**Overlap : 0.1 ~ 0.9 取最大值**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **P = 10** | **K= 3** | | | | | | | | | |
| **Dataset** | **Origin** | **Kmeans** | **Random** | **MLP 64** | **MLP 32** | **MLP+F 64** | **MLP+F 32** | **Overlap** | **MLP+F 32 O** | **MLP O** |
| **HRSS** | **87.13** | **72.01** | **72.86** | **79.87** | **79.11** | **77.75** | **77.67** | **92.00** | **92.55** | **93.13** |
| **MI-F** | **50.34** | **53.17** | **46.63** | **53.38** | **56.56** | **57.66** | **55.69** | **50.69** | **60.56** | **52.87** |
| **MI-V** | **77.15** | **58.32** | **70.87** | **74.68** | **73.98** | **75.89** | **75.63** | **77.66** | **82.83** | **78.76** |
| **OPTDIGITS** | **94.57** | **92.35** | **91.57** | **88.79** | **90.51** | **95.05** | **95.05** | **99.63** | **99.65** | **97.78** |
| **PENDIGITS** | **99.56** | **91.35** | **98.14** | **96.66** | **96.48** | **96.81** | **96.61** | **99.95** | **99.91** | **99.16** |
| **SATELLITE** | **51.05** | **68.78** | **72.70** | **69.55** | **73.21** | **79.62** | **76.46** | **68.73** | **81.95** | **78.37** |
| **SHUTTLE** | **39.34** | **27.95** | **99.83** | **96.44** | **95.66** | **95.39** | **86.07** | **96.93** | **79.94** | **99.77** |
| **THYROID** | **71.36** | **78.80** | **89.73** | **93.17** | **91.42** | **89.89** | **91.14** | **87.98** | **83.29** | **90.61** |
| **P = 10** | **K = 6** | | | | | | | | | |
| **Dataset** | **Origin** | **Kmeans** | **Random** | **MLP 64** | **MLP 32** | **MLP+F 64** | **MLP+F 32** | **Overlap** | **MLP+F 32 O** | **MLP O** |
| **HRSS** | **87.13** | **63.74** | **67.43** | **67.40** | **67.01** | **67.03** | **66.48** | **93.69** | **86.56** | **95.02** |
| **MI-F** | **50.34** | **40.91** | **46.41** | **50.54** | **50.13** | **51.64** | **51.48** | **51.79** | **56.29** | **53.52** |
| **MI-V** | **77.15** | **59.61** | **69.25** | **72.98** | **72.78** | **74.34** | **73.45** | **85.70** | **83.38** | **86.24** |
| **OPTDIGITS** | **94.57** | **83.87** | **88.23** | **86.33** | **82.19** | **93.19** | **91.91** | **99.54** | **99.91** | **99.74** |
| **PENDIGITS** | **99.56** | **84.27** | **85.52** | **81.16** | **83.08** | **81.96** | **80.43** | **99.94** | **99.58** | **99.90** |
| **SATELLITE** | **51.05** | **87.63** | **84.74** | **74.51** | **76.67** | **77.80** | **77.74** | **76.33** | **79.53** | **79.76** |
| **SHUTTLE** | **39.34** | **91.90** | **93.58** | **98.85** | **98.97** | **98.62** | **99.55** | **98.49** | **99.53** | **99.42** |
| **THYROID** | **71.36** | **84.26** | **86.74** | **89.06** | **89.46** | **89.95** | **85.11** | **85.19** | **92.65** | **91.92** |
| **P = 10** | **K = 9** | | | | | | | | | |
| **Dataset** | **Origin** | **Kmeans** | **Random** | **MLP 64** | **MLP 32** | **MLP+F 64** | **MLP+F 32** | **Overlap** | **MLP+F 32 O** | **MLP O** |
| **HRSS** | **87.13** | **62.48** | **63.57** | **63.40** | **62.58** | **62.22** | **61.89** | **93.94** | **95.40** | **95.80** |
| **MI-F** | **50.34** | **48.33** | **46.24** | **48.08** | **48.16** | **47.61** | **48.04** | **50.01** | **62.55** | **57.38** |
| **MI-V** | **77.15** | **58.47** | **68.80** | **73.96** | **73.30** | **72.55** | **73.31** | **85.38** | **87.06** | **83.83** |
