

Table of Contents

| | | |
|----------|---|------------|
| 1 | Introduction | 1 |
| 1.1 | Impact of Mental Health Disorders | 1 |
| 1.2 | Advances in Neuroimaging | 2 |
| 1.3 | Machine Learning - the Missing Ingredient? | 2 |
| 1.4 | Limited Success of Machine Learning in Psychiatry | 3 |
| 1.5 | Overview and Scope of this Dissertation | 5 |
| 2 | Big Data Neuroimaging (publication) | 9 |
| 3 | Deep Learning in Neuroimaging Psychiatry (publication) | 31 |
| 4 | Scaling Behavior of Classical and Deep Machine Learning (publication) | 55 |
| 5 | Performance Reserves of Machine Learning in Neuroimaging (publication) | 73 |
| 6 | Explainability and Data Augmentation | 103 |
| 6.1 | Domain Specific Data Augmentation | 105 |
| 6.2 | Explainability in Machine Learning | 107 |
| 6.3 | Disease Subtype Detection | 109 |
| 6.4 | Clinical Application of Explainable Machine Learning | 111 |
| 7 | Discussion | 113 |
| 7.1 | Summary of Core Results | 113 |
| 7.2 | Understanding the Limitations of Machine Learning in Neuroimaging | 114 |
| 7.2.1 | Predictive Information About Mental Health Encoded in Brain Images | 114 |
| 7.2.2 | Feasibility of Extracting Predictive Information from Brain Images | 115 |
| 7.2.3 | Attaining Practically Useful Prediction Accuracy | 115 |
| 7.3 | Potential Solutions and Future Directions | 116 |
| 7.4 | Limitations | 116 |
| 8 | Supplementary Material | 119 |
| | Scaling Behaviour of Classical and Deep Machine Learning | 119 |
| | Performance Reserves of Machine Learning in Neuroimaging | 128 |
| | References | 145 |