

DETECTION OF DISTRIBUTED DENIAL OF SERVICE ATTACK VIA MACHINE LEARNING

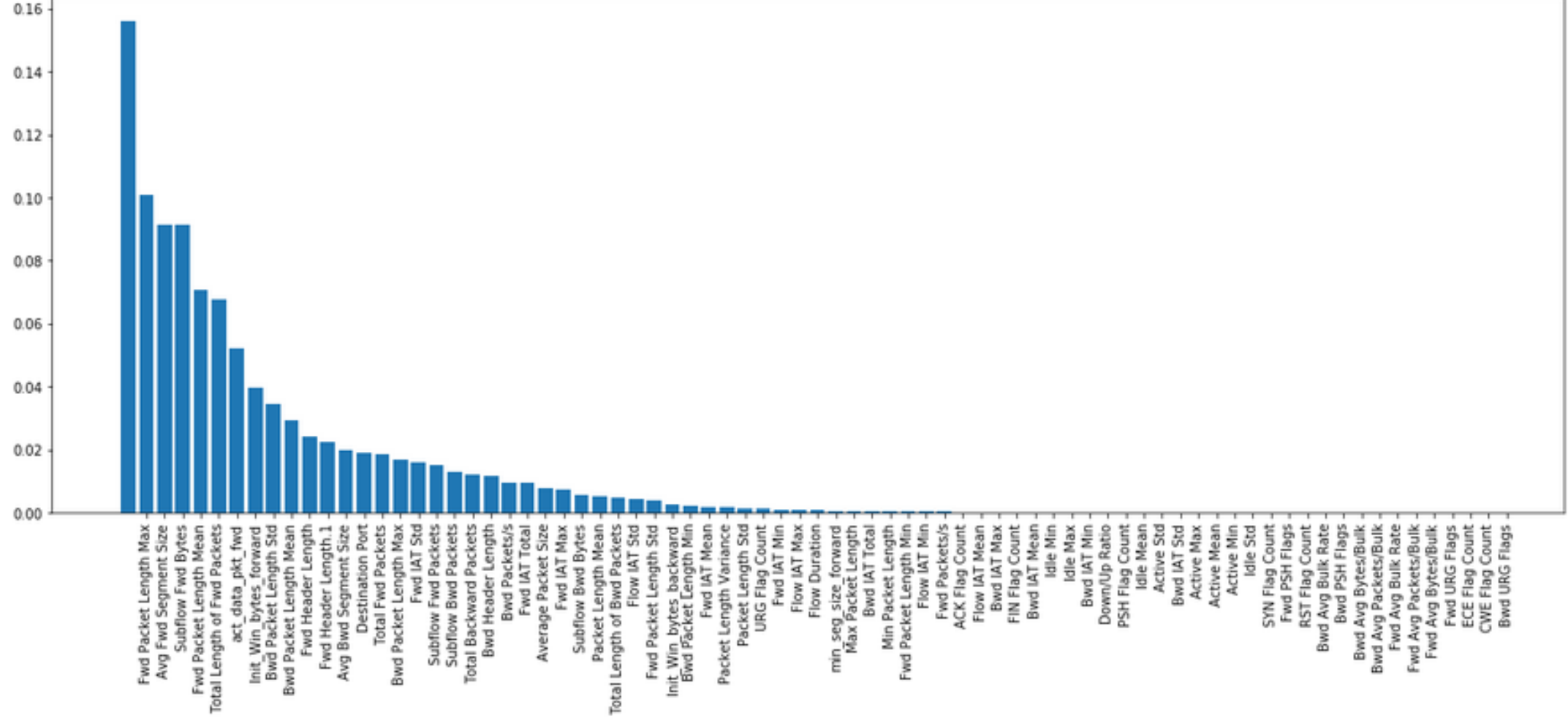
■ RESULTS AND ANALYSIS

■ MUDIT RATHORE

■ ICM 2015 502

MODELS DATASETS	LOGISTIC REGRESSION CLASSIFIER	RANDOM FOREST CLASSIFIER	MULTILAYER PERCEPTRON CLASSIFIER	LINEAR DISCRIMINANT ANALYSIS CLASSIFIER	K-NEAREST NEIGHBOUR CLASSIFIER	GAUSSIAN NAÏVE BAYES CLASSIFIER	DECISION TREE CLASSIFIER
MONDAY	----	1.0	1.0	1.0	1.0	1.0	1.0
TUESDAY	95.44	99.99	98.24	96.08	99.72	18.38	99.99
WEDNESDAY	60.18	99.96	97.51	95.94	99.71	37.59	99.95
THURSDAY INFILTRATION	95.55	99.99	99.98	99.98	99.98	97.84	99.99
THURSDAY WEBATTACKS	97.44	99.56	99.50	96.61	99.54	18.36	99.50
FRIDAY MORNING	98.20	99.97	99.17	98.27	99.43	18.86	99.96
FRIDAY AFTERNOON PORTSCAN	67.35	99.99	99.49	98.72	99.95	65.88	99.98
FRIDAY AFTERNOON DDoS	76.14	99.98	95.27	98.01	99.84	78.75	99.98

Feature Importance



CROSS VALIDATION SCORES
DATA: TUESDAY

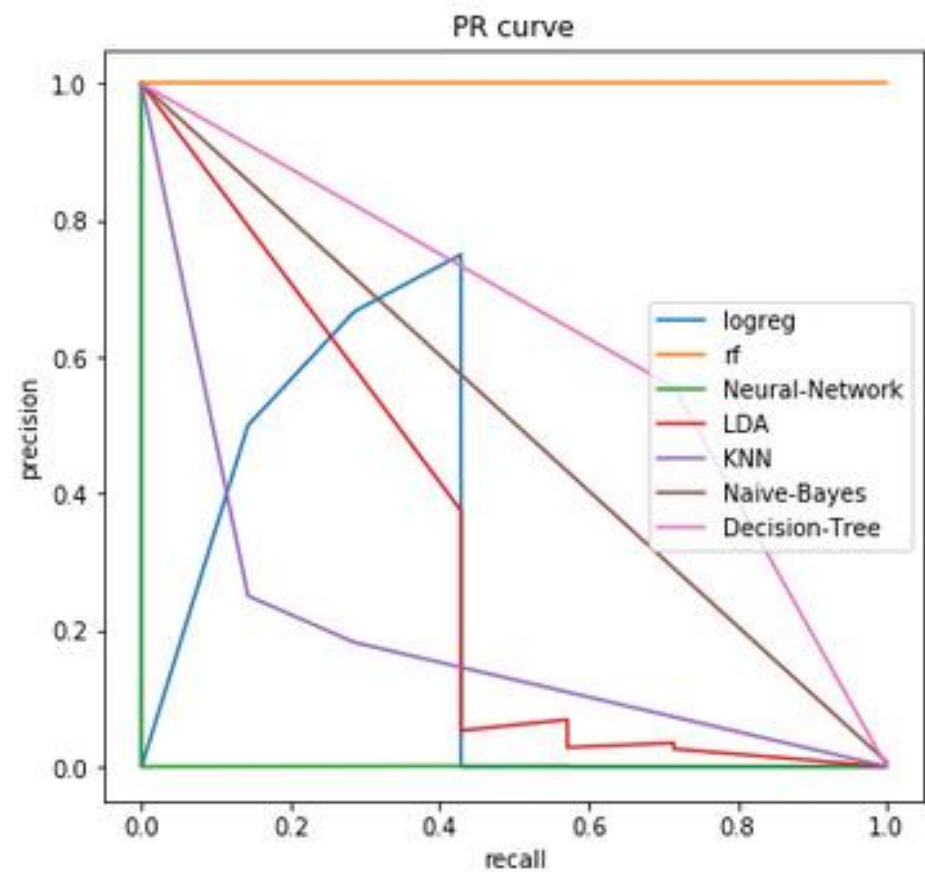
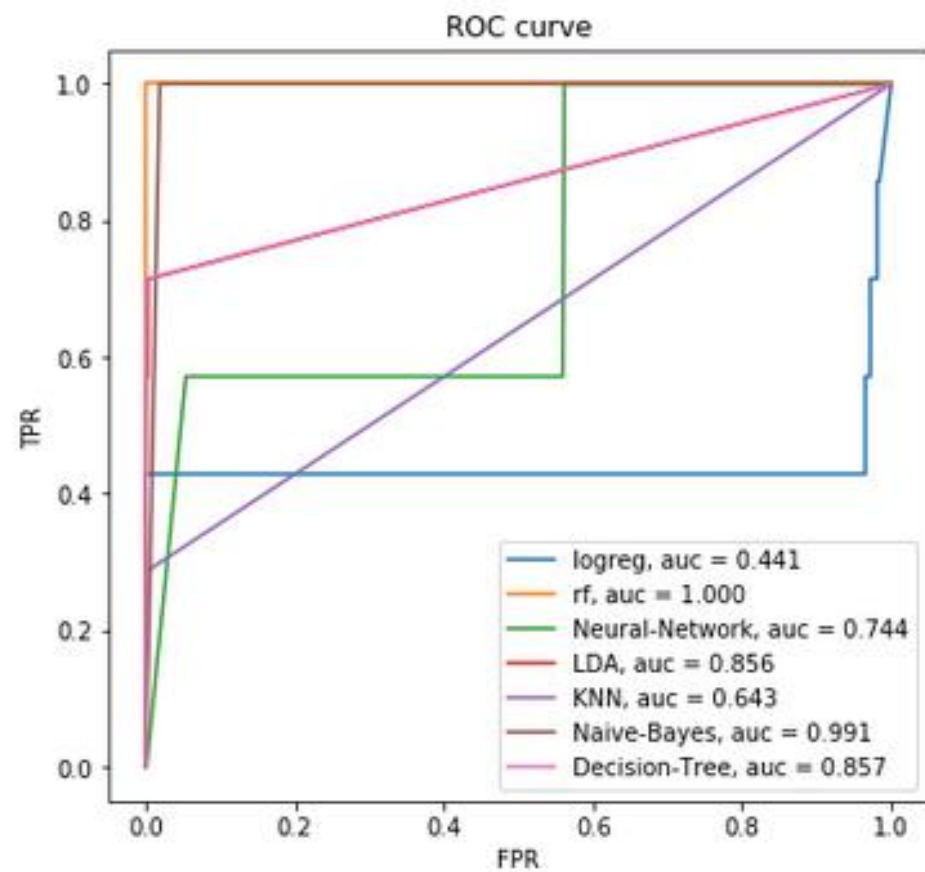
MODELS	3 SPLITS	5 SPLITS	7 SPLITS
LOGISTIC REGRESSION CLASSIFIER	98.32		
RANDOM FOREST CLASSIFIER	99.98		
MULTILAYER PERCEPTRON CLASSIFIER	97.27		
LINEAR DISCRIMINANT ANALYSIS CLASSIFIER	93.55		
K-NEAREST NEIGHBOUR CLASSIFIER	99.84		
GAUSSIAN NAÏVE BAYES CLASSIFIER	49.33		
DECISION TREE CLASSIFIER	99.98		

