TABLE I
PERFORMANCE METRICS OF SVM WITH TF-IDF USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.71	0.65	0.68	0.82	0.13	0.23	0.76	0.71	0.74
DNA BINDING	0.66	0.37	0.47	0.00	0.00	0.00	0.69	0.41	0.52
HYDROLASE	0.54	0.65	0.59	0.39	0.60	0.47	0.59	0.68	0.63
HYDROLASE INHIBITOR	0.69	0.69	0.69	0.62	0.51	0.56	0.71	0.68	0.69
IMMUNE SYSTEM	0.79	0.82	0.80	0.59	0.79	0.67	0.81	0.85	0.83
ISOMERASE	0.68	0.43	0.53	0.51	0.05	0.09	0.68	0.53	0.60
LIGASE	0.70	0.25	0.37	0.50	0.02	0.04	0.68	0.36	0.47
LYASE	0.66	0.55	0.60	0.61	0.18	0.28	0.69	0.61	0.65
MEMBRANE PROTEIN	0.62	0.42	0.50	0.40	0.13	0.20	0.64	0.51	0.56
OXIDOREDUCTASE	0.59	0.72	0.65	0.37	0.55	0.45	0.66	0.75	0.70
PROTEIN BINDING	0.47	0.12	0.20	0.12	0.00	0.01	0.54	0.20	0.29
RIBOSOME	0.87	0.90	0.88	0.38	0.13	0.19	0.87	0.92	0.89
SIGNALING PROTEIN	0.52	0.27	0.36	0.39	0.02	0.04	0.55	0.33	0.41
STR. UNKNOWNS	0.60	0.12	0.20	0.00	0.00	0.00	0.58	0.16	0.25
STRUCTURAL PROTEIN	0.64	0.43	0.52	0.69	0.04	0.08	0.70	0.51	0.59
TRANSCRIPTION	0.57	0.55	0.56	0.39	0.30	0.34	0.58	0.58	0.58
TRANSFERASE	0.53	0.65	0.58	0.37	0.57	0.45	0.59	0.69	0.64
TRANSPORT PROTEIN	0.63	0.44	0.51	0.53	0.06	0.11	0.62	0.49	0.55
VIRAL PROTEIN	0.69	0.60	0.64	0.67	0.23	0.35	0.73	0.65	0.68
VIRUS	0.80	0.75	0.77	0.62	0.38	0.47	0.81	0.81	0.81

P: Precision, R: Recall, F1: F1-score
Blue denotes best performing classes, Red denotes common class across models

TABLE II
PERFORMANCE METRICS OF NN WITH TF-IDF USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.92	0.86	0.89	0.87	0.42	0.57	0.85	0.77	0.81
DNA BINDING	0.84	0.74	0.79	0.73	0.09	0.12	0.80	0.47	0.59
HYDROLASE	0.85	0.90	0.87	0.54	0.73	0.62	0.83	0.83	0.83
HYDROLASE INHIBITOR	0.75	0.66	0.71	0.72	0.60	0.66	0.75	0.65	0.70
IMMUNE SYSTEM	0.88	0.94	0.91	0.72	0.84	0.77	0.82	0.91	0.87
ISOMERASE	0.90	0.94	0.92	0.74	0.48	0.58	0.85	0.81	0.83
LIGASE	0.92	0.82	0.87	0.70	0.18	0.29	0.89	0.65	0.75
LYASE	0.96	0.90	0.93	0.65	0.58	0.61	0.90	0.87	0.88
MEMBRANE PROTEIN	0.80	0.74	0.77	0.51	0.17	0.25	0.71	0.67	0.69
OXIDOREDUCTASE	0.97	0.96	0.96	0.79	0.72	0.75	0.93	0.93	0.93
PROTEIN BINDING	0.65	0.59	0.62	0.39	0.01	0.02	0.44	0.36	0.40
