Zero-Shot Learning for Requirements Classification: An Exploratory Study (Appendices)

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Table 1: Overall classification results for *Task FR/NFR* for each ZSL Classifier, which is a combination of a specific LM and a specific label configuration. Bold values indicate the best results for a specific ZSL classifier; underlined values indicate the overall best performance across all the classifiers; values in italics indicate a possibly misleading performance, related to the imbalance of F1 between classes.

ZSL Classifier	**wP**	**wR**	**wF1**
Sbert + FR_A	0.52	0.43	0.35
Sbert + FR_B	0.60	0.46	0.37
Sbert + FR_C	0.64	0.48	0.40
Sbert + FR_D	0.54	0.55	0.54
Sbert + FR_E	**0.71**	**0.66**	**0.66**
Sbert + FR_F	0.69	0.64	0.64
AllMini + FR_A	0.56	0.55	0.55
AllMini + FR_B	0.53	0.48	0.46
AllMini + FR_C	0.54	0.45	0.39
AllMini + FR_D	**0.63**	**0.59**	**0.59**
AllMini + FR_E	0.60	0.53	0.51
AllMini + FR_F	0.66	0.56	0.53
Bert4RE + FR_A	0.35	0.59	*0.44*
Bert4RE + FR_B	0.52	0.56	0.51
Bert4RE + FR_C	**0.58**	**0.56**	**0.57**
Bert4RE + FR_D	0.59	0.56	0.56
Bert4RE + FR_E	0.59	0.52	0.51
Bert4RE + FR_F	0.57	0.47	0.42
SObert + FR_A	0.35	0.59	*0.44*
SObert + FR_B	0.55	0.59	0.51
SObert + FR_C	**0.58**	**0.59**	**0.58**
SObert + FR_D	0.53	0.58	0.48
SObert + FR_E	0.60	0.56	0.56
SObert + FR_F	0.60	0.55	0.54

Table 2: Label configurations for the remaining NFR classes for Task NFR, binary classification case (continued to table for Table 6 in the paper).