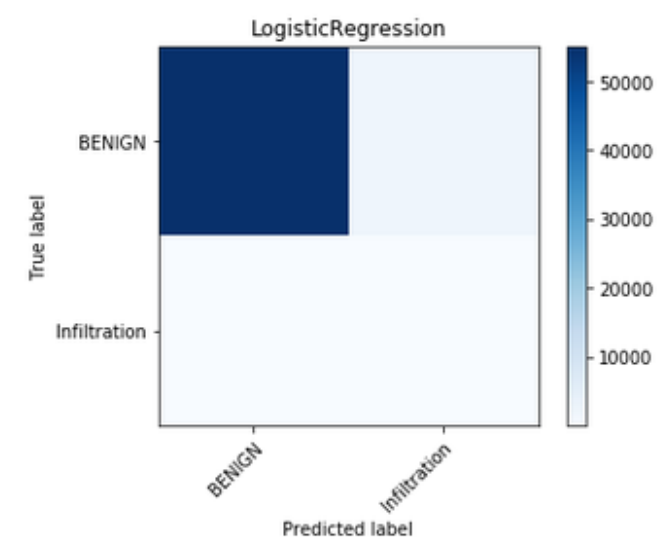
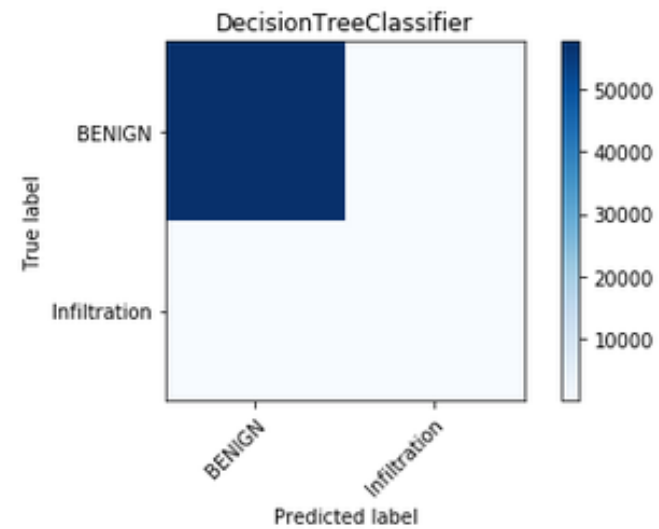
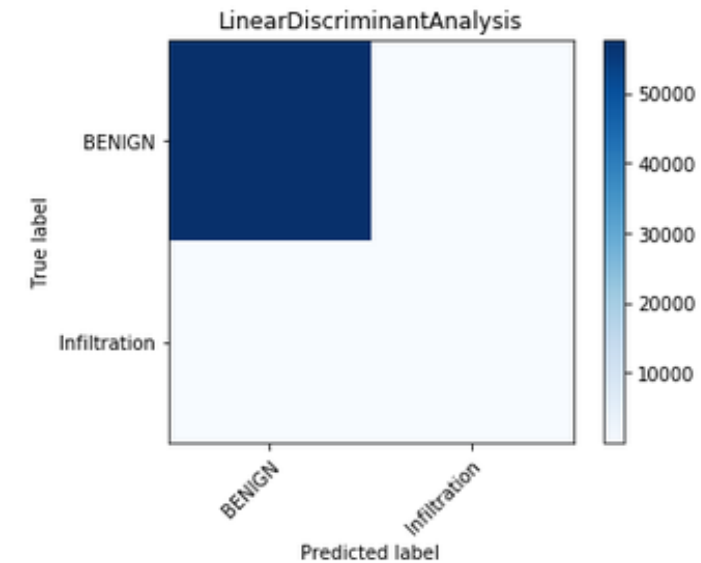
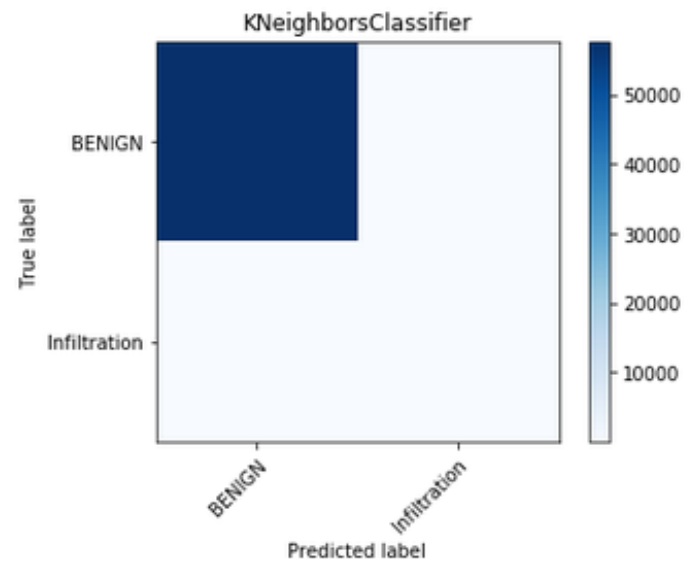
CROSS VALIDATION SCORES
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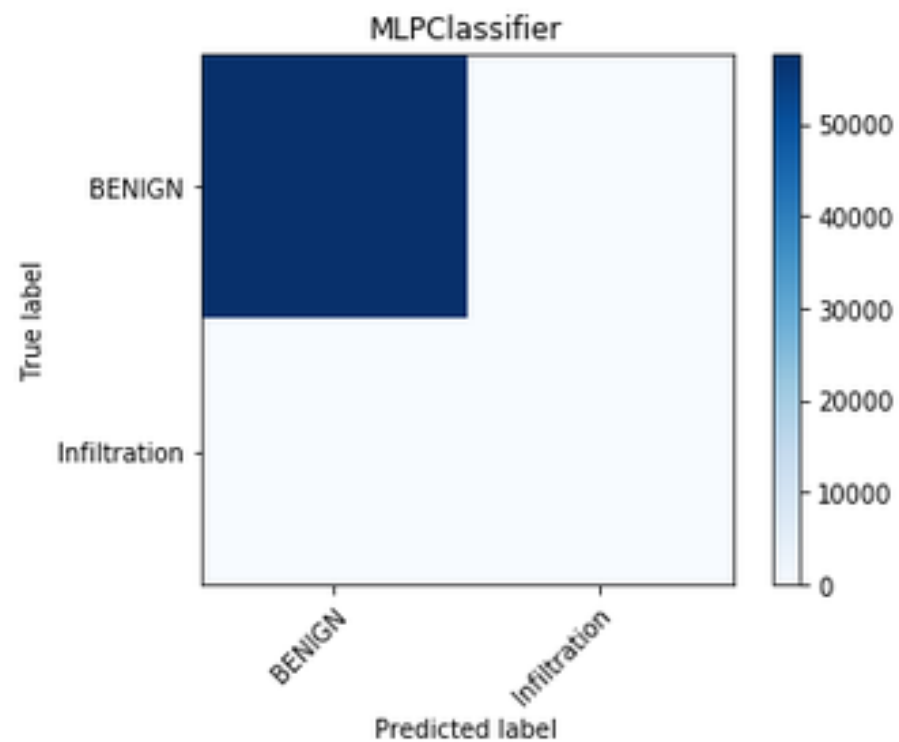
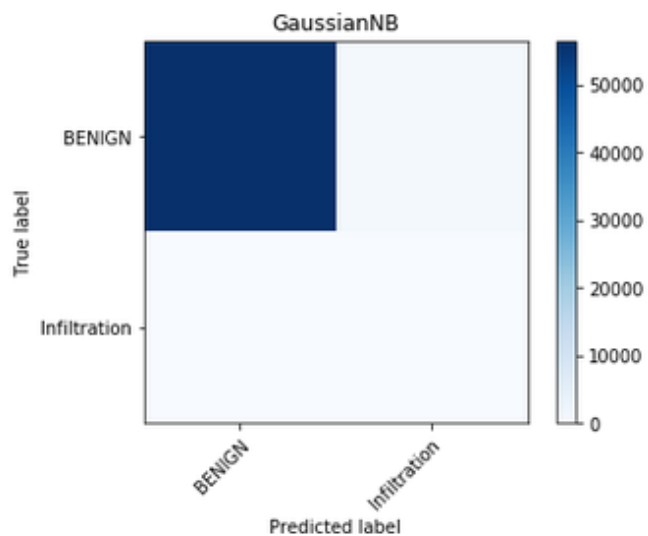
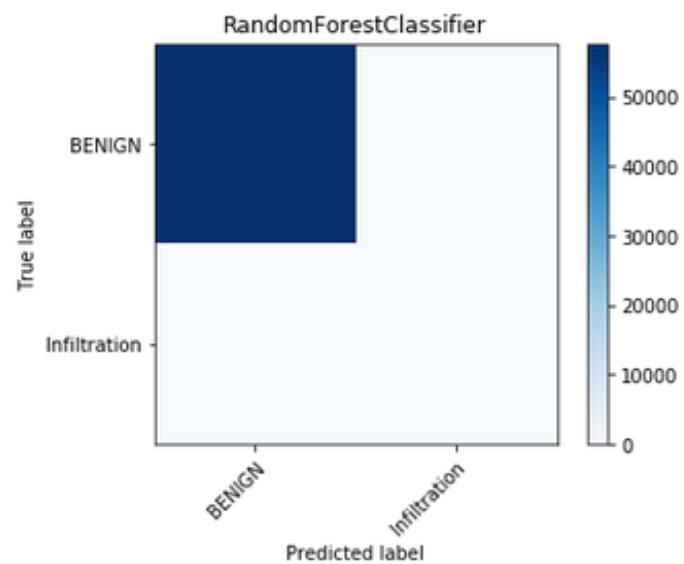
MODELS	3 SPLITS	5 SPLITS	7 SPLITS
LOGISTIC REGRESSION CLASSIFIER	069		
RANDOM FOREST CLASSIFIER	99.48		
MULTILAYER PERCEPTRON CLASSIFIER	84.57		
LINEAR DISCRIMINANT ANALYSIS CLASSIFIER	91.67		
K-NEAREST NEIGHBOUR CLASSIFIER	97.77		
GAUSSIAN NAÏVE BAYES CLASSIFIER	50.79		
DECISION TREE CLASSIFIER	99.63		