RIBOSOME	0.96	0.95	0.96	0.41	0.64	0.50	0.92	0.95	0.94
SIGNALING PROTEIN	0.71	0.71	0.71	0.42	0.15	0.22	0.61	0.49	0.54
STR. UNKNOWNS	0.73	0.68	0.70	0.59	0.01	0.03	0.59	0.37	0.45
STRUCTURAL PROTEIN	0.88	0.76	0.82	0.79	0.20	0.32	0.71	0.68	0.70
TRANSCRIPTION	0.80	0.85	0.82	0.31	0.58	0.40	0.63	0.83	0.71
TRANSFERASE	0.91	0.93	0.92	0.59	0.72	0.65	0.82	0.90	0.86
TRANSPORT PROTEIN	0.82	0.83	0.82	0.44	0.39	0.41	0.79	0.70	0.74
VIRAL PROTEIN	0.92	0.86	0.89	0.77	0.43	0.55	0.75	0.87	0.80
VIRUS	0.92	0.94	0.93	0.75	0.54	0.63	0.86	0.86	0.86

TABLE III
PERFORMANCE METRICS OF NN WITH EMBEDDING USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.97	0.85	0.90	0.91	0.61	0.73	0.95	0.83	0.89
DNA BINDING	0.90	0.78	0.84	0.58	0.38	0.46	0.88	0.77	0.82
HYDROLASE	0.85	0.90	0.87	0.68	0.82	0.74	0.84	0.90	0.87
HYDROLASE INHIBITOR	0.76	0.72	0.74	0.75	0.70	0.73	0.78	0.70	0.73
IMMUNE SYSTEM	0.90	0.92	0.91	0.77	0.85	0.81	0.88	0.93	0.90
ISOMERASE	0.97	0.90	0.93	0.90	0.74	0.81	0.97	0.90	0.93
LIGASE	0.88	0.86	0.87	0.89	0.64	0.57	0.92	0.81	0.86
LYASE	0.96	0.94	0.95	0.87	0.80	0.83	0.96	0.93	0.94
MEMBRANE PROTEIN	0.85	0.79	0.82	0.63	0.52	0.57	0.87	0.78	0.82
OXIDOREDUCTASE	0.97	0.96	0.96	0.88	0.88	0.88	0.95	0.96	0.95
PROTEIN BINDING	0.70	0.65	0.68	0.49	0.19	0.27	0.78	0.57	0.66
RIBOSOME	0.98	0.91	0.95	0.81	0.78	0.79	0.96	0.94	0.95
SIGNALING PROTEIN	0.73	0.78	0.75	0.51	0.38	0.43	0.76	0.71	0.73
STR. UNKNOWNS	0.87	0.71	0.78	0.56	0.25	0.35	0.85	0.69	0.76
STRUCTURAL PROTEIN	0.91	0.81	0.85	0.86	0.42	0.68	0.93	0.77	0.84
TRANSCRIPTION	0.82	0.85	0.83	0.52	0.65	0.58	0.78	0.84	0.81
TRANSFERASE	0.90	0.93	0.92	0.73	0.84	0.78	0.88	0.93	0.91
TRANSPORT PROTEIN	0.92	0.83	0.88	0.70	0.62	0.66	0.89	0.83	0.86
VIRAL PROTEIN	0.90	0.90	0.90	0.78	0.67	0.72	0.92	0.87	0.90
VIRUS	0.94	0.89	0.91	0.92	0.74	0.82	0.94	0.89	0.92

TABLE IV
PERFORMANCE METRICS OF RANDOM FOREST WITH TF-IDF USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.99	0.91	0.95	0.94	0.71	0.81	0.99	0.90	0.94
DNA BINDING	0.95	0.85	0.91	0.86	0.57	0.69	0.97	0.84	0.90
HYDROLASE	0.86	0.93	0.89	0.75	0.91	0.82	0.86	0.94	0.90