Label Abbr.	Label Configuration	NFR Label	"Other" Label
Performance			
PE_A	Original 1	"performance"	"not about performance"
PE_B	Expert curated	"periodic execution or efficacy performance"	"not about periodic execution or efficacy performance"
PE_C	Word Embedding (selected from top 20 words)	"throughput, reliability, scalability, responsiveness, efficiency, workload, benchmark, latency, speed, improvement, or accuracy"	"not about throughput, reliability, scalability, responsiveness, efficiency, workload, benchmark, latency, speed, improvement, or accuracy"
PE_D	Word Embedding (selected from top 20 words) + Original 2	"throughput, reliability, scalability, responsiveness, efficiency, workload, benchmark, latency, speed, improvement, or accuracy"	"usability, security, operational, look & feel, legal, fault & tolerance, maintainability, scalability, availability, or portability"
PE_E	Word Embedding (selected from top 50 words) + Original 2	"throughput, reliability, scalability, responsiveness, efficiency, workload, benchmark, latency, speed, improvement, accuracy, achieve, tuning, bottleneck, better, high, optimize, effectiveness, low, enhances, reducing, incresaed, quality, faster, or degrades"	"usability, security, operational, look & feel, legal, fault & tolerance, maintainability, scalability, availability, or portability"
Operational			
O_A	Original 1	"operational"	"not about operational"
O_B	Expert curated	"working, running, connecting, interfacing, or operative environment"	"not about working, running, connecting, interfacing, or operative environment"
O_C	Word Embedding (selected from top 20 words)	"environmental, organizational, coordination, systemic, or logistics"	"not about environmental, organizational, coordination, systemic, or logistics"
O_D	Word Embedding (selected from top 20 words) + Original 2	"environmental, organizational, coordination, systemic, or logistics"	"usability, security, performance, look & feel, legal, fault & tolerance, maintainability, scalability, availability, or portability"
O_E	Word Embedding (selected from top 50 words) + Original 2	"environmental, organizational, coordination, systemic, logistics, coordination, or automation"	"usability, security, performance, look & feel, legal, fault & tolerance, maintainability, scalability, availability, or portability"
Look & feel			
LF_A	Original 1	"Look feel"	"not about Look feel"
LF_B	Expert curated	"appearance, interface, look feel"	"not about appearance, interface, look feel"
LF_C	Word Embedding (selected from top 20 words)	"graphical, gui, ui, widget, interaction, habit, prefer, comfortable, friendly, feeling, experience, or familiar"	" not about graphical, gui, ui, widget, interaction, habit, prefer, comfortable, friendly, feeling, experience, or familiar"
LF_D	Word Embedding (selected from top 20 words) + Original 2	"graphical, gui, ui, widget, interaction, habit, prefer, comfortable, friendly, feeling, experience, or familiar"	"usability, security, operational, performance, fault & tolerance, legal, maintainability, scalability, availability, or portability"
LF_E	Word Embedding (selected from top 50 words) + Original 2	"graphical, gui, ui, widget, interaction, habit, prefer, comfortable, friendly, feeling, experience, familiar, desire, customize, intent, disability, or impression"	"usability, security, operational, performance, fault & tolerance, legal, maintainability, scalability, availability, or portability"
Legal			
L_A	Original 1	"legal"	"not about legal"
L_B	Expert curated	"legal, law, or rules"	"not about legal, law, or rules"
L_C	Word Embedding (selected from top 20 words)	"liability, litigation, jurisdiction, regulation, copyright, legislation, enforcement, governmental, directive, civil, right, patentability, claim, violate, infringement, or counsel"	"not about liability, litigation, jurisdiction, regulation, copyright, legislation, enforcement, governmental, directive,civil, right, patentability, claim, violate, infringement, or counsel"
L_D	Word Embedding (selected from top 20 words) + Original 2	"liability, litigation, jurisdiction, regulation, copyright, legislation, enforcement, governmental, directive,civil, right, patentability, claim, violate, infringement, or counsel"	"usability, security, operational, performance, look & feel, fault & tolerance, maintainability, scalability, availability, or portability"
L_E	Word Embedding (selected from top 50 words) + Original 2	"liability, litigation, jurisdiction, regulation, copyright, legislation, enforcement, governmental, directive,civil, right, patentability, claim, violate, infringement, counsel, holder, dispute, illegal, judicial, ruling, agreement, ownership, comply, authority, law, accountability, abuse, intellectual, obligation, invention, court, ethical, concern, or policy"	"usability, security, operational, performance, look & feel, fault & tolerance, maintainability, scalability, availability, or portability"