CROSS VALIDATION SCORES
DATA: THURSDAY INFILTRATION

MODELS	3 SPLITS	5 SPLITS	7 SPLITS
LOGISTIC REGRESSION CLASSIFIER	99.96	99.97	99.97
RANDOM FOREST CLASSIFIER	99.99	99.99	99.99
MULTILAYER PERCEPTRON CLASSIFIER	99.98	99.98	99.98
LINEAR DISCRIMINANT ANALYSIS CLASSIFIER	99.97	99.98	99.98
K-NEAREST NEIGHBOUR CLASSIFIER	99.97	99.97	99.98
GAUSSIAN NAÏVE BAYES CLASSIFIER	97.67	97.60	97.63
DECISION TREE CLASSIFIER	99.98	99.99	99.98





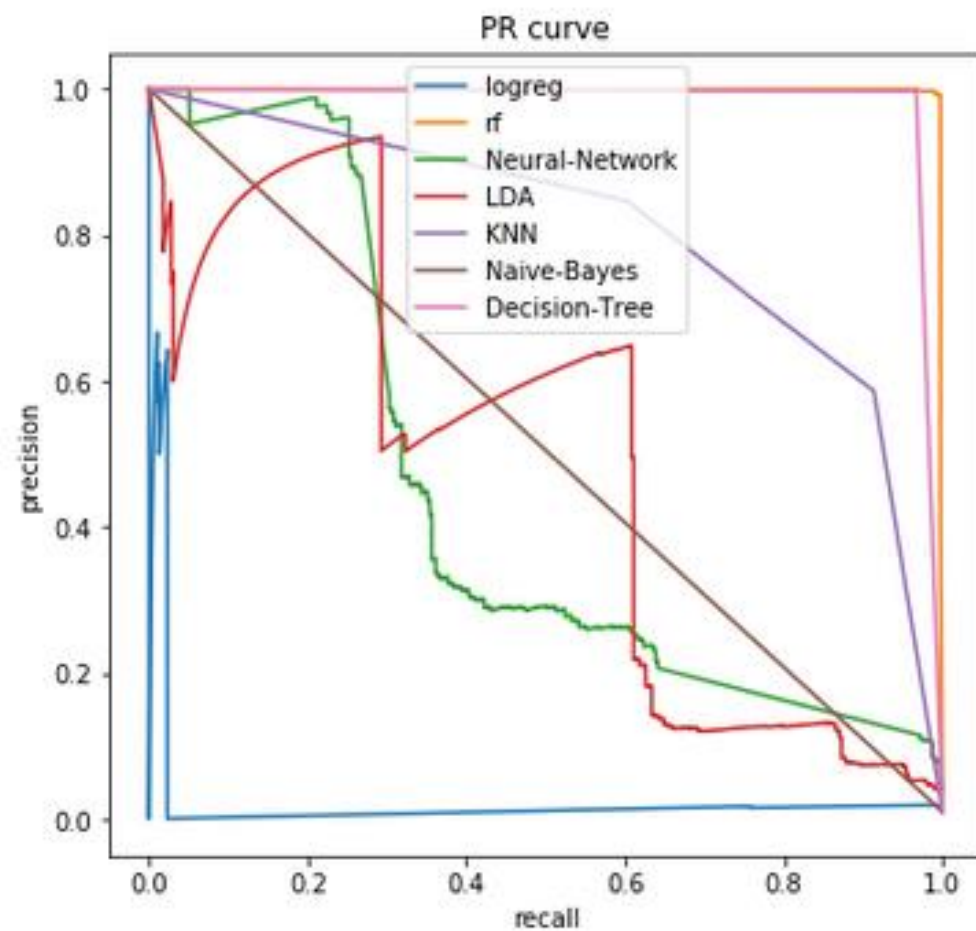
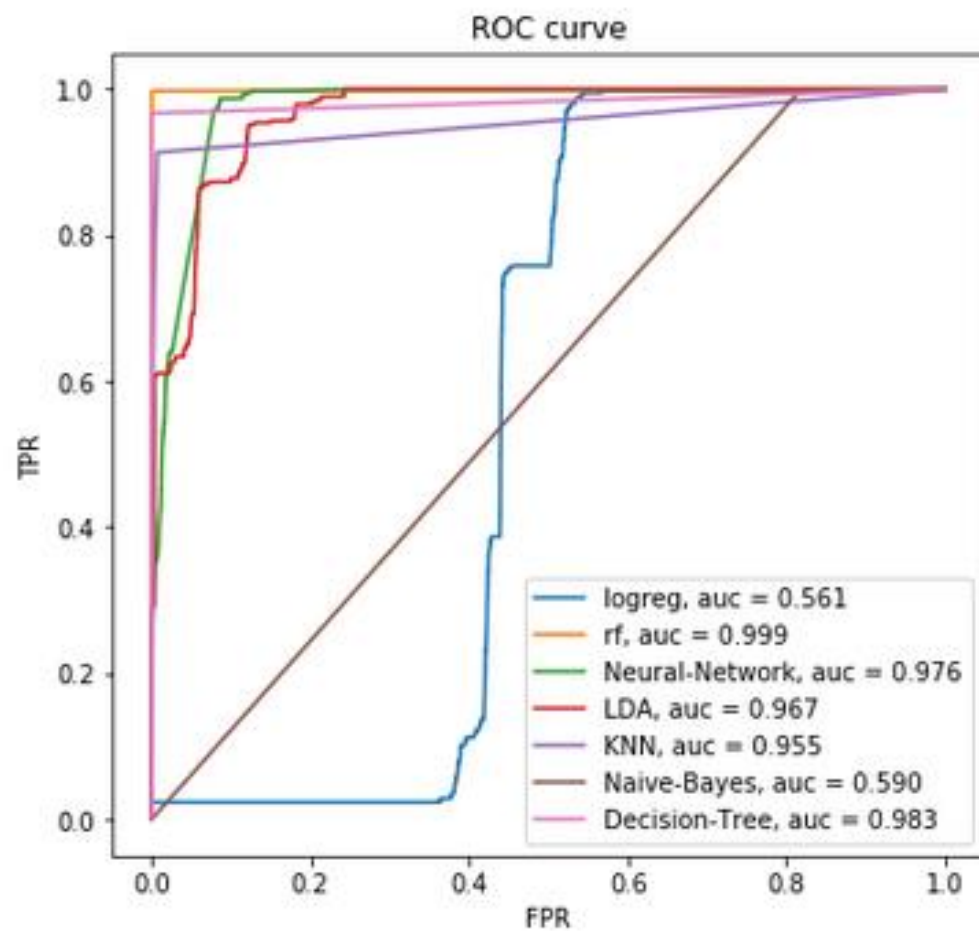