| **OPTDIGITS** | **94.57** | **85.87** | **84.05** | **81.22** | **78.92** | **81.87** | **80.43** | **99.03** | **100.00** | **99.30** |
| **PENDIGITS** | **99.56** | **79.58** | **78.23** | **76.47** | **77.47** | **70.41** | **69.81** | **99.86** | **100.00** | **100.00** |
| **SATELLITE** | **51.05** | **92.06** | **95.39** | **84.93** | **86.68** | **85.95** | **87.75** | **73.95** | **87.46** | **84.78** |
| **SHUTTLE** | **39.34** | **99.43** | **98.68** | **99.49** | **99.68** | **99.53** | **99.19** | **99.53** | **99.73** | **99.76** |
| **THYROID** | **71.36** | **82.55** | **90.18** | **92.48** | **92.38** | **92.66** | **94.82** | **91.02** | **97.82** | **95.83** |

**Overlap : 0.1 ~ 0.9 取最大值**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **P = 30** | **K= 3** | | | | | | | | | |
| **Dataset** | **Origin** | **Kmeans** | **Random** | **MLP 64** | **MLP 32** | **MLP+F 64** | **MLP+F 32** | **Overlap** | **MLP+F 32 O** | **MLP O** |
| **HRSS** | **78.33** | **67.27** | **68.20** | **68.54** | **67.32** | **67.02** | **66.94** | **83.78** | **88.66** | **90.03** |
| **MI-F** | **46.54** | **45.40** | **41.06** | **52.20** | **50.56** | **51.85** | **53.28** | **44.95** | **59.46** | **50.70** |
| **MI-V** | **64.10** | **65.18** | **63.21** | **68.16** | **67.74** | **69.27** | **70.19** | **67.18** | **76.68** | **71.20** |
| **OPTDIGITS** | **68.44** | **83.23** | **70.39** | **73.21** | **70.86** | **78.56** | **78.59** | **66.37** | **81.27** | **73.67** |
| **PENDIGITS** | **53.95** | **81.84** | **84.95** | **85.68** | **85.55** | **85.26** | **85.64** | **76.11** | **71.78** | **72.29** |
| **SATELLITE** | **45.64** | **59.78** | **69.49** | **66.02** | **65.15** | **67.89** | **68.32** | **63.48** | **74.27** | **67.81** |
| **SHUTTLE** | **90.22** | **94.03** | **94.55** | **79.47** | **88.20** | **86.87** | **63.67** | **86.95** | **92.00** | **88.38** |
| **THYROID** | **70.09** | **68.95** | **80.55** | **86.61** | **87.19** | **85.33** | **86.53** | **95.25** | **87.53** | **86.82** |
| **P = 30** | **K = 6** | | | | | | | | | |
| **Dataset** | **Origin** | **Kmeans** | **Random** | **MLP 64** | **MLP 32** | **MLP+F 64** | **MLP+F 32** | **Overlap** | **MLP+F 32 O** | **MLP O** |
| **HRSS** | **78.33** | **61.21** | **64.02** | **62.80** | **62.42** | **61.85** | **60.73** | **86.85** | **89.54** | **91.24** |
| **MI-F** | **46.54** | **41.56** | **42.71** | **48.51** | **48.64** | **51.00** | **51.86** | **46.53** | **57.81** | **51.86** |
| **MI-V** | **64.10** | **62.71** | **63.82** | **69.22** | **68.41** | **69.83** | **69.13** | **70.72** | **75.29** | **72.04** |
| **OPTDIGITS** | **68.44** | **71.23** | **77.13** | **74.14** | **73.20** | **77.17** | **74.75** | **80.97** | **84.62** | **80.39** |
| **PENDIGITS** | **53.95** | **73.88** | **77.50** | **74.25** | **79.08** | **67.47** | **69.44** | **90.73** | **89.06** | **87.98** |
| **SATELLITE** | **45.64** | **85.43** | **83.59** | **76.69** | **76.54** | **79.19** | **78.27** | **67.14** | **80.04** | **71.83** |
| **SHUTTLE** | **90.22** | **93.09** | **76.23** | **78.40** | **84.54** | **97.04** | **88.89** | **87.14** | **89.42** | **86.69** |