Table 2: Continued

Label Abbr.	*Label Configuration*	*NFR Label*	*"Other" Label*
Fault tolerance			
FT_A	Original 1	"fault tolerance"	"not about fault tolerance"
FT_B	Expert curated	"system recovery fault tolerance"	"not about system recovery fault tolerance"
FT_C	Word Embedding (selected from top 20 words)	"tolerance, failure, tolerant, byzantine, deadlock, exploiting, reliability, isolation, fault, guarantee, or dependable"	"not about tolerance, failure, tolerant, byzantine, deadlock, exploiting, reliability, isolation, fault, guarantee, dependable, countermeasure, resilience, defensive, corruption, weakness, malfunction, robustness, or stability"
FT_D	Word Embedding (selected from top 20 words) + Original 2	"tolerance, failure, tolerant, byzantine, deadlock, exploiting, reliability, isolation, fault, guarantee, or dependable"	"usability, security, operational, performance, look & feel, legal, maintainability, scalability, availability, or portability"
FT_E	Word Embedding (selected from top 50 words) + Original 2	"tolerance, failure, tolerant, byzantine, deadlock, exploiting, reliability, isolation, fault, guarantee, dependable, countermeasure, resilience, defensive, corruption, weakness, malfunction, robustness, or stability"	"usability, security, operational, performance, look & feel, legal, maintainability, scalability, availability, or portability"
Maintainability			
MN_A	Original 1	"maintainability"	"not about maintainability"
MN_B	Expert curated	"maintaining, fixing, running or updating"	"not about maintaining, fixing, running or updating"
MN_C	Word Embedding (selected from top 20 words)	"adaptability, effectiveness, agility, preventive, or dependability"	"not about adaptability, effectiveness, agility, preventive, or dependability"
MN_D	Word Embedding (selected from top 20 words) + Original 2	"adaptability, effectiveness, agility, preventive, or dependability"	"usability, security, operational, performance, look & feel, legal, fault & tolerance, scalability, availability, or portability"
MN_E	Word Embedding (selected from top 50 words) + Original 2	"adaptability, effectiveness, agility, preventive, dependability, correcting, reuse, defect, mitigation, validated, resilience, achievable, remedy, assessing, or maintaining"	"usability, security, operational, performance, look & feel, legal, fault & tolerance, scalability, availability, or portability"
Scalability			
SC_A	Original 1	"scalability"	"not about scalability"
SC_B	Expert curated	"scalable, increasable or developable"	"not about scalable, increasable or developable"
SC_C	Word Embedding (selected from top 20 words)	"flexibility, workload, efficiency, or optimize"	"not about flexibility, workload, efficiency, or optimize"
SC_D	Word Embedding (selected from top 20 words) + Original 2	"flexibility, workload, efficiency, or optimize"	"usability, security, operational, performance, look & feel, legal, fault & tolerance, maintainability, availability, or portability"
SC_E	Word Embedding (selected from top 50 words) + Original 2	"flexibility, workload, efficiency, optimize, caching, improvement, robust, overhead, adaptability, scalable, or increased"	"usability, security, operational, performance, look & feel, legal, fault & tolerance, maintainability, availability, or portability"
Availability			
A_A	Original 1	"availability"	"not about availability"
A_B	Expert curated	"avaliable or timely achievable"	"not about avaliable or timely achievable"
A_C	Word Embedding (selected from top 20 words)	"reliability, dependability, resilience"	"not about reliability, dependability, resilience"
A_D	Word Embedding (selected from top 20 words) + Original 2	"reliability, dependability, resilience"	"usability, security, operational, performance, look & feel, legal, fault & tolerance, maintainability, scalability, or portability"
A_E	Word Embedding (selected from top 50 words) + Original 2	"reliability, dependability, resilience, flexibility, accountability, ensur, disruption, timely, or standby"	"usability, security, operational, performance, look & feel, legal, fault & tolerance, maintainability, scalability, or portability"

Table 3: Label configurations for all the NFR classes for the multi-class and multi-label classification sub-tasks in Task NFR (cf. Table 7 in the paper)

