

8.7	Summary.....	54
9.	Conclusion	55
9.1	Introduction.....	55
9.2	Achievements.....	55
9.3	Limitations.....	56
9.4	Future work.....	56
9.5	Summary.....	57
References.....		58
Appendix I: Topological Genetic Algorithm		61
Appendix II: Topological Data Analysis		62
Appendix III: Topological Pruner		63
Appendix IV: VGG Model Implementation.....		64

List of Figures

Figure 1.1: Top Level Architecture	2
Figure 1.2: Topological Pruner Abstract Model	3
Figure 2.1: Model Compression Taxonomy	6
Figure 4.1: Branches of Mathematics (Algebraic topology is in the shaded area)	11
Figure 4.2: Topological Similarities	12
Figure 4.3: Neighborhood of x	14
Figure 4.4: A Separated Space	14
Figure 4.5: Continuous Deformations of a Topological Space	15
Figure 4.6: Equivalence in Topology	15
Figure 4.7: Polygon with Triangles	16
Figure 4.8: First four simplexes	18
Figure 4.9: Examples for Polyhedrons	18
Figure 4.10: Decomposing a Polyhedral	18
Figure 4.11: Bar codes and Persistence Diagrams	19
Figure 4.12: Generating simplicial complexes	20
Figure 4.13: Filtration of the simplicial complexes	20
Figure 4.14: Features vs Noise	21
Figure 4.15: Pairing a point with its Projection	22
Figure 4.16: Three datasets with similar topological properties	22
Figure 4.17: Topological Data Analysis	23
Figure 4.18: Distinguish Zero from Eight	24
Figure 4.19: Mapper representation of a Hand shaped point could	24
Figure 4.20: Responsibilities of each layer of VGG-16	25
Figure 4.21: Taxonomy of Metaheuristics	26
Figure 4.22: General Algorithm for GA (Source: [34])	27
Figure 4.23: Operations use in GA (source [34])	28
Figure 6.1: Abstract composer module	34
Figure 6.2: Abstract Data Collector Module	36
Figure 6.3: Abstract Metric Calculator Module	37
Figure 6.4: Abstract Evolutionary Module	37
Figure 6.5: Abstract Sparsity Allocator Module	38
Figure 6.6: Abstract Speedup Module	39
Figure 7.1: Generating a Point Cloud	43
Figure 7.2: Generate persistence diagram	44
Figure 7.3: Fitness Function	44
Figure 7.4: Implementation of Topological Pruner	46
Figure 7.5: Compression pipeline	46
Figure 7.6: Model Speedup process	47
Figure 8.1: Standard Comparison	51
Figure 8.2: Recoverability Comparison	52

List of Tables

Table 3.1: Issues and Challenges in Current Technologies	9
Table 4.1: Faces of Simplexes	17
Table 7.1: Trainable parameters arranged by layers	42
Table 8.1: Models used in Evaluation	50
Table 8.2: FLOPS and Number of Parameters.....	51
Table 8.3: Recoverability Test Results	52
Table 8.4: Convergence Test Results	53

List of Abbreviations

CBIS : Component based software engineering

FLOPS: Floating-point Operations per Second

GA : Genetic Algorithms

NAS : Neural Architecture Search

NNP : Neural Network Pruning