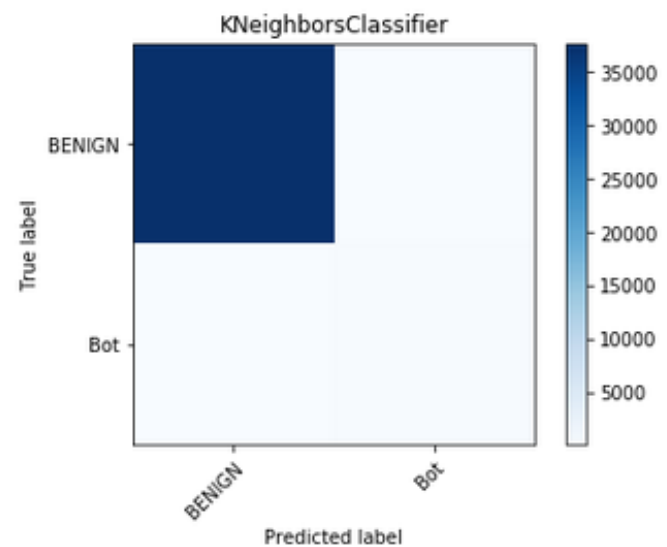
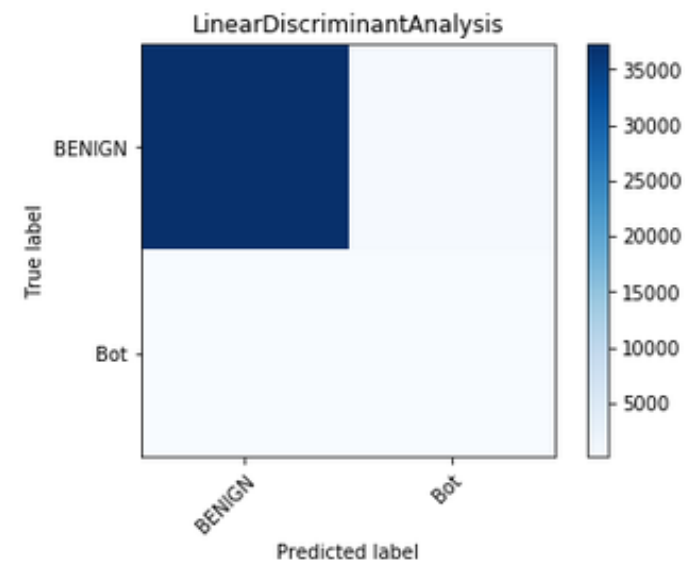
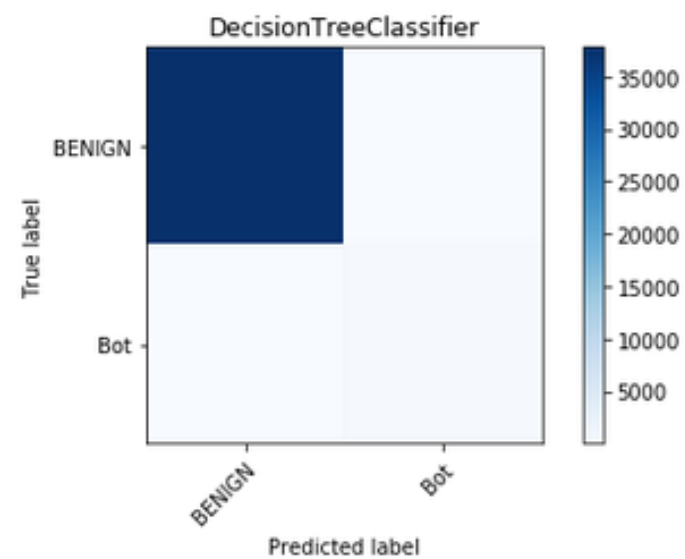
CROSS VALIDATION SCORES
DATA: THURSDAY WEBATTACKS

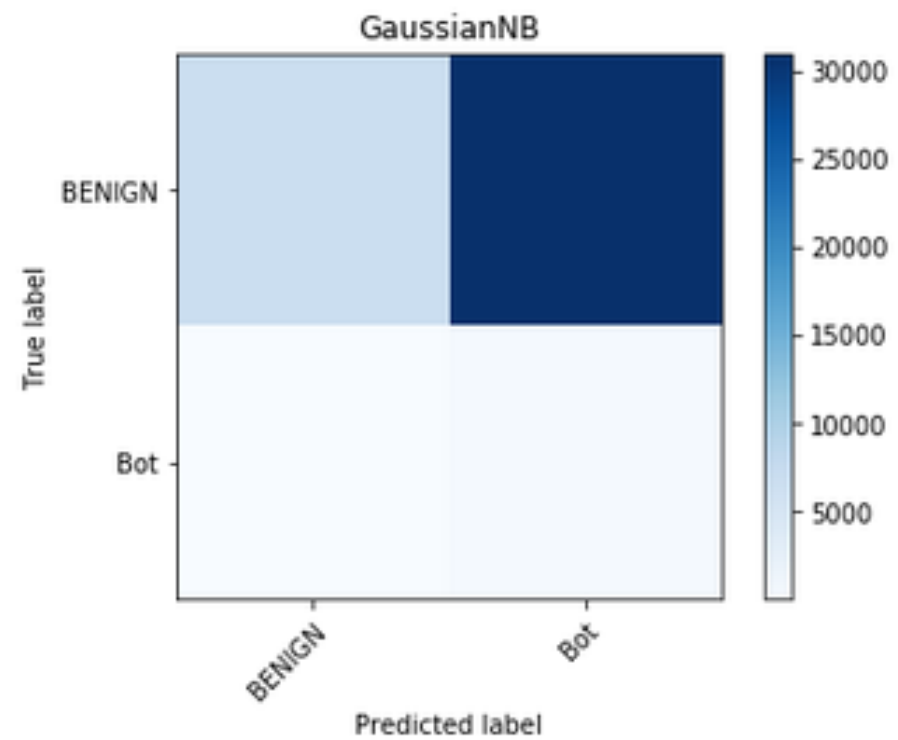
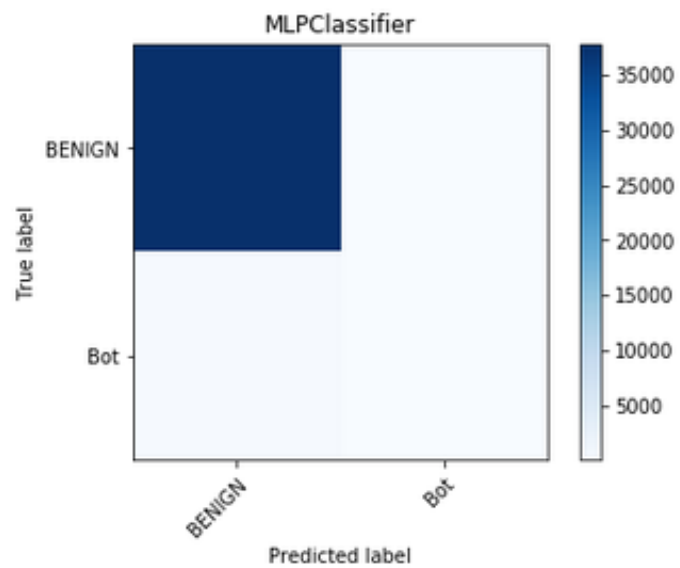
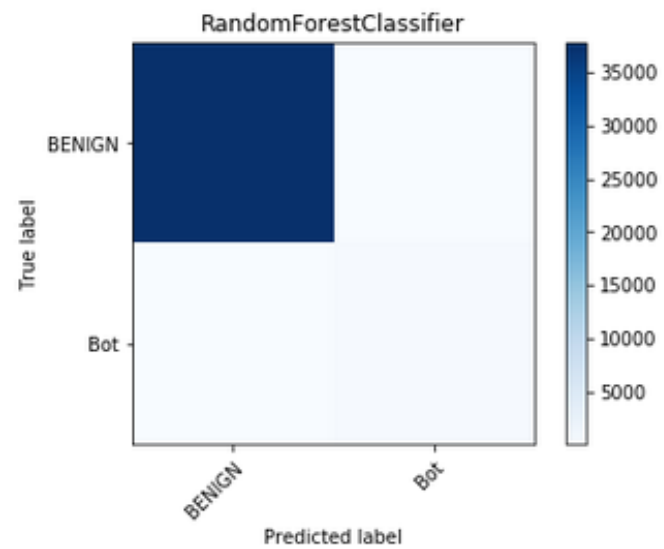
MODELS	3 SPLITS	5 SPLITS	7 SPLITS
LOGISTIC REGRESSION CLASSIFIER	99.20	99.20	99.08
RANDOM FOREST CLASSIFIER	99.54	99.55	99.58
MULTILAYER PERCEPTRON CLASSIFIER	98.72	98.72	98.72
LINEAR DISCRIMINANT ANALYSIS CLASSIFIER	96.16	96.27	96.27
K-NEAREST NEIGHBOUR CLASSIFIER	99.45	99.48	99.48
GAUSSIAN NAÏVE BAYES CLASSIFIER	52.58	52.47	52.47
DECISION TREE CLASSIFIER	99.49	99.50	99.52