Label Abbr.	Label Configuration	List of Labels
MultiNFR_A	Original	["usability", "security", "performance", "operational", "look & feel", "legal", "fault tolerance", "maintainability", scalability" availability"]
MultiNFR_B	Expert curated	["instructive, easy, helpful, useful, learnable, explainable, affordable, intuitive, or understandable", "security, authorization, or protection", "periodic execution or efficacy performance", "working, running, connecting, interfacing, or operative environment", "appearance, interface, look & feel", "legal, law, or rules", "system recovery & fault tolerance", "maintaining, fixing, running or updating", "scalable, increasable or developable", "avaliable or timely achievable"]
MultiNFR_C	Word Embedding (selected from top 20 words)	["accessibility, aesthetic, contextual, experience, satisfaction, HCI, UX, questionnaire, ease, or ergonomics" , "vulnerability, securing. protecting, protection, cybersecurity, assurance, cyber, countermeasure, threat, privacy, authentication, prevention, or confidentiality", "throughput, reliability, scalability, responsiveness, efficiency, workload, benchmark, latency, speed, improvement, or accuracy", "environmental, organizational, coordination, systemic, or logistics", "graphical, gui, ui, widget, interaction, habit, prefer, comfortable, friendly, feeling, experience, or familiar", "liability, litigation, jurisdiction, regulation, copyright, legislation, enforcement, governmental, directive,civil, right, patentability, claim, violate, infringement, or counsel", "tolerance, failure, tolerant, byzantine, deadlock, exploiting, reliability, isolation, fault, guarantee, or dependable", "adaptability, effectiveness, agility, preventive, or dependability", "flexibility, workload, efficiency, or optimize", "reliability, dependability, resilience"]
MultiNFR_D	Word Embedding (selected from top 50 words)	["accessibility, aesthetic, contextual, experience, satisfaction, HCI, UX, questionnaire, ease, ergonomics, designer, evaluate, multimodal, practitioner, prototyping, preference, personalization, suitability, focus, clarity, responsiveness, judgement, feel, or helpful" , "vulnerability, security, protection, cybersecurity, assurance, countermeasure, threat, privacy, authentication, prevention, confidentiality, trusted, intrusion, compromise, safety, insecure, defensive, breach, proactive, tampering, penetration, policy, phishing, vulnerable, authorization, dependability, or certification", "throughput, reliability, scalability, responsiveness, efficiency, workload, benchmark, latency, speed, improvement, accuracy, achieve, tuning, bottleneck, better, high, optimize, effectiveness, low, enhances, reducing, incresaed, quality, faster, or degrades", "environmental, organizational, coordination, systemic, logistics, coordination, or automation", "graphical, gui, ui, widget, interaction, habit, prefer, comfortable, friendly, feeling, experience, familiar, desire, customize, intent, disability, or impression", "liability, litigation, jurisdiction, regulation, copyright, legislation, enforcement, governmental, directive,civil, right, patentability, claim, violate, infringement, counsel, holder, dispute, illegal, judicial, ruling, agreement, ownership, comply, authority, law, accountability, abuse, intellectual, obligation, invention, court, ethical, concern, or policy", "tolerance, failure, tolerant, byzantine, deadlock, exploiting, reliability, isolation, fault, guarantee, dependable, countermeasure, resilience, defensive, corruption, weakness, malfunction, robustness, or stability", "adaptability, effectiveness, agility, preventive, dependability, correcting, reuse, defect, mitigation, validated, resilience, achievable, remedy, assessing, or maintaining", "flexibility, workload, efficiency, optimize, caching, improvement, robust, overhead, adaptability, scalable, or increased", "reliability, dependability, resilience, flexibility, accountability, ensur, disruption, timely, or standby"]

Table 4: Binary classification results for top four NFR classes in *Task NFR*.