HYDROLASE INHIBITOR	0.78	0.80	0.82	0.84	0.73	0.78	0.85	0.82	0.83
IMMUNE SYSTEM	0.93	0.96	0.95	0.86	0.90	0.88	0.92	0.96	0.94
ISOMERASE	0.98	0.94	0.96	0.97	0.84	0.90	0.98	0.94	0.96
LIGASE	0.97	0.89	0.93	0.97	0.68	0.80	0.97	0.88	0.92
LYASE	0.99	0.96	0.97	0.97	0.88	0.92	0.99	0.96	0.97
MEMBRANE PROTEIN	0.91	0.85	0.88	0.84	0.70	0.77	0.93	0.84	0.89
OXIDOREDUCTASE	0.97	0.97	0.97	0.93	0.95	0.94	0.98	0.97	0.98
PROTEIN BINDING	0.91	0.75	0.82	0.74	0.46	0.57	0.93	0.75	0.83
RIBOSOME	0.99	0.92	0.96	0.79	0.79	0.79	0.98	0.92	0.95
SIGNALING PROTEIN	0.87	0.83	0.85	0.80	0.58	0.67	0.90	0.80	0.85
STR. UNKNOWNS	0.96	0.74	0.83	0.93	0.43	0.59	0.98	0.71	0.82
STRUCTURAL PROTEIN	0.95	0.86	0.90	0.87	0.67	0.75	0.96	0.85	0.90
TRANSCRIPTION	0.89	0.89	0.89	0.71	0.75	0.73	0.85	0.90	0.87
TRANSFERASE	0.92	0.95	0.94	0.81	0.92	0.86	0.93	0.96	0.95
TRANSPORT PROTEIN	0.97	0.88	0.92	0.87	0.73	0.79	0.96	0.90	0.93
VIRAL PROTEIN	0.96	0.93	0.94	0.92	0.80	0.86	0.97	0.92	0.94
VIRUS	0.97	0.93	0.95	0.90	0.80	0.85	0.97	0.96	0.96

TABLE V
PERFORMANCE METRICS OF RANDOM FOREST WITH EMBEDDING USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.98	0.89	0.93	0.95	0.77	0.85	0.99	0.86	0.92
DNA BINDING	0.93	0.87	0.90	0.86	0.67	0.75	0.92	0.81	0.86
HYDROLASE	0.84	0.92	0.88	0.78	0.90	0.84	0.83	0.93	0.88
HYDROLASE INHIBITOR	0.78	0.80	0.79	0.82	0.78	0.80	0.85	0.82	0.83
IMMUNE SYSTEM	0.94	0.94	0.94	0.88	0.91	0.89	0.92	0.94	0.93
ISOMERASE	0.98	0.93	0.95	0.97	0.86	0.91	0.98	0.91	0.95
LIGASE	0.97	0.88	0.92	0.95	0.71	0.81	0.96	0.82	0.88
LYASE	0.98	0.95	0.97	0.97	0.88	0.92	0.99	0.93	0.96
MEMBRANE PROTEIN	0.91	0.84	0.87	0.86	0.71	0.78	0.94	0.81	0.87
OXIDOREDUCTASE	0.97	0.96	0.97	0.95	0.94	0.94	0.97	0.96	0.96
PROTEIN BINDING	0.86	0.74	0.80	0.77	0.53	0.63	0.87	0.71	0.78
RIBOSOME	0.99	0.91	0.95	0.89	0.89	0.89	0.98	0.90	0.94
SIGNALING PROTEIN	0.86	0.82	0.84	0.76	0.62	0.68	0.87	0.74	0.80
STR. UNKNOWNS	0.93	0.75	0.83	0.91	0.59	0.71	0.95	0.68	0.79
STRUCTURAL PROTEIN	0.96	0.84	0.90	0.91	0.71	0.79	0.97	0.83	0.89
TRANSCRIPTION	0.83	0.86	0.88	0.73	0.80	0.76	0.81	0.88	0.84
TRANSFERASE	0.92	0.94	0.93	0.83	0.92	0.87	0.90	0.95	0.92