| **THYROID** | **70.09** | **81.17** | **77.64** | **79.28** | **80.16** | **80.86** | **80.00** | **86.12** | **85.89** | **84.59** |
| **P = 30** | **K = 9** | | | | | | | | | |
| **Dataset** | **Origin** | **Kmeans** | **Random** | **MLP 64** | **MLP 32** | **MLP+F 64** | **MLP+F 32** | **Overlap** | **MLP+F 32 O** | **MLP O** |
| **HRSS** | **78.33** | **59.64** | **58.84** | **58.21** | **59.44** | **57.89** | **58.02** | **88.82** | **92.41** | **92.87** |
| **MI-F** | **46.54** | **44.41** | **43.83** | **46.90** | **46.94** | **47.20** | **47.33** | **44.89** | **57.51** | **53.87** |
| **MI-V** | **64.10** | **65.59** | **64.31** | **66.45** | **66.00** | **65.91** | **66.91** | **71.83** | **79.19** | **73.70** |
| **OPTDIGITS** | **68.44** | **71.18** | **83.92** | **83.87** | **81.21** | **81.48** | **83.99** | **86.43** | **77.61** | **85.50** |
| **PENDIGITS** | **53.95** | **76.88** | **71.03** | **73.63** | **76.83** | **74.74** | **66.47** | **92.34** | **90.85** | **91.28** |
| **SATELLITE** | **45.64** | **88.48** | **90.47** | **81.30** | **82.05** | **80.80** | **83.38** | **64.34** | **86.92** | **79.97** |
| **SHUTTLE** | **90.22** | **98.87** | **85.12** | **89.84** | **95.61** | **93.32** | **97.79** | **93.44** | **98.18** | **96.37** |
| **THYROID** | **70.09** | **80.17** | **80.68** | **77.49** | **81.63** | **80.82** | **80.47** | **87.08** | **93.11** | **94.17** |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **P = 50** | **K= 3** | | | | | | | | | |
| **Dataset** | **Origin** | **Kmeans** | **Random** | **MLP 64** | **MLP 32** | **MLP+F 64** | **MLP+F 32** | **Overlap** | **MLP+F 32 O** | **MLP O** |
| **HRSS** | **70.10** | **62.44** | **63.72** | **68.07** | **67.24** | **66.36** | **67.09** | **81.26** | **79.97** | **83.46** |
| **MI-F** | **47.19** | **41.14** | **41.55** | **53.87** | **50.27** | **53.01** | **52.44** | **43.78** | **63.43** | **53.37** |
| **MI-V** | **59.85** | **63.58** | **58.99** | **66.49** | **65.28** | **66.87** | **67.33** | **64.64** | **74.75** | **67.42** |
| **OPTDIGITS** | **50.49** | **68.98** | **69.92** | **53.55** | **63.31** | **62.70** | **63.37** | **56.78** | **65.97** | **54.58** |
| **PENDIGITS** | **25.20** | **57.82** | **77.47** | **68.28** | **69.64** | **66.37** | **69.41** | **46.19** | **42.28** | **42.98** |
| **SATELLITE** | **49.94** | **62.47** | **62.99** | **61.35** | **60.33** | **63.14** | **63.27** | **57.39** | **67.62** | **63.97** |
| **SHUTTLE** | **86.11** | **80.48** | **86.99** | **68.59** | **84.57** | **69.04** | **86.35** | **86.13** | **71.95** | **85.08** |
| **THYROID** | **66.38** | **72.20** | **79.62** | **85.50** | **84.48** | **84.01** | **84.62** | **79.39** | **83.46** | **83.52** |
| **P = 50** | **K = 6** | | | | | | | | | |
| **Dataset** | **Origin** | **Kmeans** | **Random** | **MLP 64** | **MLP 32** | **MLP+F 64** | **MLP+F 32** | **Overlap** | **MLP+F 32 O** | **MLP O** |
| **HRSS** | **70.10** | **61.22** | **62.66** | **61.89** | **60.23** | **61.46** | **60.55** | **83.23** | **82.91** | **86.13** |
| **MI-F** | **47.19** | **44.20** | **42.21** | **47.47** | **51.38** | **47.25** | **49.40** | **41.90** | **60.85** | **52.19** |