ZSL Classifier	US			SE			O			PE		
	wP	**wR**	**wF1**	**wP**	**wR**	**wF1**	**wP**	**wR**	**wF1**	**wP**	**wR**	**wF1**
Sbert + (NFR)_A	0.74	0.40	0.37	0.49	0.28	0.18	0.79	0.45	0.44	0.76	0.39	0.39
Sbert + (NFR)_B	0.71	0.43	0.42	0.35	0.24	0.17	0.78	0.43	0.42	0.75	0.36	0.35
Sbert + (NFR)_C	0.74	0.43	0.41	0.34	0.22	0.19	0.80	0.45	0.44	0.76	0.38	0.38
Sbert + (NFR)_D	0.77	0.78	0.78	**0.72**	**0.71**	**0.72**	**0.68**	**0.72**	**0.70**	0.80	0.67	0.70
Sbert + (NFR)_E	**0.81**	**0.82**	**0.80**	**0.76**	**0.78**	**0.75**	0.68	0.63	0.65	**0.78**	**0.78**	**0.78**
AllMini + (NFR)_A	0.73	0.62	0.64	0.72	0.50	0.51	0.54	0.43	0.47	0.73	0.59	0.63
AllMini + (NFR)_B	0.54	0.35	0.35	0.73	0.73	0.73	**0.71**	**0.65**	**0.67**	**0.80**	**0.70**	**0.78**
AllMini + (NFR)_C	0.31	0.23	0.17	0.59	0.65	0.61	0.67	0.58	0.61	0.68	0.57	0.60
AllMini + (NFR)_D	**0.75**	**0.75**	**0.75**	**0.84**	**0.84**	**0.84**	0.65	0.55	0.58	0.81	0.69	0.71
AllMini + (NFR)_E	0.69	0.71	0.69	0.73	0.72	0.73	0.60	0.54	0.57	0.75	0.73	0.74
Bert4RE + (NFR)_A	*0.53*	*0.73*	*0.62*	*0.59*	*0.70*	*0.62*	*0.56*	*0.75*	*0.64*	0.61	0.58	0.59
Bert4RE + (NFR)_B	0.51	0.30	0.24	*0.81*	*0.74*	*0.63*	0.67	0.70	0.68	0.61	0.75	0.67*
Bert4RE + (NFR)_C	**0.52**	**0.43**	**0.46**	**0.62**	**0.65**	**0.63**	**0.72**	**0.73**	**0.72**	**0.68**	**0.41**	**0.43**
Bert4RE + (NFR)_D	**0.54**	**0.42**	**0.45**	*0.56*	*0.70*	*0.61*	0.63	0.41	0.42	**0.60**	**0.46**	**0.51**
Bert4RE + (NFR)_E	*0.53*	*0.73*	*0.62*	*0.54*	*0.73*	*0.62*	0.63	0.40	0.41	0.61	0.78	*0.69*
SObert + (NFR)_A	*0.53*	*0.73*	*0.62*	*0.54*	*0.73*	*0.62*	*0.56*	*0.75*	*0.64*	0.61	0.78	*0.69*
SObert + (NFR)_B	**0.55**	**0.51**	**0.53**	*0.81*	*0.74*	*0.63*	*0.65*	*0.73*	*0.67*	0.61	0.78	*0.68*
SObert + (NFR)_C	0.51	0.32	0.30	**0.66**	**0.53**	**0.56**	*0.71*	*0.74*	*0.71*	**0.61**	**0.55**	**0.58**
SObert + (NFR)_E	0.54	0.45	0.48	*0.58*	*0.69*	*0.61*	**0.68**	**0.58**	**0.61**	0.61	0.76	0.67
SObert + (NFR)_D	*0.53*	*0.70*	*0.60*	*0.63*	*0.73*	*0.63*	0.68	0.57	0.60	0.66	0.77	0.69

Table 5: Multi-label classification results for all NFR classes—Top 3 results—369 requirements from PROMISE dataset.