CROSS VALIDATION SCORES
DATA: FRIDAY MORNING

MODELS	3 SPLITS	5 SPLITS	7 SPLITS
LOGISTIC REGRESSION CLASSIFIER	98.98	98.93	98.93
RANDOM FOREST CLASSIFIER	99.68	99.95	99.95
MULTILAYER PERCEPTRON CLASSIFIER	98.97	98.97	98.97
LINEAR DISCRIMINANT ANALYSIS CLASSIFIER	98.47	98.39	98.38
K-NEAREST NEIGHBOUR CLASSIFIER	99.05	99.44	99.47
GAUSSIAN NAÏVE BAYES CLASSIFIER	35.57	35.39	35.13
DECISION TREE CLASSIFIER	99.59	99.90	99.93

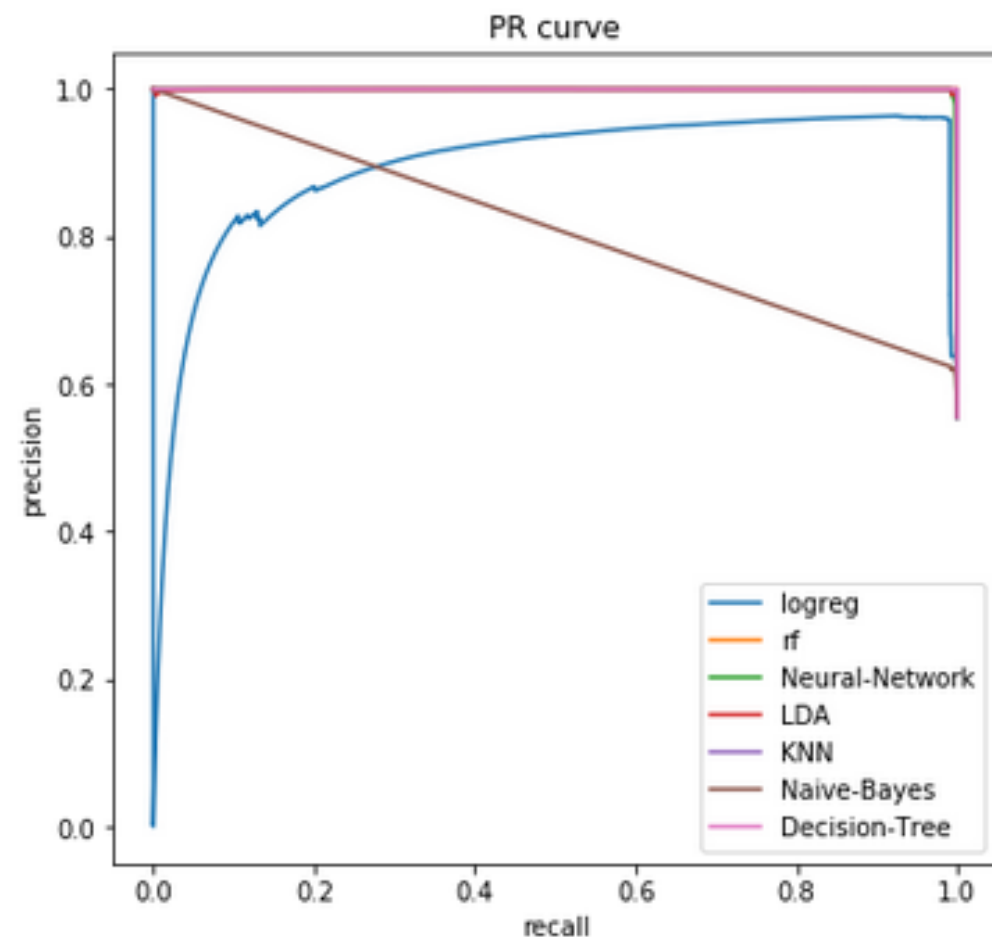
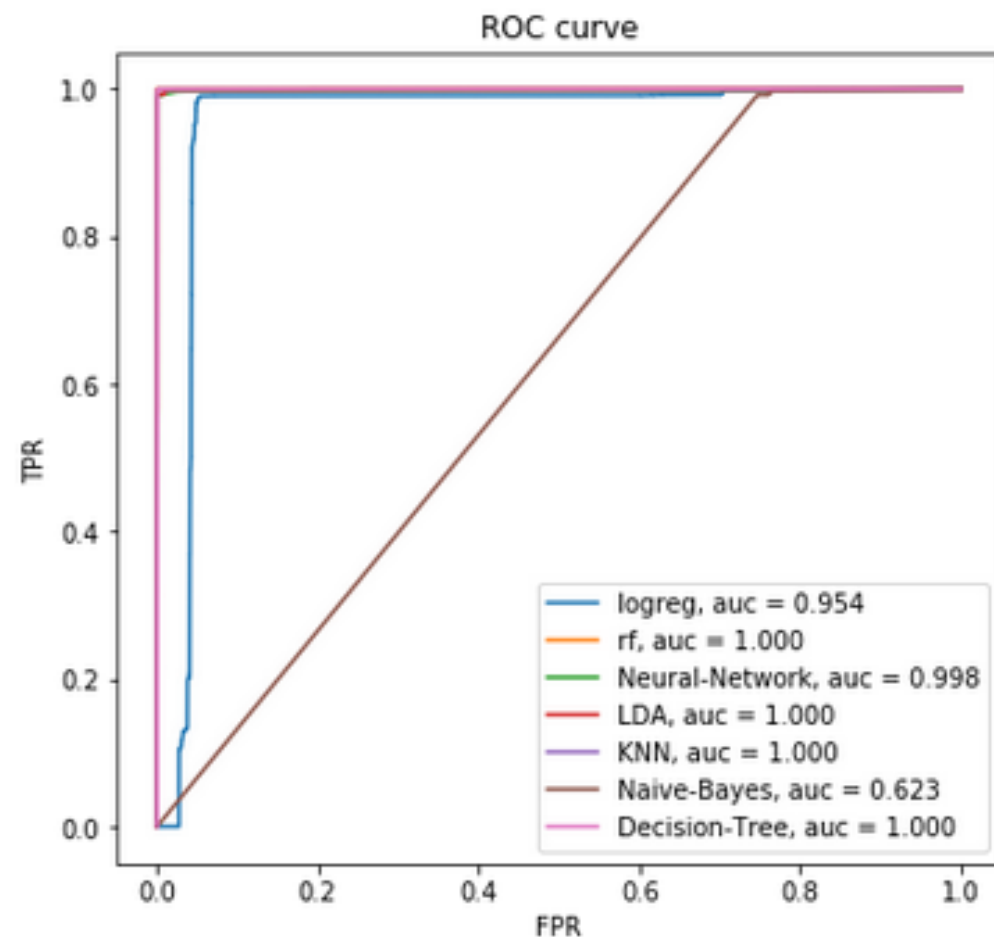


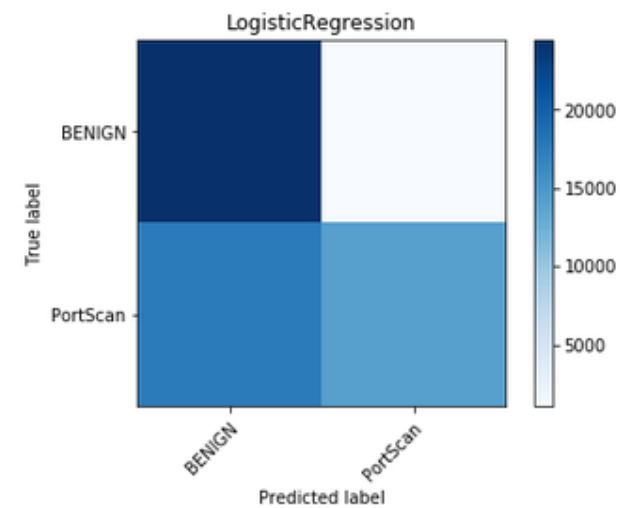
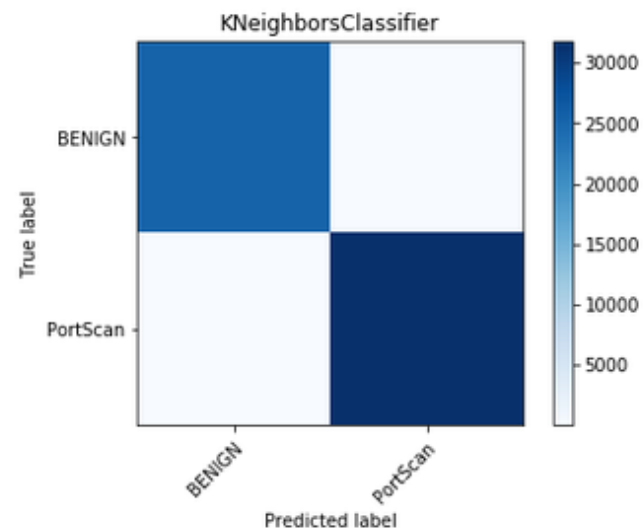
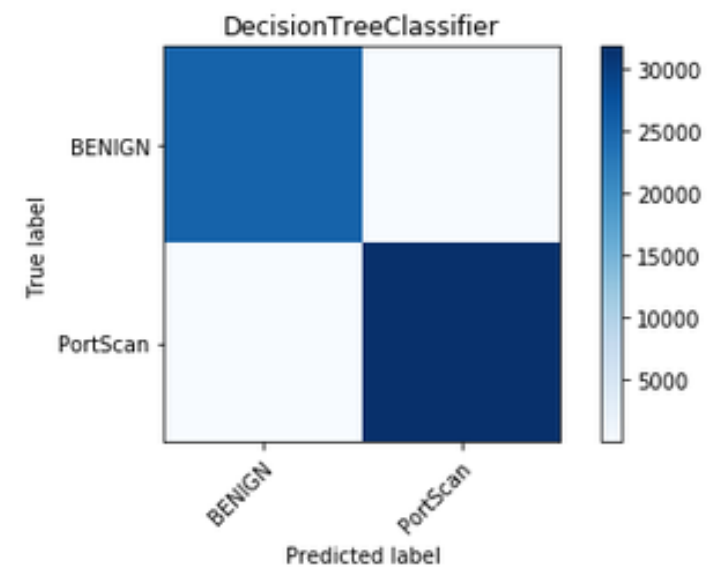
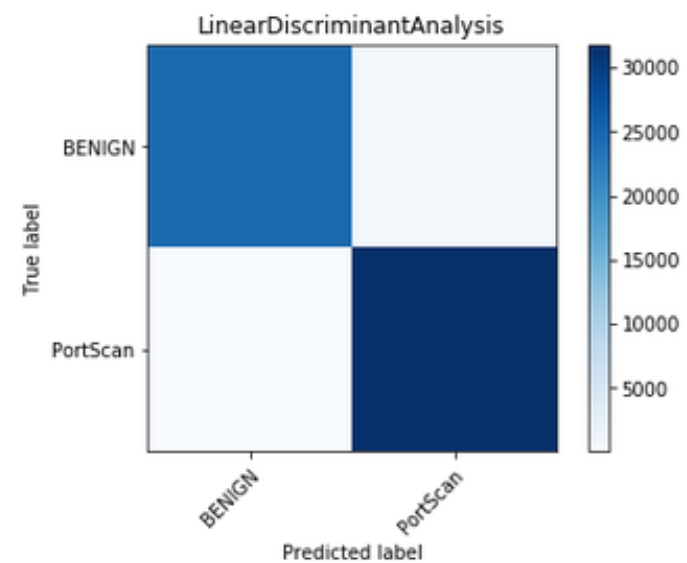