TRANSPORT PROTEIN	0.96	0.87	0.91	0.91	0.77	0.83	0.97	0.85	0.91
VIRAL PROTEIN	0.96	0.92	0.94	0.92	0.83	0.87	0.97	0.89	0.93
VIRUS	0.96	0.92	0.94	0.94	0.87	0.91	0.97	0.90	0.93

TABLE VI
PERFORMANCE METRICS OF XGBOOST WITH TF-IDF USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.97	0.85	0.91	0.93	0.56	0.70	0.98	0.85	0.91
DNA BINDING	0.93	0.75	0.83	0.78	0.40	0.53	0.93	0.69	0.79
HYDROLASE	0.74	0.85	0.79	0.60	0.77	0.68	0.74	0.86	0.80
HYDROLASE INHIBITOR	0.77	0.76	0.77	0.75	0.70	0.72	0.78	0.76	0.77
IMMUNE SYSTEM	0.84	0.91	0.87	0.78	0.86	0.82	0.86	0.92	0.89
ISOMERASE	0.97	0.81	0.88	0.92	0.63	0.74	0.96	0.80	0.87
LIGASE	0.96	0.71	0.81	0.92	0.50	0.65	0.96	0.71	0.81
LYASE	0.98	0.82	0.89	0.91	0.71	0.80	0.96	0.83	0.81
MEMBRANE PROTEIN	0.88	0.74	0.80	0.63	0.51	0.56	0.85	0.74	0.89
OXIDOREDUCTASE	0.89	0.91	0.90	0.78	0.81	0.80	0.91	0.91	0.91
PROTEIN BINDING	0.82	0.53	0.65	0.62	0.28	0.39	0.82	0.53	0.64
RIBOSOME	0.96	0.94	0.95	0.64	0.74	0.69	0.96	0.94	0.95
SIGNALING PROTEIN	0.81	0.63	0.71	0.71	0.34	0.46	0.83	0.62	0.71
STR. UNKNOWNS	0.84	0.55	0.66	0.75	0.20	0.31	0.86	0.52	0.65
STRUCTURAL PROTEIN	0.95	0.74	0.83	0.83	0.47	0.60	0.92	0.73	0.82
TRANSCRIPTION	0.77	0.80	0.78	0.55	0.61	0.58	0.75	0.82	0.78
TRANSFERASE	0.79	0.88	0.83	0.65	0.78	0.71	0.80	0.88	0.84
TRANSPORT PROTEIN	0.94	0.86	0.84	0.72	0.49	0.59	0.91	0.75	0.83
VIRAL PROTEIN	0.94	0.85	0.90	0.78	0.65	0.71	0.94	0.85	0.89
VIRUS	0.96	0.92	0.94	0.84	0.73	0.78	0.96	0.94	0.95

TABLE VII
PERFORMANCE METRICS OF XGBOOST WITH EMBEDDING USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.98	0.80	0.88	0.89	0.62	0.73	0.98	0.81	0.89
DNA BINDING	0.93	0.74	0.82	0.71	0.43	0.53	0.92	0.72	0.81
HYDROLASE	0.72	0.89	0.80	0.59	0.80	0.68	0.71	0.89	0.79
HYDROLASE INHIBITOR	0.76	0.73	0.75	0.75	0.73	0.74	0.79	0.73	0.76
IMMUNE SYSTEM	0.87	0.90	0.89	0.77	0.86	0.81	0.83	0.90	0.87
ISOMERASE	0.97	0.83	0.89	0.96	0.63	0.76	0.97	0.82	0.89
LIGASE	0.96	0.75	0.84	0.95	0.54	0.68	0.97	0.75	0.85
LYASE	0.98	0.87	0.92	0.95	0.67	0.79	0.98	0.85	0.91
MEMBRANE PROTEIN	0.87	0.72	0.79	0.69	0.49	0.57	0.88	0.72	0.75