ZSL Classifier	US			SE			O			PE			LF		
	P	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**
Sbert + MultiNFR_A	0.74	0.55	0.63	**0.78**	**0.71**	**0.75**	0.56	0.53	0.55	0.73	0.35	0.48	0.64	0.37	0.47
Sbert + MultiNFR_B	**0.87**	**0.51**	**0.64**	0.87	0.62	0.73	**0.71**	**0.74**	**0.72**	**0.62**	**0.69**	**0.65**	**0.55**	**0.76**	**0.64**
Sbert + MultiNFR_C	0.76	0.39	0.51	**0.80**	**0.71**	**0.75**	0.80	0.39	0.52	0.41	0.81	0.54	0.68	0.55	0.61
Sbert + MultiNFR_D	0.82	0.40	0.54	0.90	0.58	0.70	0.63	0.73	0.68	0.81	0.46	0.59	0.46	0.58	0.51
AllMini + MultiNFR_A	0.73	0.45	0.56	**0.92**	**0.88**	**0.90**	0.52	0.90	0.28	0.76	0.46	0.57	1.00	0.32	0.48
AllMini + MultiNFR_B	1.00	0.40	0.57	0.80	0.92	0.86	**0.78**	**0.52**	**0.62**	**0.70**	**0.65**	**0.67**	**0.71**	**0.63**	**0.67**
AllMini + MultiNFR_C	**0.79**	**0.49**	**0.61**	0.96	0.39	0.56	0.49	0.32	0.39	0.56	0.52	0.54	0.79	0.29	0.42
AllMini + MultiNFR_D	1.00	0.36	0.53	1.00	0.22	0.37	0.32	0.35	0.34	1.00	0.33	0.50	0.75	0.32	0.28
Bert4RE + MultiNFR_A	1.00	0.16	0.28	1.00	0.09	0.17	1.00	0.10	0.18	**1.00**	**0.52**	**0.68**	0.60	0.39	0.48
Bert4RE + MultiNFR_B	**0.29**	**0.66**	**0.40**	*0.00*	*0.00*	*0.00*	**0.35**	**0.81**	**0.49**	0.83	0.09	0.17	0.63	0.58	0.60
Bert4RE + MultiNFR_C	1.00	0.06	0.11	**0.50**	**0.27**	**0.35**	0.25	0.71	0.37	1.00	0.13	0.23	0.33	0.37	0.35
Bert4RE + MultiNFR_D	1.00	0.03	0.06	*0.00*	*0.00*	*0.00*	0.22	0.89	0.35	0.30	0.19	0.23	**1.00**	**0.45**	**0.62**
SObert + MultiNFR_A	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	1.00	0.06	0.12	1.00	0.04	0.07	*0.00*	*0.00*	*0.00*
SObert + MultiNFR_B	0.28	0.85	0.43	*0.00*	*0.00*	*0.00*	**0.62**	**0.76**	**0.68**	**0.40**	**0.19**	**0.25**	**0.93**	**0.34**	**0.50**
SObert + MultiNFR_C	**0.54**	**0.63**	**0.58**	**0.64**	**0.32**	**0.42**	0.60	0.65	0.62	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
SObert + MultiNFR_E	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	0.42	0.77	0.55	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*

ZSL classifier	SC			A			MN			L			FT		
	P	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**
Sbert + MultiNFR_A	**0.53**	**0.76**	**0.63**	0.41	0.33	0.37	0.16	0.59	0.25	0.50	0.31	0.38	0.22	0.70	0.33
Sbert + MultiNFR_B	0.55	0.29	0.38	0.83	0.24	0.37	**0.42**	**0.94**	**0.58**	**1.00**	**0.31**	**0.47**	0.20	0.90	0.32
Sbert + MultiNFR_C	0.36	0.81	0.50	0.50	0.14	0.22	0.36	0.47	0.41	0.38	0.38	0.38	0.21	0.40	0.28
Sbert + MultiNFR_D	0.24	0.81	0.38	**0.33**	**0.76**	**0.46**	0.57	0.47	0.52	0.42	0.23	0.30	**0.67**	**0.40**	**0.50**
AllMini + MultiNFR_A	**0.45**	**0.81**	**0.58**	0.31	1.00	0.48	0.58	0.65	0.61	**0.43**	**0.77**	**0.56**	0.14	0.70	0.23
AllMini + MultiNFR_B	0.57	0.57	0.57	**0.54**	**0.95**	**0.69**	**0.62**	**0.76**	**0.68**	0.35	1.00	0.52	0.24	0.60	0.34
AllMini + MultiNFR_C	0.35	0.81	0.49	0.15	0.81	0.26	0.33	0.35	0.34	0.50	0.34	0.52	1.00	0.50	0.67
AllMini + MultiNFR_D	0.22	0.38	0.28	0.30	1.00	0.46	0.09	0.59	0.18	1.00	0.31	0.47	**1.00**	**0.60**	**0.75**
Bert4RE + MultiNFR_A	**1.00**	**0.62**	**0.76**	*0.00*	*0.00*	*0.00*	0.06	1.00	0.11	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Bert4RE + MultiNFR_B	1.00	0.05	0.09	0.40	0.57	0.47	1.00	0.12	0.21	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Bert4RE + MultiNFR_C	0.14	0.05	0.07	0.24	0.62	0.35	**0.67**	**0.47**	**0.55**	*0.00*	*0.00*	*0.00*	**0.05**	**0.10**	**0.07**
Bert4RE + MultiNFR_D	0.24	0.19	0.21	**1.00**	**0.76**	**0.86**	0.37	0.65	0.47	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
SObert + MultiNFR_A	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	**1.00**	**0.94**	**0.97**	*0.00*	*0.00*	*0.00*	1.00	1.00	1.00
SObert + MultiNFR_B	0.33	0.71	0.45	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	**0.50**	**0.31**	**0.38**	*0.00*	*0.00*	*0.00*
SObert + MultiNFR_C	1.00	0.14	0.25	0.20	0.14	0.17	0.06	0.41	0.11	0.02	0.08	0.03	**0.13**	**0.20**	**0.15**
SObert + MultiNFR_E	**1.00**	**0.95**	**0.98**	**0.10**	**0.95**	**0.19**	0.24	0.53	0.33	*0.00*	*0.00*	*0.00*	0.25	0.10	0.14