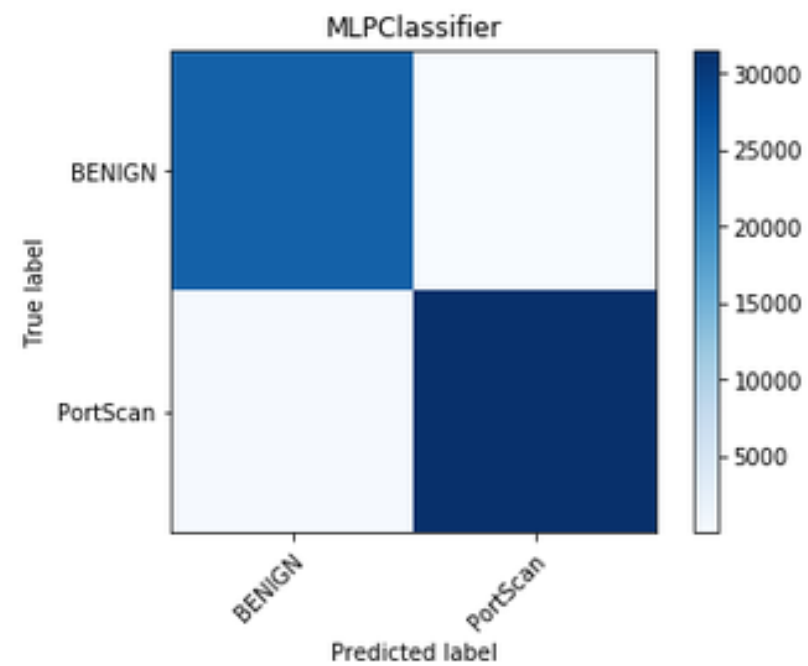
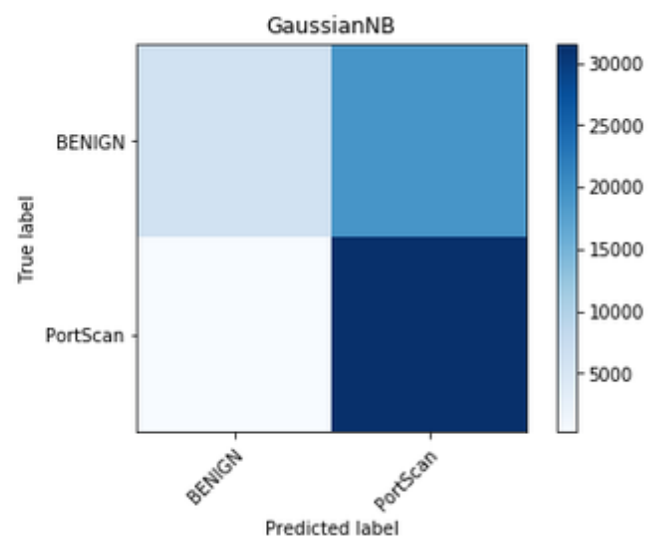
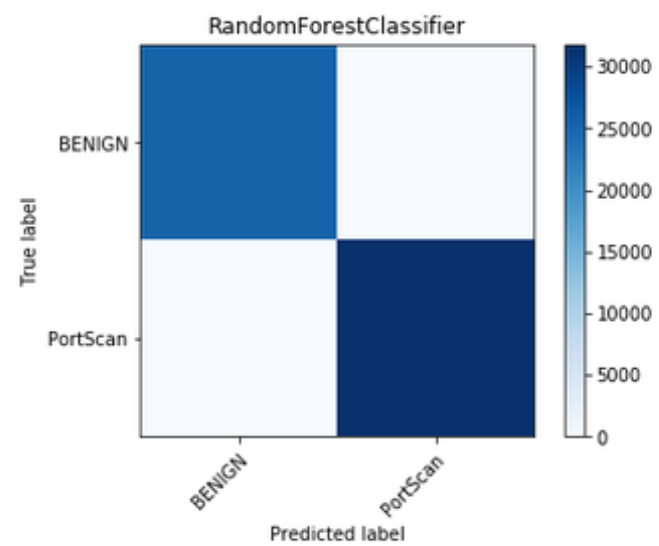


CROSS VALIDATION SCORES
DATA: FRIDAY AFTERNOON PORTSCAN

MODELS	3 SPLITS	5 SPLITS	7 SPLITS
LOGISTIC REGRESSION CLASSIFIER	89.88	87.88	87.69
RANDOM FOREST CLASSIFIER	99.97	99.97	99.97
MULTILAYER PERCEPTRON CLASSIFIER	98.47	98.77	98.68
LINEAR DISCRIMINANT ANALYSIS CLASSIFIER	98.92	98.84	98.75
K-NEAREST NEIGHBOUR CLASSIFIER	99.04	99.28	99.34
GAUSSIAN NAÏVE BAYES CLASSIFIER	69.33	68.70	68.47
DECISION TREE CLASSIFIER	99.92	99.94	99.96