OXIDOREDUCTASE	0.94	0.92	0.93	0.82	0.81	0.82	0.93	0.91	0.92
PROTEIN BINDING	0.81	0.56	0.66	0.61	0.25	0.35	0.84	0.55	0.67
RIBOSOME	0.98	0.90	0.94	0.75	0.80	0.77	0.95	0.88	0.91
SIGNALING PROTEIN	0.80	0.64	0.71	0.68	0.34	0.45	0.84	0.60	0.70
STR. UNKNOWNS	0.83	0.61	0.70	0.82	0.22	0.35	0.86	0.61	0.71
STRUCTURAL PROTEIN	0.96	0.71	0.82	0.95	0.45	0.61	0.96	0.70	0.81
TRANSCRIPTION	0.75	0.81	0.77	0.48	0.66	0.56	0.72	0.80	0.76
TRANSFERASE	0.85	0.88	0.87	0.69	0.70	0.63	0.84	0.88	0.86
TRANSPORT PROTEIN	0.94	0.75	0.83	0.83	0.53	0.65	0.95	0.74	0.83
VIRAL PROTEIN	0.95	0.85	0.90	0.91	0.64	0.75	0.96	0.83	0.89
VIRUS	0.96	0.88	0.92	0.94	0.80	0.87	0.96	0.88	0.92

TABLE VIII
PERFORMANCE METRICS OF LSTM WITH TF-IDF USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.85	0.85	0.85	0.82	0.54	0.65	0.90	0.84	0.87
DNA BINDING	0.79	0.67	0.72	0.63	0.32	0.42	0.72	0.74	0.73
HYDROLASE	0.87	0.86	0.86	0.65	0.75	0.70	0.87	0.87	0.87
HYDROLASE INHIBITOR	0.74	0.73	0.73	0.73	0.67	0.70	0.69	0.80	0.74
IMMUNE SYSTEM	0.90	0.91	0.90	0.81	0.84	0.82	0.91	0.92	0.91
ISOMERASE	0.87	0.88	0.88	0.70	0.66	0.68	0.90	0.89	0.90
LIGASE	0.89	0.77	0.83	0.72	0.43	0.54	0.77	0.83	0.80
LYASE	0.94	0.87	0.91	0.71	0.76	0.73	0.95	0.89	0.92
MEMBRANE PROTEIN	0.77	0.70	0.73	0.57	0.41	0.48	0.82	0.76	0.79
OXIDOREDUCTASE	0.96	0.94	0.95	0.83	0.81	0.82	0.97	0.95	0.96
PROTEIN BINDING	0.60	0.52	0.56	0.38	0.15	0.22	0.64	0.58	0.61
RIBOSOME	0.97	0.92	0.95	0.57	0.72	0.64	0.96	0.95	0.96
SIGNALING PROTEIN	0.65	0.70	0.67	0.49	0.29	0.37	0.68	0.72	0.70
STR. UNKNOWNS	0.69	0.63	0.66	0.37	0.05	0.09	0.68	0.65	0.66
STRUCTURAL PROTEIN	0.75	0.77	0.76	0.60	0.43	0.50	0.84	0.76	0.80
TRANSCRIPTION	0.71	0.86	0.78	0.50	0.54	0.52	0.76	0.85	0.80
TRANSFERASE	0.87	0.91	0.89	0.65	0.80	0.72	0.92	0.91	0.92
TRANSPORT PROTEIN	0.77	0.84	0.80	0.60	0.46	0.52	0.82	0.84	0.83
VIRAL PROTEIN	0.86	0.88	0.87	0.62	0.63	0.63	0.89	0.88	0.88
VIRUS	0.95	0.87	0.91	0.72	0.66	0.69	0.93	0.92	0.92

TABLE IX
PERFORMANCE METRICS OF LSTM WITH EMBEDDING USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.95	0.88	0.92	0.91	0.73	0.81	0.97	0.89	0.93