| **MI-V** | **59.85** | **47.32** | **61.51** | **64.56** | **64.29** | **64.27** | **65.37** | **66.68** | **73.61** | **70.22** |
| **OPTDIGITS** | **50.49** | **71.13** | **70.76** | **71.51** | **75.59** | **77.26** | **72.82** | **67.35** | **75.95** | **63.64** |
| **PENDIGITS** | **25.20** | **64.22** | **86.28** | **82.28** | **84.03** | **81..78** | **81.17** | **78.16** | **84.16** | **87.15** |
| **SATELLITE** | **49.94** | **73.69** | **80.21** | **67.53** | **70.03** | **70.07** | **72.14** | **60.39** | **77.73** | **67.86** |
| **SHUTTLE** | **86.11** | **98.51** | **68.33** | **82.60** | **84.93** | **93.00** | **84.33** | **80.18** | **79.08** | **86.12** |
| **THYROID** | **66.38** | **81.59** | **85.14** | **86.97** | **89.14** | **88.78** | **84.60** | **85.73** | **92.31** | **94.08** |
| **P = 50** | **K = 9** | | | | | | | | | |
| **Dataset** | **Origin** | **Kmeans** | **Random** | **MLP 64** | **MLP 32** | **MLP+F 64** | **MLP+F 32** | **Overlap** | **MLP+F 32 O** | **MLP O** |
| **HRSS** | **70.10** | **57.42** | **57.24** | **57.03** | **62.86** | **62.73** | **62.81** | **83.45** | **82.93** | **85.97** |
| **MI-F** | **47.19** | **40.00** | **41.47** | **44.02** | **43.18** | **43.70** | **43.58** | **41.27** | **52.77** | **50.12** |
| **MI-V** | **59.85** | **54.26** | **61.99** | **62.60** | **63.69** | **63.24** | **63.94** | **67.43** | **73.21** | **69.46** |
| **OPTDIGITS** | **50.49** | **74.38** | **70.68** | **70.55** | **64.69** | **69.77** | **69.24** | **68.79** | **86.84** | **71.09** |
| **PENDIGITS** | **25.20** | **70.58** | **69.10** | **66.59** | **70.18** | **70.55** | **61.76** | **73.54** | **83.91** | **91.51** |
| **SATELLITE** | **49.94** | **81.01** | **86.85** | **76.49** | **78.49** | **78.85** | **79.85** | **61.83.** | **72.55** | **63.88** |
| **SHUTTLE** | **86.11** | **81.68** | **76.78** | **83.64** | **85.74** | **83.23** | **82.05** | **89.51** | **81.66** | **90.34** |
| **THYROID** | **66.38** | **76.17** | **79.25** | **76.91** | **76.30** | **68.99** | **65.41** | **89.15** | **90.21** | **91.41** |

**MLP+Feature 64**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **P = 10** | | | | **P = 30** | | | | **P = 50** | | | |
| **Dataset** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |
| **HRSS** |  | **77.75** | **67.03** | **62.22** |  | **67.02** | **61.85** | **57.89** |  | **66.36** | **61.46** | **62.73** |
| **MI-F** |  | **57.66** | **51.64** | **47.61** |  | **51.85** | **51.00** | **47.20** |  | **53.01** | **47.25** | **43.70** |
| **MI-V** |  | **75.89** | **74.34** | **72.55** |  | **69.27** | **69.83** | **65.91** |  | **66.87** | **64.27** | **63.24** |
| **OPTDIGITS** |  | **95.05** | **93.19** | **81.87** |  | **78.56** | **77.17** | **81.48** |  | **62.70** | **77.26** | **69.77** |
| **PENDIGITS** |  | **96.81** | **81.96** | **70.41** |  | **85.26** | **67.47** | **74.74** |  | **66.37** | **81..78** | **70.55** |
| **SATELLITE** |  | **79.62** | **77.80** | **85.95** |  | **67.89** | **79.19** | **80.80** |  | **63.14** | **70.07** | **78.85** |
| **SHUTTLE** |  | **95.39** | **98.62** | **99.53** |  | **86.87** | **97.04** | **93.32** |  | **69.04** | **93.00** | **83.23** |