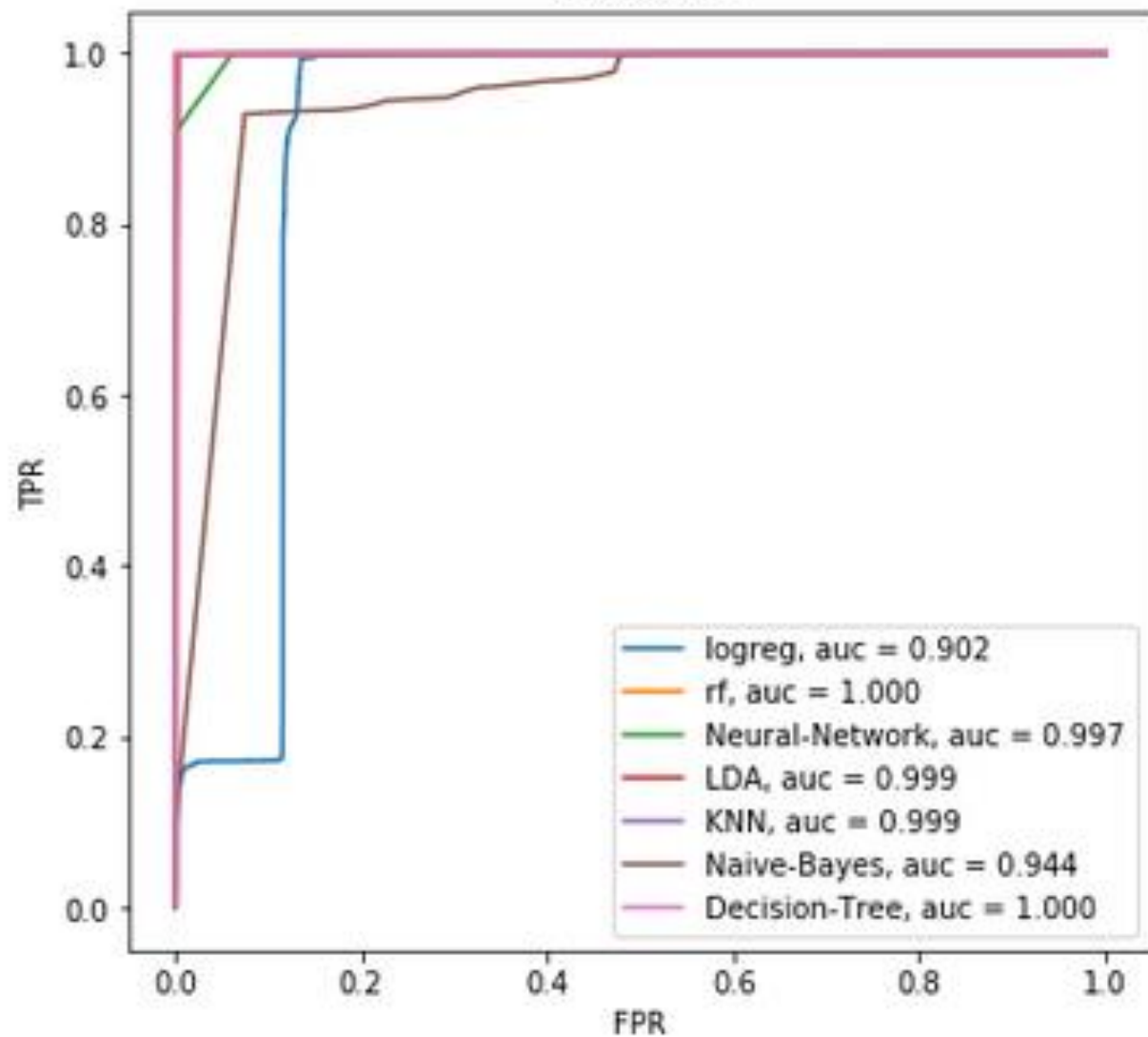




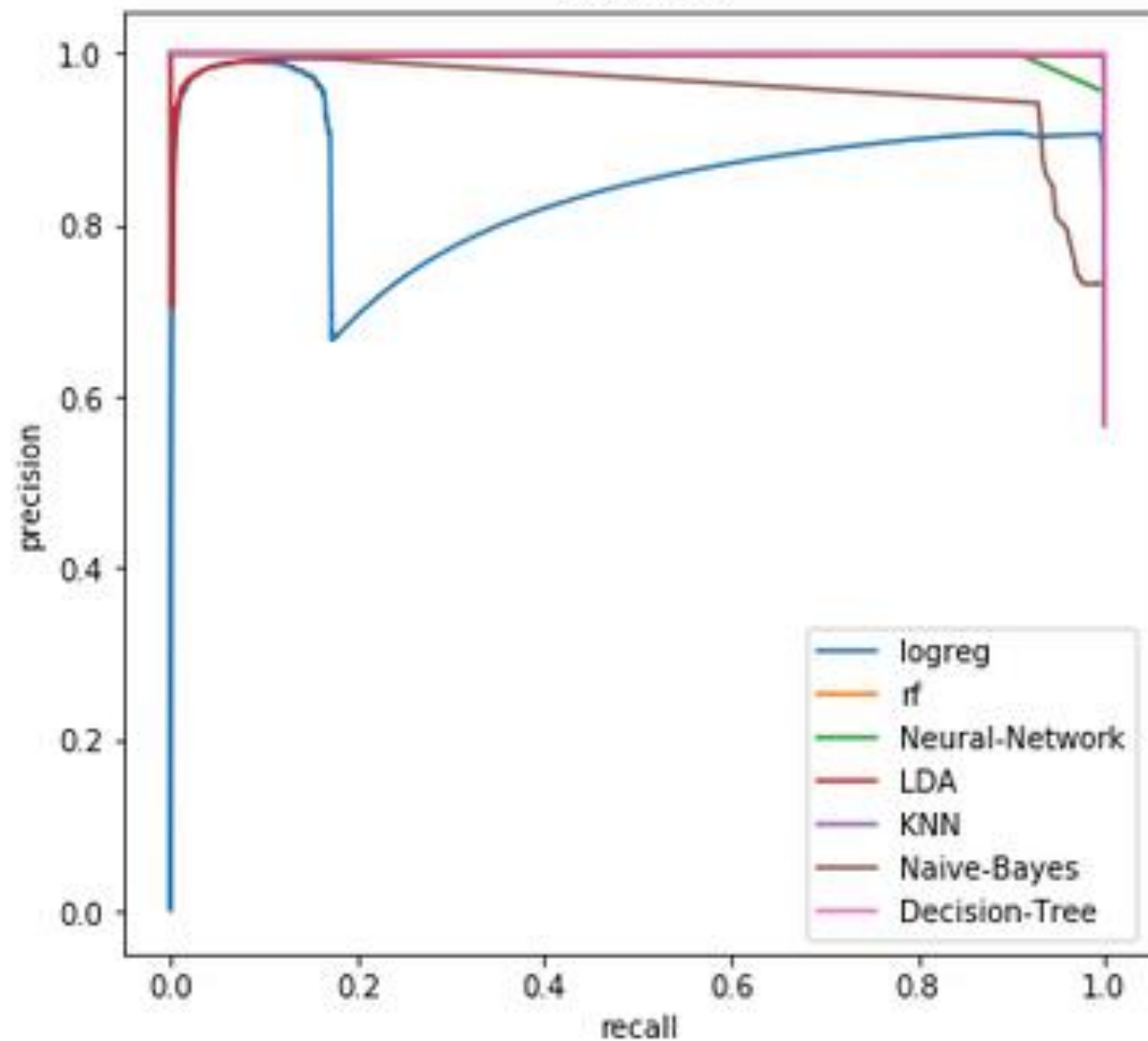
CROSS VALIDATION SCORES
DATA: FRIDAY AFTERNOON DDoS

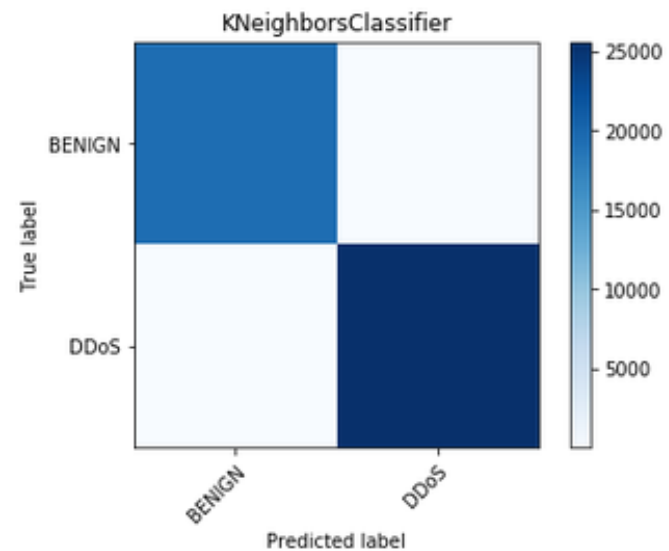
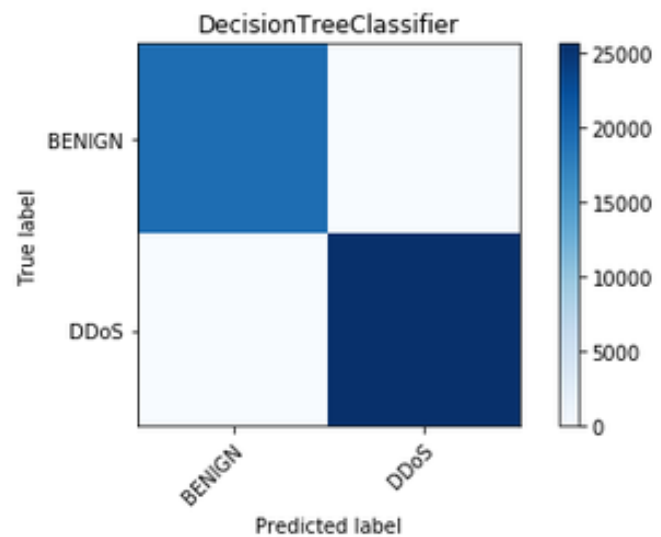
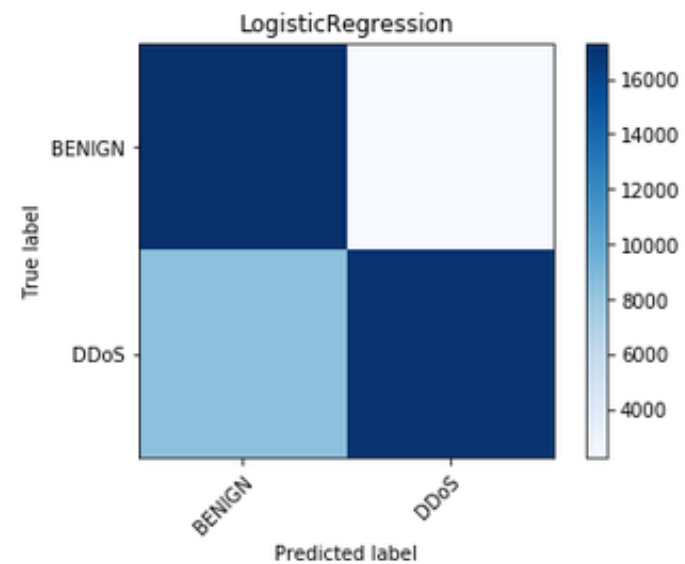
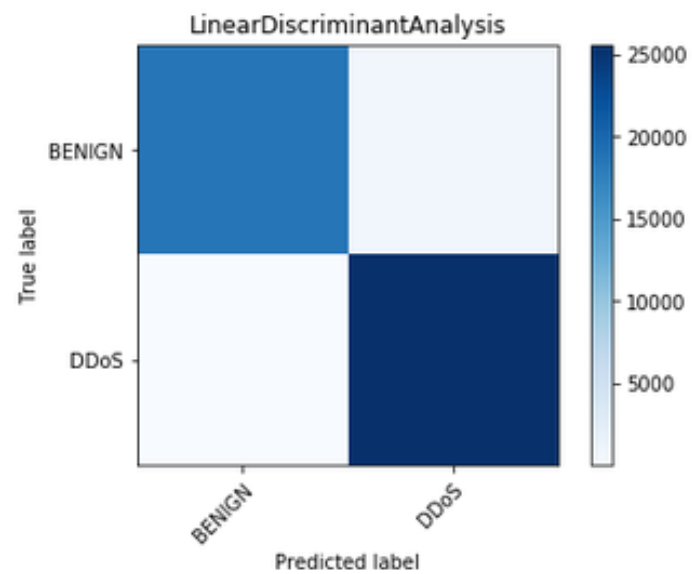
MODELS	3 SPLITS	5 SPLITS	7 SPLITS
LOGISTIC REGRESSION CLASSIFIER	92.43	93.40	92.81
RANDOM FOREST CLASSIFIER	99.97	99.94	99.94
MULTILAYER PERCEPTRON CLASSIFIER	91.10	90.57	92.74
LINEAR DISCRIMINANT ANALYSIS CLASSIFIER	97.77	97.86	97.89
K-NEAREST NEIGHBOUR CLASSIFIER	99.45	99.80	99.76
GAUSSIAN NAÏVE BAYES CLASSIFIER	80.75	80.80	80.80
DECISION TREE CLASSIFIER	99.92	99.93	99.70