DNA BINDING	0.87	0.85	0.86	0.77	0.54	0.63	0.89	0.86	0.87
HYDROLASE	0.86	0.91	0.89	0.79	0.88	0.83	0.87	0.92	0.89
HYDROLASE INHIBITOR	0.77	0.74	0.76	0.81	0.70	0.75	0.79	0.70	0.74
IMMUNE SYSTEM	0.91	0.94	0.93	0.85	0.90	0.88	0.94	0.94	0.94
ISOMERASE	0.97	0.92	0.95	0.91	0.85	0.88	0.95	0.93	0.94
LIGASE	0.93	0.87	0.90	0.85	0.70	0.77	0.95	0.87	0.91
LYASE	0.97	0.95	0.96	0.92	0.88	0.90	0.96	0.95	0.95
MEMBRANE PROTEIN	0.90	0.76	0.82	0.75	0.68	0.72	0.86	0.84	0.85
OXIDOREDUCTASE	0.97	0.96	0.97	0.93	0.93	0.93	0.98	0.97	0.97
PROTEIN BINDING	0.83	0.72	0.77	0.56	0.48	0.52	0.78	0.72	0.75
RIBOSOME	0.97	0.95	0.96	0.90	0.85	0.87	0.97	0.96	0.96
SIGNALING PROTEIN	0.75	0.80	0.78	0.65	0.56	0.60	0.80	0.80	0.80
STR. UNKNOWNS	0.87	0.74	0.80	0.70	0.51	0.59	0.88	0.75	0.81
STRUCTURAL PROTEIN	0.90	0.83	0.86	0.84	0.64	0.73	0.91	0.83	0.87
TRANSCRIPTION	0.84	0.87	0.85	0.66	0.75	0.70	0.84	0.88	0.86
TRANSFERASE	0.92	0.94	0.93	0.83	0.90	0.87	0.92	0.95	0.93
TRANSPORT PROTEIN	0.89	0.88	0.88	0.81	0.74	0.77	0.92	0.85	0.89
VIRAL PROTEIN	0.94	0.88	0.91	0.86	0.80	0.83	0.92	0.91	0.92
VIRUS	0.91	0.92	0.92	0.91	0.85	0.88	0.95	0.95	0.95

TABLE X
PERFORMANCE METRICS OF BI-LSTM WITH TF-IDF USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.90	0.81	0.86	0.79	0.50	0.61	0.86	0.84	0.85
DNA BINDING	0.78	0.71	0.74	0.68	0.26	0.38	0.77	0.68	0.72
HYDROLASE	0.85	0.86	0.86	0.59	0.77	0.67	0.84	0.89	0.86
HYDROLASE INHIBITOR	0.70	0.74	0.72	0.75	0.61	0.67	0.76	0.69	0.72
IMMUNE SYSTEM	0.90	0.91	0.91	0.76	0.84	0.80	0.92	0.90	0.91
ISOMERASE	0.89	0.89	0.89	0.84	0.58	0.68	0.86	0.89	0.87
LIGASE	0.85	0.76	0.80	0.75	0.33	0.46	0.88	0.78	0.83
LYASE	0.90	0.92	0.91	0.76	0.72	0.74	0.93	0.90	0.92
MEMBRANE PROTEIN	0.80	0.71	0.75	0.50	0.35	0.41	0.81	0.71	0.76
OXIDOREDUCTASE	0.96	0.94	0.95	0.78	0.83	0.80	0.94	0.96	0.95
PROTEIN BINDING	0.52	0.54	0.53	0.39	0.08	0.13	0.56	0.55	0.55
RIBOSOME	0.95	0.92	0.94	0.60	0.66	0.63	0.90	0.96	0.93
SIGNALING PROTEIN	0.62	0.70	0.66	0.47	0.26	0.33	0.67	0.66	0.67
STR. UNKNOWNS	0.76	0.55	0.63	0.60	0.04	0.07	0.74	0.48	0.58
STRUCTURAL PROTEIN	0.80	0.77	0.78	0.76	0.37	0.49	0.77	0.74	0.75
