep Learning</b>	<b>5</b>
2.1	Multilayer Perceptrons . . . . .	5
2.2	Activation Functions . . . . .	6
2.3	Supervised Training . . . . .	7
2.3.1	Error Measures . . . . .	8
2.3.2	Training Protocols . . . . .	8
2.3.3	Parameter Optimization . . . . .	8
2.3.4	Weight Initialization . . . . .	9
2.3.5	Error Backpropagation . . . . .	10
2.4	Unsupervised Training . . . . .	10
2.4.1	Auto-Encoders . . . . .	10
2.4.2	Layer-Wise Training . . . . .	11
2.5	Regularization . . . . .	11
2.5.1	$L_p$ -Regularization . . . . .	11
2.5.2	Early Stopping . . . . .	12
2.5.3	Dropout . . . . .	12
2.5.4	Weight Sharing . . . . .	12
2.5.5	Unsupervised Pre-Training . . . . .	12
<b>3</b>	<b>Convolutional Neural Networks</b>	<b>13</b>
3.1	Convolution . . . . .	13
3.2	Layers . . . . .	13
3.2.1	Convolutional Layer . . . . .	13
3.2.2	Non-Linearity Layer . . . . .	14
3.2.3	Rectification . . . . .	15
3.2.4	Local Contrast Normalization Layer . . . . .	15
3.2.5	Feature Pooling and Subsampling Layer . . . . .	15
3.2.6	Fully Connected Layer . . . . .	16
3.3	Architectures . . . . .	16
3.3.1	Traditional Convolutional Neural Network . . . . .	16
3.3.2	Modern Convolutional Neural Networks . . . . .	17
<b>4</b>	<b>Understanding Convolutional Neural Networks</b>	<b>18</b>
4.1	Deconvolutional Neural Networks . . . . .	18
4.1.1	Deconvolutional Layer . . . . .	18
4.1.2	Unsupervised Training . . . . .	19
4.2	Visualizing Convolutional Neural Networks . . . . .	19
4.2.1	Pooling Layers . . . . .	19
4.2.2	Rectification Layers . . . . .	20
4.3	Convolutional Neural Network Visualization . . . . .	20
4.3.1	Filters and Features . . . . .	20
4.3.2	Architecture Evaluation . . . . .	20
<b>5</b>	<b>Conclusion</b>	<b>21</b>