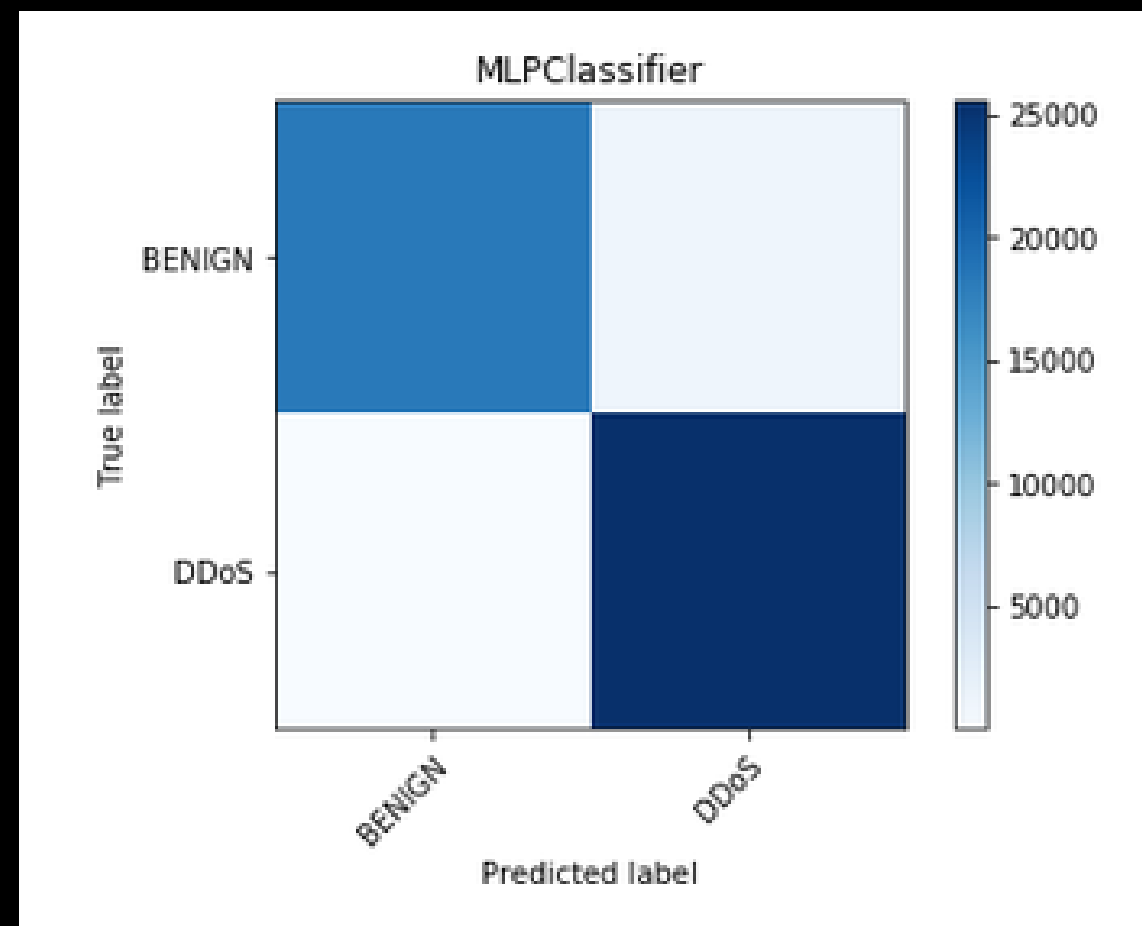
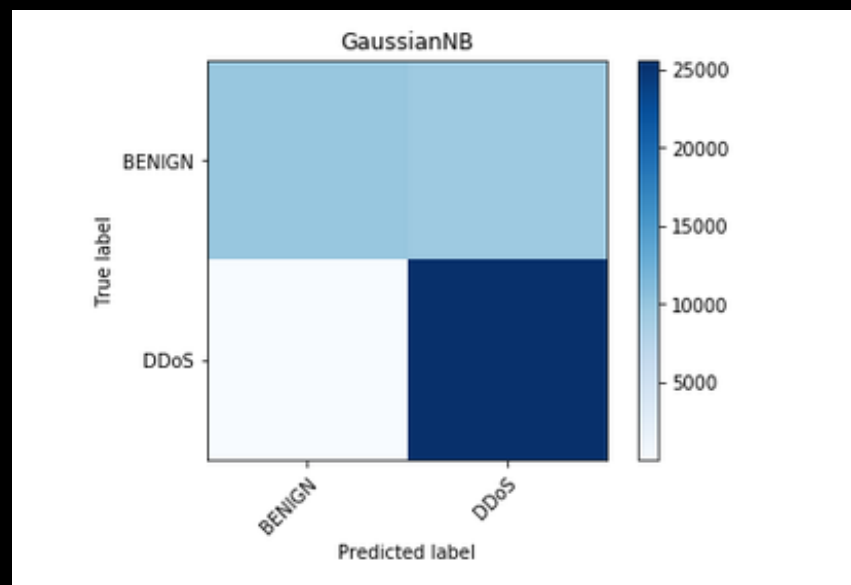
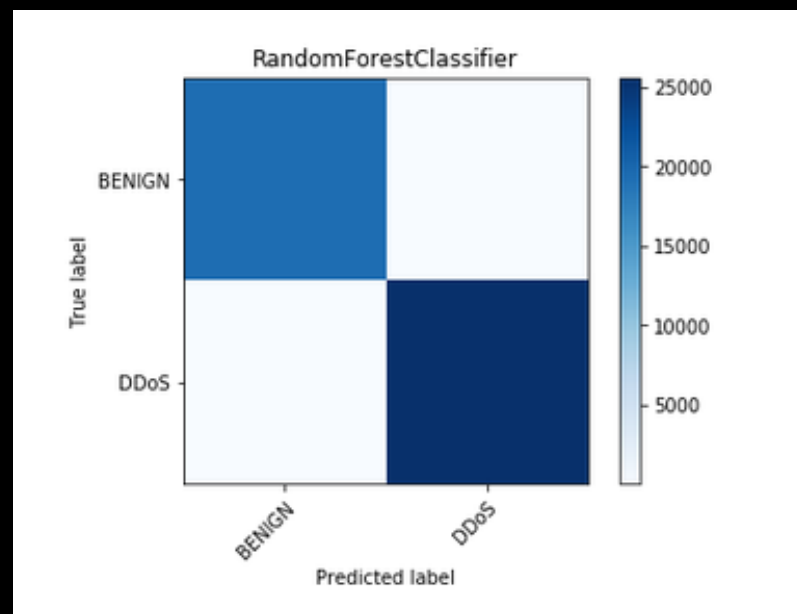
ROC curve



PR curve







CROSS VALIDATION SCORES
DATA: MONDAY

MODELS

**LOGISTIC REGRESSION
CLASSIFIER**

RANDOM FOREST CLASSIFIER

**MULTILAYER PERCEPTRON
CLASSIFIER**

**LINEAR DISCRIMINANT ANALYSIS
CLASSIFIER**

**K-NEAREST NEIGHBOUR
CLASSIFIER**

**GAUSSIAN NAÏVE BAYES
CLASSIFIER**

DECISION TREE CLASSIFIER

3 SPLITS

5 SPLITS

7 SPLITS