TRANSCRIPTION	0.76	0.82	0.79	0.49	0.54	0.52	0.74	0.83	0.78
TRANSFERASE	0.89	0.91	0.90	0.64	0.77	0.70	0.92	0.90	0.91
TRANSPORT PROTEIN	0.70	0.80	0.80	0.57	0.45	0.50	0.84	0.81	0.82
VIRAL PROTEIN	0.89	0.85	0.87	0.65	0.59	0.62	0.86	0.88	0.87
VIRUS	0.89	0.90	0.90	0.78	0.63	0.70	0.89	0.91	0.90

TABLE XI
PERFORMANCE METRICS OF BI-LSTM WITH EMBEDDING USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.95	0.88	0.91	0.92	0.75	0.83	0.96	0.87	0.92
DNA BINDING	0.87	0.83	0.85	0.78	0.58	0.66	0.86	0.85	0.86
HYDROLASE	0.89	0.89	0.89	0.80	0.87	0.84	0.87	0.92	0.90
HYDROLASE INHIBITOR	0.72	0.79	0.75	0.76	0.76	0.76	0.81	0.73	0.77
IMMUNE SYSTEM	0.93	0.94	0.93	0.86	0.90	0.88	0.93	0.94	0.94
ISOMERASE	0.94	0.93	0.93	0.94	0.84	0.89	0.96	0.95	0.95
LIGASE	0.92	0.87	0.89	0.89	0.74	0.81	0.93	0.88	0.90
LYASE	0.94	0.95	0.94	0.92	0.89	0.90	0.95	0.95	0.95
MEMBRANE PROTEIN	0.86	0.82	0.84	0.78	0.65	0.71	0.89	0.83	0.86
OXIDOREDUCTASE	0.97	0.97	0.97	0.95	0.93	0.94	0.95	0.98	0.96
PROTEIN BINDING	0.76	0.71	0.74	0.54	0.51	0.53	0.80	0.74	0.77
RIBOSOME	0.98	0.95	0.96	0.90	0.86	0.88	0.98	0.95	0.97
SIGNALING PROTEIN	0.77	0.79	0.78	0.63	0.61	0.62	0.82	0.77	0.80
STR. UNKNOWNS	0.81	0.75	0.77	0.73	0.50	0.59	0.78	0.78	0.78
STRUCTURAL PROTEIN	0.92	0.83	0.87	0.80	0.68	0.74	0.89	0.85	0.87
TRANSCRIPTION	0.83	0.86	0.85	0.69	0.77	0.73	0.85	0.87	0.86
TRANSFERASE	0.91	0.94	0.93	0.85	0.90	0.87	0.94	0.94	0.94
TRANSPORT PROTEIN	0.90	0.85	0.87	0.82	0.75	0.78	0.92	0.87	0.90
VIRAL PROTEIN	0.94	0.90	0.92	0.86	0.81	0.83	0.93	0.92	0.92
VIRUS	0.95	0.90	0.92	0.92	0.87	0.89	0.95	0.92	0.94

TABLE XII
PERFORMANCE METRICS OF GRU WITH TF-IDF USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.90	0.83	0.86	0.84	0.54	0.65	0.86	0.84	0.85
DNA BINDING	0.72	0.70	0.71	0.66	0.31	0.42	0.78	0.67	0.72
HYDROLASE	0.86	0.87	0.87	0.67	0.76	0.71	0.87	0.88	0.87
HYDROLASE INHIBITOR	0.76	0.67	0.71	0.76	0.58	0.66	0.78	0.65	0.71
IMMUNE SYSTEM	0.91	0.91	0.91	0.77	0.84	0.80	0.93	0.91	0.90
ISOMERASE	0.87	0.90	0.89	0.79	0.63	0.70	0.85	0.91	0.88
LIGASE	0.85	0.84	0.84	0.78	0.50	0.61	0.80	0.83	0.81
LYASE	0.92	0.91	0.91	0.74	0.78	0.76	0.93	0.90	0.92