| **THYROID** |  | **89.89** | **89.95** | **92.66** |  | **85.33** | **80.86** | **80.82** |  | **84.01** | **88.78** | **68.99** |

**MLP+Feature 32**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **P = 10** | | | | **P = 30** | | | | **P = 50** | | | |
| **Dataset** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |
| **HRSS** |  | **77.67** | **66.48** | **61.89** |  | **66.94** | **60.73** | **58.02** |  | **67.09** | **60.55** | **62.81** |
| **MI-F** |  | **55.69** | **51.48** | **48.04** |  | **53.28** | **51.86** | **47.33** |  | **52.44** | **49.40** | **43.58** |
| **MI-V** |  | **75.63** | **73.45** | **73.31** |  | **70.19** | **69.13** | **66.91** |  | **67.33** | **65.37** | **63.94** |
| **OPTDIGITS** |  | **95.05** | **91.91** | **80.43** |  | **78.59** | **74.75** | **83.99** |  | **63.37** | **72.82** | **69.24** |
| **PENDIGITS** |  | **96.61** | **80.43** | **69.81** |  | **85.64** | **69.44** | **66.47** |  | **69.41** | **81.17** | **61.76** |
| **SATELLITE** |  | **76.46** | **77.74** | **87.75** |  | **68.32** | **78.27** | **83.38** |  | **63.27** | **72.14** | **79.85** |
| **SHUTTLE** |  | **86.07** | **99.55** | **99.19** |  | **63.67** | **88.89** | **97.79** |  | **86.35** | **84.33** | **82.05** |
| **THYROID** |  | **91.14** | **85.11** | **94.82** |  | **86.53** | **80.00** | **80.47** |  | **84.62** | **84.60** | **65.41** |

**Num\_heads = 4**

**Trans +MLP 32**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **P = 10** | | | | **P = 30** | | | | **P = 50** | | | |
| **Dataset** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |
| **OPTDIGITS** |  | **99.68** | **95.09** | **98.34** |  | **79.89** | **86.87** | **82.37** |  | **56.46** | **68.46** | **54.74** |
| **PENDIGITS** |  | **94.75** | **99.68** | **97.15** |  | **77.57** | **79.88** | **80.51** |  | **61.82** | **67.46** | **67.01** |
| **SATELLITE** |  | **74.57** | **78.66** | **84.20** |  | **75.11** | **76.09** | **72.54** |  | **72.14** | **65.95** | **71.52** |
| **THYROID** |  | **82.97** | **93.97** | **88.95** |  | **83.95** | **90.36** | **80.74** |  | **82.66** | **86.51** | **81.66** |

**Trans +MLP 64**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **P = 10** | | | | **P = 30** | | | | **P = 50** | | | |
| **Dataset** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |
| **OPTDIGITS** |  | **98.95** | **98.79** | **99.47** |  | **79.39** | **84.61** | **86.46** |  | **55.98** | **66.93** | **64.30** |
| **PENDIGITS** |  | **99.05** | **99.80** | **96.79** |  | **76.36** | **80.15** | **85.07** |  | **59.16** | **68.47** | **75.72** |
| **SATELLITE** |  | **82.72** | **86.10** | **89.72** |  | **76.94** | **77.24** | **75.62** |  | **73.04** | **70.37** | **72.64** |
| **THYROID** |  | **84.38** | **94.18** | **88.53** |  | **84.78** | **89.73** | **82.54** |  | **85.61** | **84.50** | **82.54** |

**GAT32 + MLP heads = 1**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **P = 10** | | | | **P = 30** | | | | **P = 50** | | | |
| **Dataset** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |
| **OPTDIGITS** |  | **97.29** | **96.13** | **93.47** |  | **62.36** | **74.17** | **74.24** |  | **32.39** | **53.13** | **52.86** |