Table 6: Overall performance results of multi-class classification of all 10 NFR classes in PROMISE dataset (369 requirements) for *Task NFR*.

ZSL Classifier	US			SE			O			PE			LF		
	P	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**
Sbert + MultiNFR_A	0.50	0.21	0.29	0.56	0.44	0.49	0.29	0.24	0.26	0.29	0.07	0.12	0.33	0.13	0.19
Sbert + MultiNFR_B	**0.64**	**0.31**	**0.42**	**0.76**	**0.38**	**0.51**	**0.44**	**0.32**	**0.37**	**0.30**	**0.26**	**0.28**	**0.34**	**0.58**	**0.43**
Sbert + MultiNFR_C	0.28	0.07	0.12	0.57	0.44	0.50	0.52	0.18	0.27	0.15	0.31	0.20	0.28	0.18	0.22
Sbert + MultiNFR_D	0.39	0.10	0.16	0.74	0.30	0.43	3.32	0.32	0.32	0.61	0.20	0.31	0.20	0.29	0.23
AllMini + MultiNFR_A	**0.48**	**0.16**	**0.24**	**0.79**	**0.62**	**0.69**	0.20	0.06	0.10	**0.56**	**0.28**	**0.37**	1.00	0.13	0.23
AllMini + MultiNFR_B	**1.00**	**0.13**	**0.24**	0.70	0.67	0.68	**0.60**	**0.29**	**0.39**	0.13	0.06	0.08	**0.51**	**0.47**	**0.49**
AllMini + MultiNFR_C	0.28	0.07	0.12	0.88	0.21	0.34	0.18	0.15	0.16	0.29	0.28	0.28	0.22	0.05	0.09
AllMini + MultiNFR_D	1.00	0.01	0.03	1.00	0.02	0.03	0.16	0.19	0.18	1.00	0.02	0.04	*0.00*	*0.00*	*0.00*
Bert4RE + MultiNFR_A	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	0.11	0.18	0.14
Bert4RE + MultiNFR_B	**0.23**	**0.60**	**0.33**	*0.00*	*0.00*	*0.00*	0.17	0.39	0.24	0.50	0.02	0.04	0.05	0.03	0.04
Bert4RE + MultiNFR_C	*0.00*	*0.00*	*0.00*	**0.16**	**0.06**	**0.09**	0.16	0.47	0.23	*0.00*	*0.00*	*0.00*	**0.19**	**0.21**	**0.20**
Bert4RE + MultiNFR_D	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	**0.16**	**0.73**	**0.26**	**0.19**	**0.13**	**0.16**	*0.00*	*0.00*	*0.00*
SObert + MultiNFR_A	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	**0.10**	**0.95**	**0.18**
SObert + MultiNFR_B	**0.21**	**0.81**	**0.33**	*0.00*	*0.00*	*0.00*	0.16	0.11	0.13	**0.14**	**0.06**	**0.08**	0.50	0.05	0.10
SObert + MultiNFR_C	0.23	0.18	0.20	**0.16**	**0.05**	**0.07**	0.29	0.21	0.24	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
SObert + MultiNFR_E	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	**0.21**	**0.34**	**0.26**	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*

ZSL Classifier	SC			A			MN			L			FT		
	P	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**	**P**	**R**	**F1**
Sbert + MultiNFR_A	**0.24**	**0.48**	**0.32**	0.11	0.10	0.10	0.09	0.47	0.15	0.38	0.23	0.29	0.04	0.20	0.07
Sbert + MultiNFR_B	0.20	0.14	0.17	*0.00*	*0.00*	*0.00*	**0.22**	**0.71**	**0.33**	**0.67**	**0.31**	**0.42**	**0.07**	**0.50**	**0.13**
Sbert + MultiNFR_C	0.05	0.14	0.08	*0.00*	*0.00*	*0.00*	0.09	0.18	0.12	0.14	0.23	0.18	0.09	0.20	0.12
Sbert + MultiNFR_D	0.15	0.76	0.25	**0.10**	**0.24**	**0.14**	0.08	0.06	0.07	0.18	0.15	0.17	*0.00*	*0.00*	*0.00*
AllMini + MultiNFR_A	**0.27**	**0.62**	**0.38**	**0.18**	**0.86**	**0.30**	0.24	0.41	0.30	0.05	0.08	0.06	0.07	0.30	0.11
AllMini + MultiNFR_B	0.25	0.33	0.29	0.13	0.43	0.21	**0.42**	**0.47**	**0.44**	**0.20**	**0.69**	**0.32**	0.11	0.60	0.19
AllMini + MultiNFR_C	0.12	0.29	0.17	0.09	0.62	0.16	0.07	0.06	0.06	**0.28**	**0.38**	**0.32**	0.50	0.20	0.29
AllMini + MultiNFR_D	0.02	0.05	0.03	0.12	0.52	0.19	0.05	0.05	0.03	*0.00*	*0.00*	*0.00*	**1.00**	**0.20**	**0.33**
Bert4RE + MultiNFR_A	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	**0.06**	**0.94**	**0.10**	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Bert4RE + MultiNFR_B	*0.00*	*0.00*	*0.00*	0.07	0.10	0.08	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Bert4RE + MultiNFR_C	**0.13**	**0.05**	**0.07**	**0.07**	**0.19**	**0.10**	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Bert4RE + MultiNFR_D	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	0.03	0.06	0.04	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
SObert + MultiNFR_A	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
SObert + MultiNFR_B	**0.08**	**0.14**	**0.10**	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	**0.20**	**0.08**	**0.11**	*0.00*	*0.00*	*0.00*
SObert + MultiNFR_C	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	0.05	0.41	0.08	0.02	0.08	0.03	**0.04**	**0.10**	**0.06**
SObert + MultiNFR_D	*0.00*	*0.00*	*0.00*	**0.05**	**0.60**	**0.10**	**0.08**	**0.18**	**0.11**	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*

Table 7: Overall classification results for *Task Security*, considering all the requirements in SecReq as a single dataset.

ZSL Classifier	**wP**	**wR**	**wF1**
Sbert + Sec_A	0.62	0.40	0.30
Sbert + Sec_B	0.58	0.39	0.28
Sbert + Sec_C	**0.58**	**0.41**	**0.31**
Sbert + Sec_D	0.56	0.40	0.31
AllMini + Sec_A	0.69	0.58	0.58
AllMini + Sec_B	**0.68**	**0.65**	**0.66**
AllMini + Sec_C	0.65	0.45	0.38
AllMini + Sec_D	0.52	0.45	0.45
Bert4RE + Sec_A	**0.52**	**0.53**	**0.52**
Bert4RE + Sec_B	0.40	0.63	0.49
Bert4RE + Sec_C	0.48	0.39	0.36
Bert4RE + Sec_D	0.50	0.50	0.50
SObert + Sec_A	0.40	0.63	0.49
SObert + Sec_B	0.40	0.63	0.49
SObert + Sec_C	**0.56**	**0.54**	**0.55**
SObert + Sec_D	0.70	0.46	0.39