MEMBRANE PROTEIN	0.84	0.60	0.70	0.46	0.43	0.44	0.77	0.73	0.75
OXIDOREDUCTASE	0.95	0.95	0.95	0.80	0.87	0.83	0.95	0.96	0.95
PROTEIN BINDING	0.61	0.55	0.58	0.40	0.14	0.21	0.60	0.55	0.58
RIBOSOME	0.95	0.94	0.95	0.63	0.66	0.65	0.95	0.95	0.95
SIGNALING PROTEIN	0.65	0.70	0.68	0.55	0.24	0.33	0.68	0.69	0.68
STR. UNKNOWNS	0.60	0.59	0.60	0.44	0.06	0.10	0.65	0.58	0.61
STRUCTURAL PROTEIN	0.82	0.78	0.80	0.64	0.40	0.49	0.88	0.72	0.79
TRANSCRIPTION	0.75	0.84	0.79	0.45	0.64	0.53	0.71	0.84	0.77
TRANSFERASE	0.91	0.91	0.91	0.72	0.77	0.75	0.90	0.91	0.91
TRANSPORT PROTEIN	0.75	0.82	0.79	0.50	0.53	0.52	0.75	0.85	0.79
VIRAL PROTEIN	0.84	0.90	0.87	0.58	0.64	0.61	0.90	0.86	0.88
VIRUS	0.93	0.89	0.91	0.70	0.67	0.69	0.91	0.92	0.91

TABLE XIII
PERFORMANCE METRICS OF GRU WITH EMBEDDING USING DIFFERENT SEQUENCE TYPE ACROSS CLASSES

Classes	Primary Sequence			Structure Sequence			Combined Sequence		
	P	R	F1	P	R	F1	P	R	F1
CHAPERONE	0.95	0.88	0.91	0.93	0.71	0.81	0.96	0.89	0.92
DNA BINDING	0.88	0.84	0.86	0.75	0.54	0.63	0.81	0.85	0.83
HYDROLASE	0.86	0.91	0.88	0.77	0.86	0.82	0.88	0.91	0.90
HYDROLASE INHIBITOR	0.76	0.74	0.75	0.77	0.72	0.75	0.78	0.73	0.75
IMMUNE SYSTEM	0.92	0.94	0.93	0.87	0.88	0.87	0.93	0.94	0.94
ISOMERASE	0.97	0.92	0.94	0.92	0.83	0.88	0.96	0.93	0.94
LIGASE	0.94	0.86	0.90	0.91	0.69	0.79	0.93	0.87	0.90
LYASE	0.96	0.95	0.95	0.93	0.87	0.89	0.97	0.95	0.96
MEMBRANE PROTEIN	0.85	0.82	0.84	0.75	0.66	0.70	0.89	0.82	0.86
OXIDOREDUCTASE	0.97	0.96	0.96	0.92	0.93	0.92	0.96	0.97	0.96
PROTEIN BINDING	0.72	0.75	0.73	0.59	0.44	0.50	0.78	0.71	0.74
RIBOSOME	0.98	0.94	0.96	0.87	0.84	0.85	0.95	0.96	0.95
SIGNALING PROTEIN	0.80	0.78	0.79	0.60	0.56	0.58	0.80	0.78	0.79
STR. UNKNOWNS	0.88	0.73	0.80	0.68	0.49	0.57	0.79	0.78	0.78
STRUCTURAL PROTEIN	0.90	0.82	0.86	0.78	0.67	0.72	0.94	0.83	0.88
TRANSCRIPTION	0.85	0.86	0.86	0.66	0.74	0.70	0.83	0.87	0.85
TRANSFERASE	0.91	0.94	0.93	0.82	0.89	0.86	0.93	0.94	0.93
TRANSPORT PROTEIN	0.90	0.85	0.88	0.84	0.72	0.78	0.87	0.88	0.88
VIRAL PROTEIN	0.91	0.92	0.91	0.81	0.80	0.80	0.95	0.90	0.92
VIRUS	0.95	0.90	0.93	0.95	0.85	0.90	0.95	0.91	0.93