| **PENDIGITS** |  | **94.97** | **98.21** | **93.39** |  | **61.15** | **56.98** | **60.73** |  | **33.26** | **41.97** | **38.19** |
| **SATELLITE** |  | **49.67** | **49.59** | **48.44** |  | **46.75** | **44.43** | **40.19** |  | **46.39** | **39.82** | **45.23** |
| **THYROID** |  | **80.32** | **88.80** | **81.60** |  | **80.14** | **86.18** | **78.03** |  | **81.87** | **78.78** | **76.69** |

**GAT32 heads = 4**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **P = 10** | | | | **P = 30** | | | | **P = 50** | | | |
| **Dataset** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |
| **OPTDIGITS** |  | **99.68** | **99.82** | **99.61** |  | **71.49** | **83.30** | **82.06** |  | **37.48** | **47.95** | **49.16** |
| **PENDIGITS** |  | **96.52** | **98.13** | **98.23** |  | **66.79** | **70.79** | **69.45** |  | **32.29** | **45.17** | **42.75** |
| **SATELLITE** |  | **66.19** | **68.39** | **71.44** |  | **56.80** | **59.90** | **60.72** |  | **49.73** | **52.97** | **53.35** |
| **THYROID** |  | **79.97** | **90.51** | **80.86** |  | **83.26** | **87.21** | **79.57** |  | **85.13** | **85.86** | **79.65** |

**Attention32+MLP**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **P = 10** | | | | **P = 30** | | | | **P = 50** | | | |
| **Dataset** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |
| **OPTDIGITS** |  | **98.48** | **91.22** | **93.59** |  | **73.86** | **72.61** | **64.02** |  | **63.74** | **38.74** | **50.43** |
| **PENDIGITS** |  | **98.71** | **96.14** | **96.49** |  | **71.13** | **86.08** | **77.53** |  | **59.13** | **51.63** | **65.01** |
| **SATELLITE** |  | **59.13** | **51.63** | **65.01** |  | **66.71** | **74.24** | **75.54** |  | **64.17** | **66.31** | **67.91** |
| **THYROID** |  | **83.60** | **90.80** | **88.40** |  | **83.69** | **88.35** | **81.73** |  | **85.88** | **84.66** | **76.72** |

**GAT32 + MLP heads = 4**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **P = 10** | | | | **P = 30** | | | | **P = 50** | | | |
| **Dataset** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |  | **K = 3** | **K = 6** | **K = 9** |
| **OPTDIGITS** |  | **97.94** | **97.43** | **96.24** |  | **66.74** | **77.28** | **71.82** |  | **41.77** | **54.79** | **51.24** |
| **PENDIGITS** |  | **96.16** | **97.75** | **96.87** |  | **65.55** | **62.79** | **58.74** |  | **39.86** | **44.71** | **45.57** |
| **SATELLITE** |  | **47.69** | **55.27** | **58.02** |  |  |  |  |  |  |  |  |
| **THYROID** |  |  |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **P = 10** | **K= 3** | | | | | **K = 6** | | | | | **K = 9** | | | | |
| **Dataset** | **Origin** | **MLP** | **TF+**  **MLP** | **ATT+**  **MLP** | **GAT** | **Origin** | **MLP** | **TF+**  **MLP** | **ATT+**  **MLP** | **GAT** | **Origin** | **MLP** | **TF+**  **MLP** | **ATT+**  **MLP** | **GAT** |
| **OPTDIGITS** | **99.46** | **97.99** | **99.68** | **98.48** | **99.68** | **99.38** | **99.37** | **95.09** | **91.22** | **99.82** | **98.99** | **97.66** | **98.34** | **93.59** | **99.61** |
| **PENDIGITS** | **99.09** | **97.61** | **94.75** | **98.71** | **96.52** | **99.46** | **98.33** | **99.68** | **96.14** | **98.13** | **98.81** | **96.81** | **97.15** | **96.49** | **98.23** |
| **SATELLITE** | **64.93** | **71.85** | **74.57** | **59.13** | **66.19** | **72.06** | **78.09** | **78.66** | **51.63** | **68.39** | **73.71** | **79.20** | **84.20** | **65.01** | **71.44** |
| **THYROID** | **82.26** | **83.84** | **82.97** | **83.60** | **79.97** | **90.13** | **93.47** | **93.97** | **90.80** | **90.51** | **85.05** | **88.13** | **88.95** | **88.40** | **80.86** |
| **P = 30** | **K= 3** | | | | | **K = 6** | | | | | **K = 9** | | | | |
| **Dataset** | **Origin** | **MLP** | **TF+**  **MLP** | **ATT+**  **MLP** | **GAT** | **Origin** | **MLP** | **TF+**  **MLP** | **ATT+**  **MLP** | **GAT** | **Origin** | **MLP** | **TF+**  **MLP** | **ATT+**  **MLP** | **GAT** |
| **OPTDIGITS** | **64.64** | **66.02** | **79.89** | **73.86** | **71.49** | **71.84** | **77.28** | **86.87** | **72.61** | **83.30** | **75.57** | **78.13** | **82.37** | **64.02** | **82.06** |
| **PENDIGITS** | **64.87** | **74.16** | **77.57** | **71.13** | **66.79** | **81.80** | **77.11** | **79.88** | **86.08** | **70.79** | **79.11** | **81.85** | **80.51** | **77.53** | **69.45** |
| **SATELLITE** | **58.17** | **65.52** | **75.11** | **66.71** | **56.80** | **62.64** | **65.48** | **76.09** | **74.24** | **59.90** | **64.83** | **67.78** | **72.54** | **75.54** | **60.72** |
| **THYROID** | **84.05** | **85.05** | **84.14** | **83.69** | **83.26** | **86.70** | **89.68** | **90.36** | **88.35** | **87.21** | **80.73** | **82.78** | **80.74** | **81.73** | **79.57** |
| **P =50** | **K= 3** | | | | | **K = 6** | | | | | **K = 9** | | | | |
| **Dataset** | **Origin** | **MLP** | **TF+**  **MLP** | **ATT+**  **MLP** | **GAT** | **Origin** | **MLP** | **TF+**  **MLP** | **ATT+**  **MLP** | **GAT** | **Origin** | **MLP** | **TF+**  **MLP** | **ATT+**  **MLP** | **GAT** |
| **OPTDIGITS** | **36.15** | **41.49** | **56.46** | **63.74** | **37.48** | **43.57** | **55.70** | **68.46** | **38.74** | **47.95** | **41.51** | **53.70** | **54.74** | **50.43** | **49.16** |
| **PENDIGITS** | **47.84** | **52.11** | **61.82** | **59.13** | **32.29** | **53.65** | **55.28** | **67.46** | **51.63** | **45.17** | **55.39** | **58.76** | **67.01** | **65.01** | **42.75** |
| **SATELLITE** | **53.71** | **61.96** | **72.14** | **64.17** | **49.73** | **58.61** | **63.73** | **65.95** | **66.31** | **52.97** | **63.13** | **67.64** | **71.52** | **67.91** | **53.35** |
| **THYROID** | **82.31** | **84.45** | **82.66** | **85.88** | **85.13** | **84.03** | **84.86** | **86.51** | **84.66** | **85.86** | **76.55** | **81.30** | **81.66** | **76.72** | **79.65** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | | |  | | | |  | | | |
|  | **99.46** | **99.38** | **98.99** |  | **64.64** | **71.84** | **75.57** |  | **36.15** | **43.57** | **41.51** |  |
|  | **99.09** | **99.46** | **98.81** |  | **64.87** | **81.80** | **79.11** |  | **47.84** | **53.65** | **55.39** |  |
|  | **64.93** | **72.06** | **73.71** |  | **58.17** | **62.64** | **64.83** |  | **53.71** | **58.61** | **63.13** |  |
|  | **82.26** | **90.13** | **85.05** |  | **84.05** | **86.70** | **80.73** |  | **82.31** | **84.03** | **76.55** |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |