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Performance Results Tables "Evaluation of static analysis tools in detecting the OWASP Top 10 vulnerabilities"

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Dissertation in the context of the Masters in Informatics Security, advised by Professor Marcos Vieira and Professor Bruno Sousa and presented to the Department of Informatics Engineering of the Faculty of Sciences and Technology of the University of Coimbra.

Contents

1	Introduction	3
2	Performance results for all SAST Tools	4
3	Performance results for all Combinations of 2 and 3 SAST Tools using the 1st strategy	14
4	Performance results for all Combinations of 2 Tools using the 2nd strategy	17

Glossary

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FN False Negative. 4
FP False Positive. 4
OWASP Open Worldwide Application Security Project. 3, 4, 17
SAST Static Application Security Testing. 3, 4, 14, 17
TN True Negative. 4
TP True Positive. 4
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Chapter 1

Introduction

The purpose of this document is to complement and provide a better insight into the conclusions drawn in the "Benchmark Results" section of the thesis "Evaluation of static analysis tools in detecting the Open Worldwide Application Security Project (OWASP) Top 10 vulnerabilities". In it, the following performance rankings are made available in their integrality: Static Application Security Testing (SAST) tools individual evaluation; SAST tools combinations of 2 and 3; and combinations of 2 per vulnerability based on the new SAST tools combination strategy developed.

Chapter 2

Performance results for all SAST Tools

This section covers the accomplishment of the SAST tools results stage as part of the stipulated benchmarking methodology. The outputs of the SAST tools have been classified into True Positive (TP), False Positive (FP), True Negative (TN) and False Negative (FN) within the scope of the issues contained in each web application or test cases that compose the workload. The detection capacity demonstrated by the SAST tools in identifying the vulnerabilities covered by the OWASP Top 10, among the various vulnerable and non-vulnerable instances contained in the workload, is detailed below, with each set of two tables referring to the same test component included in the latter. As the key conclusions drawn from the analysis of the results obtained have already been highlighted in section 5.1.1.1, providing these tables constitutes a reference to the observations made.

Results obtained in WebGoat

Vulnerability											То	ols							
Name		Total			Sn	yk			For	tify			Sem	grep			Spot	Bugs	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	5	0	0	0	5	0	0	0	5	0	0	0	5	0	0	0	5	0	0
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	9	4	11	6	3	0	15	1	8	0	15	4	5	0	15	6	3	10	5
Cross-Site Request Forgery	1	7	0	1	0	0	7	0	1	0	7	1	0	5	2	1	0	5	2
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	14	3	0	0	14	0	3	0	14	0	3	0	14	0	3	0	14	0	3
Deprecated Hash Functions	5	2	3	1	4	0	5	1	4	0	5	1	4	0	5	1	4	0	5
Use of Weak PRNG	16	2	0	5	11	0	2	11	5	0	2	6	10	0	2	11	5	0	2
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SQL Injection	15	10	2	15	0	0	12	15	0	0	12	14	1	0	12	15	0	0	12
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	31	6	20	10	21	2	24	0	31	0	26	18	13	5	21	0	31	0	26
XPath Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTTP Response Splitting	2	4	13	1	1	1	16	0	2	0	17	0	2	0	17	0	2	13	4
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	84	51	0	0	84	0	51	39	45	0	51	0	84	0	51	0	84	0	51
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	11	3	0	0	11	0	3	0	11	0	3	0	11	0	3	0	11	0	3
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	4	0	0	2	2	0	0	0	4	0	0	0	4	0	0	1	3	0	0
Bad Programming of Cookies	17	3	0	0	17	0	3	0	17	0	3	13	4	0	3	0	17	0	3
Insecure Use of Hard Coded Constants	13	0	0	13	0	0	0	4	9	0	0	0	13	0	0	0	13	0	0
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	6	0	0	0	6	0	0	0	6	0	0	1	5	0	0	0	6	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
Hard Coded Credentials	26	1	5	18	8	1	5	7	19	0	6	0	26	0	6	2	24	1	5
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	3	1	0	2	1	0	1	0	3	0	1	2	1	0	1	2	1	0	1
A9 Security Logging and Monitoring Fail-	Р	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
ures	1					1.1				1.1		11							
Improper Output Neutralization for Logs	96	143	2	0	96	0	145	9	87	0	145	4	92	0	145	9	87	3	142
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	4	0	4	1	3	0	4	0	4	0	4	3	1	0	4	1	3	0	4

Table 2.1: SAST tools output in relation to the WebGoat - Part1 $\,$

Vulnerability							To	ols							
Name		Total			Syno	psis			Kiu	wan			Hor	usec	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	5	0	0	0	5	0	0	0	5	0	0	0	5	0	0
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	9	4	11	6	3	0	15	6	3	1	14	0	9	0	15
Cross-Site Request Forgery	1	7	0	1	0	0	7	1	0	0	7	0	1	0	7
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	14	3	0	1	13	1	2	0	14	0	3	14	0	0	3
Deprecated Hash Functions	5	2	3	1	4	2	3	1	4	1	4	1	4	0	5
Use of Weak PRNG	16	2	0	1	15	0	2	2	14	0	2	10	6	0	2
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SQL Injection	15	10	2	13	2	0	12	12	3	0	12	3	12	2	10
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	31	6	20	1	30	0	26	1	30	15	11	0	31	0	26
XPath Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTTP Response Splitting	2	4	13	0	2	0	17	0	2	0	17	0	2	0	17
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	84	51	0	0	84	0	51	1	83	0	51	3	81	0	51
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	11	3	0	0	11	0	3	0	11	0	3	0	11	0	3
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	4	0	0	1	3	0	0	1	3	0	0	0	4	0	0
Bad Programming of Cookies	17	3	0	0	17	0	3	0	17	0	3	0	17	0	3
Insecure Use of Hard Coded Constants	13	0	0	3	10	0	0	3	10	0	0	3	10	0	0
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	6	0	0	0	6	0	0	1	5	0	0	5	1	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
Hard Coded Credentials	26	1	5	0	26	0	6	6	20	4	2	2	24	0	6
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	3	1	0	2	1	0	1	1	2	0	1	0	3	0	1
A9 Security Logging and Monitoring Fail-	Р	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
ures	r			11						TT			I-IN	TT	
Improper Output Neutralization for Logs	96	143	2	0	96	3	142	9	87	0	145	0	96	0	145
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	4	0	4	1	3	0	4	1	3	4	0	0	4	0	4

Table 2.2: SAST tools output concerning the WebGoat - Part2

Results obtained in Juice Shop

Vulnerability							To	ols							
Name		Total			Sn	yk			For	tify			Sem	grep	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	10	1	0	0	10	0	1	0	10	0	1	1	9	1	0
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	11	3	0	2	9	0	3	0	11	0	3	8	3	3	0
Cross-Site Request Forgery	1	46	0	1	0	0	46	0	1	0	46	1	0	0	46
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	5	1	0	0	5	0	1	0	5	0	1	0	5	0	1
Deprecated Hash Functions	8	3	0	1	7	0	3	0	8	0	3	0	8	0	3
Use of Weak PRNG	1	1	0	0	1	0	1	0	1	0	1	0	1	0	1
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SQL Injection	47	25	0	6	41	0	25	0	47	0	25	7	40	1	24
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	15	1	1	10	5	0	2	0	15	0	2	4	11	1	1
XPath Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTTP Response Splitting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	4	32	0	0	4	0	32	0	4	0	32	0	4	0	32
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0
Bad Programming of Cookies	32	0	0	0	32	0	0	2	30	0	0	0	32	0	0
Insecure Use of Hard Coded Constants	3	0	5	3	0	0	5	0	3	0	5	2	1	0	5
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	13	0	0	1	12	0	0	0	13	0	0	1	12	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	0	0	2	0	0	0	2	0	0	0	2	0	0	0	2
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Descrialization	1	1	0	0	1	0	1	0	1	0	1	0	1	0	1
A9 Security Logging and Monitoring Fail-	Р	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
ures	P	IN	ININ	TP	FIN	FP	IN	TP	FIN	FP	IN	TP	FIN	FP	IN
Improper Output Neutralization for Logs	11	23	0	0	11	0	23	0	11	0	23	0	11	0	23
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	1	0	0	1	0	0	0	0	1	0	0	1	0	0	0

Table 2.3: SAST tools output in relation to the JuiceShop - Part1 $\,$

Vulnerability									To	ols					
Name		Total			Syno	opsis			Kiu	wan			Hor	usec	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	10	1	0	0	10	0	1	0	10	0	1	0	10	0	1
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	11	3	0	0	11	0	3	0	11	0	3	0	11	0	3
Cross-Site Request Forgery	1	46	0	0	1	0	46	0	1	0	46	0	1	0	46
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	5	1	0	0	5	0	1	0	5	0	1	0	5	0	1
Deprecated Hash Functions	8	3	0	1	7	0	3	0	8	0	3	1	7	0	3
Use of Weak PRNG	1	1	0	0	1	0	1	0	1	0	1	0	1	0	1
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SQL Injection	47	25	0	0	47	0	25	0	47	0	25	0	47	0	25
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	15	1	1	7	8	1	1	1	14	0	2	0	15	0	2
XPath Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTTP Response Splitting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	4	32	0	0	4	0	32	0	4	0	32	0	4	0	32
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
Bad Programming of Cookies	32	0	0	0	32	0	0	0	32	0	0	0	32	0	0
Insecure Use of Hard Coded Constants	3	0	5	0	3	5	0	0	3	0	5	0	3	0	5
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	13	0	0	0	13	0	0	0	13	0	0	0	13	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	0	0	2	0	0	0	2	0	0	0	2	0	0	2	0
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	1	1	0	0	1	0	1	0	1	0	1	0	1	0	1
A9 Security Logging and Monitoring Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Output Neutralization for Logs	11	23	0	0	11	0	23	0	11	0	23	0	11	0	23
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0

Table 2.4: SAST tools output in relation to the JuiceShop - Part2 $\,$

Results obtained in Mutillidae II

Vulnerability									To	ols					
Name		Total			Sn	yk			For	tify			Sem	grep	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	1	2	0	0	1	0	2	0	1	0	2	0	1	0	2
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	7	9	0	4	3	0	9	2	5	0	9	1	6	0	9
Cross-Site Request Forgery	18	4	2	0	18	0	6	4	14	2	4	0	18	0	6
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	10	0	0	0	10	0	0	0	10	0	0	0	10	0	0
Deprecated Hash Functions	5	2	7	4	1	7	2	5	0	0	9	0	5	0	9
Use of Weak PRNG	11	0	0	0	11	0	0	11	0	0	0	0	11	0	0
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	9	6	0	5	4	0	6	6	3	0	6	9	0	0	6
SQL Injection	19	7	0	0	19	0	7	0	19	0	7	1	18	0	7
LDAP Injection	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
Cross-Site Scripting	107	75	2	60	47	9	68	45	62	14	63	37	70	11	66
XPath Injection	2	0	0	1	1	0	0	0	2	0	0	0	2	0	0
HTTP Response Splitting	0	4	0	0	0	0	4	0	0	0	4	0	0	0	4
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	104	0	0	0	104	0	0	4	100	0	0	4	100	0	0
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	110	45	0	0	110	0	45	0	110	0	45	0	110	0	45
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	2	2	0	2	0	0	2	0	2	0	2	0	2	0	2
Bad Programming of Cookies	24	24	0	20	4	4	20	24	0	12	12	11	13	4	20
Insecure Use of Hard Coded Constants	2	3	2	0	2	0	5	0	2	0	5	0	2	0	5
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	2	0	0	0	2	0	0	0	2	0	0	2	0	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	2	0	0	0	2	0	0	0	2	0	0	0	2	0	0
Hard Coded Credentials	3	2	12	2	1	0	14	0	3	9	5	0	3	0	14
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
A9 Security Logging and Monitoring Fail-	Р	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
ures	1							11							
Improper Output Neutralization for Logs	102	0	5	81	21	0	5	1	101	5	0	5	97	0	5
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	11	0	1	3	8	0	1	0	11	0	1	2	9	1	0

Table 2.5: SAST tools output in relation to the Mutillidae II - Part1 $\,$

Vulnerability									To	ols					
Name		Total			Syno	psis			Kiu	wan			Hor	usec	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	1	2	0	0	1	0	2	0	1	1	1	0	1	0	2
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	7	9	0	2	5	0	9	1	6	0	9	0	7	0	9
Cross-Site Request Forgery	18	4	2	0	18	0	6	0	18	2	4	0	18	0	6
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	10	0	0	0	10	0	0	0	10	0	0	0	10	0	0
Deprecated Hash Functions	5	2	7	4	1	0	9	1	4	0	9	0	5	0	9
Use of Weak PRNG	11	0	0	11	0	0	0	1	10	0	0	0	11	0	0
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	9	6	0	0	9	0	6	5	4	0	6	0	9	0	6
SQL Injection	19	7	0	0	19	0	7	0	19	0	7	0	19	0	7
LDAP Injection	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0
Cross-Site Scripting	107	75	2	0	107	0	77	47	60	7	70	0	107	0	77
XPath Injection	2	0	0	0	2	0	0	0	2	0	0	0	2	0	0
HTTP Response Splitting	0	4	0	0	0	0	4	0	0	4	0	0	0	0	4
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	104	0	0	0	104	0	0	0	104	0	0	0	104	0	0
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	110	45	0	0	110	0	45	110	0	0	45	0	110	0	45
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	2	2	0	0	2	0	2	0	2	0	2	0	2	0	2
Bad Programming of Cookies	24	24	0	20	4	0	24	0	24	0	24	0	24	0	24
Insecure Use of Hard Coded Constants	2	3	2	1	1	2	3	0	2	0	5	0	2	0	5
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	2	0	0	0	2	0	0	0	2	0	0	1	1	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	2	0	0	0	2	0	0	0	2	0	0	0	2	0	0
Hard Coded Credentials	3	2	12	0	3	3	11	1	2	1	13	2	1	0	14
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Descrialization	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
A9 Security Logging and Monitoring Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Output Neutralization for Logs	102	0	5	0	102	0	5	5	97	0	5	0	102	0	5
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	11	0	1	0	11	0	1	1	10	0	1	0	11	0	1

Table 2.6: SAST tools output in relation to the Mutillidae II - Part2 $\,$

Results obtained in OWASP Benchmark

Vulnerability											To	ols							
Name		Total			Sn	yk			For	tify			Sem	grep			Spot	bugs	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	133	135	879	133	0	66	948	122	11	667	347	123	10	118	896	133	0	484	530
Cross-Site Request Forgery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	130	116	0	130	0	0	116	130	0	0	116	130	0	0	116	130	0	0	116
Deprecated Hash Functions	129	107	0	89	40	0	107	89	40	0	107	89	40	0	107	89	40	0	107
Use of Weak PRNG	218	275	0	218	0	0	275	218	0	52	223	218	0	0	275	218	0	0	275
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	126	125	0	126	0	45	80	126	0	125	0	117	9	109	16	126	0	111	14
SQL Injection	272	232	236	272	0	87	381	185	87	154	314	253	19	170	298	272	0	210	258
LDAP Injection	27	32	0	27	0	13	19	27	0	31	1	26	1	28	4	27	0	27	5
Cross-Site Scripting	246	209	1023	231	15	110	1122	215	31	68	1164	46	200	26	1206	246	0	696	536
XPath Injection	15	20	0	15	0	7	13	14	1	15	5	14	1	13	7	15	0	19	1
HTTP Response Splitting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trust Boundary Violation	83	43	493	76	7	24	512	31	52	12	524	69	14	26	510	83	0	35	501
Method Tampering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bad Programming of Cookies	1536	1516	0	170	1366	82	1434	62	1474	190	1326	856	680	163	1353	170	1366	82	1434
Insecure Use of Hard Coded Constants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A8 Software and data integrity failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Descrialization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A9 Security Logging and Monitoring Fail-	Р	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
ures	1																		
Improper Output Neutralization for Logs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7: SAST tools output in relation to the OWASP Benchmark - Part1 $\,$

Vulnerability															
Name		Total			Sync	psys			Kiu	wan			Hor	usec	
Name		Total			Sync	psys			Kiu	wan			Hor	usec	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	133	135	879	0	133	0	1014	118	15	110	904	0	133	0	1014
Cross-Site Request Forgery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	130	116	0	97	33	0	116	130	0	40	76	97	33	66	50
Deprecated Hash Functions	129	107	0	89	40	0	107	89	40	0	107	28	101	0	107
Use of Weak PRNG	218	275	0	218	0	0	275	0	218	0	275	193	25	52	223
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	126	125	0	115	11	67	58	126	0	125	0	0	126	0	125
SQL Injection	272	232	236	272	0	128	340	263	9	119	349	199	73	414	54
LDAP Injection	27	32	0	27	0	15	17	24	3	8	24	2	25	7	25
Cross-Site Scripting	246	209	1023	246	0	561	671	246	0	844	388	15	231	4	1228
XPath Injection	15	20	0	15	0	15	5	15	0	5	15	15	0	20	0
HTTP Response Splitting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trust Boundary Violation	83	43	493	83	0	30	506	72	11	509	27	0	83	0	536
Method Tampering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bad Programming of Cookies	1536	1516	0	686	850	81	1435	0	1536	0	1516	0	1536	36	1480
Insecure Use of Hard Coded Constants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A8 Software and data integrity failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A9 Security Logging and Monitoring Fail-	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
ures						_		_						0	
Improper Output Neutralization for Logs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.8: SAST tools output in relation to the OWASP Benchmark - Part2

Results obtained in Juliet Test Suite

Vulnerability											To	ols							
Name		Total			Sn	ıyk			For	tify			Sem	grep			Spot	bugs	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	233	372	1535	152	81	0	1907	32	201	480	1427	9	224	9	1898	196	37	1099	808
Insufficient Session Expiration	17	30	0	0	17	0	30	0	17	0	30	0	17	0	30	0	17	0	30
Path Traversal	230	378	0	160	70	0	378	230	0	4	374	53	177	24	354	213	17	188	190
Cross-Site Request Forgery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	34	60	494	34	0	298	256	18	16	0	554	34	0	0	554	34	0	298	256
Deprecated Hash Functions	51	90	0	51	0	0	90	51	0	0	90	34	17	0	90	51	0	0	90
Use of Weak PRNG	34	60	17	0	34	0	77	34	0	0	77	0	34	0	77	34	0	0	77
Seeds Hard Coded in PRNG	17	30	0	0	17	0	30	0	17	0	30	0	17	0	30	0	17	0	30
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	252	411	0	164	88	0	411	252	0	411	0	60	192	9	402	252	0	411	0
SQL Injection	260	863	223	144	116	22	1064	260	0	126	960	226	34	358	728	260	0	861	225
LDAP Injection	265	433	0	176	89	0	433	265	0	61	372	265	0	423	10	265	0	433	0
Cross-Site Scripting	196	323	44	115	81	0	367	96	100	0	367	41	155	0	367	16	180	0	367
XPath Injection	263	850	0	0	263	0	850	263	0	18	832	54	209	288	562	263	0	850	0
HTTP Response Splitting	389	1266	115	249	140	0	1381	137	252	307	1074	0	389	0	1381	368	21	861	520
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	90	155	2063	0	90	0	2218	51	39	2123	95	0	90	0	2218	0	90	0	2218
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bad Programming of Cookies	17	30	638	17	0	0	668	17	0	30	638	17	0	0	668	16	1	0	668
Insecure Use of Hard Coded Constants	37	52	2	22	15	0	54	0	37	0	54	2	35	2	52	17	20	0	54
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	68	120	364	0	68	0	484	34	34	364	120	0	68	0	484	0	68	0	484
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	111	156	75	78	33	106	125	21	90	51	180	36	75	51	180	56	55	0	231
A8 Software and data integrity failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A9 Security Logging and Monitoring Fail-	Р	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
ures	P	IN	ININ	Ir		rr	TIN	IP	FIN	rr	TIN	IP	FIN	rr	IIN	IP	FIN	rr	TIN
Improper Output Neutralization for Logs	51	90	53	17	34	0	143	0	51	0	143	34	17	0	143	0	51	0	143
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.9: SAST tools output in relation to the Juliet Test Suit - Part1 $\,$

Vulnerability															
Name		Total			Sync	psys			Kiu	wan			Hor	usec	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	233	372	1535	87	146	0	1907	106	127	105	1802	0	233	0	1907
Insufficient Session Expiration	17	30	0	17	0	0	30	0	17	0	30	0	17	0	30
Path Traversal	230	378	0	0	230	0	378	149	81	0	378	0	230	0	378
Cross-Site Request Forgery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	34	60	494	34	0	388	166	17	17	0	554	34	0	164	390
Deprecated Hash Functions	51	90	0	51	0	0	90	51	0	0	90	51	0	0	90
Use of Weak PRNG	34	60	17	0	34	0	77	0	34	17	60	17	17	0	77
Seeds Hard Coded in PRNG	17	30	0	17	0	0	30	0	17	0	30	17	0	0	30
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	252	411	0	98	154	0	411	142	110	0	411	252	0	0	411
SQL Injection	260	863	223	125	135	0	1086	242	18	356	730	260	0	217	869
LDAP Injection	265	433	0	265	0	432	1	151	114	0	433	264	1	0	433
Cross-Site Scripting	196	323	44	86	110	0	367	194	2	0	367	0	196	44	323
XPath Injection	263	850	0	105	158	175	675	164	99	310	540	0	263	0	850
HTTP Response Splitting	389	1266	115	0	389	0	1381	168	221	32	1349	0	389	0	1381
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	90	155	2063	0	90	0	2218	20	70	33	2185	0	90	0	2218
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bad Programming of Cookies	17	30	638	0	17	0	668	0	17	0	668	0	17	0	668
Insecure Use of Hard Coded Constants	37	52	2	35	2	0	54	26	11	0	54	0	37	0	54
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	68	120	364	0	68	0	484	0	68	0	484	0	68	0	484
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	111	156	75	102	9	3	228	70	41	104	127	0	111	75	156
A8 Software and data integrity failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A9 Security Logging and Monitoring Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Output Neutralization for Logs	51	90	53	0	51	0	143	34	17	4	139	0	51	49	94
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.10: SAST tools output in relation to the Juliet Test Suit - Part2 $\,$

Results obtained in Shopizer $\,$

Vulnerability											То	ols							
Name		Total			Sn	yk			For	tify			Sem	grep			Spot	Bugs	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	0	2	0	0	0	0	2	0	0	0	2	0	0	0	2	0	0	2	0
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	6	3	33	0	6	0	36	0	6	0	36	0	6	0	36	1	5	25	11
Cross-Site Request Forgery	4	0	0	4	0	0	0	0	4	0	0	4	0	0	0	4	0	0	0
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	3	0	0	1	2	0	0	1	2	0	0	1	2	0	0	1	2	0	0
Deprecated Hash Functions	7	10	2	0	7	0	12	0	7	0	12	0	7	0	12	0	7	0	12
Use of Weak PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SQL Injection	0	11	0	0	0	0	11	0	0	0	11	0	0	0	11	0	0	11	0
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	0	316	6	0	0	10	312	0	0	0	322	0	0	0	322	0	0	0	322
XPath Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTTP Response Splitting	3	0	17	3	0	0	17	2	1	0	17	0	3	0	17	3	0	0	17
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	289	260	0	0	289	0	260	248	41	0	260	0	289	0	260	0	289	0	260
Trust Boundary Violation	0	5	0	0	0	0	5	0	0	0	5	0	0	0	5	0	0	5	0
Method Tampering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bad Programming of Cookies	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecure Use of Hard Coded Constants	2	0	0	2	0	0	0	0	2	0	0	0	2	0	0	1	1	0	0
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	0	5	0	0	0	0	5	0	0	0	5	0	0	0	5	0	0	0	5
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	0	0	51	0	0	0	51	0	0	16	35	0	0	0	51	0	0	0	51
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Descrialization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A9 Security Logging and Monitoring Fail-	Р	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
ures	1		ININ	IP		rr				rr		IP		rr	IIN	ır		rr	
Improper Output Neutralization for Logs	187	97	0	0	187	0	97	129	58	1	96	7	180	0	97	4	183	0	97
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	0	4	0	0	0	0	4	0	0	0	4	0	0	0	4	0	0	3	1

Table 2.11: SAST tools output in relation to the Shopizer - Part1 $\,$

Vulnerability									To	ols					
Name		Total			Syno	psis			Kiu	wan			Hor	usec	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	0	2	0	0	0	0	2	0	0	0	2	0	0	0	2
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	6	3	33	5	1	9	27	0	6	3	33	0	6	0	36
Cross-Site Request Forgery	4	0	0	2	2	0	0	4	0	0	0	0	4	0	0
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	3	0	0	1	2	0	0	0	3	0	0	0	3	0	0
Deprecated Hash Functions	7	10	2	0	7	0	12	0	7	0	12	6	1	11	1
Use of Weak PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SQL Injection	0	11	0	0	0	0	11	0	0	0	11	0	0	0	11
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	0	316	6	0	0	0	322	0	0	106	216	0	0	0	322
XPath Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTTP Response Splitting	3	0	17	0	3	0	17	3	0	17	0	0	3	0	17
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	289	260	0	0	289	0	260	0	289	0	260	5	284	0	260
Trust Boundary Violation	0	5	0	0	0	0	5	0	0	0	5	0	0	0	5
Method Tampering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bad Programming of Cookies	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecure Use of Hard Coded Constants	2	0	0	0	2	0	0	1	1	0	0	0	2	0	0
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	0	5	0	0	0	0	5	0	0	0	5	0	0	0	5
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	0	0	51	0	0	0	51	0	0	27	24	0	0	8	43
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A9 Security Logging and Monitoring Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Output Neutralization for Logs	187	97	0	0	187	0	97	7	180	0	97	0	187	0	97
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	0	4	0	0	0	0	4	0	0	- 1	3	0	0	0	4

Table 2.12: SAST tools output in relation to the Shopizer - Part2 $\,$

Results obtained in Piwigo

Vulnerability									То	ols					
Name		Total			Sn	yk			For	tify			Sem	grep	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	0	9	0	0	0	2	7	0	0	0	9	0	0	0	9
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	0	110	0	0	0	25	85	0	0	38	72	0	0	54	56
Cross-Site Request Forgery	57	25	0	0	57	0	25	3	54	0	25	0	57	0	25
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	4	0	1	0	4	0	1	3	1	1	0	0	4	0	1
Deprecated Hash Functions	41	8	0	34	7	0	8	32	9	2	6	0	41	0	8
Use of Weak PRNG	9	1	0	0	9	0	1	8	1	0	1	0	9	0	1
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	0	15	0	0	0	0	15	0	0	15	0	0	0	15	0
SQL Injection	2	5	1	2	0	0	6	2	0	0	6	0	2	4	2
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	11	32	15	3	8	29	18	0	11	10	37	0	11	1	46
XPath Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTTP Response Splitting	1	11	0	0	1	0	11	0	1	6	5	0	1	0	11
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	17	0	0	0	17	0	0	0	17	0	0	0	17	0	0
Trust Boundary Violation	0	13	0	0	0	0	13	0	0	0	13	0	0	0	13
Method Tampering	27	0	0	0	27	0	0	0	27	0	0	0	27	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	1	1	0	0	1	1	0	0	1	0	1	0	1	0	1
Bad Programming of Cookies	28	7	0	14	14	0	7	16	12	0	7	0	28	0	7
Insecure Use of Hard Coded Constants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	4	2	0	0	4	0	2	0	4	0	2	0	4	0	2
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	0	0	5	0	0	0	5	0	0	0	5	0	0	0	5
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	1	25	0	0	1	0	25	0	1	0	25	1	0	25	0
A9 Security Logging and Monitoring Fail-	Р	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
ures	r	14	ININ	ır	I-IN	TT			1.11	TT		11	1.11	TT	
Improper Output Neutralization for Logs	16	35	4	0	16	0	39	3	13	15	24	0	16	0	39
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	0	20	3	0	0	4	19	0	0	0	23	0	0	14	9

Table 2.13: SAST tools output in relation to the Piwigo - Part1 $\,$

Vulnerability									To	ols					
Name		Total			Syno	psis			Kiu	wan			Hor	usec	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	0	9	0	0	0	0	9	0	0	0	9	0	0	0	9
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	0	110	0	0	0	0	110	0	0	2	108	0	0	0	110
Cross-Site Request Forgery	57	25	0	0	57	0	25	0	57	0	25	0	57	0	25
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	4	0	1	1	3	0	1	3	1	0	1	0	4	0	1
Deprecated Hash Functions	41	8	0	25	16	2	6	35	6	2	6	0	41	0	8
Use of Weak PRNG	9	1	0	7	2	0	1	2	7	0	1	1	8	0	1
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	0	15	0	0	0	0	15	0	0	0	15	0	0	0	15
SQL Injection	2	5	1	0	2	0	6	0	2	0	6	0	2	1	5
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	11	32	15	0	11	0	47	1	10	6	41	0	11	0	47
XPath Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTTP Response Splitting	1	11	0	0	1	0	11	0	1	2	9	0	1	0	11
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	17	0	0	0	17	0	0	0	17	0	0	0	17	0	0
Trust Boundary Violation	0	13	0	0	0	0	13	0	0	13	0	0	0	0	13
Method Tampering	27	0	0	0	27	0	0	26	1	0	0	0	27	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	1	1	0	0	1	1	0	0	1	0	1	0	1	0	1
Bad Programming of Cookies	28	7	0	16	12	1	6	0	28	0	7	0	28	0	7
Insecure Use of Hard Coded Constants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	4	2	0	0	4	0	2	0	4	0	2	4	0	2	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	0	0	5	0	0	0	5	0	0	0	5	0	0	5	0
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	1	25	0	0	1	0	25	0	1	2	23	0	1	0	25
A9 Security Logging and Monitoring Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Output Neutralization for Logs	16	35	4	0	16	0	39	0	16	3	36	0	16	0	39
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	0	20	3	0	0	0	23	0	0	0	23	0	0	0	23

Table 2.14: SAST tools output in relation to the Piwigo - Part2

Results obtained in Peertube

Vulnerability									To	ols					
Name		Total			Sn	yk			For	tify			Sem	grep	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	0	16	6	0	0	1	21	0	0	0	22	0	0	0	22
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	4	55	81	2	2	15	121	0	4	0	136	4	0	124	12
Cross-Site Request Forgery	194	0	0	0	194	0	0	3	191	0	0	0	194	0	0
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deprecated Hash Functions	4	1	0	1	3	0	1	1	3	0	1	0	4	0	1
Use of Weak PRNG	2	3	0	0	2	0	3	0	2	0	3	0	2	0	3
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	0	7	0	0	0	0	7	0	0	0	7	0	0	0	7
SQL Injection	0	19	0	0	0	0	19	0	0	0	19	0	0	0	19
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	0	28	1	0	0	7	22	0	0	0	29	0	0	28	1
XPath Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTTP Response Splitting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bad Programming of Cookies	3	1	0	3	0	1	0	0	3	0	1	0	3	0	1
Insecure Use of Hard Coded Constants	3	0	2	3	0	1	1	0	3	0	2	0	3	0	2
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	194	0	0	0	194	0	0	3	191	0	0	0	194	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	0	0	43	0	0	2	41	0	0	14	29	0	0	0	43
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Descrialization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A9 Security Logging and Monitoring Fail-	Р	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
ures															
Improper Output Neutralization for Logs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	1	6	0	0	1	3	3	0	1	0	6	0	1	0	6

Table 2.15: SAST tools output in relation to the PeerTube - Part1 $\,$

Vulnerability									To	ols					
Name		Total			Syno	opsis			Kiu	wan			Hor	usec	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	0	16	6	0	0	0	22	0	0	9	13	0	0	5	17
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	4	55	81	0	4	0	136	0	4	0	136	0	4	0	136
Cross-Site Request Forgery	194	0	0	0	194	0	0	194	0	0	0	0	194	0	0
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deprecated Hash Functions	4	1	0	1	3	0	1	0	4	0	1	4	0	0	1
Use of Weak PRNG	2	3	0	0	2	0	3	0	2	0	3	2	0	3	0
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
OS Command Injection	0	7	0	0	0	0	7	0	0	0	7	0	0	5	2
SQL Injection	0	19	0	0	0	0	19	0	0	0	19	0	0	0	19
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	0	28	1	0	0	0	29	0	0	0	29	0	0	0	29
XPath Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTTP Response Splitting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bad Programming of Cookies	3	1	0	0	3	0	1	0	3	0	1	0	3	0	1
Insecure Use of Hard Coded Constants	3	0	2	0	3	0	2	0	3	0	2	2	1	1	1
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	194	0	0	0	194	0	0	194	0	0	0	0	194	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	0	0	43	0	0	4	39	0	0	0	43	0	0	23	20
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A9 Security Logging and Monitoring Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Output Neutralization for Logs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	1	6	0	0	1	0	6	0	1	0	6	0	1	0	6

Table 2.16: SAST tools output in relation to the PeerTube - Part2 $\,$

Results obtained in Metafresh

Vulnerability											То	ols							
Name		Total			Sn	yk			For	tify			Sem	grep			Spot	Bugs	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	1	34	2	1	0	6	30	0	1	25	11	0	1	2	34	0	1	0	36
Cross-Site Request Forgery	3	0	0	3	0	0	0	0	3	0	0	2	1	0	0	0	3	0	0
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	28	0	0	0	28	0	0	0	28	0	0	0	28	0	0	0	28	0	0
Deprecated Hash Functions	126	4	14	4	122	0	18	3	123	0	18	3	123	0	18	0	126	0	18
Use of Weak PRNG	16	0	0	1	15	0	0	14	2	0	0	3	13	0	0	0	16	0	0
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	0	5	0	0	0	0	5	0	0	4	1	0	0	1	4	0	0	0	5
SQL Injection	0	262	217	0	0	17	462	0	0	38	441	0	0	47	432	0	0	2	477
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	7	223	21	0	7	4	240	0	7	142	102	0	7	1	243	0	7	0	244
XPath Injection	0	3	0	0	0	0	3	0	0	3	0	0	0	0	3	0	0	0	3
HTTP Response Splitting	0	7	1	0	0	5	3	0	0	3	5	0	0	0	8	0	0	0	8
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	112	71	0	0	112	0	71	59	53	71	0	0	112	0	71	0	112	0	71
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	2	22	0	1	1	2	20	0	2	16	6	1	1	12	10	0	2	0	22
Bad Programming of Cookies	8	0	0	6	2	0	0	4	4	0	0	6	2	0	0	0	8	0	0
Insecure Use of Hard Coded Constants	2	0	0	2	0	0	0	0	2	0	0	0	2	0	0	0	2	0	0
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	4	4	73	4	0	2	75	0	4	19	58	0	4	0	77	0	4	0	77
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	1	4	1	0	1	0	5	0	1	0	5	0	1	1	4	0	1	0	5
A9 Security Logging and Monitoring Fail-	Р	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
ures	r				1-11	TT	IIN							I'P		11		I-P	
Improper Output Neutralization for Logs	274	370	51	32	242	12	409	203	71	284	137	130	144	1	420	1	273	0	421
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.17: SAST tools output in relation to the Metafresh - Part1 $\,$

Vulnerability									То	ols					
Name		Total			Syno	psis			Kiu	wan			Hor	usec	
A1 Broken Access Control	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authorization	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1
Insufficient Session Expiration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Path Traversal	1	34	2	0	1	0	36	1	0	8	28	0	1	4	32
Cross-Site Request Forgery	3	0	0	1	2	0	0	3	0	0	0	0	3	0	0
A2 Cryptographic Failure	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Use of Old/Insecure algorithms	28	0	0	1	27	0	0	0	28	0	0	28	0	0	0
Deprecated Hash Functions	126	4	14	3	123	0	18	3	123	0	18	125	1	18	0
Use of Weak PRNG	16	0	0	0	16	0	0	6	10	0	0	3	13	0	0
Seeds Hard Coded in PRNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Injection	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Command Injection	0	5	0	0	0	0	5	0	0	0	5	0	0	0	5
SQL Injection	0	262	217	0	0	1	478	0	0	0	479	0	0	380	99
LDAP Injection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross-Site Scripting	7	223	21	7	0	15	229	6	1	11	233	0	7	0	244
XPath Injection	0	3	0	0	0	0	3	0	0	0	3	0	0	0	3
HTTP Response Splitting	0	7	1	0	0	0	8	0	0	4	4	0	0	0	8
A4 Insecure Design	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Error Handling	112	71	0	0	112	0	71	0	112	0	71	53	59	0	71
Trust Boundary Violation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Method Tampering	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0
A5 Security Misconfiguration	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
XML External Entities	2	22	0	0	2	0	22	0	2	9	13	0	2	5	17
Bad Programming of Cookies	8	0	0	3	5	0	0	0	8	0	0	1	7	0	0
Insecure Use of Hard Coded Constants	2	0	0	1	1	0	0	1	1	0	0	0	2	0	0
A6 Vulnerable and Outdated Components	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Vulnerable Third-Party Components	1	0	0	1	0	0	0	0	1	0	0	0	1	0	0
A7 Identification and Authentication Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Bypassing Authentication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hard Coded Credentials	4	4	73	0	4	0	77	3	1	0	77	0	4	56	21
A8 Software and Data Integrity Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Insecure Deserialization	1	4	1	1	0	4	1	0	1	0	5	0	1	0	5
A9 Security Logging and Monitoring Failures	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Improper Output Neutralization for Logs	274	370	51	18	256	120	301	78	196	0	421	0	274	0	421
A10 Server-Side Request Forgery	P	N	NN	TP	FN	FP	TN	TP	FN	FP	TN	TP	FN	FP	TN
Server-Side Request Forgery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.18: SAST tools output in relation to the Metafresh - Part2 $\,$

Chapter 3

Performance results for all Combinations of 2 and 3 SAST Tools using the 1st strategy

This section includes the results achieved by applying the strategy demonstrated in example 1 of the "Combinations of tools" step, which was incorporated into Methodology stage 4.1.4.4. The established approach involves the disjunction of the SAST tools' outputs obtained individually and was extended to the combinations of 2, table 3.1, and 3, table 3.2. As the latter were characterized on the basis of representative metrics for different vulnerability detection scenarios, the rankings derived make it possible to observe the progression of the SAST tool combination ranking over different contexts. Due to the proximity of certain performance values reached through the main metric, this was used in conjunction with a tiebreaker metric in order to break the tie between those within the same 5% range.

Results obtained in Combinations of 2 Tools

	Busines	s Critic	cal		Metric	Tiebreaker	Н	eighten	ed Crit	ical		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	Recall	Precison	Comb.	TP	FN	FP	TN	Rec.*Infor.	Recall
C, A	5072	7615	12708	3249	60.95%	39.98%	A, E	4821	4411	15912	3500	39.47%	57.94%
C, F	5054	7781	12542	3267	60.74%	39.38%	B, A	4628	2901	17422	3693	39.31%	55.62%
C, E	5098	8398	11925	3223	61.27%	37.77%	C, E	5098	8398	11925	3223	36.74%	61.27%
B, A	4628	2901	17422	3693	55.62%	61.47%	C, A	5072	7615	12708	3249	37.63%	60.95%
F, E	4650		16169	3671	55.88%	52.82%	C, F	5054	7781	12542	3267	37.19%	60.74%
A, E	4821	4411	15912	3500	57.94%	52.22%	B, C	4919	6815	13508	3402	37.12%	59.12%
B, C	4919	6815	13508	3402	59.12%	41.92%	A, D	4824	6856	13467	3497	36.01%	57.97%
A, D	4824	6856	13467	3497	57.97%	41.3%	F, E	4650	4154	16169	3671	37.84%	55.88%
E, D	4643	7030	13293	3678	55.8%	39.78%	E, D	4643	7030	13293	3678	33.82%	55.8%
C, D	4774	10907	9416	3547	57.37%	30.44%	F, D	4444	6954	13369	3877	31.83%	53.41%
B, F	4191	2693	17630	4130	50.37%	60.88%	B, F	4191	2693	17630	4130	34.53%	50.37%
G, E	4165	4534	15789	4156	50.05%	47.88%	G, E	4165	4534	15789	4156	31.97%	50.05%
F, D C, G	4444		13369 12799	3877 4039	53.41% 51.46%	38.99% 36.27%	B, E A, F	4096	3719 3354	16604 16969	4225 4285	32.22% 32.01%	49.22% 48.5%
A, F	4282	3354		4039	48.5%	54.61%	C, D	4774	10907	9416	3547	29.75%	57.37%
В, Е	4036	3719			49.22%	52.41%	C, D	4282	7524	12799	4039	29.73%	51.46%
B, D	4157	7181	13142	4164	49.22%	36.66%	B, D	4157	7181	13142	4164	28.63%	49.96%
G, D	3896	7642	12681	4425	46.82%	33.77%	G, D	3896	7642	12681	4425	25.57%	46.82%
F, G	3604	3536	16787	4717	43.31%	50.48%	A, G	3686	3683	16640	4635	27.95%	44.3%
A, G	3686	3683	16640	4635	44.3%	50.02%	F, G	3604	3536	16787	4717	27.27%	43.31%
B, G	3317		17793		39.86%	56.73%	B, G	3317		17793	5004	25.4%	39.86%
2, 0		Effort	11170	2001	Metric	Tiebreaker		Minimu			2001	Metric	Tiebreaker
Comb.													
Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.	TP	FN	FP	TN	Markedness	Precision
B, A	4628	FN 2901	FP 17422	TN 3693	F-measure 58.4%	Recall 55.62%	Comb. B, A	TP 4628	FN 2901	FP 17422	TN 3693	Markedness 71.99%	Precision 61.47%
				3693							3693		
B, A	4628	2901	17422	3693	58.4%	55.62%	B, A	4628	2901	17422	3693	71.99%	61.47%
B, A B, F	4628 4191	2901 2693	17422 17630	3693 4130	58.4% 55.13%	55.62% 50.37%	B, A B, F B, G A, F	4628 4191	2901 2693	17422 17630	3693 4130	71.99% 70.95%	61.47% 60.88%
B, A B, F A, E F, E B, E	4628 4191 4821 4650 4096	2901 2693 4411 4154 3719	17422 17630 15912 16169 16604	3693 4130 3500 3671 4225	58.4% 55.13% 54.93% 54.31% 50.77%	55.62% 50.37% 57.94% 55.88% 49.22%	B, A B, F B, G A, F F, E	4628 4191 3317 4036 4650	2901 2693 2530 3354 4154	17422 17630 17793 16969 16169	3693 4130 5004 4285 3671	71.99% 70.95% 67.39% 67.23% 67.16%	61.47% 60.88% 56.73% 54.61% 52.82%
B, A B, F A, E F, E B, E A, F	4628 4191 4821 4650 4096 4036	2901 2693 4411 4154 3719 3354	17422 17630 15912 16169 16604 16969	3693 4130 3500 3671 4225 4285	58.4% 55.13% 54.93% 54.31% 50.77% 51.38%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5%	B, A B, F B, G A, F F, E B, E	4628 4191 3317 4036 4650 4096	2901 2693 2530 3354 4154 3719	17422 17630 17793 16969 16169 16604	3693 4130 5004 4285 3671 4225	71.99% 70.95% 67.39% 67.23% 67.16% 66.06%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41%
B, A B, F A, E F, E B, E A, F C, E	4628 4191 4821 4650 4096 4036 5098	2901 2693 4411 4154 3719 3354 8398	17422 17630 15912 16169 16604 16969 11925	3693 4130 3500 3671 4225 4285 3223	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27%	B, A B, F B, G A, F F, E B, E A, E	4628 4191 3317 4036 4650 4096 4821	2901 2693 2530 3354 4154 3719 4411	17422 17630 17793 16969 16169 16604 15912	3693 4130 5004 4285 3671 4225 3500	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.1%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22%
B, A B, F A, E F, E B, E A, F C, E C, A	4628 4191 4821 4650 4096 4036 5098 5072	2901 2693 4411 4154 3719 3354 8398 7615	17422 17630 15912 16169 16604 16969 11925 12708	3693 4130 3500 3671 4225 4285 3223 3249	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95%	B, A B, F B, G A, F F, E B, E A, E F, G	4628 4191 3317 4036 4650 4096 4821 3604	2901 2693 2530 3354 4154 3719 4411 3536	17422 17630 17793 16969 16169 16604 15912 16787	3693 4130 5004 4285 3671 4225 3500 4717	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.1% 64.27%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48%
B, A B, F A, E F, E B, E A, F C, E C, A C, F	4628 4191 4821 4650 4096 4036 5098 5072 5054	2901 2693 4411 4154 3719 3354 8398 7615 7781	17422 17630 15912 16169 16604 16969 11925 12708 12542	3693 4130 3500 3671 4225 4285 3223 3249 3267	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74%	B, A B, F B, G A, F F, E B, E A, E F, G A, G	4628 4191 3317 4036 4650 4096 4821 3604 3686	2901 2693 2530 3354 4154 3719 4411 3536 3683	17422 17630 17793 16969 16169 16604 15912 16787 16640	3693 4130 5004 4285 3671 4225 3500 4717 4635	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.1% 64.27% 64.12%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48% 50.02%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.1% 64.27% 64.12% 63.52%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48% 50.02% 47.88%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C A, D	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919 4824	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815 6856	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508 13467	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402 3497	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06% 48.24%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12% 57.97%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E B, C	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165 4919	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534 6815	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789 13508	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156 3402	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.1% 64.27% 64.12% 63.52% 60.9%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48% 50.02% 47.88% 41.92%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C A, D E, D	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919 4824 4643	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815 6856 7030	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508 13467 13293	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402 3497 3678	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06% 48.24% 46.44%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12% 57.97% 55.8%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E B, C A, D	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165 4919 4824	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534 6815 6856	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789 13508 13467	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156 3402 3497	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.1% 64.27% 64.12% 63.52% 60.9% 60.34%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48% 50.02% 47.88% 41.92% 41.3%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C A, D E, D F, D	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919 4824 4643 4444	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815 6856 7030 6954	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508 13467 13293 13369	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402 3497 3678 3877	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06% 48.24% 46.44% 45.07%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12% 57.97% 55.8% 53.41%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E B, C A, D C, A	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165 4919 4824 5072	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534 6815 6856 7615	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789 13508 13467 12708	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156 3402 3497 3249	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.1% 64.27% 64.12% 63.52% 60.9% 60.34% 59.81%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48% 50.02% 47.88% 41.92% 41.3% 39.98%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C A, D E, D G, E	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919 4824 4643 4444 4165	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815 6856 7030 6954 4534	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508 13467 13293 13369 15789	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402 3497 3678 3877 4156	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06% 48.24% 46.44% 45.07% 48.94%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12% 57.97% 55.8% 53.41% 50.05%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E B, C A, D C, A E, D	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165 4919 4824 5072 4643	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534 6815 6856 7615	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789 13508 13467 12708	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156 3402 3497 3249 3678	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.1% 64.27% 64.12% 63.52% 60.9% 60.34% 59.81%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48% 50.02% 47.88% 41.92% 41.3% 39.98% 39.78%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C A, D E, D G, E A, G	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919 4824 4643 4444 4165 3686	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815 6856 7030 6954 4534 3683	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508 13467 13293 13369 15789 16640	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402 3497 3678 3877 4156 4635	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06% 48.24% 46.44% 45.07% 48.94% 46.99%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12% 57.97% 55.8% 53.41% 50.05% 44.3%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E B, C A, D C, A E, D C, F	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165 4919 4824 5072 4643 5054	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534 6815 6856 7615 7030 7781	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789 13508 13467 12708 13293 12542	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156 3402 3497 3249 3678 3267	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.1% 64.27% 64.12% 63.52% 60.9% 60.34% 59.81% 59.05% 59.36%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48% 50.02% 47.88% 41.92% 41.3% 39.98% 39.78% 39.38%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C A, D E, D G, E A, G F, G	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919 4824 4643 4444 4165 3686 3604	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815 6856 7030 6954 4534 3683 3536	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508 13467 13293 13369 15789 16640 16787	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402 3497 3678 3877 4156 4635 4717	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06% 48.24% 46.44% 45.07% 48.94% 46.99% 46.62%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12% 57.97% 55.8% 53.41% 50.05% 44.3% 43.31%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E B, C A, D C, A E, D C, F F, D	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165 4919 4824 5072 4643 5054 4444	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534 6815 6856 7615 7030 7781 6954	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789 13508 13467 12708 13293 12542 13369	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156 3402 3497 3249 3678 3267 3877	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.17% 64.12% 63.52% 60.9% 60.34% 59.81% 59.05% 59.36% 58.25%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.02% 47.88% 41.92% 41.3% 39.98% 39.78% 39.38% 38.99%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C A, D E, D F, D G, E A, G F, G B, G	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919 4824 4643 4444 4165 3686 3604 3317	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815 6856 7030 6954 4534 3683 3536 2530	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508 13467 13293 13369 15789 16640 16787 17793	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402 3497 3678 3877 4156 4635 4717 5004	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06% 48.24% 46.44% 45.07% 48.94% 46.99% 46.62%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12% 57.97% 55.8% 53.41% 50.05% 44.3% 43.31% 39.86%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E B, C A, D C, A E, D C, F F, D C, E	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165 4919 4824 5072 4643 5054 4444 5098	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534 6815 6856 7615 7030 7781 6954 8398	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789 13508 13467 12708 13293 12542 13369 11925	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156 3402 3497 3249 3678 3267 3877 3223	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.17% 64.12% 63.52% 60.9% 60.34% 59.81% 59.05% 59.36% 58.25%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48% 50.02% 47.88% 41.92% 41.3% 39.98% 39.78% 39.38% 38.99% 37.77%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C A, D E, D F, D G, E A, G F, G B, G C, G	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919 4824 4643 4444 4165 3686 3604 3317 4282	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815 6856 7030 6954 4534 3683 3536 2530 7524	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508 13467 13293 13369 15789 16640 16787 17793	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402 3497 3678 3877 4156 4635 4717 5004 4039	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06% 48.24% 46.44% 45.07% 48.94% 46.99% 46.62% 46.82% 42.55%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12% 57.97% 55.8% 53.41% 50.05% 44.3% 43.31% 39.86% 51.46%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E B, C A, D C, A E, D C, F F, D C, E B, D	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165 4919 4824 5072 4643 5054 4444 5098 4157	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534 6815 7615 7030 7781 6954 8398 7181	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789 13508 13467 12708 13293 12542 13369 11925 13142	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156 3402 3497 3249 3678 3267 3877 3223 4164	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.17% 64.12% 63.52% 60.9% 60.34% 59.81% 59.85% 58.25% 58.25% 56.3%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.02% 47.88% 41.92% 41.3% 39.98% 39.78% 39.38% 38.99% 37.77% 36.66%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C A, D E, D G, E A, G F, G B, G C, G B, D	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919 4824 4643 4444 4165 3686 3604 3317 4282 4157	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815 6856 7030 6954 4534 3683 3536 2530 7524 7181	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508 13467 13293 13369 15789 16640 16787 17793 12799	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402 3497 3678 3877 4156 4635 4717 5004 4039 4164	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06% 48.24% 46.44% 45.07% 48.94% 46.99% 46.62% 46.82% 42.55% 42.29%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12% 57.97% 55.8% 53.41% 50.05% 44.3% 43.31% 39.86% 51.46% 49.96%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E B, C A, D C, A E, D C, F F, D C, E B, D C, G	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165 4919 4824 5072 4643 5054 4444 5098 4157 4282	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534 6815 7615 7030 7781 6954 8398 7181 7524	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789 13508 13467 12708 13293 12542 13369 11925 13142	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156 3402 3497 3249 3678 3267 3877 3223 4164 4039	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.17% 64.12% 63.52% 60.9% 60.34% 59.81% 59.05% 59.36% 58.25% 56.3% 56.14%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48% 50.02% 47.88% 41.92% 41.3% 39.98% 39.78% 39.38% 38.99% 37.77% 36.66% 36.27%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C A, D E, D G, E A, G F, G B, G C, G B, D C, D	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919 4824 4643 4444 4165 3686 3604 3317 4282 4157 4774	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815 6856 7030 6954 4534 3683 3536 2530 7524 7181	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508 13467 13293 13369 15789 16640 16787 17793 12799 13142 9416	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402 3497 3678 3877 4156 4635 4717 5004 4039 4164 3547	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06% 48.24% 46.44% 45.07% 48.94% 46.62% 46.62% 46.82% 42.55% 42.29% 39.78%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12% 57.97% 55.8% 53.41% 50.05% 44.3% 43.31% 39.86% 51.46% 49.96% 57.37%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E B, C A, D C, A E, D C, F F, D C, E B, D C, G G, D	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165 4919 4824 5072 4643 5054 4444 5098 4157 4282 3896	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534 6815 7615 7030 7781 6954 8398 7181 7524 7642	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789 13508 13467 12708 13293 12542 13369 11925 13142 12799 12681	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156 3402 3497 3249 3678 3267 3877 3223 4164 4039 4425	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.17% 64.12% 63.52% 60.9% 60.34% 59.81% 59.85% 58.25% 58.25% 56.3% 56.14% 53.95%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48% 41.92% 41.3% 39.98% 39.78% 39.38% 38.99% 37.77% 36.66% 36.27% 33.77%
B, A B, F A, E F, E B, E A, F C, E C, A C, F B, C A, D E, D G, E A, G F, G B, G C, G B, D	4628 4191 4821 4650 4096 4036 5098 5072 5054 4919 4824 4643 4444 4165 3686 3604 3317 4282 4157	2901 2693 4411 4154 3719 3354 8398 7615 7781 6815 6856 7030 6954 4534 3683 3536 2530 7524 7181 10907 7642	17422 17630 15912 16169 16604 16969 11925 12708 12542 13508 13467 13293 13369 15789 16640 16787 17793 12799 13142 9416	3693 4130 3500 3671 4225 4285 3223 3249 3267 3402 3497 3678 3877 4156 4635 4717 5004 4039 4164 3547 4425	58.4% 55.13% 54.93% 54.31% 50.77% 51.38% 46.73% 48.29% 47.78% 49.06% 48.24% 45.07% 46.44% 45.07% 46.99% 46.62% 46.92% 42.55% 42.29% 39.78% 39.24%	55.62% 50.37% 57.94% 55.88% 49.22% 48.5% 61.27% 60.95% 60.74% 59.12% 57.97% 55.8% 53.41% 50.05% 44.3% 43.31% 39.86% 51.46% 49.96%	B, A B, F B, G A, F F, E B, E A, E F, G A, G G, E B, C A, D C, A E, D C, F F, D C, E B, D C, G G, D C, D	4628 4191 3317 4036 4650 4096 4821 3604 3686 4165 4919 4824 5072 4643 5054 4444 5098 4157 4282 3896 4774	2901 2693 2530 3354 4154 3719 4411 3536 3683 4534 6815 6856 7615 7030 7781 6954 8398 7181 7524 7642	17422 17630 17793 16969 16169 16604 15912 16787 16640 15789 13508 13467 12708 13293 12542 13369 11925 13142 12799 12681 9416	3693 4130 5004 4285 3671 4225 3500 4717 4635 4156 3492 3497 3249 3678 3267 3223 4164 4039 4425 3547	71.99% 70.95% 67.39% 67.23% 67.16% 66.06% 67.1% 64.27% 64.12% 63.52% 60.9% 60.34% 59.81% 59.05% 59.36% 58.25% 56.3% 56.14% 53.95% 51.54%	61.47% 60.88% 56.73% 54.61% 52.82% 52.41% 52.22% 50.48% 50.02% 47.88% 41.92% 41.3% 39.98% 39.78% 39.38% 38.99% 37.77% 36.66% 36.27%

Table 3.1: Ranking of Combination of 2 SAST tools by scenario

Results obtained in Combinations of 3 Tools

I	Busines	s Critic	al		Metric	Tiebreaker	Н	eighten	ed Crit	ical		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	Recall	Precison	Comb.	TP	FN	FP	TN	Rec.*Infor.	Recall
B, C, A	5866	8265	12058	2455	70.5%	41.51%	C, A, E	6077	9553	10770	2244	46.02%	73.03%
C, A, E	6077	9553	10770	2244	73.03%	38.88%	B, C, A	5866	8265	12058	2455	45.76%	70.5%
C, F, E	5923	9438	10885	2398	71.18%	38.56%	B, A, E	5540	4979	15344	2781	47.3%	66.58%
B, A, E	5540	4979	15344	2781	66.58%	52.67%	C, F, E	5923	9438	10885	2398	44.4%	71.18%
A, E, D	5562	7431	12892	2759	66.84%	42.81%	C, A, D	5789	10724	9599	2532	40.63%	69.57%
F, E, D	5427	7407	12916	2894	65.22%	42.29%	B, C, E	5628	9040	11283	2693	41.65%	67.64%
B, C, F	5572	8265	12058	2749	66.96%	40.27%	B, C, F	5572	8265	12058	2749	42.29%	66.96%
C, A, F	5554	8698	11625	2767	66.75%	38.97%	A, E, D	5562	7431	12892	2759	43.54%	66.84%
B, C, E	5628	9040	11283	2693	67.64%	38.37%	C, A, F	5554	8698	11625	2767	41.37%	66.75%
C, A, D	5789	10724	9599	2532	69.57%	35.06%	F, E, D	5427	7407	12916	2894	41.99%	65.22%

C, E, D	5516	11369	9054	2775	66.65%	32.79%	A, G, E	5243 5	3962	14460	2079	42.27%	63.01%
C, E, D	5467	11296		2854	65.7%	32.61%	B, F, E			15725	3128	43.62%	62.41%
B, A, G	5025		15885		60.39%	53.1%	A, F, E			15399		42.99%	62.28%
B, F, E	5193		15725		62.41%	53.04%	F, G, E		-	14780		40.51%	60.71%
A, F, E	5182		15399		62.28%	51.28%	B, A, G			15885	3296	41.84%	60.39%
F, G, E	5052		14780		60.71%	47.68%	C, E, D			8954	2775	36.89%	66.65%
A, G, E	5243		14460		63.01%	47.21%	C, F, D		1296		2854	36.17%	65.7%
B, A, D	5079		13817	3242	61.04%	43.84%	C, A, G		9042	11281	2923	39.05%	64.87%
A, G, D	5110	7414	12909	3211	61.41%	40.8%	C, G, E	5382 9	9807	10516	2939	37.65%	64.68%
B, C, G	5181	8171	12152	3140	62.26%	38.8%	C, F, G	5342 9	9127	11196	2979	38.29%	64.2%
C, A, G	5398	9042	11281	2923	64.87%	37.38%	B, C, G	5181 8	3171	12152	3140	38.0%	62.26%
C, F, G	5342	9127	11196		64.2%	36.92%	A, G, D			12909	3211	38.36%	61.41%
C, G, E	5382	9807	10516		64.68%	35.43%	B, A, D	5079 6		13817	3242	39.38%	61.04%
B, C, D	5113			3208	61.45%	31.37%	B, E, D			13036		37.24%	59.99%
C, G, D		11402		3281	60.57%	30.65%	B, G, E			15103		39.46%	59.14%
B, A, F	4674		16549	3647	56.17%	55.33%	A, F, D			13752	3406	37.43%	59.07%
B, F, G	4642		16205	3679	55.79%	52.99%	G, E, D			12183	3409	35.12%	59.03%
B, G, E	4921		15103		59.14%	48.53%	B, F, D			13369		35.98%	58.09%
A, F, D	4915		13752		59.07%	42.79%	B, A, F			16549	3647	38.65%	56.17%
B, F, D	4834		13369		58.09%	41.01%	B, F, G			16205	3679	37.8%	55.79%
B, E, D G, E, D	4992		13036 12183		59.99% 59.03%	40.65% 37.63%	A, F, G B, C, D		1753 1186	15570	3822 3208	35.33% 32.69%	54.07% 61.45%
F, G, D	4699		12183		56.47%	36.92%	В, С, D С, G, D		1402	8921	3281	31.64%	60.57%
A, F, G	4499		15570		54.07%	48.63%	F, G, D			12293	3622	33.02%	56.47%
B, G, D	4424		13114		53.17%	38.03%	B, G, D			13114		31.29%	53.17%
<i>B</i> , <i>G</i> , <i>B</i>		Effort	13111	3077	Metric	Tiebreaker		Minimum			3071	Metric	Tiebreaker
Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.		FN	FP	TN	Markedness	Precision
B, A, E	5540	4979	15344	2781	58.81%	66.58%	B, A, F	4674 3	3774	16549	3647	68.63%	55.33%
B, F, E	5193	4598	15725	3128	57.34%	62.41%	B, A, G	5025 4	1438	15885	3296	67.96%	53.1%
A, F, E	5182	4924	15399	3139	56.24%	62.28%	B, F, E	5193 4	1598	15725	3128	68.22%	53.04%
B, A, G	5025	4438	15885	3296	56.51%	60.39%	B, F, G	4642 4	1118	16205	3679	67.24%	52.99%
B, A, F	1/7/												
	4674		16549		55.75%	56.17%	B, A, E			15344		68.66%	52.67%
C, A, E	6077	9553	10770	2244	50.75%	73.03%	A, F, E	5182 4	1924	15399	3139	67.17%	51.28%
C, A, E C, F, E	6077 5923	9553 9438	10770 10885	2244 2398	50.75% 50.02%	73.03% 71.18%	A, F, E B, G, E	5182 4 4921 5	1924 5220	15399 15103	3139 3400	67.17% 65.08%	51.28% 48.53%
C, A, E C, F, E B, C, A	6077 5923 5866	9553 9438 8265	10770 10885 12058	2244 2398 2455	50.75% 50.02% 52.25%	73.03% 71.18% 70.5%	A, F, E B, G, E A, F, G	5182 4 4921 5 4499 4	1924 5220 1753	15399 15103 15570	3139 3400 3822	67.17% 65.08% 64.46%	51.28% 48.53% 48.63%
C, A, E C, F, E B, C, A B, C, F	6077 5923 5866 5572	9553 9438 8265 8265	10770 10885 12058 12058	2244 2398 2455 2749	50.75% 50.02% 52.25% 50.29%	73.03% 71.18% 70.5% 66.96%	A, F, E B, G, E A, F, G F, G, E	5182 4 4921 5 4499 4 5052 5	1924 5220 1753 5543	15399 15103 15570 14780	3139 3400 3822 3269	67.17% 65.08% 64.46% 64.79%	51.28% 48.53% 48.63% 47.68%
C, A, E C, F, E B, C, A B, C, F A, E, D	5923 5866 5572 5562	9553 9438 8265 8265 7431	10770 10885 12058 12058 12892	2244 2398 2455 2749 2759	50.75% 50.02% 52.25% 50.29% 52.19%	73.03% 71.18% 70.5% 66.96% 66.84%	A, F, E B, G, E A, F, G F, G, E A, G, E	5182 4 4921 5 4499 4 5052 5 5243 5	1924 5220 1753 5543 5863	15399 15103 15570 14780 14460	3139 3400 3822 3269 3078	67.17% 65.08% 64.46% 64.79% 64.83%	51.28% 48.53% 48.63% 47.68% 47.21%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D	5923 5866 5572 5562 5427	9553 9438 8265 8265 7431 7407	10770 10885 12058 12058 12892 12916	2244 2398 2455 2749 2759 2894	50.75% 50.02% 52.25% 50.29% 52.19% 51.31%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6	1924 5220 1753 5543 5863 5506	15399 15103 15570 14780 14460 13817	3139 3400 3822 3269 3078 3242	67.17% 65.08% 64.46% 64.79% 64.83% 62.42%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E	6077 5923 5866 5572 5562 5427 5243	9553 9438 8265 8265 7431 7407 5863	10770 10885 12058 12058 12892 12916 14460	2244 2398 2455 2749 2759 2894 3078	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7	1924 5220 1753 5543 5863 6506 7431	15399 15103 15570 14780 14460 13817 12892	3139 3400 3822 3269 3078 3242 2759	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D	6077 5923 5866 5572 5562 5427 5243 5079	9553 9438 8265 8265 7431 7407 5863 6506	10770 10885 12058 12058 12892 12916 14460 13817	2244 2398 2455 2749 2759 2894 3078 3242	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, F, D	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6	1924 5220 1753 5543 5863 5506 7431	15399 15103 15570 14780 14460 13817 12892 13752	3139 3400 3822 3269 3078 3242 2759 3406	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.79%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E	5923 5866 5572 5562 5427 5243 5079 5052	9553 9438 8265 8265 7431 7407 5863 6506 5543	10770 10885 12058 12058 12892 12916 14460 13817	2244 2398 2455 2749 2759 2894 3078 3242 3269	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, F, D F, E, D	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7	1924 5220 1753 5543 5863 5506 7431 5571	15399 15103 15570 14780 14460 13817 12892 13752 12916	3139 3400 3822 3269 3078 3242 2759 3406 2894	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.79% 42.29%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E B, G, E	6077 5923 5866 5572 5562 5427 5243 5079 5052 4921	9553 9438 8265 8265 7431 7407 5863 6506 5543 5220	10770 10885 12058 12058 12892 12916 14460 13817 14780 15103	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71% 59.14%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, F, D F, E, D B, C, A	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8	1924 5220 1753 5543 5863 5506 7431 7407 3265	15399 15103 15570 14780 14460 13817 12892 13752 12916 12058	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.79% 42.29% 41.51%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E	5923 5866 5572 5562 5427 5243 5079 5052	9553 9438 8265 8265 7431 7407 5863 6506 5543 5220 4118	10770 10885 12058 12058 12892 12916 14460 13817	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400 3679	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31% 54.35%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, F, D F, E, D B, C, A B, F, D	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8 4834 6	1924 5220 1753 5543 5563 5506 7431 5571 7407 3265 5954	15399 15103 15570 14780 14460 13817 12892 13752 12916	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455 3487	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3% 60.16%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.79% 42.29% 41.51% 41.01%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E B, G, E B, F, G	5923 5866 5572 5562 5427 5243 5079 5052 4921 4642 4499	9553 9438 8265 8265 7431 7407 5863 6506 5543 5220 4118	10770 10885 12058 12058 12892 12916 14460 13817 14780 15103 16205 15570	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400 3679 3822	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71% 59.14% 55.79%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, F, D F, E, D B, C, A	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8 4834 6 5110 7	1924 5220 1753 5543 5563 5563 6506 7431 6571 7407 8265 6954 7414	15399 15103 15570 14780 14460 13817 12892 13752 12916 12058 13369	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455 3487 3211	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.79% 42.29% 41.51%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E B, F, G A, F, G	5923 5866 5572 5562 5427 5243 5079 5052 4921 4642 4499	9553 9438 8265 8265 7431 7407 5863 6506 5543 5220 4118 4753 10724	10770 10885 12058 12058 12892 12916 14460 13817 14780 15103 16205 15570	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400 3679 3822 2532	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31% 54.35% 51.2%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71% 59.14% 55.79% 54.07%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, F, D F, E, D B, C, A B, F, D A, G, D	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8 4834 6 5110 7	1924 5220 1753 5543 5863 5506 7431 5571 7407 3265 5954 7414	15399 15103 15570 14780 14460 13817 12892 13752 12916 12058 13369 12909	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455 3487 3211 3329	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3% 60.16% 60.44%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.79% 42.29% 41.51% 40.8%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E B, F, G A, F, G C, A, D	5923 5866 5572 5562 5427 5243 5079 5052 4921 4642 4499 5789	9553 9438 8265 8265 7431 7407 5863 6506 5543 5220 4118 4753 10724 9040	10770 10885 12058 12058 12892 12916 14460 13817 14780 15103 16205 15570 9599	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400 3679 3822 2532 2693	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31% 54.35% 51.2% 46.62%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71% 59.14% 55.79% 54.07% 69.57%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, F, D F, E, D B, C, A B, F, D A, G, D B, E, D	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8 4834 6 5110 7 4992 7 5572 8	4924 5220 4753 5543 5863 5506 7431 5571 7407 3265 5954 7414 7287	15399 15103 15570 14780 14460 13817 12892 13752 12916 12058 13369 12909 13036	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455 3487 3211 3329 2749	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3% 60.16% 60.44%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.79% 42.29% 41.51% 40.01% 40.8%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E B, F, G A, F, G C, A, D B, C, E	5923 5866 5572 5562 5427 5243 5079 5052 4921 4642 4499 5789 5628	9553 9438 8265 8265 7431 7407 5863 6506 5543 5220 4118 4753 10724 9040 8698	10770 10885 12058 12058 12892 12916 14460 13817 14780 15103 16205 15570 9599 11283	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400 3679 3822 2532 2693 2767	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31% 54.35% 51.2% 46.62% 48.96%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71% 59.14% 55.79% 54.07% 69.57% 67.64%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, F, D F, E, D B, C, A B, F, D A, G, D B, E, D B, C, F	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8 4834 6 5110 7 4992 7 5572 8 6077 9	1924 5220 1753 5543 5563 5506 7431 5571 7407 3265 5954 7414 7287 3265 9553	15399 15103 15570 14780 14460 13817 12892 13752 12916 12058 13369 12909 13036 12058	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455 3487 3211 3329 2749 2244	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3% 60.16% 60.44% 60.16%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.29% 41.51% 41.01% 40.8% 40.65% 40.27%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E B, F, G C, A, D B, C, E C, A, F C, A, G C, G, E	5923 5866 5572 5562 5427 5243 5079 5052 4921 4642 4499 5789 5628 5554	9553 9438 8265 7431 7407 5863 6506 5543 5220 4118 4753 10724 9040 8698 9042 9807	10770 10885 12058 12058 12892 12916 14460 13817 14780 15103 16205 15570 9599 11283 11625 11281	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400 3679 3822 2532 2693 2767 2923	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31% 54.35% 51.2% 46.62% 48.96% 49.21%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71% 59.14% 55.79% 54.07% 69.57% 67.64% 66.75% 64.87% 64.68%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D F, E, D B, C, A B, F, D A, G, D B, E, D B, C, F C, A, E C, F, E C, A, F	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8 4834 6 5110 7 4992 7 5572 8 6077 9 5923 9 5554 8	4924 4924	15399 15103 15570 14780 14460 13817 12892 13752 12916 12058 13369 12909 13036 12058 10770 10885 11625	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455 3487 3211 3329 2749 2244 2398 2767	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3% 60.16% 60.44% 60.16% 60.85% 60.82% 59.87%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.29% 41.51% 40.05% 40.65% 40.27% 38.88%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E B, F, G C, A, D B, C, E C, A, F C, A, G C, C, F, G	5923 5866 5572 5562 5427 5243 5079 5052 4921 4642 4499 5789 5628 5554 5398 5382 5342	9553 9438 8265 7431 7407 5863 6506 5543 5220 4118 4753 10724 9040 8698 9042 9807 9127	10770 10885 12058 12058 12892 12916 14460 13817 14780 15103 16205 15570 9599 11283 11625 11281 10516	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400 3679 3822 2532 2693 2767 2923 2939 2979	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31% 54.35% 51.2% 46.62% 48.96% 49.21% 47.43% 45.78% 46.88%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71% 59.14% 55.79% 54.07% 69.57% 67.64% 66.75% 64.87% 64.68%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D F, E, D B, C, A B, F, D A, G, D B, E, D B, C, F C, A, E C, F, E C, A, F B, C, G	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8 4834 6 5110 7 4992 7 5572 8 6077 9 5923 9 5554 8 5181 8	4924 5220 17753 55543 5863 55506 7431 5571 7407 3265 5954 7414 7287 3265 59553 3438 8698 8171	15399 15103 15570 14780 14460 13817 12892 13752 12916 12058 13369 12909 13036 12058 10770 10885 11625 12152	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455 3487 3211 3329 2749 2244 2398 2767 3140	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3% 60.16% 60.44% 60.16% 60.85% 60.82% 59.87% 59.13%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.29% 41.51% 40.65% 40.65% 40.27% 38.88% 38.56% 38.97% 38.8%
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C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E B, F, G C, A, D B, C, E C, A, F C, A, G C, G, E C, F, G B, C, G A, G, D B, E, D A, F, D C, E, D C, E, D C, E, D C, F, D B, C, D	5923 5866 5572 5562 5427 5243 5079 5052 4921 4642 4499 5789 5628 5554 5398 5382 5181 5110 4992 4915 4912 4834 5546 5467 5113	9553 9438 8265 7431 7407 5863 6506 5543 5220 4118 4753 10724 9040 8698 9042 9807 8171 7414 7287 6571 8140 6954 11369 11186	10770 10885 12058 12058 12892 12916 14460 13817 14780 15103 16205 15570 9599 11283 11625 11281 10516 12152 12909 13036 13752 12183 13369 8954 9027 9137	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400 3679 3822 2532 2693 2767 2923 2939 3140 3211 3329 3406 3409 3487 2775 2854 3208	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31% 54.35% 51.2% 46.62% 49.21% 47.43% 45.78% 49.03% 48.47% 49.03% 48.47% 49.63% 48.96% 49.21% 47.43% 41.54%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71% 59.14% 55.79% 64.67% 64.68% 64.2% 62.26% 61.41% 59.99% 59.07% 59.03% 58.09% 66.65% 65.7% 61.45%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, E, D B, C, A B, F, D B, C, A B, F, D B, C, F C, A, E C, F, E C, A, F B, C, G B, C, E B, G, D C, A, G C, F, G C, C, C, C C, C C, C C, C, C C C, C C C,	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8 4834 6 5110 7 4992 7 5572 8 6077 9 5923 9 5554 8 5181 8 5382 9 4424 7 4912 8 5398 9 5342 9 4699 8 5382 9 5789 10 5546 1	1924 1924 1924 1924 1924 1924 1922 1935	15399 15103 15570 14780 14460 13817 12892 13752 12916 12058 13369 12058 10770 10885 16255 12152 111283 13114 12183 11281 11196 12293 10516 9599 8954	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455 3487 3211 3329 2749 2244 2398 2767 3140 2693 3897 3409 2923 2979 3622 2939 2532 2775	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3% 60.16% 60.82% 60.25% 59.87% 59.13% 59.55% 57.56% 57.89% 58.4% 57.95% 57.08% 56.8% 57.09%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.29% 41.51% 40.65% 40.27% 38.88% 38.56% 38.56% 38.77% 38.38% 37.63% 37.38% 36.92% 35.43% 35.06% 32.79%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E B, F, G C, A, D B, C, E C, A, F C, A, G C, A, G C, F, G B, C, G A, G, D B, C, E C, F, G B, C, G A, G, D B, C, C C, F, G B, C, G C, F, G B, C, G C, F, C C, F, C C, F, D C, E, D C, E, D C, E, D C, G, D C, G, D	5923 5866 5572 5562 5427 5243 5079 5052 4921 4642 4499 5789 5628 5554 5398 5382 5342 5110 4992 4915 4912 4834 5546 5467 5113 5040	9553 9438 8265 7431 7407 5863 6506 5543 5220 4118 4753 10724 9040 8698 9042 9807 9127 8171 7414 7287 6571 8140 6954 11369 11186 11402	10770 10885 12058 12058 12892 12916 14460 13817 14780 15103 16205 15570 9599 11283 11625 11281 10516 11196 12152 12909 13036 13752 12183 13369 8954 9027 9137	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400 3679 3822 2532 2693 2767 2923 2939 2979 3140 3211 3329 3406 3409 3487 2775 2854 3208	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31% 54.35% 51.2% 46.62% 48.96% 49.21% 47.43% 45.78% 47.81% 49.03% 48.47% 49.03% 48.47% 49.63% 43.95% 43.95% 41.54% 40.71%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71% 59.14% 55.79% 64.67% 64.87% 64.87% 64.2% 62.26% 61.41% 59.99% 59.07% 59.03% 58.09% 66.65% 65.7% 61.45% 60.57%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, F, D B, C, A B, F, D B, C, F C, A, E C, F, E C, A, E B, G, D G, E, D C, A, G C, F, G C, G, E C, A, D C, C, E, D C, E, D C, E, D C, F, D	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8 4834 6 5110 7 4992 7 5572 8 6077 9 5923 9 5554 8 5181 8 5628 9 5382 9 5382 9 5789 10 5546 11 5467 11	1924 1924 1753 1753 1863 1855 1863 1855 1740 1740 1740 1740 1740 1740 1740 1740	15399 15103 15570 14780 14460 13817 12892 13752 12916 12058 13369 12058 10770 10885 16255 12152 111283 13114 12183 11281 11196 12293 10516 9599 8954 9027	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455 3487 3211 3329 2749 2244 2398 2767 3140 2693 3897 3409 2923 2979 3622 2939 2532 2775 2854	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3% 60.16% 60.82% 60.25% 59.87% 59.13% 59.55% 57.56% 57.89% 58.4% 57.95% 57.09% 54.56% 54.3%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.29% 41.51% 40.65% 40.27% 38.88% 38.56% 38.97% 38.37% 38.37% 38.37% 37.38% 36.92% 35.43% 35.06% 32.79% 32.61%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E B, F, G C, A, D B, C, E C, A, F C, A, G C, A, G C, F, G B, C, G B, C, G A, G, D B, E, D C, E, D C, E, D C, E, D C, G, D F, G, D F, G, D F, G, D	5923 5866 5572 5562 5427 5243 5079 5052 4921 4642 4499 5789 5628 5554 5398 5382 5342 5110 4992 4915 4912 4834 5546 5467 5113 5040 4699	9553 9438 8265 7431 7407 5863 6506 5543 5220 4118 4753 10724 9040 8698 9042 9807 9127 8171 7414 7287 6571 8140 6954 111369 11186 111402 8030	10770 10885 12058 12058 12892 12916 14460 13817 14780 15103 16205 15570 9599 11283 11625 11281 10516 11196 12152 12909 13036 13752 12183 13369 8954 9027 9137 8921 12293	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400 3679 3822 2532 2693 2767 2923 2939 2979 3140 3211 3329 3406 3409 3487 2775 2854 3208 3281 3622	50.75% 50.02% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31% 54.35% 51.2% 46.62% 48.96% 49.21% 47.43% 45.78% 47.81% 49.03% 48.47% 49.03% 48.47% 49.63% 43.95% 43.95% 43.59% 41.54% 40.71% 44.65%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71% 59.14% 55.79% 64.67% 64.87% 64.87% 64.2% 62.26% 61.41% 59.99% 59.07% 59.03% 58.09% 66.65% 65.7% 61.45% 60.57% 56.47%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, E, D B, C, A B, F, D B, C, F C, A, E C, F, E C, A, E B, G, D G, E, D C, A, G C, F, G C, G, E C, A, D C, C, E, D	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8 4834 6 5110 7 4992 7 5572 8 6077 9 5923 9 5554 8 5181 8 5628 7 4912 8 5398 9 5382 9 5789 10 5546 11 5467 11	1924 1924 1924 1924 1926 1936	15399 15103 15570 14780 14460 13817 12892 13752 12916 12058 13369 12909 13036 12058 10770 10885 16152 12152 11283 13114 12183 11281 11196 12293 10516 9599 8954 9027	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455 3487 3211 3329 2749 2244 2398 2767 3140 2693 3897 3409 2923 2979 3622 2939 2532 2775 2854 3208	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3% 60.16% 60.82% 60.25% 59.87% 59.13% 57.56% 57.56% 57.89% 58.4% 57.95% 57.09% 54.56% 54.3% 52.69%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.29% 41.51% 40.65% 40.65% 40.27% 38.88% 38.56% 38.97% 38.37% 38.33% 37.38% 36.92% 35.43% 35.06% 32.79% 32.61% 31.37%
C, A, E C, F, E B, C, A B, C, F A, E, D F, E, D A, G, E B, A, D F, G, E B, F, G C, A, D B, C, E C, A, F C, A, G C, A, G C, F, G B, C, G A, G, D B, C, E C, F, G B, C, G A, G, D B, C, C C, F, G B, C, G C, F, G B, C, G C, F, C C, F, C C, F, D C, E, D C, E, D C, E, D C, G, D C, G, D	5923 5866 5572 5562 5427 5243 5079 5052 4921 4642 4499 5789 5628 5554 5398 5382 5342 5110 4992 4915 4912 4834 5546 5467 5113 5040	9553 9438 8265 7431 7407 5863 6506 5543 5220 4118 4753 10724 9040 8698 9042 9807 9127 8171 7414 7287 6571 8140 6954 111369 111369 111402 8030 7209	10770 10885 12058 12058 12916 14460 13817 14780 15103 16205 15570 9599 11283 11625 11281 10516 11196 12152 12909 13036 13752 12183 13369 8954 9027 9137 8921 12293 13114	2244 2398 2455 2749 2759 2894 3078 3242 3269 3400 3679 3822 2532 2693 2767 2923 2939 2979 3140 3211 3329 3406 3409 3487 2775 2854 3208 3281 3622 3897	50.75% 50.02% 50.029% 52.25% 50.29% 52.19% 51.31% 53.98% 51.03% 53.42% 53.31% 54.35% 51.2% 46.62% 48.96% 49.21% 47.43% 45.78% 46.88% 47.81% 49.03% 48.47% 49.63% 43.95% 43.95% 43.95% 43.95% 44.65% 44.34%	73.03% 71.18% 70.5% 66.96% 66.84% 65.22% 63.01% 61.04% 60.71% 59.14% 55.79% 64.67% 64.87% 64.87% 64.2% 62.26% 61.41% 59.99% 59.07% 59.03% 58.09% 66.65% 65.7% 61.45% 60.57%	A, F, E B, G, E A, F, G F, G, E A, G, E B, A, D A, E, D A, F, D B, C, A B, F, D A, G, D B, C, F C, A, E C, F, E C, A, F B, C, G B, C, E B, G, D C, A, G C, F, G C, F, G C, F, G C, G, D	5182 4 4921 5 4499 4 5052 5 5243 5 5079 6 5562 7 4915 6 5427 7 5866 8 4834 6 5110 7 4992 7 5572 8 6077 9 5923 9 5554 8 5181 8 5628 9 4424 7 4912 8 5398 9 5382 9 5382 9 5382 9 5546 11 5467 11 5546 11 5467 11	1924 1924 1924 1924 1926 1938	15399 15103 15570 14780 14460 13817 12892 13752 12916 12058 13369 12058 10770 10885 11625 12152 11283 13114 12183 11281 11196 12293 10516 9599 8954 9027 9137 8921	3139 3400 3822 3269 3078 3242 2759 3406 2894 2455 3487 3211 3329 2749 2244 2398 2767 3140 2693 3897 3409 2923 2979 2923 2979 2532 2775 2854 3208 3281	67.17% 65.08% 64.46% 64.79% 64.83% 62.42% 62.59% 61.47% 61.99% 62.3% 60.16% 60.82% 60.25% 59.87% 59.13% 59.55% 57.56% 57.56% 57.89% 57.95% 57.08% 57.08% 54.36% 54.36% 51.88%	51.28% 48.53% 48.63% 47.68% 47.21% 43.84% 42.81% 42.29% 41.51% 40.65% 40.27% 38.88% 38.56% 38.97% 38.37% 38.37% 38.37% 37.38% 36.92% 35.43% 35.06% 32.79% 32.61%

Table 3.2: Ranking of Combination of 3 SAST tools by scenario

Chapter 4

Performance results for all Combinations of 2 Tools using the 2nd strategy

In order to refine the analysis already carried out in the combined execution of SAST tools and, consequently, understand the impact of this approach on the vulnerabilities contained within each category of the OWASP Top 10, a new strategy was implemented in which the performance of the tools dictates their weight in the combination. Since the application of this strategy involves assigning a weight to the SAST tools according to their position in the ranking against a given vulnerability and scenario, as shown in example 2 of the "Combinations of tools" step in the Methodology stage 4.1.4.4, the weights obtained according to their performance in relation to this scope are shown in table 4.1. The results of combining two SAST tools' outputs based on them are displayed in the present section from table 4.2 to table 4.21, each of which refers to a specific OWASP Top 10 category. For a given vulnerability contained in the latter, the rankings achieved with regard to the metrics associated with different vulnerability detection contexts are provided.

Weights of tools for each scenario regarding all different vulnerabilities

Vulnerability	I	Bypassing A	uthorizatio	n	Vulnerability	Insu	ifficient Ses	ssion Expira	tion
Tool	1	2	3	4	Tool	1	2	3	4
Snyk	0.1529	0.1529	0.1579	0.1529	Snyk	0.1404	0.1404	0.1404	0.1404
Fortify	0.1379	0.1379	0.1379	0.1329	Fortify	0.1404	0.1404	0.1404	0.1404
Semgrep	0.1329	0.1329	0.1329	0.1429	Semgrep	0.1404	0.1404	0.1404	0.1404
Synopsis	0.1429	0.1429	0.1529	0.1579	Synopsis	0.1579	0.1579	0.1579	0.1579
Horusec	0.1279	0.1279	0.1279	0.1279	Horusec	0.1404	0.1404	0.1404	0.1404
Kiuwan	0.1479	0.1479	0.1479	0.1479	Kiuwan	0.1404	0.1404	0.1404	0.1404
SpotBugs	0.1579	0.1579	0.1429	0.1379	SpotBugs	0.1404	0.1404	0.1404	0.1404
Vulnerability			aversal		Vulnerability	Cı		equest Forge	
Tool	1	2	3	4	Tool	1	2	3	4
Snyk	0.1479	0.1529	0.1579	0.1579	Snyk	0.1529	0.1479	0.1479	0.1529
Fortify	0.1529	0.1479	0.1479	0.1329	Fortify	0.1429	0.1529	0.1529	0.1429
Semgrep	0.1379	0.1379	0.1379	0.1429	Semgrep	0.1379	0.1429	0.1429	0.1379
Synopsis	0.1329	0.1329	0.1329	0.1479	Synopsis	0.1479	0.1329	0.1329	0.1479
Horusec	0.1304	0.1304	0.1304	0.1304	Horusec	0.1279	0.1279	0.1279	0.1279
Kiuwan	0.1429	0.1429	0.1529	0.1529	Kiuwan	0.1579	0.1579	0.1579	0.1579
SpotBugs	0.1579	0.1579	0.1429	0.1379	SpotBugs	0.1329	0.1379	0.1379	0.1329
Vulnerability		of Old/Inse			Vulnerability		1	Iash Function	
Tool	0.1454	2	3	0.1254	Tool	0.1270	2	0.1520	0.1220
Snyk	0.1454	0.1354	0.1354	0.1354	Snyk	0.1379	0.1529	0.1529	0.1329
Fortify	0.1379	0.1529	0.1529	0.1529	Fortify	0.1529	0.1479 0.1279	0.1479	0.1479
Semgrep	0.1529 0.1279	0.1579 0.1279	0.1579 0.1279	0.1579 0.1279	Semgrep	0.1279 0.1429	0.1279	0.1279 0.1379	0.1529 0.1379
Synopsis Horusec	0.1279	0.1279	0.1279	0.1279	Synopsis Horusec	0.1429	0.1379	0.1379	0.1379
Kiuwan	0.1379	0.1479	0.1429	0.1429	Kiuwan	0.1379	0.1379	0.1379	0.1279
SpotBugs	0.1329	0.1429	0.1479	0.1479	SpotBugs	0.1479	0.1429	0.1429	0.1429
Vulnerability		eds Hard Co			Vulnerability			and Injection	
Tool	1	2	3	4	Tool	1	2	3	4
Snyk	0.1379	0.1379	0.1379	0.1379	Snyk	0.1379	0.1379	0.1379	0.1429
Fortify	0.1379	0.1379	0.1379	0.1379	Fortify	0.1579	0.1579	0.1579	0.1379
Semgrep	0.1379	0.1379	0.1379	0.1379	Semgrep	0.1429	0.1429	0.1429	0.1479
Synopsis	0.1554	0.1554	0.1554	0.1554	Synopsis	0.1479	0.1479	0.1479	0.1529
Horusec	0.1554	0.1554	0.1554	0.1554	Horusec	0.1329	0.1329	0.1329	0.1329
Kiuwan		0.1379	0.1379	0.1379	Kiuwan				
LAIU W AII	0.13/9	0.15/9	0.13/9	0.15/9	Niuwan	1 0.12/9	0.12/9	0.12/9	0.1279
	0.1379 0.1379	0.1379	0.1379			0.1279 0.1529	0.1279 0.1529	0.1279 0.1529	0.1279 0.1579
SpotBugs	0.1379	0.1379	0.1379	0.1379	SpotBugs	0.1279	0.1529		0.1279
	0.1379	l	0.1379	0.1379		I	0.1529	0.1529	I I
SpotBugs Vulnerability	0.1379	0.1379 OS Comma	0.1379 nd Injection	0.1379 n	SpotBugs Vulnerability	0.1529	0.1529 SQL It	0.1529 njection	0.1579
SpotBugs Vulnerability Tool	0.1379	0.1379 OS Comma 2	0.1379 nd Injection 3	0.1379 n 4	SpotBugs Vulnerability Tool	0.1529	0.1529 SQL II	0.1529 njection 3	0.1579
SpotBugs Vulnerability Tool Snyk	0.1379 1 0.1479 0.1529 0.1279	0.1379 OS Comma 2 0.1579 0.1529 0.1279	0.1379 nd Injection 3 0.1579 0.1379 0.1279	0.1379 n 4 0.1529 0.1279 0.1379	SpotBugs Vulnerability Tool Snyk	0.1529 1 0.1329 0.1429 0.1479	0.1529 SQL II 2 0.1379 0.1429 0.1479	0.1529 njection 3 0.1579 0.1479 0.1379	0.1579 4 0.1579 0.1479 0.1379
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis	0.1379 1 0.1479 0.1529 0.1279 0.1329	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429	0.1379 4 0.1529 0.1279 0.1379 0.1479	SpotBugs Vulnerability Tool Snyk Fortify	0.1529 1 0.1329 0.1429 0.1479 0.1279	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1329	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529	0.1579 4 0.1579 0.1479
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379	0.1379 OS Comma 2 0.1579 0.1529 0.1279	0.1379 nd Injection 3 0.1579 0.1379 0.1279	0.1379 0.1379 0.1529 0.1279 0.1379 0.1479 0.1579	SpotBugs Vulnerability Tool Snyk Fortify Semgrep	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1329 0.1279	0.1529 njection 3 0.1579 0.1479 0.1379	0.1579 4 0.1579 0.1479 0.1379
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479	0.1379 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379 0.1529	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1329 0.1279 0.1579	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329	0.1379 0.1379 0.1529 0.1279 0.1379 0.1479 0.1579	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1329 0.1279 0.1579 0.1529	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection	0.1379 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379 0.1529 0.1579	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1329 0.1279 0.1579 0.1529 Cross-Site	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3	0.1379 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379 0.1529 0.1579	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1329 0.1279 0.1579 0.1529 Cross-Site	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479	0.1379 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379 0.1529 0.1579	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1329 0.1279 0.1579 0.1529 Cross-Site 2 0.1529	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479 0.1579	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529	0.1379 1 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1429	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379 0.1529 0.1579 1 0.1529 0.1479	0.1529 SQL Ir 2 0.1379 0.1429 0.1479 0.1329 0.1579 0.1529 Cross-Site 2 0.1529 0.1479	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1529	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1479
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1479	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479 0.1579 0.1329	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1529 0.1479	0.1379 1 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1429 0.1329	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1529 0.1579 1 0.1529 0.1529 0.1479 0.1329	0.1529 SQL Ir 2 0.1379 0.1429 0.1479 0.1329 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1529 0.1529 0.1579	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1479 0.1529
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1479 0.1529	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479 0.1579 0.1329 0.1429	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1529 0.1479 0.1529 0.1529 0.1529	0.1379 1 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1429 0.1329 0.1329	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1529 0.1579 1 0.1529 0.1579 0.1529 0.1479 0.1329 0.1429	0.1529 SQL Ir 2 0.1379 0.1429 0.1479 0.1329 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329 0.1429	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1529 0.1529 0.1529 0.1529 0.1529 0.1379	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1479 0.1529 0.1429
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1479 0.1529 0.1304	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479 0.1579 0.1329 0.1329 0.1429 0.1304	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1279 0.1379 0.1379 0.1304	0.1379 1 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1429 0.1329 0.1329 0.1379 0.1304	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379 0.1529 0.1579 1 0.1529 0.1479 0.1329 0.1429 0.1279	0.1529 SQL Ir 2 0.1379 0.1429 0.1479 0.1329 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329 0.1429 0.1429	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1529 0.1529 0.1529 0.1529 0.1529 0.179	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1479 0.1529 0.1429 0.1529
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1479 0.1529 0.1304 0.1279	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479 0.1579 0.1329 0.1429 0.1304 0.1279	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1279 0.1379 0.1304 0.1429	0.1379 1 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1429 0.1329 0.1329 0.1379 0.1304 0.1529	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1529 0.1579 1 0.1529 0.1479 0.1329 0.1429 0.1429 0.1579	0.1529 SQL Is 2 0.1379 0.1429 0.1479 0.1329 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329 0.1429 0.1429 0.1579	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1529 0.1529 0.1529 0.1529 0.1529 0.179 0.1429 0.1429 0.1479	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1479 0.1529 0.1429 0.1529 0.1429 0.1529
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1479 0.1529 0.1304	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479 0.1579 0.1329 0.1329 0.1429 0.1304 0.1279 0.1379	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1279 0.1379 0.1379 0.1304 0.1429 0.1329	0.1379 1 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1429 0.1329 0.1329 0.1379 0.1304	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1579 1 0.1529 0.1579 1 0.1529 0.1479 0.1329 0.1429 0.1279 0.1579 0.1579	0.1529 SQL Is 2 0.1379 0.1429 0.1479 0.1329 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329 0.1429 0.1279 0.1379	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1529 0.1529 0.1529 0.1379 0.1529 0.1379 0.1429 0.1429 0.1279 0.1429 0.1329	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1479 0.1529 0.1429 0.1529 0.1429 0.1329
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1479 0.1529 0.1304 0.1279 0.1429	0.1379 OS Comma 2 0.1579 0.1529 0.1529 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479 0.1579 0.1329 0.1329 0.1329 0.1379 XPath I	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1279 0.1379 0.1304 0.1429 0.1329 njection	0.1379 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1429 0.1329 0.1379 0.1304 0.1529 0.1279	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1529 0.1579 1 0.1529 0.1479 0.1329 0.1429 0.1279 0.1579 0.1379	0.1529 SQL Ir 2 0.1379 0.1429 0.1479 0.1329 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329 0.1429 0.1429 0.1279 0.1579 0.1579 0.1579 0.1579	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1529 0.1529 0.1529 0.1529 0.1529 0.1529 0.1529 0.1379 0.1429 0.1279 0.1429 0.1279 0.1479 0.1329 0.1329 0.1329 0.1379	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1479 0.1529 0.1429 0.1329 0.1329 0.1329
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1479 0.1529 0.1304 0.1279 0.1429	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479 0.1579 0.1329 0.1429 0.1304 0.1279 0.1379 XPath I 2	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1279 0.1379 0.1304 0.1429 0.1329 njection 3 0.1429 0.1329 njection 3	0.1379 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1429 0.1329 0.1379 0.1304 0.1529 0.1379	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379 0.1529 0.1579 1 0.1529 0.1479 0.1329 0.1429 0.1279 0.1579 1 0.1579	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1329 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329 0.1479 0.1329 0.1479 0.1329 0.1479 0.1579 0.1579 0.1379	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1579 0.1529 0.1379 0.1529 0.1379 0.1429 0.1379 0.1429 0.1379 0.1429 0.1379 0.1429 0.1379 0.1429 0.1379 0.1429 0.1379 0.1479 0.1329	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1479 0.1529 0.1429 0.1529 0.1429 0.1329 0.1379 0.1329 g 4
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SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1479 0.1529 0.1304 0.1279 0.1429 1 0.1329 0.1579 0.1429 0.1554	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479 0.1579 0.1329 0.1304 0.1279 0.1304 0.1279 0.1379 XPath I 2 0.1479 0.1579 0.1379 0.1579 0.1554	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1279 0.1379 0.1304 0.1429 0.1329 njection 3 0.1479 0.1554	0.1379 4 0.1529 0.1279 0.1379 0.1479 0.1429 0.1329 4 0.1479 0.1329 0.1379 0.1304 0.1529 0.1379 0.1279 4 0.1479 0.1554	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec	0.1529 1 0.1329 0.1429 0.1479 0.1379 0.1529 0.1579 1 0.1529 0.1479 0.1329 0.1429 0.1279 0.1379 1 0.1529 0.1429 0.1329 0.1329 0.1329 0.1329	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1529 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329 0.1429 0.1279 0.1579 0.1379 ITTP Respo	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1429 0.1379 0.1429 0.1379 0.1429 0.1329 0.1579 0.1429 0.1329 0.1329 0.1329 0.1329	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1479 0.1529 0.1479 0.1529 0.1429 0.1379 0.1329 g 4 0.1579 0.1329 0.1329 0.1329 0.1329 0.1329
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SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1479 0.1529 0.1304 0.1279 0.1429 1 0.1329 0.1579 0.1429 0.1554 0.1479 0.1529 0.1554 0.1479 0.1529	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479 0.1579 0.1329 0.1304 0.1279 0.1379 XPath I 2 0.1479 0.1579 0.1379 XPath I 2 0.1479 0.1579 0.1529	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1379 0.1304 0.1429 0.1329 njection 3 0.1479 0.1559 0.1379 0.1379 0.1579 0.1579 0.1379 0.1579 0.1579 0.1479 0.1554 0.1529 0.1429	0.1379 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1329 0.1379 0.1304 0.1529 0.1379 0.1579 0.1279 4 0.1479 0.1579 0.1579 0.1579 0.1379 0.1379 0.1379 0.1379 0.1379	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379 0.1529 0.1529 0.1579 1 0.1529 0.1479 0.1329 0.1429 0.1379 0.1579 1 0.1529 0.1429 0.1329 0.1429 0.1329 0.1329 0.1329 0.1329 0.1329 0.1379	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1329 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329 0.1479 0.1329 0.1479 0.1379 ITTP Responsible State S	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1429 0.1379 0.1429 0.1379 0.1429 0.1379 0.1429 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1479	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1479 0.1529 0.1479 0.1329 g 4 0.1579 0.1329 g 4 0.1579 0.1329 g 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1479 0.1529 0.1304 0.1279 0.1429 1 0.1329 0.1579 0.1429 0.1554 0.1479 0.1529 0.1554 0.1479 0.1529	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 LDAP I 2 0.1479 0.1579 0.1329 0.1304 0.1279 0.1304 0.1279 0.1379 XPath I 2 0.1479 0.1579 0.1379 0.1429 0.1554 0.1479	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1379 0.1304 0.1429 0.1329 njection 3 0.1479 0.1559 0.1379 0.1379 0.1579 0.1579 0.1379 0.1579 0.1579 0.1479 0.1554 0.1529 0.1429	0.1379 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1329 0.1379 0.1304 0.1529 0.1379 0.1579 0.1279 4 0.1479 0.1579 0.1579 0.1579 0.1379 0.1379 0.1379 0.1379 0.1379	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379 0.1529 0.1529 0.1579 1 0.1529 0.1479 0.1329 0.1429 0.1379 0.1579 1 0.1529 0.1429 0.1329 0.1429 0.1329 0.1329 0.1329 0.1329 0.1329 0.1379	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1329 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329 0.1479 0.1329 0.1479 0.1379 ITTP Responsible State S	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1529 0.1379 0.1429 0.1279 0.1329 0.1329 0.1529 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1479 0.1529 0.1479 0.1329 g 4 0.1579 0.1329 g 4 0.1579 0.1329 g 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Semgrep Synopsis Horusec Kiuwan SpotBugs	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1529 0.1304 0.1279 0.1429 1 0.1329 0.1579 0.1429 0.1579 0.1429 1 0.1329 0.1579 0.1429 1 0.1529 0.1579 0.1429 1 0.1529 0.1554 0.1479 0.1529	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 0.1579 0.1329 0.1429 0.1304 0.1279 0.1379 XPath I 2 0.1479 0.1579 0.1379 XPath I 2 0.1479 0.1579 0.1529 mproper Er	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1379 0.1304 0.1429 0.1329 njection 3 0.1479 0.1559 0.1379 0.1579 0.1379 0.1579 0.1579 0.1579 0.1579 0.1579 0.1429 ror Handlin	0.1379 1 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1329 0.1379 0.1304 0.1529 0.1279 4 0.1479 0.1579 0.1279 0.1379 0.1379 0.1379 0.1379 0.1379 0.1379 0.1379 0.1379	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379 0.1529 0.1529 0.1579 1 0.1529 0.1479 0.1329 0.1429 0.1279 0.1579 0.1379 Fig. 1 0.1529 0.1429 0.1329 0.1329 0.1329 0.1329 0.1329 0.1379 T	0.1529 SQL II 2 0.1379 0.1429 0.1479 0.1529 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329 0.1479 0.1329 0.1479 0.1379 ITTP Responsible State S	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 0.1579 0.1529 0.1379 0.1429 0.1379 0.1429 0.1379 0.1429 0.1379 0.1429 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1479 ary Violatic	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1429 0.1329 0.1279 0.1329 0.1329 0.1329 g 4 0.1579 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1529 0.1479 0.1579
SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool	0.1379 1 0.1479 0.1529 0.1279 0.1329 0.1379 0.1429 0.1579 1 0.1329 0.1579 0.1479 0.1529 0.1304 0.1279 0.1429 1 0.1329 0.1579 0.1429 0.1554 0.1479 0.1529 1 1	0.1379 OS Comma 2 0.1579 0.1529 0.1279 0.1329 0.1379 0.1429 0.1479 1.1579 0.1329 0.1479 0.1579 0.1329 0.1429 0.1374 0.1279 0.1379 XPath I 2 0.1479 0.1579 0.1379 0.1529 mproper Er 2	0.1379 nd Injection 3 0.1579 0.1379 0.1279 0.1429 0.1529 0.1479 0.1329 njection 3 0.1479 0.1529 0.1279 0.1379 0.1304 0.1429 0.1329 njection 3 0.1479 0.1554 0.1529 0.1479 0.1554 0.1529 0.1429 ror Handlin 3	0.1379 1 4 0.1529 0.1279 0.1379 0.1479 0.1579 0.1429 0.1329 4 0.1479 0.1329 0.1379 0.1304 0.1529 0.1279 4 0.1479 0.1554 0.1479 0.1329 0.1379 0.1379 0.1379 0.1379 0.1379 0.1379 0.1379 0.1379 0.1554	SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool Snyk Fortify Semgrep Synopsis Horusec Kiuwan SpotBugs Vulnerability Tool	0.1529 1 0.1329 0.1429 0.1479 0.1279 0.1379 0.1529 0.1529 0.1579 1 0.1529 0.1479 0.1329 0.1429 0.1379 0.1579 1 0.1529 0.1429 0.1329 0.1329 0.1329 0.1329 0.1329 0.1379 T 1	0.1529 SQL Ir 2 0.1379 0.1429 0.1479 0.1329 0.1579 0.1529 Cross-Site 2 0.1529 0.1479 0.1329 0.1479 0.1329 0.1479 0.1379 ITTP Respective Service Servic	0.1529 njection 3 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 e Scripting 3 0.1579 0.1529 0.1379 0.1429 0.1379 0.1429 0.1379 0.1429 0.1329	0.1579 4 0.1579 0.1479 0.1379 0.1529 0.1279 0.1429 0.1329 4 0.1579 0.1429 0.1329 0.1329 0.1329 0.1329 g 4 0.1579 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1329 0.1479 0.1479 0.1479

Comomon	0.1479	0.1429	0.1429	0.1529	Camanan	0.1379	0.1429	0.1429	0.1479
Semgrep Synopsis	0.1479	0.1429	0.1429	0.1329	Semgrep Synopsis	0.1579	0.1429	0.1429	0.1479
Horusec	0.1329	0.1329	0.1329	0.1329	Horusec	0.1379	0.1379	0.1379	0.1329
		0.1304			Kiuwan	0.1279			0.1279
Kiuwan	0.1429		0.1479	0.1479			0.1379	0.1329	
SpotBugs	0.1329	0.1329	0.1329	0.1329	SpotBugs	0.1529	0.1529	0.1529	0.1379
Vulnerability	1		ampering	4	Vulnerability			mal Entities	
Tool	1	2	3	4	Tool	1	2	3	4
Snyk	0.1379	0.1379	0.1379	0.1379	Snyk	0.1579	0.1579	0.1579	0.1529
Fortify	0.1379	0.1379	0.1379	0.1379	Fortify	0.1304	0.1304	0.1304	0.1279
Semgrep	0.1529	0.1529	0.1529	0.1529	Semgrep	0.1529	0.1529	0.1529	0.1429
Synopsis	0.1379	0.1379	0.1379	0.1379	Synopsis	0.1429	0.1429	0.1429	0.1479
Horusec	0.1379	0.1379	0.1379	0.1379	Horusec	0.1304	0.1304	0.1304	0.1329
Kiuwan	0.1479	0.1429	0.1429	0.1429	Kiuwan	0.1379	0.1379	0.1379	0.1379
SpotBugs	0.1379	0.1379	0.1379	0.1379	SpotBugs	0.1479	0.1479	0.1479	0.1579
Vulnerability		d Programm			Vulnerability	Insecure		rd Coded C	
Tool	1	2	3	4	Tool	1	2	3	4
Snyk	0.1479	0.1479	0.1479	0.1479	Snyk	0.1579	0.1579	0.1579	0.1579
Fortify	0.1379	0.1379	0.1379	0.1379	Fortify	0.1379	0.1329	0.1329	0.1429
Semgrep	0.1579	0.1579	0.1579	0.1529	Semgrep	0.1279	0.1279	0.1279	0.1279
Synopsis	0.1529	0.1529	0.1529	0.1579	Synopsis	0.1529	0.1529	0.1529	0.1379
Horusec	0.1329	0.1329	0.1329	0.1329	Horusec	0.1329	0.1379	0.1379	0.1329
Kiuwan	0.1279	0.1279	0.1279	0.1279	Kiuwan	0.1479	0.1479	0.1479	0.1529
SpotBugs	0.1429	0.1429	0.1429	0.1429	SpotBugs	0.1429	0.1429	0.1429	0.1479
Vulnerability	Vulner	able Third-	Party Comp	onents	Vulnerability	В	ypassing A	uthentication	on
Tool	1	2	3	4	Tool	1	2	3	4
Snyk	0.1404	0.1354	0.1354	0.1454	Snyk	0.1429	0.1429	0.1429	0.1429
Fortify	0.1579	0.1579	0.1579	0.1579	Fortify	0.1429	0.1429	0.1429	0.1429
Semgrep	0.1479	0.1429	0.1429	0.1529	Semgrep	0.1429	0.1429	0.1429	0.1429
Synopsis	0.1529	0.1429	0.1379	0.1379	Synopsis	0.1429	0.1429	0.1429	0.1429
Horusec	0.1329	0.1479	0.1479	0.1379	Horusec	0.1429	0.1429	0.1429	0.1429
Kiuwan	0.1579	0.1579	0.1579	0.1579	Kiuwan	0.1429	0.1429	0.1429	0.1429
SpotBugs	0.1479	0.1479	0.1479	0.1579	SpotBugs	0.1429	0.1429	0.1429	0.1429
Vulnerability		Hard Coded	l Passwords	3	Vulnerability]	insecure De	serialization	n
Tool	1	2	3	4	Tool	1	2	3	4
Snyk	0.1529	0.1529	0.1529	0.1479	Snyk	0.1454	0.1504	0.1504	0.1554
Fortify	0.1329	0.1329	0.1329	0.1329	Fortify	0.1304	0.1304	0.1304	0.1354
Semgrep	0.1379	0.1379	0.1379	0.1429	Semgrep	0.1529	0.1429	0.1379	0.1279
Synopsis	0.1579	0.1579	0.1579	0.1529	Synopsis	0.1579	0.1579	0.1579	0.1479
Horusec	0.1279	0.1279	0.1279	0.1279	Horusec	0.1304	0.1304	0.1304	0.1354
Kiuwan	0.1479	0.1479	0.1429	0.1379	Kiuwan	0.1379	0.1379	0.1429	0.1429
SpotBugs	0.1429	0.1429	0.1479	0.1579	SpotBugs	0.1454	0.1504	0.1504	0.1554
Vulnerability		Output Ne			Vulnerability			equest Forg	
Tool	1	2	3	4	Tool	1	2	3	4
Snyk	0.1429	0.1429	0.1429	0.1479	Snyk	0.1529	0.1529	0.1529	0.1529
Fortify	0.1579	0.1579	0.1579	0.1379	Fortify	0.1304	0.1304	0.1304	0.1304
Semgrep	0.1529	0.1529	0.1529	0.1579	Semgrep	0.1579	0.1579	0.1579	0.1429
Synopsis	0.1329	0.1329	0.1329	0.1379	Synopsis	0.1379	0.1379	0.1379	0.1429
Horusec	0.1329	0.1379	0.1379	0.1329	Horusec	0.1429	0.1429	0.1429	0.1379
Kiuwan	0.1279	0.1279	0.1279	0.1279	Kiuwan	0.1304	0.1304	0.1304	0.1304
SpotBugs	0.1479	0.1479	0.1479	0.1479	SpotBugs	0.1479	0.1479	0.1479	0.1479
Spotbugs					ical 3 - Best Effe				0.1379
	r - Dus	iness Citile	ui 2 - 11018	sincincu CIII	icai i 3 - Dest Elle	Sit - IVIIII	imum Eno.		

Table 4.1: Weights of each tool for each scenario regarding all the vulnerabilities

Results obtained in A1: Broken Access Control

					1	A1: Broken A	ccess Contro	ol					
]	Busines				Metric	Tiebreaker		eighten				Metric	Tiebreaker
Comb.	TP	FN	FP	TN	Recall	Precison	Comb.	TP	FN	FP	TN	Rec.*Infor.	Recall
G D	202		700	020	07.766	Path Tr		270	- 22	110	1.400	00.2001	04.066
C, D	392	9	782	828	97.76%	33.39%	B, C	378	23	112	1498	88.28%	94.26%
B, D B, C	385	16 35	782 732	828 878	96.01% 91.27%	32.99% 33.33%	B, E C, D	340	61	112 782	1498 828	75.39% 72.92%	84.79% 97.76%
С, А	364	37	732	878	90.77%	33.33%	B, D	385	16	782	828	70.78%	96.01%
C, A	363	38	732	878	90.77%	33.15%	E, D	380	21	782	828	69.27%	94.76%
E, D	380	21	782	828	94.76%	32.7%	F, D	375	26	782	828	67.77%	93.52%
F, D	375	26	782	828	93.52%	32.41%	A, D	375	26	782	828	67.77%	93.52%
A, D	375	26	782	828	93.52%	32.41%	G, D	375	26	782	828	67.77%	93.52%
G, D	375	26	782	828	93.52%	32.41%	C, A	364	37	732	878	65.95%	90.77%
C, F	355	46	732	878	88.53%	32.66%	C, E	363	38	732	878	65.66%	90.52%
C, G	355	46	732	878	88.53%	32.66%	B, A	308	93	112	1498	65.23%	76.81%
B, E	340	61	112	1498	84.79%	75.22%	B, F	308	93	112	1498	65.23%	76.81%
B, A	308	93	112	1498	76.81%	73.33%	B, G	308	93	112	1498	65.23%	76.81%
B, F	308	93	112	1498	76.81%	73.33%	C, F	355	46	732	878	63.33%	88.53%
B, G	308	93	112	1498 1487	76.81% 72.07%	73.33% 70.15%	C, G A, E	355	46 112	732 123	878 1487	63.33% 59.25%	88.53% 72.07%
A, E F, E	275	126	123	1487	68.58%	69.1%	F, E	275	126	123	1487	55.18%	68.58%
G, E	275	126	123	1487	68.58%	69.1%	G, E	275	126	123	1487	55.18%	68.58%
A, F	193	208	228	1382	48.13%	45.84%	A, F	193	208	228	1382	32.24%	48.13%
A, G	193	208	228	1382	48.13%	45.84%	A, G	193	208	228	1382	32.24%	48.13%
F, G	13	388	1	1609	3.24%	92.86%	F, G	13	388	1	1609	1.67%	3.24%
, -						Bypassing A				l .			
C, D	239	10	294	1643	95.98%	44.84%	C, D	239	10	294	1643	86.77%	95.98%
F, D	207	42	294	1643	83.13%	41.32%	F, D	207	42	294	1643	69.81%	83.13%
B, D	207	42	294	1643	83.13%	41.32%	B, D	207	42	294	1643	69.81%	83.13%
A, D	207	42	294	1643	83.13%	41.32%	A, D	207	42	294	1643	69.81%	83.13%
E, D	207	42	294	1643	83.13%	41.32%	E, D	207	42	294	1643	69.81%	83.13%
G, D	207	42	294	1643	83.13%	41.32%	G, D	207	42	294	1643	69.81%	83.13%
B, C	184	65	3	1934	73.9%	98.4%	B, C	184	65	3	1934	64.19%	73.9%
B, A	154	95 97	3	1934	61.85%	98.09%	B, A	154	95 97	3	1934	50.0% 49.11%	61.85%
B, F B, G	152	97	3	1934 1934	61.04%	98.06% 98.06%	B, F B, G	152	97	3	1934 1934	49.11%	61.04% 61.04%
В, Б	152	97	3	1934	61.04%	98.06%	В, Е	152	97	3	1934	49.11%	61.04%
C, E	138	111	109	1828	55.42%	55.87%	C, E	138	111	109	1828	41.51%	55.42%
C, F	119	130	0	1937	47.79%	100.0%	C, F	119	130	0	1937	35.32%	47.79%
A, E	110	139	109	1828	44.18%	50.23%	A, E	110	139	109	1828	30.6%	44.18%
F, E	109	140	109	1828	43.78%	50.0%	F, E	109	140	109	1828	30.24%	43.78%
G, E	106	143	109	1828	42.57%	49.3%	G, E	106	143	109	1828	29.15%	42.57%
A, F	92	157	0	1937	36.95%	100.0%	A, F	92	157	0	1937	25.3%	36.95%
F, G	87	162	0	1937	34.94%	100.0%	F, G	87	162	0	1937	23.57%	34.94%
C, A	41	208	263	1674	16.47%	13.49%	C, A	41	208	263	1674	8.47%	16.47%
C, G	32	217	263	1674	12.85%	10.85%	C, G	32	217	263	1674	6.38%	12.85%
A, G	10	239	10	1927	4.02%	50.0%	A, G	10	239	10	1927	2.08%	4.02%
C D	275	2	00		98.92%	Cross-Site Re			7/	0	02	62.720	72.660
G, D B, E	202	76	80	82	72.66%	77.46% 100.0%	B, E C, E	202	76 76	0	82 82	62.73% 62.73%	72.66% 72.66%
C, E	202	76	0	82	72.66%	100.0%	A, E	202	76	0	82	62.73%	72.66%
A, E	202	76	0	82	72.66%	100.0%	F, E	202	76	0	82	62.73%	72.66%
F, E	202	76	0	82	72.66%	100.0%	G, E	202	76	0	82	62.73%	72.66%
G, E	202	76	0	82	72.66%	100.0%	E, D	202	76	0	82	62.73%	72.66%
E, D	202	76	0	82	72.66%	100.0%	F, D	275	3	80	2	50.13%	98.92%
B, C	9	269	0	82	3.24%	100.0%	G, D	275	3	80	2	50.13%	98.92%
B, A	9	269	0	82	3.24%	100.0%	B, C	10	268	2	80	1.82%	3.6%
B, F	9	269	0	82	3.24%	100.0%	C, F	10	268	2	80	1.82%	3.6%
B, G	9	269	0	82	3.24%	100.0%	C, A	10	268	2	80	1.82%	3.6%
B, D	9	269	0	82	3.24%	100.0%	C, G	10	268	2	80	1.82%	3.6%
F, D	4	274	0	82	1.44%	100.0%	C, D	10	268	2	80	1.82%	3.6%
C, F	4	274	0	82	1.44%	100.0%	B, A	9	269	0	82	1.67%	3.24%
A, F	4	274	0	82	1.44%	100.0%	B, F	9	269	0	82	1.67%	3.24%
F, G	10	274	0	82	1.44%	100.0%	B, G	9	269	0	82	1.67%	3.24%
C, A C, G	10	268 268	2	80	3.6%	83.33% 83.33%	B, D A, F	9	269 270	5	82 77	1.67% 1.39%	3.24% 2.88%
C, G	10	268	2	80	3.6%	83.33%	A, F	8	270	5	77	1.39%	2.88%
С, Б	10	200		00	3.070	05.5570	A, U	_ 0	270		//	1.59/0	2.00 /0

A, G	8	270	5	77	2.88%	61.54%	A, D	8	270	5	77	1.39%	2.88%
A, D	8	270	5	77	2.88%	61.54%	F, G	4	274	0	82	0.73%	1.44%
					Ins	sufficient Ses	sion Expirati	on					
B, F	17	0	0	30	100.0%	100.0%	B, F	17	0	0	30	100.0%	100.0%
C, F	17	0	0	30	100.0%	100.0%	C, F	17	0	0	30	100.0%	100.0%
A, F	17	0	0	30	100.0%	100.0%	A, F	17	0	0	30	100.0%	100.0%
F, G	17	0	0	30	100.0%	100.0%	F, G	17	0	0	30	100.0%	100.0%
F, E	17	0	0	30	100.0%	100.0%	F, E	17	0	0	30	100.0%	100.0%
F, D	17	0	0	30	100.0%	100.0%	F, D	17	0	0	30	100.0%	100.0%
B, C	0	17	0	30	0.0%	0.00%	B, C	0	17	0	30	0.0%	0.0%
B, A	0	17	0	30	0.0%	0.00%	B, A	0	17	0	30	0.0%	0.0%
B, G	0	17	0	30	0.0%	0.00%	B, G	0	17	0	30	0.0%	0.0%
B, E	0	17	0	30	0.0%	0.00%	B, E	0	17	0	30	0.0%	0.0%
B, D	0	17	0	30	0.0%	0.00%	B, D	0	17	0	30	0.0%	0.0%
C, A	0	17	0	30	0.0%	0.00%	C, A	0	17	0	30	0.0%	0.0%
C, G	0	17	0	30	0.0%	0.00%	C, G	0	17	0	30	0.0%	0.0%
C, E	0	17	0	30	0.0%	0.00%	C, E	0	17	0	30	0.0%	0.0%
C, D	0	17	0	30	0.0%	0.00%	C, D	0	17	0	30	0.0%	0.0%
A, G	0	17	0	30	0.0%	0.00%	A, G	0	17	0	30	0.0%	0.0%
A, E	0	17	0	30	0.0%	0.00%	A, E	0	17	0	30	0.0%	0.0%
A, D	0	17	0	30	0.0%	0.00%	A, D	0	17	0	30	0.0%	0.0%
G, E	0	17	0	30	0.0%	0.00%	G, E	0	17	0	30	0.0%	0.0%
G, D	0	17	0	30	0.0%	0.00%	G, D	0	17	0	30	0.0%	0.0%
E, D	0	17	0	30	0.0%	0.00%	E, D	0	17	0	30	0.0%	0.0%
		A - Sei	mgrep	B - Sr	ıyk C - Forti	fy D - Spot	bugs E - Kiu	iwan 🗀	F - Syn	ospys l	G - Ho	rusec	

Table 4.2: Ranking of combinations of 2 SAST tools regarding their performance in category A1: Broken Access Control - Business and Heightened Critical Scenarios

						A1: Broken A	ccess Contro	ol					
	Best	Effort			Metric	Tiebreaker]	Minimu	ım Effo	rt		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.	TP	FN	FP	TN	Markedness	Precision
				1		Path Tr	aversal						
B, C	378	23	112	1498	84.85%	94.26%	C, F	365	36	1	1609	98.77%	99.73%
B, D	371	30	112	1498	83.94%	92.52%	F, D	359	42	1	1609	98.59%	99.72%
C, E	368	33	123	1487	82.51%	91.77%	A, F	189	212	1	1609	93.92%	99.47%
E, D	359	42	123	1487	81.31%	89.53%	F, G	13	388	1	1609	86.71%	92.86%
B, E	340	61	112	1498	79.72%	84.79%	B, C	378	23	112	1498	87.82%	77.14%
B, A	308	93	112	1498	75.03%	76.81%	B, D	371	30	112	1498	87.42%	76.81%
B, F	308	93	112	1498	75.03%	76.81%	B, E	340	61	112	1498	85.65%	75.22%
B, G	308	93	112	1498	75.03%	76.81%	C, E	368	33	123	1487	86.39%	74.95%
A, E	289	112	123	1487	71.09%	72.07%	E, D	359	42	123	1487	85.87%	74.48%
F, E	275	126	123	1487	68.84%	68.58%	B, A	308	93	112	1498	83.74%	73.33%
G, E	275	126	123	1487	68.84%	68.58%	B, F	308	93	112	1498	83.74%	73.33%
F, D	375	26	782	828	48.14%	93.52%	B, G	308	93	112	1498	83.74%	73.33%
A, D	375	26	782	828	48.14%	93.52%	A, E	289	112	123	1487	81.57%	70.15%
G, D	375	26	782	828	48.14%	93.52%	F, E	275	126	123	1487	80.64%	69.1%
C, D	366	35	732	878	48.83%	91.27%	G, E	275	126	123	1487	80.64%	69.1%
C, A	364	37	732	878	48.63%	90.77%	C, A	378	23	228	1382	80.37%	62.38%
C, F	355	46	732	878	47.72%	88.53%	A, D	363	38	228	1382	79.37%	61.42%
C, G	355	46	732	878	47.72%	88.53%	A, G	193	208	228	1382	66.38%	45.84%
A, F	193	208	228	1382	46.96%	48.13%	C, D	392	9	782	828	66.16%	33.39%
A, G	193	208	228	1382	46.96%	48.13%	C, G	355	46	732	878	63.84%	32.66%
F, G	13	388	1	1609	6.27%	3.24%	G, D	375	26	782	828	64.68%	32.41%
						Bypassing A	uthorization						
F, D	196	53	0	1937	88.09%	78.71%	F, D	196	53	0	1937	98.67%	100.0%
B, D	196	53	3	1934	87.5%	78.71%	B, F	152	97	0	1937	97.62%	100.0%
B, C	184	65	3	1934	84.4%	73.9%	C, F	119	130	0	1937	96.86%	100.0%
B, A	154	95	3	1934	75.86%	61.85%	F, E	109	140	0	1937	96.63%	100.0%
B, F	152	97	3	1934	75.25%	61.04%	A, F	92	157	0	1937	96.25%	100.0%
B, G	152	97	3	1934	75.25%	61.04%	F, G	87	162	0	1937	96.14%	100.0%
B, E	152	97	3	1934	75.25%	61.04%	B, D	196	53	3	1934	97.91%	98.49%
E, D	196	53	109	1828	70.76%	78.71%	B, C	184	65	3	1934	97.57%	98.4%
C, D	239	10	294	1643	61.13%	95.98%	B, A	154	95	3	1934	96.7%	98.09%
C, F	119	130	0	1937	64.67%	47.79%	B, G	152	97	3	1934	96.64%	98.06%
F, E	109	140	0	1937	60.89%	43.78%	B, E	152	97	3	1934	96.64%	98.06%
A, D	207	42	294	1643	55.2%	83.13%	A, D	197	52	10	1927	96.27%	95.17%

G, D	207	42	294	1643	55.2%	83.13%	C, A	42	207	10	1927	85.53%	80.77%
C, E	138	111	109	1828	55.65%	55.42%	E, D	196	53	109	1828	80.72%	64.26%
A, F	92	157	0	1937	53.96%	36.95%	C, E	138	111	109	1828	75.07%	55.87%
F, G	87	162	0	1937	51.79%	34.94%	A, E	110	139	109	1828	71.58%	50.23%
A, E	110	139	109	1828	47.01%	44.18%	G, E	106	143	109	1828	71.02%	49.3%
G, E	106	143	109	1828	45.69%	42.57%	C, D	239	10	294	1643	72.12%	44.84%
C, A	41	208	263	1674	14.83%	16.47%	A, G	10	239	10	1927	69.48%	50.0%
C, A	32	217	263	1674	11.76%	12.85%	G, D	207	42	294	1643	69.41%	41.32%
A, G	10	239	10	1927	7.43%	4.02%	C, G	32	217	263	1674	49.69%	10.85%
A, G	10	237	10	1/2/			quest Forger		217	203	1074	47.0770	10.03 /6
F, D	275	3	80	2	86.89%	98.92%	B, E	202	76	0	82	75.95%	100.0%
G, D	275	3	80	2	86.89%	98.92%	C, E	202	76	0	82	75.95%	100.0%
B, E	202	76	0	82	84.17%	72.66%	A, E	202	76	0	82	75.95%	100.0%
C, E	202	76	0	82	84.17%	72.66%	F, E	202	76	0	82	75.95%	100.0%
A, E	202	76	0	82	84.17%	72.66%	G, E	202	76	0	82	75.95%	100.0%
F, E	202	76	0	82	84.17%	72.66%	E, D	202	76	0	82	75.95%	100.0%
G, E	202	76	0	82	84.17%	72.66%	B, C	9	269	0	82	61.68%	100.0%
E, D	202	76	0	82	84.17%	72.66%	B, A	9	269	0	82	61.68%	100.0%
B, C	10	268	2	80	6.9%	3.6%	B, F	9	269	0	82	61.68%	100.0%
C, F	10	268	2	80	6.9%	3.6%	B, G	9	269	0	82	61.68%	100.0%
C, A	10	268	2	80	6.9%	3.6%	B, D	9	269	0	82	61.68%	100.0%
C, G	10	268	2	80	6.9%	3.6%	F, D	4	274	0	82	61.52%	100.0%
C, D	10	268	2	80	6.9%	3.6%	C, F	4	274	0	82	61.52%	100.0%
B, A	9	269	0	82	6.27%	3.24%	A, F	4	274	0	82	61.52%	100.0%
B, F	9	269	0	82	6.27%	3.24%	F, G	4	274	0	82	61.52%	100.0%
B, G	9	269	0	82	6.27%	3.24%	G, D	275	3	80	2	58.73%	77.46%
B, D	9	269	0	82	6.27%	3.24%	C, A	10	268	2	80	53.16%	83.33%
A, F	8	270	5	77	5.5%	2.88%	C, G	10	268	2	80	53.16%	83.33%
A, G	8	270	5	77	5.5%	2.88%	C, D	10	268	2	80	53.16%	83.33%
A, D	8	270	5	77	5.5%	2.88%	A, G	8	270	5	77	41.86%	61.54%
F, G	4	274	0	82	2.84%	1.44%	A, D	8	270	5	77	41.86%	61.54%
, -							sion Expirati	on					
B, F	17	0	0	30	100.0%	100.0%	B, F	17	0	0	30	100.0%	100.0%
C, F	17	0	0	30	100.0%	100.0%	C, F	17	0	0	30	100.0%	100.0%
A, F	17	0	0	30	100.0%	100.0%	A, F	17	0	0	30	100.0%	100.0%
F, G	17	0	0	30	100.0%	100.0%	F, G	17	0	0	30	100.0%	100.0%
F, E	17	0	0	30	100.0%	100.0%	F, E	17	0	0	30	100.0%	100.0%
F, D	17	0	0	30	100.0%	100.0%	F, D	17	0	0	30	100.0%	100.0%
B, C	0	17	0	30	0.0%	0.0%	B, C	0	17	0	30	0.00%	0.00%
B, A	0	17	0	30	0.0%	0.0%	B, A	0	17	0	30	0.00%	0.00%
B, G	0	17	0	30	0.0%	0.0%	B, G	0	17	0	30	0.00%	0.00%
B, E	0	17	0	30	0.0%	0.0%	B, E	0	17	0	30	0.00%	0.00%
B, D	0	17	0	30	0.0%	0.0%	B, D	0	17	0	30	0.00%	0.00%
C, A	0	17	0	30	0.0%	0.0%	C, A	0	17	0	30	0.00%	0.00%
C, G	0	17	0	30	0.0%	0.0%	C, G	0	17	0	30	0.00%	0.00%
C, E	0	17	0	30	0.0%	0.0%	C, E	0	17	0	30	0.00%	0.00%
C, D	0	17	0	30	0.0%	0.0%	C, D	0	17	0	30	0.00%	0.00%
A, G	0	17	0	30	0.0%	0.0%	A, G	0	17	0	30	0.00%	0.00%
A, E	0	17	0	30	0.0%	0.0%	A, E	0	17	0	30	0.00%	0.00%
A, D	0	17	0	30	0.0%	0.0%	A, D	0	17	0	30	0.00%	0.00%
G, E	0	17	0	30	0.0%	0.0%	G, E	0	17	0	30	0.00%	0.00%
G, D	0	17	0	30	0.0%	0.0%	G, D	0	17	0	30	0.00%	0.00%
E, D	0	17	0	30	0.0%	0.0%	E, D	0	17	0	30	0.00%	0.00%
		A - Se	mgrep	B - Sn	yk C - Fort	ify D - Spot	bugs E - Kiu	ıwan]	F - Syn	ospys l	G - Ho	rusec	

Table 4.3: Ranking of combinations of 2 SAST tools regarding their performance in category A1: Broken Access Control - Best and Minimum Effort Scenarios

Results obtained in A2: Cryptographic Failures

					A	A2: Cryptogra	aphic Failure	S					
]	Busines	s Critic	al		Metric	Tiebreaker	Н	eighten	ed Crit	ical		Metric	Tiebreaker
Comb.													
	Use of Old/Insecure algorithms												
C, G	206	22	122	552	90.35%	62.8%	G, E	206	22	122	552	77.81%	90.35%
A, G	206	22	122	552	90.35%	62.8%	B, G	206	22	122	552	77.81%	90.35%

G, E	206	22	122	552	90.35%	62.8%	G, D	206	22	122	552	77.81%	90.35%
B, G	206	22	122	552	90.35%	62.8%	B, D	184	44	71	603	68.66%	80.7%
G, D	206	22	122	552	90.35%	62.8%	F, D	184	44	71	603	68.66%	80.7%
C, D	184	44	71	603	80.7%	72.16%	C, G	168	60	0	674	63.99%	73.68%
E, D	184	44	71	603	80.7%	72.16%	C, D	168	60	0	674	63.99%	73.68%
B, D	184	44	71	603	80.7%	72.16%	C, F	168	60	0	674	63.99%	73.68%
F, D F, G	184 173	44 55	71 122	603 552	80.7% 75.88%	72.16% 58.64%	B, C E, D	168 167	60	40	674	63.99% 61.27%	73.68% 73.25%
C, F	168	60	0	674	73.68%	100.0%	F, E	167	61	40	634	61.27%	73.25%
B, A	165	63	0	674	72.37%	100.0%	B, E	167	61	40	634	61.27%	73.25%
C, A	165	63	0	674	72.37%	100.0%	A, G	165	63	0	674	62.37%	72.37%
A, F	165	63	0	674	72.37%	100.0%	B, A	165	63	0	674	62.37%	72.37%
A, E	165	63	0	674	72.37%	100.0%	C, A	165	63	0	674	62.37%	72.37%
A, D	165	63	0	674	72.37%	100.0%	A, F	165	63	0	674	62.37%	72.37%
F, E	167	61	40	634	73.25%	80.68%	A, E	165	63	0	674	62.37%	72.37%
B, C B, E	165	63	70 70	604	72.37% 72.37%	70.21% 70.21%	A, D F, G	165	63 55	122	674 552	62.37%	72.37% 75.88%
В, Е	165	63	70	604	72.37%	70.21%	B, F	165	63	70	604	59.86% 58.61%	72.37%
C, E	152	76	0	674	66.67%	100.0%	C, E	152	76	0	674	55.56%	66.67%
						Deprecated H				_			0010111
B, G	277	99	13	214	73.67%	95.52%	B, G	277	99	13	214	61.86%	73.67%
C, G	277	99	13	214	73.67%	95.52%	C, G	277	99	13	214	61.86%	73.67%
G, E	277	99	13	214	73.67%	95.52%	G, E	277	99	13	214	61.86%	73.67%
F, G	277	99	13	214	73.67%	95.52%	F, G	277	99	13	214	61.86%	73.67%
A, G G, D	277	99 99	13 13	214	73.67% 73.67%	95.52% 95.52%	A, G G, D	277	99 99	13 13	214	61.86% 61.86%	73.67% 73.67%
A, D	199	177	14	214	52.93%	93.32%	A, D	199	177	14	214	38.84%	52.93%
В, А	185	191	0	227	49.2%	100.0%	B, C	185	191	0	227	36.71%	49.2%
B, D	185	191	0	227	49.2%	100.0%	B, E	185	191	0	227	36.71%	49.2%
B, C	182	194	2	225	48.4%	98.91%	B, F	185	191	0	227	36.71%	49.2%
C, F	182	194	2	225	48.4%	98.91%	B, A	185	191	0	227	36.71%	49.2%
C, E	182	194	2	225	48.4%	98.91%	B, D	185	191	0	227	36.71%	49.2%
C, A	182	194	2	225	48.4%	98.91%	C, F	182	194	2	225	35.7%	48.4%
C, D B, E	182	194 196	2	225 225	48.4% 47.87%	98.91% 98.9%	C, E C, A	182 182	194 194	2	225	35.7% 35.7%	48.4% 48.4%
F, E	180	196	2	225	47.87%	98.9%	C, A	182	194	2	225	35.7%	48.4%
A, E	180	196	2	225	47.87%	98.9%	F, E	180	196	2	225	35.18%	47.87%
E, D	180	196	2	225	47.87%	98.9%	A, E	180	196	2	225	35.18%	47.87%
B, F	175	201	2	225	46.54%	98.87%	E, D	180	196	2	225	35.18%	47.87%
A, F	175	201	2	225	46.54%	98.87%	A, F	175	201	2	225	33.9%	46.54%
F, D	175	201	2	225	46.54%	98.87%	F, D	175	201	2	225	33.9%	46.54%
C, F	296	11	52	307	96.42%	85.06%	eak PRNG C, F	296	11	52	307	97.716/	96.42%
C, F	296	11 11	52	307	96.42%	85.06%	C, F	296	11	52	307	87.71% 87.71%	96.42%
C, D	296	11	52	307	96.42%	85.06%	C, D	296	11	52	307	87.71%	96.42%
B, C	296	11	52	307	96.42%	85.06%	B, C	296	11	52	307	87.71%	96.42%
C, G	296	11	52	307	96.42%	85.06%	C, G	296	11	52	307	87.71%	96.42%
C, E	296	11	52	307	96.42%	85.06%	C, E	296	11	52	307	87.71%	96.42%
B, D	286	21	5	354	93.16%	98.28%	B, D	286	21	5	354	89.32%	93.16%
A, D	286	21	5	354	93.16%	98.28%	A, D	286	21	5	354	89.32%	93.16%
F, D G, D	286	21	5	354 354	93.16% 93.16%	98.28% 98.28%	F, D G, D	286	21	5	354 354	89.32% 89.32%	93.16% 93.16%
E, D	286	21	5	354	93.16%	98.28%	E, D	286	21	5	354	89.32%	93.16%
F, G	254	53	0	359	82.74%	100.0%	F, G	254	53	0	359	75.59%	82.74%
A, G	244	63	0	359	79.48%	100.0%	A, G	244	63	0	359	71.32%	79.48%
B, G	241	66	0	359	78.5%	100.0%	B, G	241	66	0	359	70.06%	78.5%
B, F	237	70	0	359	77.2%	100.0%	B, F	237	70	0	359	68.4%	77.2%
A, F	237	70	0	359	77.2%	100.0%	A, F	237	70	0	359	68.4%	77.2%
F, E B, A	237	70 80	0	359 359	77.2% 73.94%	100.0% 100.0%	F, E B, A	237	70 80	0	359 359	68.4% 64.31%	77.2% 73.94%
A, E	227	80	0	359	73.94%	100.0%	B, A A, E	227	80	0	359	64.31%	73.94%
B, E	224	83	0	359	72.96%	100.0%	B, E	224	83	0	359	63.1%	72.96%
G, E	226	81	55	304	73.62%	80.43%	G, E	226	81	55	304	58.27%	73.62%
						Seeds Hard C		G	'		'		
B, F	17	0	0	30	100.0%	100.0%	B, F	17	0	0	30	100.0%	100.0%
B, G	17	0	0	30	100.0%	100.0%	B, G	17	0	0	30	100.0%	100.0%
C, F	17	0	0	30	100.0%	100.0%	C, F	17	0	0	30	100.0%	100.0%
C, G	17	0	0	30	100.0%	100.0%	C, G	17	0	0	30	100.0%	100.0%
A, F	17	0	0	30	100.0%	100.0%	A, F	17	0	_ U	30	100.0%	100.0%

A, G	17	0	0	30	100.0%	100.0%	A, G	17	0	0	30	100.0%	100.0%
F, G	17	0	0	30	100.0%	100.0%	F, G	17	0	0	30	100.0%	100.0%
F, E	17	0	0	30	100.0%	100.0%	F, E	17	0	0	30	100.0%	100.0%
F, D	17	0	0	30	100.0%	100.0%	F, D	17	0	0	30	100.0%	100.0%
G, E	17	0	0	30	100.0%	100.0%	G, E	17	0	0	30	100.0%	100.0%
G, D	17	0	0	30	100.0%	100.0%	G, D	17	0	0	30	100.0%	100.0%
B, C	0	17	0	30	0.0%	0.00%	B, C	0	17	0	30	0.0%	0.0%
B, A	0	17	0	30	0.0%	0.00%	B, A	0	17	0	30	0.0%	0.0%
B, E	0	17	0	30	0.0%	0.00%	B, E	0	17	0	30	0.0%	0.0%
B, D	0	17	0	30	0.0%	0.00%	B, D	0	17	0	30	0.0%	0.0%
C, A	B, A 0 17 0 30 0.0% 0.00% B, A 0 17 0 30 0.0% 0.0% B, E 0 17 0 30 0.0% 0.00% B, E 0 17 0 30 0.0% 0.0% B, D 0 17 0 30 0.0% 0.00% B, D 0 17 0 30 0.0% 0.0% C, A 0 17 0 30 0.0% 0.00% C, A 0 17 0 30 0.0% 0.0%						0.0%						
C, E	0	17	0	30	0.0%	0.00%	C, E	0	17	0	30	0.0%	0.0%
C, D	0	17	0	30	0.0%	0.00%	C, D	0	17	0	30	0.0%	0.0%
A, E	0	17	0	30	0.0%	0.00%	A, E	0	17	0	30	0.0%	0.0%
A, D	0	17	0	30	0.0%	0.00%	A, D	0	17	0	30	0.0%	0.0%
E, D	G, D 17 0 0 30 100.0% 100.0% G, D 17 0 0 30 100.0% 100.0% B, C 0 17 0 30 0.0% 0.00% B, C 0 17 0 30 0.0% 0.0% B, A 0 17 0 30 0.0% 0.00% B, A 0 17 0 30 0.0% 0.0% B, E 0 17 0 30 0.0% 0.00% B, E 0 17 0 30 0.0% 0.0% B, D 0 17 0 30 0.0% 0.00% B, D 0 17 0 30 0.0% 0.0% C, A 0 17 0 30 0.0% 0.00% C, A 0 17 0 30 0.0% 0.0% C, E 0 17 0 30 0.0% 0.00% C, E 0												0.0%
		A - Se	mgrep	B - Sr	ıyk C - Forti	ify D - Spot	bugs E - Kit	ıwan I	F - Syn	ospys l	G - Ho	rusec	

Table 4.4: Ranking of combinations of 2 SAST tools regarding their performance in category A2: Cryptographic Failures - Business and Heightened Critical Scenarios

Comb. TP FN FP TN F-measure Comb. TP FN FP TN Markedness Precision Comb. TP FN FN FN TN Markedness Telepraker Comb. The precision						A	A2: Cryptogra	phic Failure	:S						
C, G		Best	Effort							ım Effo	rt		Metric	Tiebreaker	
C, G 168 60 0 674 84.85% 73.68% C, G 168 60 0 674 95.91% 100.0% C, D 168 60 0 674 84.85% 73.68% C, D 168 60 0 674 95.91% 100.0% B, C 168 60 0 674 84.85% 73.68% B, C 168 60 0 674 95.91% 100.0% A, G 165 63 0 674 83.97% 72.37% A, G 165 63 0 674 95.73% 100.0% C, A 165 63 0 674 83.97% 72.37% A, F 165 63 0 674 95.73% 100.0% A, F 165 63 0 674 83.97% 72.37% A, E 165 63 0 674 95.73% 100.0% A, D 165 63 0 674	Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.	TP	FN	FP	TN	Markedness	Precision	
C, G 168 60 0 674 84.85% 73.68% C, G 168 60 0 674 95.91% 100.0% C, D 168 60 0 674 84.85% 73.68% C, D 168 60 0 674 95.91% 100.0% B, C 168 60 0 674 84.85% 73.68% B, C 168 60 0 674 95.91% 100.0% A, G 165 63 0 674 83.97% 72.37% A, G 165 63 0 674 95.73% 100.0% C, A 165 63 0 674 83.97% 72.37% A, F 165 63 0 674 95.73% 100.0% A, F 165 63 0 674 83.97% 72.37% A, E 165 63 0 674 95.73% 100.0% A, D 165 63 0 674						Us	e of Old/Inse	cure algorith	ms						
C. D 168 60 0 674 84.85% 73.68% C. D 168 60 0 674 95.91% 100.0% C. F 168 60 0 674 95.91% 100.0% B. C 168 60 0 674 95.91% 100.0% A. G 165 63 0 674 83.97% 72.37% B. A 165 63 0 674 95.73% 100.0% C. A 165 63 0 674 83.97% 72.37% A. G 165 63 0 674 95.73% 100.0% A. F 165 63 0 674 83.97% 72.37% A. F 165 63 0 674 95.73% 100.0% A. D 165 63 0 674 83.97% 72.37% A. D 165 63 0 674 95.73% 100.0% A. D 165 63 0	C, G	168	60	0	674					60	0	674	95.91%	100.0%	
C, F 168 60 0 674 84.85% 73.68% C, F 168 60 0 674 95.91% 100.0% B, C 168 60 0 674 85.97% 72.37% A, G 165 63 0 674 83.97% 72.37% B, A 165 63 0 674 83.97% 72.37% B, A 165 63 0 674 83.97% 72.37% C, A 165 63 0 674 83.97% 72.37% A, F 165 63 0 674 83.97% 72.37% A, F 165 63 0 674 85.73% 100.0% A, E 165 63 0 674 83.97% 72.37% A, E 165 63 0 674 95.73% 100.0% A, D 165 63 0 674 95.73% 100.0% C, E 152 76 0 674 95.73% 100.0% </td <td></td> <td>168</td> <td>60</td> <td>0</td> <td>674</td> <td></td> <td>73.68%</td> <td>C, D</td> <td>168</td> <td>60</td> <td>0</td> <td>674</td> <td></td> <td></td>		168	60	0	674		73.68%	C, D	168	60	0	674			
B, C 168 60 0 674 84,85% 73,68% B, C 168 60 0 674 95,91% 100,0% A, G 165 63 0 674 83,97% 72,37% A, G 165 63 0 674 95,73% 100,0% C, A 165 63 0 674 83,97% 72,37% A, E 165 63 0 674 95,73% 100,0% A, F 165 63 0 674 83,97% 72,37% A, E 165 63 0 674 95,73% 100,0% A, D 165 63 0 674 83,97% 72,37% A, E 165 63 0 674 95,73% 100,0% A, D 165 63 0 674 95,73% 100,0% B, D 184 44 71 603 76,19% 80,7% G, E 167 61 40 634	C, F	168	60	0	674		73.68%	C, F	168	60	0	674	95.91%	100.0%	
A, G 165 63 0 674 8,397% 72,37% A, G 165 63 0 674 89,73% 100,0% B, A 165 63 0 674 83,97% 72,37% B, A 165 63 0 674 89,73% 100,0% A, F 165 63 0 674 83,97% 72,37% A, E 165 63 0 674 89,73% 100,0% A, E 165 63 0 674 83,97% 72,37% A, D 165 63 0 674 89,73% 100,0% C, E 152 76 0 674 80,0% 66,67% C, E 152 76 0 674 80,0% 66,67% C, E 152 76 0 674 95,73% 100,0% B, D 184 44 71 603 76,19% 80,7% G, E 167 61 40 844 89,5%		168	60	0	674		73.68%		168	60	0	674	95.91%	100.0%	
B. A 165 63 0 674 83.97% 72.37% B, A 165 63 0 674 95.73% 100.0% C, A 165 63 0 674 95.73% 100.0% C, A 165 63 0 674 83.97% 72.37% C, A 165 63 0 674 95.73% 100.0% A, E 165 63 0 674 83.97% 72.37% A, E 165 63 0 674 95.73% 100.0% A, E 165 63 0 674 83.97% 72.37% A, E 165 63 0 674 95.73% 100.0% A, D 165 63 0 674 83.97% 72.37% A, D 165 63 0 674 95.73% 100.0% A, D 165 63 0 674 83.97% 72.37% A, D 165 63 0 674 95.73% 100.0% B, D 184 44 71 603 76.19% 80.7% G, E 167 61 40 634 85.95% 80.68% F, D 184 44 71 603 76.19% 80.7% G, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, D 184 44 71 603 82.68% 73.25% B, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, D 184 44 71 603 82.68% 72.16% B, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, D 184 44 71 603 82.68% 72.16% B, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, D 184 44 71 603 82.68% 72.16% B, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, D 184 44 71 603 82.68% 72.16% B, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, D 184 44 71 603 82.68% 72.16% B, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, D 184 44 71 603 82.68% 72.16% B, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, D 184 44 71 603 82.68% 72.16% B, E 167 61 40 634 83.18% 73.67% B, E 167 61 40 634 83.86% 72.16% B, E 167 61 40 634 83.18% 73.67% B, E 168 63 70 604 80.38% 70.21% G, D 206 22 122 552 74.1% 90.35% B, G 206 22 122 552 74.79% 58.64% E, G 173 55 122 552 74.18% 90.35% B, E 168 191 0 227 77.15% 100.0% C, G 277 99 13 214 83.18% 73.67% C, E 182 194 2 225 76.31% 98.91% G, E 277 99 13 214 83.18% 73.67% C, E 182 194 2 225 76.31% 98.91% G, D 277 99 13 214 83.18% 73.67% C, E 182 194 2 225 76.31% 98.91% G, D 277 99 13 214 83.18% 73.67% C, E 182 194 2 225 76.31% 98.91% G, D 277 99 13 214 83.18% 73.67% G, E 180 196 2 225 76.31% 98.91% G, D 277 99 13 214 83.18% 73.67% G, E 180 196 2 225 76.31% 98.91% G, D 277 99 13 214 83.18% 73.67% G, E 180 196 2 225 76.31% 98.91% G, D 277 99 1		165	63	0	674				165	63	0	674		100.0%	
C, A	B, A	165	63	0	674			B, A	165	63	0	674		100.0%	
A, E 165 63 0 674 83.97% 72.37% A, E 165 63 0 674 95.73% 100.0% A, D 165 63 0 674 95.73% 100.0% C, E 152 76 0 674 80.9% C, E 152 76 0 674 94.93% 100.0% B, D 184 44 71 603 76.19% 80.7% G, E 167 61 40 634 85.95% 80.68% F, D 184 44 71 603 76.19% 80.7% E, D 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, E 167 61 40 634 85.95%	C, A	165	63	0	674	83.97%	72.37%	C, A	165	63	0	674	95.73%	100.0%	
A, D 165 63 0 674 83.97% 72.37% A, D 165 63 0 674 95.73% 100.0% C, E 152 76 0 674 80.0% 66.67% C, E 152 76 0 674 94.943% 100.0% B, D 184 44 71 603 76.19% 80.7% E, D 167 61 40 634 85.95% 80.68% F, D 167 61 40 634 76.78% 73.25% F, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, E 167 61 40 634 85.95% 80.68% F, E 167 61 40 634 76.78% 73.25% B, D 167 61 40 634 75.78% 73.25% B, D 184 44 71 603 82.68	A, F	165	63	0	674	83.97%	72.37%	A, F	165	63	0	674	95.73%	100.0%	
C, E 152 76 0 674 80.0% 66.67% C, E 152 76 0 674 94.93% 100.0% B, D 184 44 71 603 76.19% 80.7% E, D 167 61 40 634 85.95% 80.68% G, E 167 61 40 634 76.78% 73.25% B, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, E 167 61 40 634 85.95% 80.68% F, E 167 61 40 634 76.78% 73.25% B, E 167 61 40 634 76.78% 73.25% F, D 184 44 71 603 82.68% 72.16% B, G 206 22 122 552 74.1% 90.35% B, F 165 63 70 604 80.3	A, E	165	63	0	674				165	63	0	674		100.0%	
B, D	A, D	165	63	0	674	83.97%	72.37%	A, D	165	63	0	674	95.73%	100.0%	
B, D	C, E	152	76	0	674	80.0%	66.67%	C, E	152	76	0	674	94.93%	100.0%	
G, E 167 61 40 634 76.78% 73.25% F, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, E 167 61 40 634 85.95% 80.68% F, E 167 61 40 634 76.78% 73.25% B, D 184 44 71 603 82.68% 72.16% B, G 206 22 122 552 74.1% 90.35% B, F 165 63 70 604 80.38% 70.21% G, D 206 22 122 552 74.1% 90.35% B, G 206 22 122 552 74.1% 90.35% B, G 206 22 122 552 74.1% 90.35% B, G 206 22 122 552 79.49% 62.8% B, F 165 63 70 604	B, D	184	44	71	603	76.19%			167	61	40	634	85.95%		
G, E 167 61 40 634 76.78% 73.25% F, E 167 61 40 634 85.95% 80.68% E, D 167 61 40 634 76.78% 73.25% B, E 167 61 40 634 85.95% 80.68% F, E 167 61 40 634 76.78% 73.25% B, D 184 44 71 603 82.68% 72.16% B, E 167 61 40 634 76.78% 73.25% F, D 184 44 71 603 82.68% 72.16% B, G 206 22 122 552 74.1% 90.35% B, F 165 63 70 604 80.38% 70.21% G, D 206 22 122 552 74.1% 90.35% B, G 206 22 122 552 79.49% 62.8% B, G 173 55 122 5	F, D	184	44	71	603	76.19%		E, D	167	61	40	634	85.95%	80.68%	
E, D		167	61	40	634				167	61	40	634		80.68%	
F, E 167 61 40 634 76.78% 73.25% B, D 184 44 71 603 82.68% 72.16% B, E 167 61 40 634 76.78% 73.25% F, D 184 44 71 603 82.68% 72.16% B, G 206 22 122 552 74.1% 90.35% B, F 165 63 70 604 80.38% 70.21% G, D 206 22 122 552 74.1% 90.35% B, G 206 22 122 552 79.49% 62.8% B, F 165 63 70 604 71.27% 72.37% G, D 206 22 122 552 79.49% 62.8% B, F 165 63 70 604 71.27% 72.37% G, D 206 22 122 552 79.49% 62.8% B, F 165 63 <t< td=""><td>E, D</td><td>167</td><td>61</td><td>40</td><td>634</td><td>76.78%</td><td>73.25%</td><td></td><td>167</td><td>61</td><td>40</td><td>634</td><td></td><td>80.68%</td></t<>	E, D	167	61	40	634	76.78%	73.25%		167	61	40	634		80.68%	
B, E 167 61 40 634 76.78% 73.25% F, D 184 44 71 603 82.68% 72.16% B, G 206 22 122 552 74.1% 90.35% B, F 165 63 70 604 80.38% 70.21% G, D 206 22 122 552 74.1% 90.35% B, G 206 22 122 552 79.49% 62.8% B, F 165 63 70 604 71.27% 72.37% G, D 206 22 122 552 79.49% 62.8% F, G 173 55 122 552 66.16% 75.88% F, G D 206 22 122 552 74.79% 62.8% Deprecated Hash Functions Deprecated Hash Functions Deprecated Hash Functions Deprecated Hash Functions Deprecated Hash Functions <th colspa<="" td=""><td>F, E</td><td>167</td><td>61</td><td>40</td><td>634</td><td></td><td></td><td>B, D</td><td>184</td><td>44</td><td>71</td><td>603</td><td>82.68%</td><td>72.16%</td></th>	<td>F, E</td> <td>167</td> <td>61</td> <td>40</td> <td>634</td> <td></td> <td></td> <td>B, D</td> <td>184</td> <td>44</td> <td>71</td> <td>603</td> <td>82.68%</td> <td>72.16%</td>	F, E	167	61	40	634			B, D	184	44	71	603	82.68%	72.16%
G, D 206 22 122 552 74.1% 90.35% B, G 206 22 122 552 79.49% 62.8% B, F 165 63 70 604 71.27% 72.37% G, D 206 22 122 552 79.49% 62.8% F, G 173 55 122 552 66.16% 75.88% F, G 173 55 122 552 74.79% 58.64% Deprecated Hash Functions Deprecated Hash Functions B, G 277 99 13 214 83.18% 73.67% C, G 182 194 2 225 76.31% 98.91% G, E 277 99 13 214 83.18% 73.67% B, C 182 194 2 225 76.31% 98.91% G, E 277 99 13 214 83.18% 73.67% C, F 182 194 2 <td< td=""><td>B, E</td><td>167</td><td>61</td><td>40</td><td>634</td><td>76.78%</td><td>73.25%</td><td>F, D</td><td>184</td><td>44</td><td>71</td><td>603</td><td>82.68%</td><td>72.16%</td></td<>	B, E	167	61	40	634	76.78%	73.25%	F, D	184	44	71	603	82.68%	72.16%	
G, D 206 22 122 552 74.1% 90.35% B, G 206 22 122 552 79.49% 62.8% B, F 165 63 70 604 71.27% 72.37% G, D 206 22 122 552 79.49% 62.8% F, G 173 55 122 552 66.16% 75.88% F, G 173 55 122 552 74.79% 58.64% Deprecated Hash Functions B, G 277 99 13 214 83.18% 73.67% B, G 185 191 0 227 77.15% 100.0% C, G 277 99 13 214 83.18% 73.67% C, G 182 194 2 225 76.31% 98.91% G, E 277 99 13 214 83.18% 73.67% C, F 182 194 2 225 76.31% 98.91% <t< td=""><td>B, G</td><td>206</td><td>22</td><td>122</td><td>552</td><td>74.1%</td><td>90.35%</td><td>B, F</td><td>165</td><td>63</td><td>70</td><td>604</td><td>80.38%</td><td>70.21%</td></t<>	B, G	206	22	122	552	74.1%	90.35%	B, F	165	63	70	604	80.38%	70.21%	
F, G 173 55 122 552 66.16% 75.88% F, G 173 55 122 552 74.79% 58.64% Deprecated Hash Functions B, G 277 99 13 214 83.18% 73.67% B, G 185 191 0 227 77.15% 100.0% C, G 277 99 13 214 83.18% 73.67% C, G 182 194 2 225 76.31% 98.91% F, G 277 99 13 214 83.18% 73.67% C, F 182 194 2 225 76.31% 98.91% F, G 277 99 13 214 83.18% 73.67% C, F 182 194 2 225 76.31% 98.91% A, D 297 99 13 214 83.18% 73.67% C, E 182 194 2 225 76.17% 98.99% A, D	G, D	206	22	122	552	74.1%			206	22	122	552			
Deprecated Hash Functions B, G 277 99 13 214 83.18% 73.67% B, G 185 191 0 227 77.15% 100.0%	B, F	165	63	70	604	71.27%	72.37%	G, D	206	22	122	552	79.49%	62.8%	
Deprecated Hash Functions B, G 277 99 13 214 83.18% 73.67% B, G 185 191 0 227 77.15% 100.0%	F, G	173	55	122	552	66.16%	75.88%	F, G	173	55	122	552	74.79%	58.64%	
C, G 277 99 13 214 83.18% 73.67% C, G 182 194 2 225 76.31% 98.91% G, E 277 99 13 214 83.18% 73.67% B, C 182 194 2 225 76.31% 98.91% F, G 277 99 13 214 83.18% 73.67% C, F 182 194 2 225 76.31% 98.91% A, G 277 99 13 214 83.18% 73.67% C, E 182 194 2 225 76.31% 98.91% G, D 277 99 13 214 83.18% 73.67% G, E 180 196 2 225 76.31% 98.91% A, D 199 177 14 213 67.57% 52.93% B, E 180 196 2 225 76.17% 98.9% B, C 185 191 0 22						I	Deprecated Ha		ıs						
G, E 277 99 13 214 83.18% 73.67% B, C 182 194 2 225 76.31% 98.91% F, G 277 99 13 214 83.18% 73.67% C, F 182 194 2 225 76.31% 98.91% A, G 277 99 13 214 83.18% 73.67% C, E 182 194 2 225 76.31% 98.91% G, D 277 99 13 214 83.18% 73.67% G, E 180 196 2 225 76.31% 98.91% A, D 199 177 14 213 67.57% 52.93% B, E 180 196 2 225 76.17% 98.9% B, C 185 191 0 227 65.95% 49.2% F, E 180 196 2 225 75.84% 98.97% B, F 185 191 0 227	B, G	277	99	13	214					191	0	227	77.15%	100.0%	
F, G 277 99 13 214 83.18% 73.67% C, F 182 194 2 225 76.31% 98.91% A, G 277 99 13 214 83.18% 73.67% C, E 182 194 2 225 76.31% 98.91% G, D 277 99 13 214 83.18% 73.67% G, E 180 196 2 225 76.17% 98.9% A, D 199 177 14 213 67.57% 52.93% B, E 180 196 2 225 76.17% 98.9% B, C 185 191 0 227 65.95% 49.2% F, E 180 196 2 225 76.17% 98.9% B, E 185 191 0 227 65.95% 49.2% F, G 175 201 2 225 75.84% 98.87% B, A 185 191 0 227 <td>C, G</td> <td>277</td> <td>99</td> <td>13</td> <td>214</td> <td>83.18%</td> <td>73.67%</td> <td>C, G</td> <td>182</td> <td>194</td> <td>2</td> <td>225</td> <td>76.31%</td> <td>98.91%</td>	C, G	277	99	13	214	83.18%	73.67%	C, G	182	194	2	225	76.31%	98.91%	
A, G 277 99 13 214 83.18% 73.67% C, E 182 194 2 225 76.31% 98.91% G, D 277 99 13 214 83.18% 73.67% G, E 180 196 2 225 76.17% 98.9% A, D 199 177 14 213 67.57% 52.93% B, E 180 196 2 225 76.17% 98.9% B, C 185 191 0 227 65.95% 49.2% F, E 180 196 2 225 76.17% 98.9% B, E 185 191 0 227 65.95% 49.2% F, G 175 201 2 225 75.84% 98.87% B, F 185 191 0 227 65.95% 49.2% B, F 175 201 2 225 75.84% 98.87% B, A 185 191 0 227 <td>G, E</td> <td>277</td> <td>99</td> <td>13</td> <td>214</td> <td>83.18%</td> <td>73.67%</td> <td>B, C</td> <td>182</td> <td>194</td> <td>2</td> <td>225</td> <td>76.31%</td> <td>98.91%</td>	G, E	277	99	13	214	83.18%	73.67%	B, C	182	194	2	225	76.31%	98.91%	
A, G 277 99 13 214 83.18% 73.67% C, E 182 194 2 225 76.31% 98.91% G, D 277 99 13 214 83.18% 73.67% G, E 180 196 2 225 76.17% 98.9% A, D 199 177 14 213 67.57% 52.93% B, E 180 196 2 225 76.17% 98.9% B, C 185 191 0 227 65.95% 49.2% F, E 180 196 2 225 76.17% 98.9% B, E 185 191 0 227 65.95% 49.2% F, G 175 201 2 225 75.84% 98.87% B, F 185 191 0 227 65.95% 49.2% B, F 175 201 2 225 75.84% 98.87% B, A 185 191 0 227 <td>F, G</td> <td>277</td> <td>99</td> <td>13</td> <td>214</td> <td></td> <td>73.67%</td> <td>C, F</td> <td>182</td> <td>194</td> <td>2</td> <td>225</td> <td>76.31%</td> <td>98.91%</td>	F, G	277	99	13	214		73.67%	C, F	182	194	2	225	76.31%	98.91%	
A, D 199 177 14 213 67.57% 52.93% B, E 180 196 2 225 76.17% 98.9% B, C 185 191 0 227 65.95% 49.2% F, E 180 196 2 225 76.17% 98.9% B, E 185 191 0 227 65.95% 49.2% F, G 175 201 2 225 75.84% 98.87% B, F 185 191 0 227 65.95% 49.2% B, F 175 201 2 225 75.84% 98.87% B, A 185 191 0 227 65.95% 49.2% A, G 144 232 0 227 74.73% 100.0% B, D 185 191 0 227 65.95% 49.2% B, A 144 232 0 227 74.73% 100.0% C, F 182 194 2 225	A, G	277	99	13	214	83.18%	73.67%		182	194	2	225	76.31%	98.91%	
B, C 185 191 0 227 65.95% 49.2% F, E 180 196 2 225 76.17% 98.9% B, E 185 191 0 227 65.95% 49.2% F, G 175 201 2 225 75.84% 98.87% B, F 185 191 0 227 65.95% 49.2% B, F 175 201 2 225 75.84% 98.87% B, A 185 191 0 227 65.95% 49.2% A, G 144 232 0 227 74.73% 100.0% B, D 185 191 0 227 65.95% 49.2% B, A 144 232 0 227 74.73% 100.0% C, F 182 194 2 225 65.0% 48.4% C, A 144 232 0 227 74.73% 100.0% C, E 182 194 2 225	G, D	277	99	13	214	83.18%	73.67%	G, E	180	196	2	225	76.17%	98.9%	
B, E 185 191 0 227 65.95% 49.2% F, G 175 201 2 225 75.84% 98.87% B, F 185 191 0 227 65.95% 49.2% B, F 175 201 2 225 75.84% 98.87% B, A 185 191 0 227 65.95% 49.2% A, G 144 232 0 227 74.73% 100.0% B, D 185 191 0 227 65.95% 49.2% B, A 144 232 0 227 74.73% 100.0% C, F 182 194 2 225 65.0% 48.4% C, A 144 232 0 227 74.73% 100.0% C, E 182 194 2 225 65.0% 48.4% A, E 144 232 0 227 74.73% 100.0% C, A 182 194 2 225	A, D	199	177	14	213	67.57%	52.93%	B, E	180	196	2	225	76.17%	98.9%	
B, F 185 191 0 227 65.95% 49.2% B, F 175 201 2 225 75.84% 98.87% B, A 185 191 0 227 65.95% 49.2% A, G 144 232 0 227 74.73% 100.0% B, D 185 191 0 227 65.95% 49.2% B, A 144 232 0 227 74.73% 100.0% C, F 182 194 2 225 65.0% 48.4% C, A 144 232 0 227 74.73% 100.0% C, E 182 194 2 225 65.0% 48.4% A, E 144 232 0 227 74.73% 100.0% C, A 182 194 2 225 65.0% 48.4% A, F 144 232 0 227 74.73% 100.0% C, D 182 194 2 225	B, C	185	191	0	227	65.95%	49.2%	F, E	180	196	2	225	76.17%	98.9%	
B, A 185 191 0 227 65.95% 49.2% A, G 144 232 0 227 74.73% 100.0% B, D 185 191 0 227 65.95% 49.2% B, A 144 232 0 227 74.73% 100.0% C, F 182 194 2 225 65.0% 48.4% C, A 144 232 0 227 74.73% 100.0% C, E 182 194 2 225 65.0% 48.4% A, E 144 232 0 227 74.73% 100.0% C, A 182 194 2 225 65.0% 48.4% A, F 144 232 0 227 74.73% 100.0% C, A 182 194 2 225 65.0% 48.4% A, F 144 232 0 227 74.73% 100.0% C, D 182 194 2 225	B, E	185	191	0	227	65.95%	49.2%	F, G	175	201	2	225	75.84%	98.87%	
B, D 185 191 0 227 65.95% 49.2% B, A 144 232 0 227 74.73% 100.0% C, F 182 194 2 225 65.0% 48.4% C, A 144 232 0 227 74.73% 100.0% C, E 182 194 2 225 65.0% 48.4% A, E 144 232 0 227 74.73% 100.0% C, A 182 194 2 225 65.0% 48.4% A, F 144 232 0 227 74.73% 100.0% C, D 182 194 2 225 65.0% 48.4% A, F 144 232 0 227 74.73% 100.0% C, D 182 194 2 225 65.0% 48.4% A, F 144 232 0 227 74.73% 100.0% C, D 182 194 2 225 65.0% 48.4% G, D 199 177 14 213 74.02% 93.43% F, E 180 196 2 225 64.52% 47.87% B, D 199 177 14 213	B, F	185	191	0	227	65.95%	49.2%	B, F	175	201	2	225	75.84%	98.87%	
C, F 182 194 2 225 65.0% 48.4% C, A 144 232 0 227 74.73% 100.0% C, E 182 194 2 225 65.0% 48.4% A, E 144 232 0 227 74.73% 100.0% C, A 182 194 2 225 65.0% 48.4% A, F 144 232 0 227 74.73% 100.0% C, D 182 194 2 225 65.0% 48.4% G, D 199 177 14 213 74.02% 93.43% F, E 180 196 2 225 64.52% 47.87% B, D 199 177 14 213 74.02% 93.43% E, D 180 196 2 225 64.52% 47.87% B, D 199 177 14 213 74.02% 93.43% E, D 180 196 2 225 <td>B, A</td> <td>185</td> <td>191</td> <td>0</td> <td>227</td> <td>65.95%</td> <td>49.2%</td> <td>A, G</td> <td>144</td> <td>232</td> <td>0</td> <td>227</td> <td>74.73%</td> <td>100.0%</td>	B, A	185	191	0	227	65.95%	49.2%	A, G	144	232	0	227	74.73%	100.0%	
C, E 182 194 2 225 65.0% 48.4% A, E 144 232 0 227 74.73% 100.0% C, A 182 194 2 225 65.0% 48.4% A, F 144 232 0 227 74.73% 100.0% C, D 182 194 2 225 65.0% 48.4% G, D 199 177 14 213 74.02% 93.43% F, E 180 196 2 225 64.52% 47.87% A, D 199 177 14 213 74.02% 93.43% A, E 180 196 2 225 64.52% 47.87% B, D 199 177 14 213 74.02% 93.43% E, D 180 196 2 225 64.52% 47.87% C, D 199 177 14 213 74.02% 93.43%		185	191	0	227	65.95%	49.2%	B, A	144	232	0	227	74.73%	100.0%	
C, A 182 194 2 225 65.0% 48.4% A, F 144 232 0 227 74.73% 100.0% C, D 182 194 2 225 65.0% 48.4% G, D 199 177 14 213 74.02% 93.43% F, E 180 196 2 225 64.52% 47.87% A, D 199 177 14 213 74.02% 93.43% A, E 180 196 2 225 64.52% 47.87% B, D 199 177 14 213 74.02% 93.43% E, D 180 196 2 225 64.52% 47.87% C, D 199 177 14 213 74.02% 93.43%	C, F	182	194	2	225	65.0%	48.4%		144	232	0	227	74.73%	100.0%	
C, A 182 194 2 225 65.0% 48.4% A, F 144 232 0 227 74.73% 100.0% C, D 182 194 2 225 65.0% 48.4% G, D 199 177 14 213 74.02% 93.43% F, E 180 196 2 225 64.52% 47.87% A, D 199 177 14 213 74.02% 93.43% A, E 180 196 2 225 64.52% 47.87% B, D 199 177 14 213 74.02% 93.43% E, D 180 196 2 225 64.52% 47.87% C, D 199 177 14 213 74.02% 93.43%	C, E	182	194	2	225	65.0%	48.4%		144	232	0	227	74.73%	100.0%	
F, E 180 196 2 225 64.52% 47.87% A, D 199 177 14 213 74.02% 93.43% A, E 180 196 2 225 64.52% 47.87% B, D 199 177 14 213 74.02% 93.43% E, D 180 196 2 225 64.52% 47.87% C, D 199 177 14 213 74.02% 93.43%	C, A	182	194	2	225		48.4%	A, F	144	232	0	227	74.73%	100.0%	
A, E 180 196 2 225 64.52% 47.87% B, D 199 177 14 213 74.02% 93.43% E, D 180 196 2 225 64.52% 47.87% C, D 199 177 14 213 74.02% 93.43%	C, D	182	194	2	225				199		14	213	74.02%	93.43%	
E, D 180 196 2 225 64.52% 47.87% C, D 199 177 14 213 74.02% 93.43%	F, E	180	196	2	225	64.52%	47.87%	A, D	199	177	14	213	74.02%	93.43%	
	A, E	180	196	2	225	64.52%	47.87%	B, D	199	177	14	213	74.02%	93.43%	
A E 175 201 2 225 63 20% 46 54% E D 100 177 14 212 74 020% 02 420%	E, D	180	196	2	225	64.52%	47.87%		199	177	14	213	74.02%	93.43%	
A,1 173 201 2 223 03.25% 40.34% E,D 199 177 14 213 74.02% 95.43%	A, F	175	201	2	225	63.29%	46.54%	E, D	199	177	14	213	74.02%	93.43%	

F, D	175	201	2	225	63.29%	46.54%	F, D	199	177	14	213	74.02%	93.43%		
,						Use of We									
B, D	286	21	5	354	95.65%	93.16%	C, F	271	36	0	359	95.44%	100.0%		
A, D	286	21	5	354	95.65%	93.16%	B, D	286	21	5	354	96.34%	98.28%		
F, D	286	21	5	354	95.65%	93.16%	A, D	286	21	5	354	96.34%	98.28%		
G, D	286	21	5	354	95.65%	93.16%	F, D	286	21	5	354	96.34%	98.28%		
E, D	286	21	5	354	95.65%	93.16%	G, D	286	21	5	354	96.34%	98.28%		
C, F	296	11	52	307	90.38%	96.42%	E, D	286	21	5	354	96.34%	98.28%		
C, D	296	11	52	307	90.38%	96.42%	C, D	286	21	5	354	96.34%	98.28%		
C, A	296	11	52	307	90.38%	96.42%	C, A	261	46	0	359	94.32%	100.0%		
B, C	296	11	52	307	90.38%	96.42%	B, C	258	49	0	359	94.0%	100.0%		
C, G	296	11	52	307	90.38%	96.42%	F, G	254	53	0	359	93.57%	100.0%		
C, E	296	11	52	307	90.38%	96.42%	A, G	244	63	0	359	92.54%	100.0%		
F, G	254	53	0	359	90.55%	82.74%	B, G	241	66	0	359	92.24%	100.0%		
A, G	244	63	0	359	88.57%	79.48%	B, F	237	70	0	359	91.84%	100.0%		
B, G	241	66	0	359	87.96%	78.5%	A, F	237	70	0	359	91.84%	100.0%		
B, F	237	70	0	359	87.13%	77.2%	F, E	237	70	0	359	91.84%	100.0%		
A, F	237	70	0	359	87.13%	77.2%	B, A	227	80	0	359	90.89%	100.0%		
F, E	F, E 237 70 0 359 87.13% 77.2% A, E 227 80 0 359 90.89% 100.0%														
B, A	B, A 227 80 0 359 85.02% 73.94% B, E 224 83 0 359 90.61% 100.0%														
A, E	A, E 227 80 0 359 85.02% 73.94% C, G 296 11 52 307 90.8% 85.06%														
B, E	B, E 224 83 0 359 84.37% 72.96% C, E 296 11 52 307 90.8% 85.06%														
G, E	226	81	55	304	76.87%	73.62%	G, E	226	81	55	304	79.69%	80.43%		
								G					<u>'</u>		
B, F	Seeds Hard Coded in PRNG B, F 17 0 0 30 100.0% 100.0% B, F 17 0 0 30 100.0% 100.0% B, G 17 0 0 30 100.0% 100.0%														
B, G	B, F 17 0 0 30 100.0% 100.0% B, F 17 0 0 30 100.0% 100.0% B, G 17 0 0 30 100.0% 100.0% B, G 17 0 0 30 100.0% 100.0% C, F 17 0 0 30 100.0% 100.0% C, F 17 0 0 30 100.0% 100.0%														
,	B, F 17 0 0 30 100.0% 100.0% B, F 17 0 0 30 100.0% 100.0% B, G 17 0 0 30 100.0% 100.0% B, G 17 0 0 30 100.0% 100.0% C, F 17 0 0 30 100.0% 100.0% C, F 17 0 0 30 100.0% 100.0%														
C, G	17	0	0	30	100.0%	100.0%	C, G	17	0	0	30	100.0%	100.0%		
A, F	17	0	0	30	100.0%	100.0%	A, F	17	0	0	30	100.0%	100.0%		
A, G	17	0	0	30	100.0%	100.0%	A, G	17	0	0	30	100.0%	100.0%		
F, G	17	0	0	30	100.0%	100.0%	F, G	17	0	0	30	100.0%	100.0%		
F, E	17	0	0	30	100.0%	100.0%	F, E	17	0	0	30	100.0%	100.0%		
F, D	17	0	0	30	100.0%	100.0%	F, D	17	0	0	30	100.0%	100.0%		
G, E	17	0	0	30	100.0%	100.0%	G, E	17	0	0	30	100.0%	100.0%		
G, D	17	0	0	30	100.0%	100.0%	G, D	17	0	0	30	100.0%	100.0%		
B, C	0	17	0	30	0.0%	0.0%	B, C	0	17	0	30	0.00%	0.00%		
B, A	0	17	0	30	0.0%	0.0%	B, A	0	17	0	30	0.00%	0.00%		
B, E	0	17	0	30	0.0%	0.0%	B, E	0	17	0	30	0.00%	0.00%		
B, D	0	17	0	30	0.0%	0.0%	B, D	0	17	0	30	0.00%	0.00%		
C, A	0	17	0	30	0.0%	0.0%	C, A	0	17	0	30	0.00%	0.00%		
C, E	0	17	0	30	0.0%	0.0%	C, E	0	17	0	30	0.00%	0.00%		
C, D	0	17	0	30	0.0%	0.0%	C, D	0	17	0	30	0.00%	0.00%		
A, E	0	17	0	30	0.0%	0.0%	A, E	0	17	0	30	0.00%	0.00%		
A, D	0	17	0	30	0.0%	0.0%	A, D	0	17	0	30	0.00%	0.00%		
E, D	0	17	0	30	0.0%	0.0%	E, D	0	17	0	30	0.00%	0.00%		
		A - Se	mgrep	l B - Sn	yk C - Fort	ify D - Spot	bugs E - Kii	uwan 1	F - Syn	ospys l	G - Ho	rusec			

Table 4.5: Ranking of combinations of 2 SAST tools regarding their performance in category A2: Cryptographic Failures - Best and Minimum Effort Scenarios

Results obtained in A3: Injection

						A3: In	jection						
F	Busines	s Critic	al		Metric	Tiebreaker	H	eighten	ed Crit	ical		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	Recall	Precison	Comb.	TP	FN	FP	TN	Rec.*Infor.	Recall
						Cross-Site	Scripting						
A, E	498	115	965	1315	81.24%	34.04%	B, F	475	138	167	2113	65.93%	77.49%
C, E	498	115	965	1315	81.24%	34.04%	B, C	460	153	167	2113	62.93%	75.04%
F, E	498	115	965	1315	81.24%	34.04%	B, A	446	167	167	2113	60.18%	72.76%
B, E	497	116	965	1315	81.08%	33.99%	A, E	498	115	965	1315	56.43%	81.24%
E, D	497	116	965	1315	81.08%	33.99%	C, E	498	115	965	1315	56.43%	81.24%
G, E	496	117	965	1315	80.91%	33.95%	F, E	498	115	965	1315	56.43%	81.24%
B, F	475	138	167	2113	77.49%	73.99%	B, E	497	116	965	1315	56.25%	81.08%
B, C	460	153	167	2113	75.04%	73.37%	E, D	497	116	965	1315	56.25%	81.08%
B, A	446	167	167	2113	72.76%	72.76%	G, E	496	117	965	1315	56.07%	80.91%
B, D	444	169	167	2113	72.43%	72.67%	B, D	444	169	167	2113	59.79%	72.43%

B, G	432	181	167	2113	70.47%	72.12%	B, G	432	181	167	2113	57.49%	70.47%
C, F	419	194	203	2077	68.35%	67.36%	C, F	419	194	203	2077	54.49%	68.35%
A, D	426	187	832	1448	69.49%	33.86%	A, D	426	187	832	1448	46.21%	69.49%
C, D	387	226	203 832	2077	63.13%	65.59%	C, D	387	226 218	203 832	2077	48.68% 41.22%	63.13%
G, D C, A	395	218	203	1448 2077	64.44% 59.54%	32.19% 64.26%	G, D C, A	365	218	203	1448 2077	41.22%	64.44% 59.54%
C, G	360	253	203	2077	58.73%	63.94%	C, A	360	253	203	2077	43.99%	58.73%
F, D	352	261	576	1704	57.42%	37.93%	F, D	352	261	576	1704	37.94%	57.42%
A, F	347	266	576	1704	56.61%	37.59%	A, F	347	266	576	1704	37.17%	56.61%
F, G	347	266	576	1704	56.61%	37.59%	F, G	347	266	576	1704	37.17%	56.61%
A, G	147	466	67	2213	23.98%	68.69%	A, G	147	466	67	2213	14.51%	23.98%
B, D	615	0	537	1356	100.0%	SQL In	B, D	615	0	537	1356	85.82%	100.0%
F, D	615	0	537	1356	100.0%	53.39%	F, D	615	0	537	1356	85.82%	100.0%
C, D	615	0	537	1356	100.0%	53.39%	C, D	615	0	537	1356	85.82%	100.0%
E, D	615	0	537	1356	100.0%	53.39%	G, D	615	0	537	1356	85.82%	100.0%
G, D	615	0	537	1356	100.0%	53.39%	A, D	615	0	537	1356	85.82%	100.0%
A, D	615	0	537	1356	100.0%	53.39%	B, G	555	60	126	1767	82.84%	90.24%
B, C C, F	549 549	66 66	281 281	1612 1612	89.27% 89.27%	66.14% 66.14%	F, G A, G	545 552	70 63	128 420	1765 1473	80.58% 75.2%	88.62% 89.76%
C, G	549	66	281	1612	89.27%	66.14%	B, C	549	66	281	1612	77.85%	89.27%
G, E	543	72	329	1564	88.29%	62.27%	C, F	549	66	281	1612	77.85%	89.27%
C, E	539	76	329	1564	87.64%	62.1%	C, G	549	66	281	1612	77.85%	89.27%
B, E	537	78	329	1564	87.32%	62.01%	E, D	544	71	329	1564	75.66%	88.46%
F, E	526	89	329	1564	85.53%	61.52%	G, E	543	72	329	1564	75.45%	88.29%
A, G	552	63	420	1473	89.76%	56.79%	C, A	544	71	420	1473	73.54% 72.92%	88.46%
C, A B, A	544	71 74	420	1473 1473	88.46% 87.97%	56.43% 56.3%	B, A C, E	541	74 76	420 329	1473 1564	72.92%	87.97% 87.64%
A, F	530	85	420	1473	86.18%	55.79%	B, E	537	78	329	1564	74.01%	87.32%
B, G	535	80	679	1214	86.99%	44.07%	A, F	530	85	420	1473	70.66%	86.18%
F, G	535	80	679	1214	86.99%	44.07%	F, E	526	89	329	1564	71.91%	85.53%
A, E	518	97	329	1564	84.23%	61.16%	A, E	518	97	329	1564	70.27%	84.23%
B, F	463	152	126	1767	75.28%	78.61%	B, F	463	152	126	1767	63.48%	75.28%
B, D	391	4	299	1100	98.99%	HTTP Respo	onse Splitting B, D		4	299	1108	87.97%	98.99%
Б, D Е, D	372	23	299	1108 1108	94.18%	55.44%	Б, D Е, D	391	23	299	1108	81.43%	98.99%
C, D	372	23	299	1108	94.18%	55.44%	C, D	372	23	299	1108	81.43%	94.18%
A, D	372	23	299	1108	94.18%	55.44%	A, D	372	23	299	1108	81.43%	94.18%
F, D	372	23	299	1108	94.18%	55.44%	F, D	372	23	299	1108	81.43%	94.18%
G, D	372	23	299	1108	94.18%	55.44%	G, D	372	23	299	1108	81.43%	94.18%
B, E	315	80	6	1401	79.75%	98.13%	B, E	315	80	6	1401	71.5%	79.75%
B, C C, E	266 265	129 130	6 42	1401 1365	67.34% 67.09%	97.79% 86.32%	B, C C, E	266 265	129 130	6 42	1401	56.2% 55.05%	67.34% 67.09%
B, A	253	142	6	1401	64.05%	97.68%	B, A	253	142	6	1401	52.4%	64.05%
B, F	253	142	6	1401	64.05%	97.68%	B, F	253	142	6	1401	52.4%	64.05%
B, G	253	142	6	1401	64.05%	97.68%	B, G	253	142	6	1401	52.4%	64.05%
A, E	171	224	42	1365	43.29%	80.28%	A, E	171	224	42	1365	30.37%	43.29%
F, E	171	224	42	1365	43.29%	80.28%	F, E	171	224	42	1365	30.37%	43.29%
G, E	171	224 256	233	1365 1174	43.29% 35.19%	80.28% 37.37%	G, E C, A	171	224	233	1365 1174	30.37% 20.87%	43.29% 35.19%
C, A C, F	139	256	233	1174	35.19%	37.37%	C, A	139	256	233	1174	20.87%	35.19%
C, G	139	256	233	1174	35.19%	37.37%	C, F	139	256	233	1174	20.87%	35.19%
A, F	0	395	0	1407	0.0%	0.00%	A, F	0	395	0	1407	0.0%	0.0%
A, G	0	395	0	1407	0.0%	0.00%	A, G	0	395	0	1407	0.0%	0.0%
F, G	0	395	0	1407	0.0%	0.00%	F, G	0	395	0	1407	0.0%	0.0%
G, D	293	0	292	173	100.0%	LDAP I 50.09%	njection G, D	292	1	7	458	98.74%	99.66%
E, D	293	0	292	173	100.0%	50.09%	F, G	292	1	7	458	98.74%	99.66%
B, D	293	0	292	173	100.0%	50.09%	B, D	292	1	13	452	98.1%	99.66%
B, G	291	2	7	458	99.32%	97.65%	B, A	292	1	13	452	98.1%	99.66%
G, E	288	5	7	458	98.29%	97.63%	B, F	292	1	13	452	98.1%	99.66%
C, G	292	1	80	385	99.66%	78.49%	B, G	291	2	7	458	98.23%	99.32%
C, E	292	1	80	385	99.66%	78.49%	A, G	291	2	7	458	98.23%	99.32%
B, C	292	1	80	385	99.66%	78.49%	G, E	288	5	7	458	96.71%	98.29%
C, A C, F	292	1	80	385 385	99.66% 99.66%	78.49% 78.49%	C, G C, E	292 292	1	80	385 385	90.92% 90.92%	99.66% 99.66%
C, D	292	1	80	385	99.66%	78.49%	В, С	292	1	80	385	90.92%	99.66%
A, E	292	1	256	209	99.66%	53.28%	C, A	292	1	80	385	90.92%	99.66%
B, A	292	1	256	209	99.66%	53.28%	C, F	292	1	80	385	90.92%	99.66%

A, D	292	1	256	209	99.66%	53.28%	C, D	292	1	80	385	90.92%	99.66%
A, G	291	2	256	209	99.32%	53.2%	A, E	292	1	256	209	72.06%	99.66%
F, G	292	1	279	186	99.66%	51.14%	E, D	293	0	292	173	68.6%	100.0%
F, E	292	1	279	186	99.66%	51.14%	A, D	293	0	292	173	68.6%	100.0%
B, F	292	1	279	186	99.66%	51.14%	F, E	292	1	279	186	69.59%	99.66%
A, F	292	1	279	186	99.66%	51.14%	A, F	292	1	279	186	69.59%	99.66%
F, D	292	1	279	186	99.66%	51.14%	F, D	292	1	279	186	69.59%	99.66%
B, E	225	68	13	452	76.79%	94.54%	B, E	225	68	13	452	66.81%	76.79%
2,2		00	-10	.02	7017710	1	nd Injection	1220	- 00	10	102	00.0170	7017770
G, D	387	0	391	178	100.0%	49.74%	B, G	383	4	45	524	94.54%	98.97%
B, D	387	0	391	178	100.0%	49.74%	B, D	383	4	45	524	94.54%	98.97%
F, D	387	0	391	178	100.0%	49.74%	B, C	383	4	45	524	94.54%	98.97%
A, D	387	0	391	178	100.0%	49.74%	A, G	369	18	5	564	92.71%	95.35%
E, D	387	0	391	178	100.0%	49.74%	F, G	367	20	5	564	91.96%	94.83%
C, D	387	0	391	178	100.0%	49.74%	G, E	383	4	125	444	87.58%	98.97%
A, G	369	18	5	564	95.35%	98.66%	B, E	317	70	45	524	71.27%	81.91%
B, G	383	4	45	524	98.97%	89.49%	G, D	387	0	391	178	65.64%	100.0%
G, E	383	4	125	444	98.97%	75.39%	F, D	387	0	391	178	65.64%	100.0%
C, G	384	3	396	173	99.22%	49.23%	A, D	387	0	391	178	65.64%	100.0%
B, C	384	3	396	173	99.22%	49.23%	E, D	387	0	391	178	65.64%	100.0%
C, F	384	3	396	173	99.22%	49.23%	C, G	384	3	396	173	64.31%	99.22%
C, A	384	3	396	173	99.22%	49.23%	C, F	384	3	396	173	64.31%	99.22%
C, E	384	3	396	173	99.22%	49.23%	C, A	384	3	396	173	64.31%	99.22%
F, G	367	20	5	564	94.83%	98.66%	C, E	384	3	396	173	64.31%	99.22%
B, E	317	70	45	524	81.91%	87.57%	C, D	384	3	396	173	64.31%	99.22%
B, A	295	92	45	524	76.23%	86.76%	B, A	295	92	45	524	64.15%	76.23%
B, F	295	92	45	524	76.23%	86.76%	B, F	295	92	45	524	64.15%	76.23%
F, E	273	114	125	444	70.54%	68.59%	F, E	273	114	125	444	52.4%	70.54%
A, E	273	114	125	444	70.54%	68.59%	A, E	273	114	125	444	52.4%	70.54%
A, F	222	165	67	502	57.36%	76.82%	A, F	222	165	67	502	41.76%	57.36%
1 2, 2		100	0,	002	27.2070		njection		100		002	1117070	0710070
B, D	280	0	282	591	100.0%	49.82%	B, C	278	2	36	837	96.88%	99.29%
G, D	280	0	282	591	100.0%	49.82%	C, A	278	2	36	837	96.88%	99.29%
F, D	280	0	282	591	100.0%	49.82%	C, F	278	2	36	837	96.88%	99.29%
E, D	280	0	282	591	100.0%	49.82%	C, G	278	2	36	837	96.88%	99.29%
A, D	280	0	282	591	100.0%	49.82%	C, E	278	2	36	837	96.88%	99.29%
B, C	278	2	36	837	99.29%	88.54%	C, D	278	2	36	837	96.88%	99.29%
C, A	278	2	36	837	99.29%	88.54%	B, D	280	0	282	591	83.85%	100.0%
C, F	278	2	36	837	99.29%	88.54%	G, D	280	0	282	591	83.85%	100.0%
C, G	278	2	36	837	99.29%	88.54%	F, D	280	0	282	591	83.85%	100.0%
C, E	278	2	36	837	99.29%	88.54%	E, D	280	0	282	591	83.85%	100.0%
C, D	278	2	36	837	99.29%	88.54%	A, D	280	0	282	591	83.85%	100.0%
B, E	179	101	169	704	63.93%	51.44%	B, E	179	101	169	704	46.21%	63.93%
A, E	179	101	169	704	63.93%	51.44%	A, E	179	101	169	704	46.21%	63.93%
F, E	179	101	169	704	63.93%	51.44%	F, E	179	101	169	704	46.21%	63.93%
G, E	179	101	169	704	63.93%	51.44%	G, E	179	101	169	704	46.21%	63.93%
A, F	123	157	120	753	43.93%	50.62%	A, F	123	157	120	753	28.59%	43.93%
B, F	120	160	120	753	42.86%	50.02%	B, F	120	160	120	753	27.67%	42.86%
F, G	120	160	120	753	42.86%	50.0%	F, G	120	160	120	753	27.67%	42.86%
B, A	69	211	67	806	24.64%	50.74%	B, A	69	211	67	806	14.41%	24.64%
A, G	69	211	67	806	24.64%	50.74%	A, G	69	211	67	806	14.41%	24.64%
B, G	16	264	7	866	5.71%	69.57%	B, G	16	264	7	866	3.0%	5.71%
D , G	10			l		ify D - Spot							3.7170
		11 . 00	grep	וט - פון	1, K 1 C - 1 OII	119 1 D - 5 POL	ougo I L - Mi	u wall []	. Syn	озруз і	5 110	,1 4500	

Table 4.6: Ranking of combinations of 2 SAST tools regarding their performance in category A3: Injection - Business and Heightened Critical Scenarios

						A3: In	jection						
	Best	Effort			Metric	Tiebreaker	ı	Minimu	ım Effc	rt		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.	TP	FN	FP	TN	Markedness	Precision
						Cross-Site	Scripting						
B, E	524	89	167	2113	80.37%	85.48%	A, E	501	112	67	2213	91.69%	88.2%
B, F	475	138	167	2113	75.7%	77.49%	A, F	391	222	67	2213	88.13%	85.37%
C, E	487	126	203	2077	74.75%	79.45%	C, A	379	234	67	2213	87.71%	84.98%
B, C	460	153	167	2113	74.19%	75.04%	A, D	352	261	67	2213	86.73%	84.01%
B, A	446	167	167	2113	72.76%	72.76%	B, E	524	89	167	2113	85.9%	75.83%
B, D	444	169	167	2113	72.55%	72.43%	B, F	475	138	167	2113	83.93%	73.99%

B, G	432	181	167	2113	71.29%	70.47%	B, C	460	153	167	2113	83.31%	73.37%
C, F	419	194	203	2077	67.85%	68.35%	B, A	446	167	167	2113	82.72%	72.76%
A, D	352	261	67	2213	68.22%	57.42%	B, D	444	169	167	2113	82.63%	72.67%
C, D	387	226	203	2077	64.34%	63.13%	B, G	432	181	167	2113	82.12%	72.12%
C, A	365	248	203	2077	61.81%	59.54%	C, E	487	126	203	2077	82.43%	70.58%
C, G	360	253	203	2077	61.22%	58.73%	A, G	147	466	67	2213	75.65%	68.69%
A, E	498 498	115	965 965	1315	47.98%	81.24%	C, F	419	194	203	2077	79.41% 77.89%	67.36%
F, E E, D	498	115 116	965	1315	47.98% 47.9%	81.24% 81.08%	C, D C, G	387	226 253	203	2077	76.54%	65.59% 63.94%
G, E	496	117	965	1315	47.83%	80.91%	F, E	457	156	576	1704	67.93%	44.24%
F, D	352	261	576	1704	45.68%	57.42%	F, D	352	261	576	1704	62.32%	37.93%
A, F	347	266	576	1704	45.18%	56.61%	F, G	347	266	576	1704	62.05%	37.59%
F, G	347	266	576	1704	45.18%	56.61%	E, D	497	116	965	1315	62.94%	33.99%
G, D	395	218	832	1448	42.93%	64.44%	G, E	496	117	965	1315	62.89%	33.95%
A, G	147	466	67	2213	35.55%	23.98%	G, D	395	218	832	1448	59.55%	32.19%
D D			126	1.5/5	0.5.65		ijection			126	45.5	00.110	04.50
B, D	555	60	126	1767	85.65%	90.24%	B, D	555	60	126	1767	89.11%	81.5%
B, G B, C	555 555	60	126 126	1767 1767	85.65% 85.65%	90.24% 90.24%	B, G B, C	555 555	60	126 126	1767 1767	89.11% 89.11%	81.5% 81.5%
B, E	548	67	126	1767	85.03%	89.11%	B, E	548	67	126	1767	88.83%	81.31%
F, D	545	70	128	1765	84.63%	88.62%	B, A	542	73	126	1767	88.59%	81.14%
F, G	545	70	128	1765	84.63%	88.62%	F, D	545	70	128	1765	88.58%	80.98%
C, F	545	70	128	1765	84.63%	88.62%	F, G	545	70	128	1765	88.58%	80.98%
B, A	542	73	126	1767	84.49%	88.13%	C, F	545	70	128	1765	88.58%	80.98%
F, E	527	88	128	1765	82.99%	85.69%	F, E	527	88	128	1765	87.85%	80.46%
A, F	521	94	128	1765	82.44%	84.72%	A, F	521	94	128	1765	87.61%	80.28%
C, D	549	66	281	1612	75.99%	89.27%	B, F	463	152	126	1767	85.34%	78.61%
C, G	549	66	281	1612	75.99%	89.27%	C, D	549	66	281	1612	81.11%	66.14%
C, E C, A	544	71 76	281 281	1612 1612	75.56% 75.12%	88.46% 87.64%	C, G C, E	549	66 71	281	1612 1612	81.11% 80.86%	66.14% 65.94%
B, F	463	152	126	1767	76.91%	75.28%	C, E	539	76	281	1612	80.61%	65.73%
E, D	544	71	329	1564	73.12%	88.46%	E, D	544	71	329	1564	78.99%	62.31%
G, E	543	72	329	1564	73.03%	88.29%	G, E	543	72	329	1564	78.93%	62.27%
A, E	518	97	329	1564	70.86%	84.23%	A, E	518	97	329	1564	77.66%	61.16%
G, D	615	0	537	1356	69.61%	100.0%	A, D	554	61	420	1473	76.45%	56.88%
A, D	554	61	420	1473	69.73%	90.08%	A, G	552	63	420	1473	76.34%	56.79%
A, G	552	63	420	1473	69.57%	89.76%	G, D	615	0	537	1356	76.69%	53.39%
D D	391	4	-	1401	00 740	HTTP Respo	,		4	6	1401	00.10/	09.400/
B, D E, D	371	24	6 42	1401 1365	98.74% 91.83%	98.99% 93.92%	B, D B, E	391	80	6	1401	99.1% 96.36%	98.49% 98.13%
B, E	315	80	6	1401	87.99%	79.75%	B, C	266	129	6	1401	94.68%	97.79%
B, C	266	129	6	1401	79.76%	67.34%	B, A	253	142	6	1401	94.24%	97.68%
C, E	265	130	42	1365	75.5%	67.09%	B, F	253	142	6	1401	94.24%	97.68%
B, A	253	142	6	1401	77.37%	64.05%	B, G	253	142	6	1401	94.24%	97.68%
B, F	253	142	6	1401	77.37%	64.05%	E, D	371	24	42	1365	94.05%	89.83%
B, G	253	142	6	1401	77.37%	64.05%	C, E	265	130	42	1365	88.81%	86.32%
C, D	372	23	299	1108	69.79%	94.18%	A, E	171	224	42	1365	83.09%	80.28%
A, D	372	23	299	1108	69.79%	94.18%	F, E	171	224	42	1365	83.09%	80.28%
F, D G, D	372 372	23	299 299	1108 1108	69.79% 69.79%	94.18% 94.18%	G, E C, D	372	224	42 299	1365 1108	83.09% 76.7%	80.28% 55.44%
A, E	171	224	42	1365	56.25%	43.29%	A, D	372	23	299	1108	76.7%	55.44%
F, E	171	224	42	1365	56.25%	43.29%	F, D	372	23	299	1108	76.7%	55.44%
G, E	171	224	42	1365	56.25%	43.29%	G, D	372	23	299	1108	76.7%	55.44%
C, A	139	256	233	1174	36.25%	35.19%	C, A	139	256	233	1174	59.73%	37.37%
C, F	139	256	233	1174	36.25%	35.19%	C, F	139	256	233	1174	59.73%	37.37%
C, G	139	256	233	1174	36.25%	35.19%	C, G	139	256	233	1174	59.73%	37.37%
A, F	0	395	0	1407	0.0%	0.0%	A, F	0	395	0	1407	0.00%	0.00%
A, G	0	395	0	1407	0.0%	0.0%	A, G	0	395	0	1407	0.00%	0.00%
F, G	0	395	0	1407	0.0%	0.0%	F, G	0	395	0	1407	0.00%	0.00%
A, E	293	0	8	457	98.65%	100.0%	njection G, D	292	1	7	458	98.72%	97.66%
F, E	293	0	8	457	98.65%	100.0%	F, G	292	1	7	458	98.72%	97.66%
E, D	293	0	8	457	98.65%	100.0%	C, G	292	1	7	458	98.72%	97.66%
G, D	292	1	7	458	98.65%	99.66%	B, G	291	2	7	458	98.61%	97.65%
F, G	292	1	7	458	98.65%	99.66%	A, G	291	2	7	458	98.61%	97.65%
C, G	292	1	7	458	98.65%	99.66%	G, E	288	5	7	458	98.27%	97.63%
B, D	292	1	13	452	97.66%	99.66%	A, E	293	0	8	457	98.67%	97.34%
B, A	292	1	13	452	97.66%	99.66%	F, E	293	0	8	457	98.67%	97.34%
B, F	292	1	13	452	97.66%	99.66%	E, D	293	0	8	457	98.67%	97.34%

B, G	291	2	7	458	98.48%	99.32%	C, E	293	0	8	457	98.67%	97.34%
A, G	291	2	7	458	98.48%	99.32%	B, D	292	1	13	452	97.76%	95.74%
G, E	288	5	7	458	97.96%	98.29%	B, A	292	1	13	452	97.76%	95.74%
C, E	292	1	80	385	87.82%	99.66%	B, F	292	1	13	452	97.76%	95.74%
B, C	292	1	80	385	87.82%	99.66%	B, C	292	1	13	452	97.76%	95.74%
C, A	292	1	80	385	87.82%	99.66%	B, E	226	67	8	457	91.9%	96.58%
C, F	292	1	80	385	87.82%	99.66%	C, A	292	1	80	385	89.12%	78.49%
C, D	292	1	80	385	87.82%	99.66%	C, F	292	1	80	385	89.12%	78.49%
B, E	225	68	13	452	84.75%	76.79%	C, D	292	1	80	385	89.12%	78.49%
A, D	293	0	292	173	66.74%	100.0%	A, D	292	1	256	209	76.4%	53.28%
A, F	292	1	279	186	67.59%	99.66%	A, F	292	1	279	186	75.3%	51.14%
F, D	292	1	279	186	67.59%	99.66%	F, D	292	1	279	186	75.3%	51.14%
1, D	272		217	100	01.3770		nd Injection	272	1	217	100	73.370	31.1470
G, E	378	9	5	564	98.18%	97.67%	G, E	378	9	5	564	98.56%	98.69%
G, D	378	9	5	564	98.18%	97.67%	G, D	378	9	5	564	98.56%	98.69%
C, G	378	9	5	564	98.18%	97.67%	C, G	378	9	5	564	98.56%	98.69%
A, G	369	18	5	564	96.98%	95.35%	B, G	378	9	5	564	98.56%	98.69%
			_						-	5			
F, G	367	20	5 45	564 524	96.71%	94.83%	A, G	369	18		564	97.79%	98.66%
B, G	383	4	45	524	93.99% 93.99%	98.97% 98.97%	F, G	367	4	5 45	564 524	97.62%	98.66% 89.49%
B, D			_	_			B, D	383				94.36%	
B, C	383	4	45	524	93.99%	98.97%	B, C	383	4	45	524	94.36%	89.49%
F, D	378	9	67	502	90.87%	97.67%	F, D	378	9	67	502	91.59%	84.94%
C, F	378	9	67	502	90.87%	97.67%	C, F	378	9	67	502	91.59%	84.94%
E, D	383	4	125	444	85.59%	98.97%	B, E	317	70	45	524	87.89%	87.57%
C, E	383	4	125	444	85.59%	98.97%	B, A	295	92	45	524	85.91%	86.76%
B, E	317	70	45	524	84.65%	81.91%	B, F	295	92	45	524	85.91%	86.76%
B, A	295	92	45	524	81.16%	76.23%	E, D	383	4	125	444	87.25%	75.39%
B, F	295	92	45	524	81.16%	76.23%	C, E	383	4	125	444	87.25%	75.39%
A, D	387	0	391	178	66.44%	100.0%	A, D	387	0	131	438	87.36%	74.71%
C, A	384	3	396	173	65.81%	99.22%	C, A	387	0	131	438	87.36%	74.71%
C, D	384	3	396	173	65.81%	99.22%	F, E	268	119	67	502	80.42%	80.0%
F, E	273	114	125	444	69.55%	70.54%	A, F	222	165	67	502	76.04%	76.82%
A, E	273	114	125	444	69.55%	70.54%	A, E	273	114	125	444	74.08%	68.59%
A, F	222	165	67	502	65.68%	57.36%	C, D	387	0	391	178	74.87%	49.74%
	•					XPath I	njection	•					
B, C	278	2	36	837	93.6%	99.29%	B, D	279	1	7	866	98.72%	97.55%
C, A	278	2	36	837	93.6%	99.29%	G, D	278	2	20	853	96.53%	93.29%
C, F	278	2	36	837	93.6%	99.29%	B, E	180	100	7	866	92.95%	96.26%
C, G	278	2	36	837	93.6%	99.29%	B, C	278	2	36	837	94.15%	88.54%
C, E	278	2	36	837	93.6%	99.29%	C, A	278	2	36	837	94.15%	88.54%
C, D	278	2	36	837	93.6%	99.29%	C, F	278	2	36	837	94.15%	88.54%
F, D	278	2	120	753	82.01%	99.29%	C, G	278	2	36	837	94.15%	88.54%
E, D	278	2	169	704	76.48%	99.29%	C, E	278	2	36	837	94.15%	88.54%
B, D	280	0	282	591	66.51%	100.0%	C, D	278	2	36	837	94.15%	88.54%
G, D	280	0	282	591	66.51%	100.0%	B, F	121	159	7	866	89.51%	94.53%
A, D	280	0	282	591	66.51%	100.0%	B, A	70	210	7	866	85.7%	90.91%
B, E	179	101	169	704	57.01%	63.93%	F, G	120	160	20	853	84.96%	85.71%
A, E	179	101	169	704	57.01%	63.93%	F, D	278	2	120	753	84.79%	69.85%
F, E	179	101	169	704	57.01%	63.93%	E, D	278	2	169	704	80.95%	62.19%
G, E	179	101	169	704	57.01%	63.93%	A, G	69	211	20	853	78.85%	77.53%
A, F	123	157	120	753	47.04%	43.93%	A, D	280	0	282	591	74.91%	49.82%
B, F	120	160	120	753	46.15%	42.86%	B, G	16	264	7	866	73.1%	69.57%
F, G	120	160	120	753	46.15%	42.86%	A, E	179	101	169	704	69.45%	51.44%
В, А	69	211	67	806	33.17%	24.64%	F, E	179	101	169	704	69.45%	51.44%
A, G	69	211	67	806	33.17%	24.64%	G, E	179	101	169	704	69.45%	51.44%
B, G	16	264	7	866	10.56%	5.71%	A, F	123	157	120	753	66.68%	50.62%
		A - Se	mgrep	D - 31	iyk IC - Fort	ify D - Spot	ougs (E - Kil	uwan (· - syn	ospys i	O - H0	nusec	

Table 4.7: Ranking of combinations of 2 SAST tools regarding their performance in category A3: Injection - Best and Minimum Effort Scenarios

Results obtained in A4: Insecure Design

						A4: Insect	ıre Design						
I	Business Critical					Tiebreaker	Н	eighten	ed Crit	ical		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	Recall	Precison	Comb.	TP	FN	FP	TN	Rec.*Infor.	Recall

						Method T	ampering						
B, E	137	12	0	48	91.95%	100.0%	B, E	137	12	0	48	88.24%	91.95%
C, E	137	12	0	48	91.95%	100.0%	C, E	137	12	0	48	88.24%	91.95%
A, E	137	12	0	48	91.95%	100.0%	A, E	137	12	0	48	88.24%	91.95%
F, E	137	12	0	48	91.95%	100.0%	F, E	137	12	0	48	88.24%	91.95%
G, E	137	12	0	48	91.95%	100.0%	G, E	137	12	0	48	88.24%	91.95%
E, D	137	12	0	48	91.95%	100.0%	E, D	137	12	0	48	88.24%	91.95%
B, D	137	12	45	3	91.95%	75.27%	B, D	137	12	45	3	45.14%	91.95%
C, D F, D	137	12	45 45	3	91.95% 91.95%	75.27% 75.27%	C, D F, D	137	12 12	45 45	3	45.14% 45.14%	91.95% 91.95%
G, D	137	12	45	3	91.95%	75.27%	G, D	137	12	45	3	45.14%	91.95%
B, A	137	148	0	48	0.67%	100.0%	B, A	1	148	0	48	0.34%	0.67%
C, A	1	148	0	48	0.67%	100.0%	C, A	1	148	0	48	0.34%	0.67%
A, F	1	148	0	48	0.67%	100.0%	A, F	1	148	0	48	0.34%	0.67%
A, G	1	148	0	48	0.67%	100.0%	A, G	1	148	0	48	0.34%	0.67%
A, D	1	148	0	48	0.67%	100.0%	A, D	1	148	0	48	0.34%	0.67%
B, C	0	149	0	48	0.0%	0.00%	B, C	0	149	0	48	0.0%	0.0%
B, F	0	149	0	48	0.0%	0.00%	B, F	0	149	0	48	0.0%	0.0%
B, G	0	149	0	48	0.0%	0.00%	B, G	0	149	0	48	0.0%	0.0%
C, F	0	149 149	0	48 48	0.0%	0.00%	C, F	0	149 149	0	48	0.0%	0.0%
C, G F, G	0	149	0	48	0.0%	0.00%	C, G F, G	0	149	0	48	0.0%	0.0%
1,0		149		40	0.070	Improper Er			149		40	0.070	0.070
C, E	403	297	730	1902	57.57%	35.57%	C, E	403	297	730	1902	37.37%	57.57%
C, G	401	299	730	1902	57.29%	35.46%	C, G	401	299	730	1902	37.11%	57.29%
C, A	401	299	730	1902	57.29%	35.46%	C, A	401	299	730	1902	37.11%	57.29%
B, C	401	299	730	1902	57.29%	35.46%	B, C	401	299	730	1902	37.11%	57.29%
C, F	401	299	730	1902	57.29%	35.46%	C, F	401	299	730	1902	37.11%	57.29%
C, D	401	299	730	1902	57.29%	35.46%	C, D	401	299	730	1902	37.11%	57.29%
B, D	125	575	32	2600	17.86%	79.62%	B, D	125	575	32	2600	10.41%	17.86%
F, D G, E	125 81	575 619	32	2600 2632	17.86% 11.57%	79.62% 100.0%	F, D G, E	125 81	575 619	32	2600 2632	10.41%	17.86% 11.57%
B, G	61	639	0	2632	8.71%	100.0%	B, G	61	639	0	2632	4.74%	8.71%
A, G	61	639	0	2632	8.71%	100.0%	A, G	61	639	0	2632	4.74%	8.71%
F, G	61	639	0	2632	8.71%	100.0%	F, G	61	639	0	2632	4.74%	8.71%
G, D	61	639	0	2632	8.71%	100.0%	G, D	61	639	0	2632	4.74%	8.71%
A, E	24	676	0	2632	3.43%	100.0%	A, E	21	679	18	2614	1.53%	3.0%
B, E	21	679	18	2614	3.0%	53.85%	B, E	21	679	18	2614	1.53%	3.0%
F, E	21	679	18	2614	3.0%	53.85%	F, E	21	679	18	2614	1.53%	3.0%
E, D	21	679	18	2614	3.0%	53.85%	E, D	21	679	18	2614	1.53%	3.0%
B, A	4	696	0	2632	0.57%	100.0%	B, A	4	696	0	2632	0.29%	0.57%
A, F A, D	4	696 696	0	2632 2632	0.57% 0.57%	100.0% 100.0%	A, F A, D	4	696 696	0	2632 2632	0.29% 0.29%	0.57% 0.57%
B, F	0	700	0	2632	0.37%	0.00%	B, F	0	700	0	2632	0.29%	0.57%
В, 1		700		2032	0.070	Trust Bounda			700		2032	0.070	0.070
C, D	83	0	53	501	100.0%	61.03%	B, F	83	0	30	524	97.29%	100.0%
B, F	83	0	30	524	100.0%	73.45%	C, F	83	0	30	524	97.29%	100.0%
B, D	83	0	53	501	100.0%	61.03%	A, F	83	0	30	524	97.29%	100.0%
A, D	83	0	53	501	100.0%	61.03%	F, G	83	0	30	524	97.29%	100.0%
C, F	83	0	30	524	100.0%	73.45%	F, E	83	0	30	524	97.29%	100.0%
A, F	83	0	30	524	100.0%	73.45%	F, D	83	0	30	524	97.29%	100.0%
F, G F, E	83	0	30	524 524	100.0%	73.45% 73.45%	C, D B, D	83	0	53	501	95.22% 95.22%	100.0% 100.0%
F, E	83	0	30	524	100.0%	73.45%	A, D	83	0	53	501	95.22%	100.0%
G, D	83	0	53	501	100.0%	61.03%	G, D	83	0	53	501	95.22%	100.0%
E, D	83	0	53	501	100.0%	61.03%	E, D	83	0	53	501	95.22%	100.0%
B, A	82	1	24	530	98.8%	77.36%	B, A	82	1	24	530	96.06%	98.8%
B, E	82	1	24	530	98.8%	77.36%	B, E	82	1	24	530	96.06%	98.8%
B, C	76	7	24	530	91.57%	76.0%	B, C	76	7	24	530	85.72%	91.57%
B, G	76	7	24	530	91.57%	76.0%	B, G	76	7	24	530	85.72%	91.57%
C, E	75	8	522	32	90.36%	12.56%	C, A	73	10	26	528	80.59%	87.95%
C, A	73	10	26 522	528	87.95%	73.74%	A, E	72	11 14	26	528	78.96%	86.75%
A, E G, E	72	11 11	522	32	86.75% 86.75%	12.12% 12.12%	A, G C, E	69 75	8	26 522	528 32	74.17% 43.44%	83.13% 90.36%
A, G	69	14	26	528	83.13%	72.63%	G, E	72	11	522	32	40.13%	86.75%
C, G	31	52	12	542	37.35%	72.09%	C, G	31	52	12	542	25.25%	37.35%
						ify D - Spot							

Table 4.8: Ranking of combinations of 2 SAST tools regarding their performance in category A4: Insecure Design - Business and Heightened Critical Scenarios

						A4: Insect	ıre Design						
	Best	Effort			Metric	Tiebreaker		Minimu	ım Effo	rt		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.	TP	FN	FP	TN	Markedness	Precision
	-	<u> </u>				Method T	ampering	1		<u> </u>			
B, E	137	12	0	48	95.8%	91.95%	B, E	137	12	0	48	90.0%	100.0%
C, E	137	12	0	48	95.8%	91.95%	C, E	137	12	0	48	90.0%	100.0%
A, E	137	12	0	48	95.8%	91.95%	A, E	137	12	0	48	90.0%	100.0%
F, E	137	12	0	48	95.8%	91.95%	F, E	137	12	0	48	90.0%	100.0%
G, E	137	12	0	48	95.8%	91.95%	G, E	137	12	0	48	90.0%	100.0%
E, D	137	12	0	48	95.8%	91.95%	E, D	137	12	0	48	90.0%	100.0%
B, D	137	12	45	3	82.78%	91.95%	B, A	1	148	0	48	62.24%	100.0%
C, D	137	12	45	3	82.78%	91.95%	C, A	1	148	0	48	62.24%	100.0%
F, D	137	12	45	3	82.78%	91.95%	A, F	1	148	0	48	62.24%	100.0%
G, D	137	12	45	3	82.78%	91.95%	A, G	1	148	0	48	62.24%	100.0%
B, A	1	148	0	48	1.33%	0.67%	A, D	1	148	0	48	62.24%	100.0%
C, A	1	148	0	48	1.33%	0.67%	B, D	137	12	45	3	47.64%	75.27%
A, F	1	148	0	48	1.33%	0.67%	C, D	137	12	45	3	47.64%	75.27%
A, G	1	148	0	48	1.33%	0.67%	F, D	137	12	45	3	47.64%	75.27%
A, D	1	148	0	48	1.33%	0.67%	G, D	137	12	45	3	47.64%	75.27%
B, C	0	149	0	48	0.0%	0.0%	B, C	0	149	0	48	0.00%	0.00%
B, F	0	149	0	48	0.0%	0.0%	B, F	0	149	0	48	0.00%	0.00%
B, G	0	149	0	48	0.0%	0.0%	B, G	0	149	0	48	0.00%	0.00%
C, F	0	149	0	48	0.0%	0.0%	C, F	0	149	0	48	0.00%	0.00%
C, G	0	149	0	48	0.0%	0.0%	C, G	0	149	0	48	0.00%	0.00%
F, G	0	149	0	48	0.0%	0.0%	F, G	0	149	0	48	0.00%	0.00%
	100	207	720	1000	12.050	Improper Er			500		0.600	000000	100.00
C, E	403	297	730	1902	43.97%	57.57%	C, G	112	588	0	2632	90.87%	100.0%
C, G	401	299	730	1902	43.8%	57.29%	G, E	81	619	0	2632	90.48%	100.0%
C, A	401	299	730	1902	43.8%	57.29%	B, G	61	639	0	2632	90.23%	100.0%
B, C	401	299	730	1902	43.8%	57.29%	A, G	61	639	0	2632	90.23%	100.0%
C, F	401	299	730	1902	43.8%	57.29%	F, G	61	639	0	2632	90.23%	100.0%
C, D	401	299	730	1902	43.8%	57.29%	G, D	61	639	0	2632	90.23%	100.0%
B, D	125	575 575	32	2600	29.17% 29.17%	17.86%	C, A A, E	55 24	645 676	0	2632	90.16%	100.0%
F, D G, E	125 81	619		2600	29.17%	17.86% 11.57%		4	696	0	2632 2632	89.78% 89.54%	100.0%
		639	0	2632			B, A	4		0			
B, G A, G	61	639	0	2632	16.03% 16.03%	8.71% 8.71%	A, F	4	696 696	0	2632 2632	89.54% 89.54%	100.0%
F, G	61	639	0	2632	16.03%	8.71%	A, D B, D	125	575	32	2600	89.34%	79.62%
G, D	61	639	0	2632	16.03%	8.71%	F, D	125	575	32	2600	80.75%	79.62%
A, E	21	679	18	2614	5.68%	3.0%	C, E	54	646	18	2614	77.59%	75.0%
B, E	21	679	18	2614	5.68%	3.0%	B, E	21	679	18	2614	66.61%	53.85%
F, E	21	679	18	2614	5.68%	3.0%	F, E	21	679	18	2614	66.61%	53.85%
E, D	21	679	18	2614	5.68%	3.0%	E, D	21	679	18	2614	66.61%	53.85%
В, А	4	696	0	2632	1.14%	0.57%	B, C	401	299	730	1902	60.94%	35.46%
A, F	4	696	0	2632	1.14%	0.57%	C, F	401	299	730	1902	60.94%	35.46%
A, D	4	696	0	2632	1.14%	0.57%	C, D	401	299	730	1902	60.94%	35.46%
B, F	0	700	0	2632	0.0%	0.0%	B, F	0	700	0	2632		0.00%
_,,,		, 50				Trust Bounda			, 50			0.0070	0.0070
B, A	82	1	24	530	86.77%	98.8%	C, D	83	0	12	542	93.68%	87.37%
B, E	82	1	24	530	86.77%	98.8%	C, E	75	8	12	542	92.38%	86.21%
C, E	75	8	12	542	88.24%	90.36%	B, F	83	0	24	530	88.79%	77.57%
B, F	83	0	30	524	84.69%	100.0%	B, D	83	0	24	530	88.79%	77.57%
C, F	83	0	30	524	84.69%	100.0%	В, А	82	1	24	530	88.59%	77.36%
A, F	83	0	30	524	84.69%	100.0%	В, Е	82	1	24	530	88.59%	77.36%
F, G	83	0	30	524	84.69%	100.0%	A, D	83	0	26	528	88.07%	76.15%
F, E	83	0	30	524	84.69%	100.0%	B, C	76	7	24	530	87.35%	76.0%
F, D	83	0	30	524	84.69%	100.0%	B, G	76	7	24	530	87.35%	76.0%
B, C	76	7	24	530	83.06%	91.57%	C, A	73	10	26	528	85.94%	73.74%
B, G	76	7	24	530	83.06%	91.57%	A, E	72	11	26	528	85.71%	73.47%
C, A	73	10	26	528	80.22%	87.95%	C, F	83	0	30	524	86.73%	73.45%
C, D	83	0	53	501	75.8%	100.0%	A, F	83	0	30	524	86.73%	73.45%
B, D	83	0	53	501	75.8%	100.0%	F, G	83	0	30	524	86.73%	73.45%
A, D	83	0	53	501	75.8%	100.0%	F, E	83	0	30	524	86.73%	73.45%
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G, D	83	0	53	501	75.8%	100.0%	F, D	83	0	30	524	86.73%	73.45%
E, D	83	0	53	501	75.8%	100.0%	A, G	69	14	26	528	85.02%	72.63%
A, E	72	11	26	528	79.56%	86.75%	C, G	31	52	12	542	81.67%	72.09%
A, G	69	14	26	528	77.53%	83.13%	G, D	83	0	53	501	80.51%	61.03%
C, G	31	52	12	542	49.21%	37.35%	E, D	83	0	53	501	80.51%	61.03%
G, E	72	11	522	32	21.27%	86.75%	G, E	72	11	522	32	43.27%	12.12%
		A - Se	mgrep	B - Sr	yk C - Fort	ify D - Spot	bugs E - Kit	iwan]	F - Syn	ospys l	G - Ho	rusec	

Table 4.9: Ranking of combinations of 2 SAST tools regarding their performance in category A4: Insecure Design - Best and Minimum Effort Scenarios

Results obtained in A5: Security Misconfiguration

Record Property Comb. Property Pro						A:	5: Security M	lisconfigurati	on					
]	Busines	s Critic	cal		Metric	Tiebreaker	Н	eighten	ed Crit	ical		Metric	Tiebreaker
B, F 59 3 0 57 95.16% 100.0% B, F 59 3 0 57 92.86% 95.16%	Comb.	TP	FN	FP	TN	Recall	Precison	Comb.	TP	FN	FP	TN	Rec.*Infor.	Recall
B, E						Insecu	re Use of Ha	rd Coded Co	nstants					
B, C	B, F	59	3	0	57	95.16%	100.0%	B, F	59	3	0	57	92.86%	95.16%
B, A	B, E	50	12	0	57	80.65%	100.0%	B, E	50	12	0	57	72.84%	80.65%
B, G	B, C	45	17	0	57	72.58%	100.0%	B, C	45	17	0	57	62.63%	72.58%
B, D	B, A	45	17	0	57	72.58%	100.0%	B, A	45	17	0	57	62.63%	72.58%
F. E	B, G	45	17	0	57	72.58%	100.0%	B, G	45	17	0	57	62.63%	72.58%
F. D	B, D	45	17	0	57	72.58%	100.0%	B, D	45	17	0	57	62.63%	72.58%
A, F 40 22 0 57 64.52% 100.0% A, F 40 22 0 57 64.52% F, G 40 22 0 57 64.52% 100.0% C, F 40 22 0 57 53.07% 64.52% C, E 40 22 0 57 53.07% 64.52% C, E 31 31 0 57 50.0% 100.0% C, E 31 31 0 57 50.0% 100.0% A, E 31 31 0 57 37.5% 50.0% 60.0% A, G 75 0 37 43.6% 41.94% 89.66% A, D 26	F, E	41	21	0	57	66.13%	100.0%	F, E	41	21	0	57	54.93%	66.13%
R, G 40 22 0 57 64.52% 100.0% C, F 40 22 0 57 64.52% 100.0% C, F 40 22 0 57 65.0% 100.0% C, E 31 31 0 57 50.0% 100.0% G, E 31 31 0 57 50.0% 100.0% G, E 31 31 0 57 50.0% 100.0% E, D 31 31 0 57 57.5% 50.0% C, D 26 36 3 54 41.94% 89.66% C, D 26 36 3 54 41.94% 89.66% C, D 26 36 3 54 42.866% 41.94% A, G 7 55	F, D	41	21	0	57	66.13%	100.0%	F, D	41	21	0	57	54.93%	66.13%
R, G 40 22 0 57 64.52% 100.0% C, F 40 22 0 57 64.52% 100.0% C, F 40 22 0 57 65.0% 100.0% C, E 31 31 0 57 50.0% 100.0% G, E 31 31 0 57 50.0% 100.0% G, E 31 31 0 57 50.0% 100.0% E, D 31 31 0 57 57.5% 50.0% C, D 26 36 3 54 41.94% 89.66% C, D 26 36 3 54 41.94% 89.66% C, D 26 36 3 54 42.866% 41.94% A, G 7 55	A, F	40	22	0	57		100.0%		40	22	0	57		64.52%
C, E	F, G	40	22	0	57	64.52%	100.0%		40	22	0	57	53.07%	
C, E	C, F	40	22	0	57				40	22	0	57		64.52%
A, E	C, E	31	31	0		50.0%	100.0%		31	31	0			50.0%
G, E 31 31 0 57 50.0% 100.0% G, E 31 31 0 57 37.5% 50.0% E, D 31 31 0 57 37.5% 50.0% 100.0% E, D 31 31 0 57 37.5% 50.0% 50.0% C, D 26 36 3 54 41.94% 89.66% C, D 26 36 3 54 28.66% 41.94% A, D 26 36 3 54 41.94% 89.66% G, D 26 36 3 54 28.66% 41.94% A, D 26 36 3 54 41.94% 89.66% G, D 26 36 3 54 28.66% 41.94% A, G 7 55 0 57 11.29% 100.0% A, G 7 55 0 57 6.88% 110.0% A, G 7 55 0 57 6.48% 100.0% C, A 6 56 0 57 5.31% 9.68% C, D 26 36 3 54 28.66% 41.94% C, A 6 56 0 57 5.31% 9.68% 100.0% C, A 6 56 0 57 5.31% 9.68% 100.0% C, A 6 56 0 57 5.31% 9.68% 8.06% 8.0		31	31	0	57		100.0%			31	0	57		50.0%
E, D 31 31 0 57 500% 100.0% E, D 31 31 0 57 37.5% 50.0% C, D 26 36 3 54 41.94% 89.66% C, D 26 36 3 54 28.66% 41.94% G, D 26 36 3 54 28.66% 41.94% A, G 7 55 0 57 11.29% 100.0% A, G 7 55 0 57 6.28% 11.29% C, A 6 56 0 57 9.68% 100.0% C, A 6 56 0 57 6.28% 11.29% C, G 4 58 0 57 6.45% 100.0% C, G 5 57 0 57 6.28% 11.29% SML External Entities SML External Entiti														
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A, D														
G, D 26 36 3 54 41.94% 89.66% G, D 26 36 3 54 28.66% 41.94% A, G 7 55 0 57 11.29% 100.0% A, G 7 55 0 57 6.28% 11.29% C, A 6 56 0 57 9.68% 100.0% C, A 6 56 0 57 9.68% 100.0% C, A 6 56 0 57 9.68% 100.0% C, G 5 57 0 57 4.36% 8.06%														
A, G														
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B, F 5 5 3 22 50.0% 62.5% B, F 5 5 3 22 34.5% 50.0% B, G 5 5 3 22 50.0% 62.5% B, G 5 5 3 22 34.5% 50.0% B, E 5 5 3 22 50.0% 62.5% B, D 5 5 3 22 34.5% 50.0% B, D 5 5 3 22 50.0% 62.5% B, D 5 5 3 22 34.5% 50.0% C, D 5 5 3 22 50.0% 62.5% C, D 5 5 3 22 34.5% 50.0% F, D 5 5 3 22 50.0% 62.5% E, D 5 5 3 22 34.5% 50.0% E, D 5 5 3 22 50.0% 62.5% E, D 5<														
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A, G 2 8 12 13 20.0% 14.29% F, G 1 9 1 24 5.3% 10.0% A, E 2 8 12 13 20.0% 14.29% F, E 1 9 1 24 5.3% 10.0% C, E 1 9 9 16 10.0% 10.0% C, E 1 9 9 16 3.7% 10.0% G, E 1 9 9 16 3.7% 10.0% 10.0% C, G 0 10 17 8 0.0% 0.0% C, G 0 10 17 8 0.0% 0.0% C, G 0 10 17 8 0.0% 0.0% C, G 0 10 17 8 0.0% 0.0% Bad Programming of Cookies B, A 1044 621 160 2059 62.7% 86.71% B, A 1044 621 160 <t< td=""><td></td><td></td><td></td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>				1										
A, E 2 8 12 13 20.0% 14.29% F, E 1 9 1 24 5.3% 10.0% C, E 1 9 9 16 10.0% 10.0% C, E 1 9 9 16 3.7% 10.0% G, E 1 9 9 16 3.7% 10.0% C, G 0 10 17 8 0.0% 0.0% C, G 0 10 17 8 0.0% 0.0% Bad Programming of Cookies B, A 1044 621 160 2059 62.7% 86.71% B, A 1044 621 160 2059 48.75% 62.7% A, D 1044 621 160 2059 53.69% 84.82% A, G 894 771 160 2059 39.33% 53.69%														
C, E 1 9 9 16 10.0% C, E 1 9 9 16 3.7% 10.0% G, E 1 9 9 16 10.0%<														
G, E 1 9 9 16 10.0% G, E 1 9 9 16 3.7% 10.0% C, G 0 10 17 8 0.0% 0.0% C, G 0 10 17 8 0.0% 0.0% Bad Programming of Cookies B, A 1044 621 160 2059 62.7% 86.71% B, A 1044 621 160 2059 48.75% 62.7% A, D 1044 621 160 2059 62.7% 86.71% A, D 1044 621 160 2059 48.75% 62.7% A, G 894 771 160 2059 53.69% 84.82% A, G 894 771 160 2059 39.33% 53.69%														
C, G 0 10 17 8 0.0% 0.0% C, G 0 10 17 8 0.0% 0.0% Bad Programming of Cookies B, A 1044 621 160 2059 62.7% 86.71% B, A 1044 621 160 2059 48.75% 62.7% A, D 1044 621 160 2059 62.7% 86.71% A, D 1044 621 160 2059 48.75% 62.7% A, G 894 771 160 2059 53.69% 84.82% A, G 894 771 160 2059 39.33% 53.69%	~ -			-				~ -			-			
Bad Programming of Cookies B, A 1044 621 160 2059 62.7% 86.71% B, A 1044 621 160 2059 48.75% 62.7% A, D 1044 621 160 2059 62.7% 86.71% A, D 1044 621 160 2059 48.75% 62.7% A, G 894 771 160 2059 53.69% 84.82% A, G 894 771 160 2059 39.33% 53.69%		_												
B, A 1044 621 160 2059 62.7% 86.71% B, A 1044 621 160 2059 48.75% 62.7% A, D 1044 621 160 2059 62.7% 86.71% A, D 1044 621 160 2059 48.75% 62.7% A, G 894 771 160 2059 53.69% 84.82% A, G 894 771 160 2059 39.33% 53.69%	C, G	U	10	17/	8					10	1/	8	0.0%	0.0%
A, D 1044 621 160 2059 62.7% 86.71% A, D 1044 621 160 2059 48.75% 62.7% A, G 894 771 160 2059 53.69% 84.82% A, G 894 771 160 2059 39.33% 53.69%	D 4	1044	(21	160	2050					(21	160	2050	40.750	(0.70
A, G 894 771 160 2059 53.69% 84.82% A, G 894 771 160 2059 39.33% 53.69%														
	-													
A, E 894 //1 100 2059 55.69% 84.82% A, E 894 7/1 160 2059 39.33% 53.69%														
	A, E	894	//1	160	2059	53.69%	84.82%	A, E	894	7/1	160	2059	39.33%	53.69%

C, A	832	833	160	2059	49.97%	83.87%	C, A	832	833	160	2059	35.67%	49.97%
F, G	716	949	82	2137	43.0%	89.72%	F, G	716	949	82	2137	29.95%	43.0%
F, E	716	949	82	2137	43.0%	89.72%	F, E	716	949	82	2137	29.95%	43.0%
C, F	671	994	82	2137	40.3%	89.11%	C, F	671	994	82	2137	27.53%	40.3%
B, F	563	1102	82	2137	33.81%	87.29%	B, F	563	1102	82	2137	22.0%	33.81%
F, D	562	1103	82	2137	33.75%	87.27%	F, D	562	1103	82	2137	21.95%	33.75%
A, F	537	1128	160	2059	32.25%	77.04%	A, F	537	1128	160	2059	20.16%	32.25%
G, D	273	1392	111	2108	16.4%	71.09%	G, D	273	1392	111	2108	9.13%	16.4%
E, D	273	1392	111	2108	16.4%	71.09%	E, D	273	1392	111	2108	9.13%	16.4%
B, G	230	1435	84	2135	13.81%	73.25%	B, G	230	1435	84	2135	7.6%	13.81%
B, E	230	1435	84	2135	13.81%	73.25%	B, E	230	1435	84	2135	7.6%	13.81%
B, C	168	1497	84	2135	10.09%	66.67%	C, D	212	1453	111	2108	6.86%	12.73%
C, D	212	1453	111	2108	12.73%	65.63%	B, C	168	1497	84	2135	5.36%	10.09%
C, G	125	1540	202	2017	7.51%	38.23%	C, G	125	1540	202	2017	3.69%	7.51%
C, E	125	1540	202	2017	7.51%	38.23%	C, E	125	1540	202	2017	3.69%	7.51%
B, D	60	1605	84	2135	3.6%	41.67%	B, D	60	1605	84	2135	1.8%	3.6%
G, E	1	1664	36	2183	0.06%	2.7%	G, E	1	1664	36	2183	0.03%	0.06%
		A - Se	mgrep	B - Sn	ıyk C - Forti	ify D - Spot	bugs E - Kiu	ıwan 🗀	F - Syn	ospys I	G - Ho	rusec	

Table 4.10: Ranking of combinations of 2 SAST tools regarding their performance in category A5: Security Misconfiguration - Business and Heightened Critical Scenarios

					A.5	5: Security M	isconfigurati	ion					
	Best	Effort			Metric	Tiebreaker		Minimu	ım Effo	rt		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.	TP	FN	FP	TN	Markedness	Precision
					Insecu	re Use of Hai	d Coded Co	nstants					
B, F	59	3	0	57	97.52%	95.16%	B, F	59	3	0	57	97.5%	100.0%
B, E	50	12	0	57	89.29%	80.65%	B, E	50	12	0	57	91.3%	100.0%
B, C	45	17	0	57	84.11%	72.58%	B, C	45	17	0	57	88.51%	100.0%
B, A	45	17	0	57	84.11%	72.58%	B, A	45	17	0	57	88.51%	100.0%
B, G	45	17	0	57	84.11%	72.58%	B, G	45	17	0	57	88.51%	100.0%
B, D	45	17	0	57	84.11%	72.58%	B, D	45	17	0	57	88.51%	100.0%
F, E	41	21	0	57	79.61%	66.13%	F, E	41	21	0	57	86.54%	100.0%
F, D	41	21	0	57	79.61%	66.13%	A, F	40	22	0	57	86.08%	100.0%
A, F	40	22	0	57	78.43%	64.52%	F, G	40	22	0	57	86.08%	100.0%
F, G	40	22	0	57	78.43%	64.52%	C, F	39	23	0	57	85.62%	100.0%
C, F	40	22	0	57	78.43%	64.52%	C, E	31	31	0	57	82.39%	100.0%
C, E	31	31	0	57	66.67%	50.0%	A, E	31	31	0	57	82.39%	100.0%
A, E	31	31	0	57	66.67%	50.0%	G, E	31	31	0	57	82.39%	100.0%
G, E	31	31	0	57	66.67%	50.0%	E, D	31	31	0	57	82.39%	100.0%
E, D	31	31	0	57	66.67%	50.0%	F, D	45	17	3	54	84.9%	93.75%
C, D	26	36	3	54	57.14%	41.94%	A, G	7	55	0	57	75.45%	100.0%
A, D	26	36	3	54	57.14%	41.94%	C, A	6	56	0	57	75.22%	100.0%
G, D	26	36	3	54	57.14%	41.94%	C, G	4	58	0	57	74.78%	100.0%
A, G	7	55	0	57	20.29%	11.29%	C, D	26	36	3	54	74.83%	89.66%
C, A	6	56	0	57	17.65%	9.68%	A, D	26	36	3	54	74.83%	89.66%
C, G	5	57	0	57	14.93%	8.06%	G, D	26	36	3	54	74.83%	89.66%
						XML Exter							
B, C	5	5	3	22	55.56%	50.0%	B, C	5	5	3	22	71.99%	62.5%
B, A	5	5	3	22	55.56%	50.0%	B, A	5	5	3	22	71.99%	62.5%
B, F	5	5	3	22	55.56%	50.0%	B, F	5	5	3	22	71.99%	62.5%
B, G	5	5	3	22	55.56%	50.0%	B, G	5	5	3	22	71.99%	62.5%
B, E	5	5	3	22	55.56%	50.0%	B, E	5	5	3	22	71.99%	62.5%
B, D	5	5	3	22	55.56%	50.0%	B, D	5	5	3	22	71.99%	62.5%
C, D	5	5	3	22	55.56%	50.0%	C, D	5	5	3	22	71.99%	62.5%
F, D	5	5	3	22	55.56%	50.0%	F, D	5	5	3	22	71.99%	62.5%
G, D	5	5	3	22	55.56%	50.0%	G, D	5	5	3	22	71.99%	62.5%
E, D	5	5	3	22	55.56%	50.0%	E, D	5	5	3	22	71.99%	62.5%
A, D	2	8	12	13	16.67%	20.0%	A, D	5	5	3	22	71.99%	62.5%
A, F	2	8	12	13	16.67%	20.0%	A, F	1	9	1	24	61.36%	50.0%
C, A	2	8	12	13	16.67%	20.0%	C, F	1	9	1	24	61.36%	50.0%
A, G	2	8	12	13	16.67%	20.0%	F, G	1	9	1	24	61.36%	50.0%
A, E	2	8	12	13	16.67%	20.0%	F, E	1	9	1	24	61.36%	50.0%
C, F	1	9	1	24	16.67%	10.0%	C, A	2	8	12	13	38.1%	14.29%
F, G	1	9	1	24	16.67%	10.0%	A, G	2	8	12	13	38.1%	14.29%
F, E	1	9	1	24	16.67%	10.0%	A, E	2	8	12	13	38.1%	14.29%
C, E	1	9	9	16	10.0%	10.0%	C, E	1	9	9	16	37.0%	10.0%

G, E	1	9	9	16	10.0%	10.0%	G, E	1	9	9	16	37.0%	10.0%
C, G	0	10	17	8	0.0%	0.0%	C, G	0	10	5	20	33.33%	0.0%
					В	ad Programm	ing of Cooki	es					
B, A	1044	621	160	2059	72.78%	62.7%	B, A	1044	621	160	2059	81.77%	86.71%
A, D	1044	621	160	2059	72.78%	62.7%	A, D	1044	621	160	2059	81.77%	86.71%
A, G	894	771	160	2059	65.76%	53.69%	F, G	716	949	82	2137	79.49%	89.72%
A, E	894	771	160	2059	65.76%	53.69%	F, E	716	949	82	2137	79.49%	89.72%
C, A	832	833	160	2059	62.63%	49.97%	C, F	671	994	82	2137	78.68%	89.11%
F, G	716	949	82	2137	58.14%	43.0%	B, F	563	1102	82	2137	76.63%	87.29%
F, E	716	949	82	2137	58.14%	43.0%	F, D	562	1103	82	2137	76.61%	87.27%
C, F	671	994	82	2137	55.5%	40.3%	A, F	546	1119	82	2137	76.29%	86.94%
B, F	563	1102	82	2137	48.74%	33.81%	A, G	894	771	160	2059	78.79%	84.82%
F, D	562	1103	82	2137	48.68%	33.75%	A, E	894	771	160	2059	78.79%	84.82%
A, F	537	1128	160	2059	45.47%	32.25%	C, A	832	833	160	2059	77.53%	83.87%
G, D	273	1392	111	2108	26.65%	16.4%	B, G	230	1435	84	2135	66.53%	73.25%
E, D	273	1392	111	2108	26.65%	16.4%	B, E	230	1435	84	2135	66.53%	73.25%
B, G	230	1435	84	2135	23.24%	13.81%	G, D	273	1392	111	2108	65.66%	71.09%
B, E	230	1435	84	2135	23.24%	13.81%	E, D	273	1392	111	2108	65.66%	71.09%
C, D	212	1453	111	2108	21.33%	12.73%	B, C	168	1497	84	2135	62.72%	66.67%
B, C	168	1497	84	2135	17.53%	10.09%	C, D	212	1453	111	2108	62.42%	65.63%
C, G	125	1540	202	2017	12.55%	7.51%	B, D	60	1605	84	2135	49.38%	41.67%
C, E	125	1540	202	2017	12.55%	7.51%	C, G	125	1540	202	2017	47.47%	38.23%
B, D	60	1605	84	2135	6.63%	3.6%	C, E	125	1540	202	2017	47.47%	38.23%
G, E	1	1664	36	2183	0.12%	0.06%	G, E	1	1664	36	2183	29.72%	2.7%
		A - Se	mgrep	B - Sn	yk C - Forti	ify D - Spot	bugs E - Kit	ıwan I	F - Syn	ospys I	G - Ho	rusec	

Table 4.11: Ranking of combinations of 2 SAST tools regarding their performance in category A5: Security Misconfiguration - Best and Minimum Effort Scenarios

Results obtained in A6: Vulnerable and Outdated Components

Business Critical Metric Tiebreaker Heightened Critical Metric Tiebreaker Comb. TP FN FP TN Recall Precison Comb. TP FN FP TN Rec.*Infor. Recall Vulnerable Third-Party Components						A6: Vul	nerable and C	Outdated Con	nponen	ts				
Vulnerable Third-Party Components C, E 229 59 0 491 79.51% 100.0% C, E 229 59 0 491 71.37% 79.51% B, E 195 93 0 491 67.71% 100.0% B, E 195 93 0 491 56.78% 67.71% A, E 195 93 0 491 67.71% 100.0% A, E 195 93 0 491 56.78% 67.71% F, E 195 93 0 491 67.71% 100.0% F, E 195 93 0 491 56.78% 67.71% G, E 195 93 0 491 67.71% 100.0% G, E 195 93 0 491 56.78% 67.71% E, D 195 93 0 491 67.71% 100.0% E, D 195 93 0 491 56.78% 67.71% E, D	I	Busines	s Critic	al		Metric	Tiebreaker	Н	eighten	ed Crit	ical		Metric	Tiebreaker
C, E 229 59 0 491 79.51% 100.0% C, E 229 59 0 491 71.37% 79.51% B, E 195 93 0 491 67.71% 100.0% B, E 195 93 0 491 56.78% 67.71% A, E 195 93 0 491 67.71% 100.0% A, E 195 93 0 491 56.78% 67.71% F, E 195 93 0 491 67.71% 100.0% F, E 195 93 0 491 56.78% 67.71% G, E 195 93 0 491 67.71% 100.0% G, E 195 93 0 491 56.78% 67.71% E, D 195 93 0 491 67.71% 100.0% E, D 195 93 0 491 56.78% 67.71% C, D 37 251 176 315	Comb.	TP	FN	FP	TN	Recall	Precison	Comb.	TP	FN	FP	TN	Rec.*Infor.	Recall
B, E 195 93 0 491 67.71% 100.0% B, E 195 93 0 491 56.78% 67.71% A, E 195 93 0 491 67.71% 100.0% A, E 195 93 0 491 56.78% 67.71% F, E 195 93 0 491 67.71% 100.0% F, E 195 93 0 491 56.78% 67.71% G, E 195 93 0 491 67.71% 100.0% G, E 195 93 0 491 56.78% 67.71% E, D 195 93 0 491 67.71% 100.0% E, D 195 93 0 491 56.78% 67.71% E, D 195 93 0 491 67.71% 100.0% E, D 195 93 0 491 56.78% 67.71% C, D 37 251 176 315						Vuln	erable Third-l	Party Compo	nents					
A, E 195 93 0 491 67.71% 100.0% A, E 195 93 0 491 56.78% 67.71% F, E 195 93 0 491 67.71% 100.0% F, E 195 93 0 491 56.78% 67.71% G, E 195 93 0 491 67.71% 100.0% G, E 195 93 0 491 56.78% 67.71% E, D 195 93 0 491 67.71% 100.0% E, D 195 93 0 491 56.78% 67.71% C, D 37 251 176 315 12.85% 17.37% C, D 37 251 176 315 12.85% 17.37% C, A 37 251 176 315 12.85% 17.37% C, F 37 251 176 315 12.85% 12.85% C, F 37 251 176 315 12.85% 17.37% C, F 37 251 176 315 4.95% 12.85%	C, E	229	59	0	491	79.51%	100.0%	C, E	229	59	0	491	71.37%	79.51%
F, E 195 93 0 491 67.71% 100.0% F, E 195 93 0 491 56.78% 67.71% G, E 195 93 0 491 67.71% 100.0% G, E 195 93 0 491 56.78% 67.71% E, D 195 93 0 491 67.71% 100.0% E, D 195 93 0 491 56.78% 67.71% C, D 37 251 176 315 12.85% 17.37% C, D 37 251 176 315 12.85% C, A 37 251 176 315 12.85% 17.37% C, A 37 251 176 315 4.95% 12.85% B, C 37 251 176 315 12.85% 17.37% C, F 37 251 176 315 4.95% 12.85% C, F 37 251 176 315 4.95%<	B, E	195	93	0	491	67.71%	100.0%	B, E	195	93	0	491	56.78%	67.71%
G, E 195 93 0 491 67.71% 100.0% G, E 195 93 0 491 56.78% 67.71% E, D 195 93 0 491 67.71% 100.0% E, D 195 93 0 491 56.78% 67.71% C, D 37 251 176 315 12.85% 17.37% C, D 37 251 176 315 4.95% 12.85% C, A 37 251 176 315 12.85% 17.37% C, A 37 251 176 315 4.95% 12.85% B, C 37 251 176 315 12.85% 17.37% B, C 37 251 176 315 4.95% 12.85% C, F 37 251 176 315 12.85% 17.37% C, F 37 251 176 315 4.95% 12.85%	A, E	195	93	0	491	67.71%	100.0%	A, E	195	93	0	491	56.78%	67.71%
E, D 195 93 0 491 67.71% 100.0% E, D 195 93 0 491 56.78% 67.71% C, D 37 251 176 315 12.85% 17.37% C, D 37 251 176 315 4.95% 12.85% C, A 37 251 176 315 12.85% 17.37% C, A 37 251 176 315 4.95% 12.85% B, C 37 251 176 315 12.85% 17.37% B, C 37 251 176 315 4.95% 12.85% C, F 37 251 176 315 12.85% 17.37% C, F 37 251 176 315 4.95% 12.85%	F, E	195	93	0	491	67.71%	100.0%	F, E	195	93	0	491	56.78%	67.71%
C, D 37 251 176 315 12.85% 17.37% C, D 37 251 176 315 4.95% 12.85% C, A 37 251 176 315 12.85% 17.37% C, A 37 251 176 315 4.95% 12.85% B, C 37 251 176 315 12.85% 17.37% B, C 37 251 176 315 4.95% 12.85% C, F 37 251 176 315 12.85% 17.37% C, F 37 251 176 315 4.95% 12.85%	G, E	195	93	0	491	67.71%	100.0%	G, E	195	93	0	491	56.78%	67.71%
C, A 37 251 176 315 12.85% 17.37% C, A 37 251 176 315 4.95% 12.85% B, C 37 251 176 315 12.85% 17.37% B, C 37 251 176 315 4.95% 12.85% C, F 37 251 176 315 12.85% 17.37% C, F 37 251 176 315 4.95% 12.85%	E, D	195	93	0	491	67.71%	100.0%	E, D	195	93	0	491	56.78%	67.71%
B, C 37 251 176 315 12.85% 17.37% B, C 37 251 176 315 4.95% 12.85% C, F 37 251 176 315 12.85% 17.37% C, F 37 251 176 315 4.95% 12.85%	C, D	37	251	176	315	12.85%	17.37%	C, D	37	251	176	315	4.95%	12.85%
C, F 37 251 176 315 12.85% 17.37% C, F 37 251 176 315 4.95% 12.85%	C, A	37	251	176	315	12.85%	17.37%	C, A	37	251	176	315	4.95%	12.85%
	B, C	37	251	176	315	12.85%	17.37%	B, C	37	251	176	315	4.95%	12.85%
C, G 37 251 176 315 12.85% 17.37% C, G 37 251 176 315 4.95% 12.85%	C, F	37	251	176	315	12.85%	17.37%	C, F	37	251	176	315	4.95%	12.85%
	C, G	37	251	176	315	12.85%	17.37%	C, G	37	251	176	315	4.95%	12.85%
A, G 5 283 0 491 1.74% 100.0% A, G 10 278 2 489 1.79% 3.47%	A, G	5	283	0	491	1.74%	100.0%	A, G	10	278	2	489	1.79%	3.47%
B, A 5 283 0 491 1.74% 100.0% B, G 10 278 2 489 1.79% 3.47%	B, A	5	283	0	491	1.74%	100.0%	B, G	10	278	2	489	1.79%	3.47%
A, F 5 283 0 491 1.74% 100.0% F, G 10 278 2 489 1.79% 3.47%	A, F	5	283	0	491	1.74%	100.0%	F, G	10	278	_	489	1.79%	3.47%
A, D 5 283 0 491 1.74% 100.0% G, D 10 278 2 489 1.79% 3.47%	A, D	5	283	0	491	1.74%	100.0%	G, D	10	278	2	489	1.79%	3.47%
B, F 2 286 0 491 0.69% 100.0% B, A 5 283 0 491 0.88% 1.74%	B, F	2	286	0	491	0.69%	100.0%	B, A	5	283	0	491	0.88%	1.74%
B, G 1 287 0 491 0.35% 100.0% A, F 5 283 0 491 0.88% 1.74%	B, G	1	287	0	491	0.35%	100.0%	A, F	5	283	0	491	0.88%	1.74%
F, G 1 287 0 491 0.35% 100.0% A, D 5 283 0 491 0.88% 1.74%	F, G	1	287	0	491	0.35%	100.0%	A, D	5	283	0	491	0.88%	1.74%
B, D 1 287 0 491 0.35% 100.0% B, F 2 286 0 491 0.35% 0.69%	B, D	1			491	0.35%	100.0%	B, F				491	0.35%	0.69%
F, D 1 287 0 491 0.35% 100.0% B, D 1 287 0 491 0.17% 0.35%	F, D	1	287	0	491	0.35%	100.0%	B, D	1	287	0	491	0.17%	0.35%
G, D 10 278 2 489 3.47% 83.33% F, D 1 287 0 491 0.17% 0.35%	G, D	10										-		0.35%
A - Semgrep B - Snyk C - Fortify D - Spotbugs E - Kiuwan F - Synospys G - Horusec			A - Se	mgrep	B - Sr	yk C - Fort	ify D - Spotl	ougs E - Kiu	ıwan l	F - Syn	ospys I	G - Ho	orusec	

Table 4.12: Ranking of combinations of 2 SAST tools regarding their performance in category A6: Vulnerable and Outdated Components - Business and Heightened Critical Scenarios

					A6: Vuli	nerable and C	Outdated Con	nponen	ts				
	Best	Effort			Metric	Tiebreaker	I	Minimu	ım Effo	ort		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.	TP	FN	FP	TN	Markedness	Precision
					Vulne	erable Third-l	Party Compo	nents					
C, E	229	59	0	491	88.59%	79.51%	C, D	247	41	2	489	95.73%	99.2%
B, E	195	93	0	491	80.75%	67.71%	C, E	229	59	0	491	94.64%	100.0%
A, E	195	93	0	491	80.75%	67.71%	B, E	195	93	0	491	92.04%	100.0%
F, E	195	93	0	491	80.75%	67.71%	A, E	195	93	0	491	92.04%	100.0%
G, E	195	93	0	491	80.75%	67.71%	F, E	195	93	0	491	92.04%	100.0%
E, D 195 93 0 491 80.75% 67.71% G, E 195 93 0 491 92.04% C, D 37 251 176 315 14.77% 12.85% E, D 195 93 0 491 92.04% C, A 37 251 176 315 14.77% 12.85% C, A 39 249 0 491 83.18% B, C 37 251 176 315 14.77% 12.85% B, C 35 253 0 491 83.0% C, F 37 251 176 315 14.77% 12.85% C, F 35 253 0 491 83.0%			100.0%										
C, D	37	251	176	315	14.77%	12.85%	E, D	195	93	0	491	92.04%	100.0%
C, A	37	251	176	315	14.77%	12.85%	C, A	39	249	0	491	83.18%	100.0%
B, C	37	251	176	315	14.77%	12.85%	B, C	35	253	0	491	83.0%	100.0%
C, F	37	251	176	315	14.77%	12.85%	C, F	35	253	0	491	83.0%	100.0%
C, G	37	251	176	315	14.77%	12.85%	A, G	5	283	0	491	81.72%	100.0%
A, G	195 93 0 491 80.75% 67.71% C, E 229 59 0 491 94.64% 1 195 93 0 491 80.75% 67.71% B, E 195 93 0 491 92.04% 1 195 93 0 491 80.75% 67.71% A, E 195 93 0 491 92.04% 1 195 93 0 491 80.75% 67.71% G, E 195 93 0 491 92.04% 1 195 93 0 491 80.75% 67.71% G, E 195 93 0 491 92.04% 1 37 251 176 315 14.77% 12.85% E, D 195 93 0 491 92.04% 1 37 251 176 315 14.77% 12.85% C, A 39 249 0 491 83.18% <td< td=""><td>100.0%</td></td<>		100.0%										
B, G	10	278	2	489	6.67%	3.47%	A, F	5	283	0	491	81.72%	100.0%
F, G	10	278	2	489	6.67%	3.47%	A, D	5	283	0	491	81.72%	100.0%
G, D	10	278	2	489	6.67%	3.47%	B, F	2	286	0	491	81.6%	100.0%
B, A	5	283	0	491	3.41%	1.74%	B, G	1	287	0	491	81.56%	100.0%
A, F	5	283	0	491	3.41%	1.74%	F, G	1	287	0	491	81.56%	100.0%
A, D	5	283	0	491	3.41%	1.74%	B, D	1	287	0	491	81.56%	100.0%
B, F	2	286	0	491	1.38%	0.69%	F, D	1	287	0	491	81.56%	100.0%
B, D	1	287	0	491	0.69%	0.35%	C, G	44	244	2	489	81.18%	95.65%
F, D	1	287	0	491	0.69%	0.35%	G, D	10	278	2	489	73.54%	83.33%
		A - Se	mgrep	B - St	nyk C - Forti	fy D - Spotl	ougs E - Kit	ıwan]	F - Syn	ospys I	G - Ho	orusec	

Table 4.13: Ranking of combinations of 2 SAST tools regarding their performance in category A6: Vulnerable and Outdated Components - Best and Minimum Effort Scenarios

Results obtained in A7: Identification and Authentication Failures

					A7: Ident	ification and A	Authentication	on Failu	ires				
]	Busines	s Critic	al		Metric	Tiebreaker	Н	eighten	ed Crit	ical		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	Recall	Precison	Comb.	TP	FN	FP	TN	Rec.*Infor.	Recall
	<u> </u>					Bypassing A	uthentication	i					
B, D	2	1	0	0	66.67%	100.0%	B, D	2	1	0	0	0.00%	66.67%
C, D	2	1	0	0	66.67%	100.0%	C, D	2	1	0	0	0.00%	66.67%
A, D	2	1	0	0	66.67%	100.0%	A, D	2	1	0	0	0.00%	66.67%
F, D	2	1	0	0	66.67%	100.0%	F, D	2	1	0	0	0.00%	66.67%
G, D	2	1	0	0	66.67%	100.0%	G, D	2	1	0	0	0.00%	66.67%
E, D	2	1	0	0	66.67%	100.0%	E, D	2	1	0	0	0.00%	66.67%
B, C	0	3	0	0	0.0%	0.00%	B, C	0	3	0	0	0.00%	0.0%
B, A	0	3	0	0	0.0%	0.00%	B, A	0	3	0	0	0.00%	0.0%
B, F	0	3	0	0	0.0%	0.00%	B, F	0	3	0	0	0.00%	0.0%
B, G	0	3	0	0	0.0%	0.00%	B, G	0	3	0	0	0.00%	0.0%
B, E	0	3	0	0	0.0%	0.00%	B, E	0	3	0	0	0.00%	0.0%
C, A	0	3	0	0	0.0%	0.00%	C, A	0	3	0	0	0.00%	0.0%
C, F	0	3	0	0	0.0%	0.00%	C, F	0	3	0	0	0.00%	0.0%
C, G	0	3	0	0	0.0%	0.00%	C, G	0	3	0	0	0.00%	0.0%
C, E	0	3	0	0	0.0%	0.00%	C, E	0	3	0	0	0.00%	0.0%
A, F	0	3	0	0	0.0%	0.00%	A, F	0	3	0	0	0.00%	0.0%
A, G	0	3	0	0	0.0%	0.00%	A, G	0	3	0	0	0.00%	0.0%
A, E	0	3	0	0	0.0%	0.00%	A, E	0	3	0	0	0.00%	0.0%
F, G	0	3	0	0	0.0%	0.00%	F, G	0	3	0	0	0.00%	0.0%
F, E	0	3	0	0	0.0%	0.00%	F, E	0	3	0	0	0.00%	0.0%
G, E	0	3	0	0	0.0%	0.00%	G, E	0	3	0	0	0.00%	0.0%
						Hard Coded	Passwords		·			,	
B, A	116	28	37	201	80.56%	75.82%	B, A	116	28	37	201	66.46%	80.56%
B, E	116	28	37	201	80.56%	75.82%	B, E	116	28	37	201	66.46%	80.56%
B, F	106	38	3	235	73.61%	97.25%	B, F	106	38	3	235	63.43%	73.61%
F, E	106	38	3	235	73.61%	97.25%	F, E	106	38	3	235	63.43%	73.61%
F, D	105	39	3	235	72.92%	97.22%	F, D	105	39	3	235	62.58%	72.92%

A, F	104	40	3	235	72.22%	97.2%	A, F	104	40	3	235	61.74%	72.22%
C, F	103	41	3	235	71.53%	97.17%	C, F	103	41	3	235	60.89%	71.53%
F, G	102	42	3	235	70.83%	97.14%	F, G	102	42	3	235	60.06%	70.83%
B, C	103	41	37	201	71.53%	73.57%	B, C	103	41	37	201	55.79%	71.53%
B, D	102	42	37	201	70.83%	73.38%	B, D	102	42	37	201	55.0%	70.83%
B, G	102	42	37	201	70.83%	73.38%	B, G	102	42	37	201	55.0%	70.83%
E, D	97	47	73	165	67.36%	57.06%	E, D	97	47	73	165	46.04%	67.36%
A, D	80	64	2	236	55.56%	97.56%	A, D	80	64	2	236	42.98%	55.56%
C, E	81	63	73	165	56.25%	52.6%	C, E	81	63	73	165	35.32%	56.25%
A, E	80	64	73	165	55.56%	52.29%	C, D	66	78	2	236	33.23%	45.83%
G, E	80	64	73	165	55.56%	52.29%	A, E	80	64	73	165	34.69%	55.56%
C, D	66	78	2	236	45.83%	97.06%	G, E	80	64	73	165	34.69%	55.56%
G, D	61	83	2	236	42.36%	96.83%	G, D	61	83	2	236	29.97%	42.36%
C, A	57	87	36	202	39.58%	61.29%	C, A	57	87	36	202	24.63%	39.58%
A, G	36	108	36	202	25.0%	50.0%	A, G	36	108	36	202	13.73%	25.0%
C, G	28	116	34	204	19.44%	45.16%	C, G	28	116	34	204	10.22%	19.44%
		A - Se	mgrep	B - Sn	yk C - Fort	ify D - Spot	bugs E - Kiu	ıwan]	F - Syn	ospys l	G - Ho	rusec	

Table 4.14: Ranking of combinations of 2 SAST tools regarding their performance in category A7: Identification and Authentication Failures - Business and Heightened Critical Scenarios

					A7: Identi	fication and a	Authentication	n Failu	res				
	Best	Effort			Metric	Tiebreaker	1	Minimu	m Effc	rt		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.	TP	FN	FP	TN	Markedness	Precision
						Bypassing A	uthentication						
B, D	2	1	0	0	80.0%	66.67%	B, D	2	1	0	0	50.0%	100.0%
C, D	2	1	0	0	80.0%	66.67%	C, D	2	1	0	0	50.0%	100.0%
A, D	2	1	0	0	80.0%	66.67%	A, D	2	1	0	0	50.0%	100.0%
F, D	2	1	0	0	80.0%	66.67%	F, D	2	1	0	0	50.0%	100.0%
G, D	2	1	0	0	80.0%	66.67%	G, D	2	1	0	0	50.0%	100.0%
E, D	2	1	0	0	80.0%	66.67%	E, D	2	1	0	0	50.0%	100.0%
B, C	0	3	0	0	0.0%	0.0%	B, C	0	3	0	0	0.00%	0.00%
B, A	0	3	0	0	0.0%	0.0%	B, A	0	3	0	0	0.00%	0.00%
B, F	0	3	0	0	0.0%	0.0%	B, F	0	3	0	0	0.00%	0.00%
B, G	0	3	0	0	0.0%	0.0%	B, G	0	3	0	0	0.00%	0.00%
B, E	0	3	0	0	0.0%	0.0%	B, E	0	3	0	0	0.00%	0.00%
C, A	0	3	0	0	0.0%	0.0%	C, A	0	3	0	0	0.00%	0.00%
C, F	0	3	0	0	0.0%	0.0%	C, F	0	3	0	0	0.00%	0.00%
C, G	0	3	0	0	0.0%	0.0%	C, G	0	3	0	0	0.00%	0.00%
C, E	0	3	0	0	0.0%	0.0%	C, E	0	3	0	0	0.00%	0.00%
A, F	0	3	0	0	0.0%	0.0%	A, F	0	3	0	0	0.00%	0.00%
A, G	0	3	0	0	0.0%	0.0%	A, G	0	3	0	0	0.00%	0.00%
A, E	0	3	0	0	0.0%	0.0%	A, E	0	3	0	0	0.00%	0.00%
F, G	0	3	0	0	0.0%	0.0%	F, G	0	3	0	0	0.00%	0.00%
F, E	0	3	0	0	0.0%	0.0%	F, E	0	3	0	0	0.00%	0.00%
G, E	0	3	0	0	0.0%	0.0%	G, E	0	3	0	0	0.00%	0.00%
						Hard Coded							
B, F	106	38	3	235	83.79%	73.61%	F, D	110	34	2	236	92.81%	98.21%
F, E	106	38	3	235	83.79%	73.61%	B, F	106	38	3	235	91.66%	97.25%
F, D	105	39	3	235	83.33%	72.92%	F, E	106	38	3	235	91.66%	97.25%
A, F	104	40	3	235	82.87%	72.22%	A, F	104	40	3	235	91.33%	97.2%
C, F	103	41	3	235	82.4%	71.53%	C, F	103	41	3	235	91.16%	97.17%
F, G	102	42	3	235	81.93%	70.83%	F, G	102	42	3	235	90.99%	97.14%
B, A	116	28	37	201	78.11%	80.56%	E, D	92	52	2	236	89.91%	97.87%
B, E	116	28	37	201	78.11%	80.56%	B, D	83	61	2	236	88.55%	97.65%
B, C	103	41	37	201	72.54%	71.53%	A, D	80	64	2	236	88.11%	97.56%
E, D	92	52	2	236	77.31%	63.89%	C, D	66	78	2	236	86.11%	97.06%
B, D	102	42	37	201	72.08%	70.83%	G, D	61	83	2	236	85.4%	96.83%
B, G	102	42	37	201	72.08%	70.83%	B, A	116	28	37	201	81.79%	75.82%
A, D	80	64	2	236	70.8%	55.56%	B, E	116	28	37	201	81.79%	75.82%
C, D	66	78	2	236	62.26%	45.83%	B, C	103	41	37	201	78.31%	73.57%
G, D	61	83	2	236	58.94%	42.36%	B, G	102	42	37	201	78.05%	73.38%
C, E	81	63	73	165	54.36%	56.25%	A, E	70	74	36	202	69.61%	66.04%
A, E	80	64	73	165	53.87%	55.56%	C, A	57	87	36	202	65.59%	61.29%
G, E	80	64	73	165	53.87%	55.56%	C, E	81	63	73	165	62.48%	52.6%
C, A	57	87	36	202	48.1%	39.58%	G, E	80	64	73	165	62.17%	52.29%

	A, G	36	108	36	202	33.33%	25.0%	A, G	36	108	36	202	57.58%	50.0%
	C, G	28	116	34	204	27.18%	19.44%	C, G	28	116	34	204	54.46%	45.16%
Ĩ			A - Se	mgrep	B - Sn	yk C - Forti	fy D - Spot	bugs E - Kiu	ıwan 🗀	F - Syn	ospys l	G - Ho	rusec	

Table 4.15: Ranking of combinations of 2 SAST tools regarding their performance in category A7: Identification and Authentication Failures - Best and Minimum Effort Scenarios

Results obtained in A8: Software and Data Integrity Failures

					A8: So	ftware and Da	ata Integrity	Failure	s				
I	Busines	s Critic	al		Metric	Tiebreaker	Н	eighten	ed Crit	ical		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	Recall	Precison	Comb.	TP	FN	FP	TN	Rec.*Infor.	Recall
						Insecure Des	serialization						
B, D	6	1	26	5	85.71%	18.75%	B, D	6	1	26	5	43.65%	85.71%
C, D	5	2	26	5	71.43%	16.13%	C, D	5	2	26	5	31.27%	71.43%
G, D	5	2	26	5	71.43%	16.13%	G, D	5	2	26	5	31.27%	71.43%
E, D	5	2	26	5	71.43%	16.13%	E, D	5	2	26	5	31.27%	71.43%
, , , , , , , , , , , , , , , , , , , ,										31.27%	71.43%		
B, A 3 4 26 5 42.86% 10.34% B, F 3 4 3 28 28.54% 42										42.86%			
C, F	3	4	3	28	42.86%	50.0%	C, F	3	4	3	28	28.54%	42.86%
A, F	3	4	3	28	42.86%	50.0%	A, F	3	4	3	28	28.54%	42.86%
F, G	3	4	3	28	42.86%	50.0%	F, G	3	4	3	28	28.54%	42.86%
F, E	3	4	3	28	42.86%	50.0%	F, E	3	4	3	28	28.54%	42.86%
A, E	3	4	26	5	42.86%	10.34%	F, D	3	4	3	28	28.54%	42.86%
F, D	3	4	3	28	42.86%	50.0%	B, A	2	5	0	31	18.37%	28.57%
A, D	3	4	26	5	42.86%	10.34%	B, C	2	5	0	31	18.37%	28.57%
C, A	3	4	26	5	42.86%	10.34%	B, G	2	5	0	31	18.37%	28.57%
A, G	3	4	26	5	42.86%	10.34%	B, E	2	5	0	31	18.37%	28.57%
B, C	2	5	0	31	28.57%	100.0%	A, E	3	4	26	5	12.64%	42.86%
B, G	2	5	0	31	28.57%	100.0%	C, A	3	4	26	5	12.64%	42.86%
B, E	2	5	0	31	28.57%	100.0%	A, G	3	4	26	5	12.64%	42.86%
C, E	1	6	2	29	14.29%	33.33%	C, E	1	6	2	29	7.7%	14.29%
G, E	1	6	2	29	14.29%	33.33%	G, E	1	6	2	29	7.7%	14.29%
C, G	0	7	0	31	0.0%	0.00%	C, G	0	7	0	31	0.0%	0.0%
		A - Se	mgrep	B - Sr	ıyk C - Fort	ify D - Spoth	ougs E - Kiu	ıwan]	F - Syn	ospys I	G - Ho	rusec	

Table 4.16: Ranking of combinations of 2 SAST tools regarding their performance in category A8: Software and Data Integrity Failures - Business and Heightened Critical Scenarios

					A8: So	ftware and Da	ata Integrity	Failure	S				
	Best	Effort			Metric	Tiebreaker		Minimu	ım Effo	rt		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.	TP	FN	FP	TN	Markedness	Precision
					·	Insecure Des	serialization						
B, D	6	1	26	5	30.77%	85.71%	B, F	2	5	0	31	93.06%	100.0%
C, D	5	2	26	5	26.32%	71.43%	B, A	2	5	0	31	93.06%	100.0%
G, D	5	2	26	5	26.32%	71.43%	B, C	2	5	0	31	93.06%	100.0%
E, D	5	2	26	5	26.32%	71.43%	B, G	2	5	0	31	93.06%	100.0%
A, D	5	2	26	5	26.32%	71.43%	B, E	2	5	0	31	93.06%	100.0%
B, F	3	4	3	28	46.15%	42.86%	C, F	3	4	3	28	68.75%	50.0%
C, F	3	4	3	28	46.15%	42.86%	A, F	3	4	3	28	68.75%	50.0%
A, F	3	4	3	28	46.15%	42.86%	F, G	3	4	3	28	68.75%	50.0%
F, G	3	4	3	28	46.15%	42.86%	F, E	3	4	3	28	68.75%	50.0%
F, E	3	4	3	28	46.15%	42.86%	A, E	1	6	2	29	58.1%	33.33%
F, D	3	4	3	28	46.15%	42.86%	C, E	1	6	2	29	58.1%	33.33%
C, A	3	4	26	5	16.67%	42.86%	G, E	1	6	2	29	58.1%	33.33%
A, G	3	4	26	5	16.67%	42.86%	B, D	6	1	26	5	51.04%	18.75%
B, A	2	5	0	31	44.44%	28.57%	F, D	5	2	26	5	43.78%	16.13%
B, C	2	5	0	31	44.44%	28.57%	C, D	5	2	26	5	43.78%	16.13%
B, G	2	5	0	31	44.44%	28.57%	G, D	5	2	26	5	43.78%	16.13%
B, E	2	5	0	31	44.44%	28.57%	E, D	5	2	26	5	43.78%	16.13%

A, E	1	6	2	29	20.0%	14.29%	A, D	5	2	26	5	43.78%	16.13%
C, E	1	6	2	29	20.0%	14.29%	C, A	0	7	0	31	0.00%	0.00%
G, E	1	6	2	29	20.0%	14.29%	A, G	0	7	0	31	0.00%	0.00%
C, G	0	7	0	31	0.0%	0.0%	C, G	0	7	0	31	0.00%	0.00%
		A - Se	mgrep	B - Sr	yk C - Forti	fy D - Spot	bugs E - Kiu	ıwan 🗀	F - Syn	ospys l	G - Ho	rusec	

Table 4.17: Ranking of combinations of 2 SAST tools regarding their performance in category A8: Software and Data Integrity Failures - Best and Minimum Effort Scenarios

Results obtained in A9: Security Logging and Monitoring Failures

					A9: Secur	ity Logging a	nd Monitorii	ng Failı	ıres				
]	Busines	s Critic	cal		Metric	Tiebreaker	Н	eighten	ed Crit	ical		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	Recall	Precison	Comb.	TP	FN	FP	TN	Rec.*Infor.	Recall
					Improp	er Output Ne	utralization f	or Log	S				
C, A	379	358	245	566	51.42%	60.74%	C, A	379	358	245	566	31.17%	51.42%
C, E	379	358	245	566	51.42%	60.74%	C, E	379	358	245	566	31.17%	51.42%
B, C	362	375	245	566	49.12%	59.64%	B, C	362	375	245	566	29.2%	49.12%
C, D	345	392	245	566	46.81%	58.47%	C, D	345	392	245	566	27.29%	46.81%
C, F	345	392	245	566	46.81%	58.47%	C, F	345	392	245	566	27.29%	46.81%
C, G	345	392	245	566	46.81%	58.47%	C, G	345	392	245	566	27.29%	46.81%
B, A	180	557	1	810	24.42%	99.45%	B, A	180	557	1	810	15.18%	24.42%
A, F	180	557	1	810	24.42%	99.45%	A, F	180	557	1	810	15.18%	24.42%
A, G	180	557	1	810	24.42%	99.45%	A, G	180	557	1	810	15.18%	24.42%
A, E	180	557	1	810	24.42%	99.45%	A, E	180	557	1	810	15.18%	24.42%
A, D	180	557	1	810	24.42%	99.45%	A, D	180	557	1	810	15.18%	24.42%
B, E	133	604	5	806	18.05%	96.38%	G, D	143	594	61	750	10.85%	19.4%
F, E	133	604	5	806	18.05%	96.38%	B, E	133	604	5	806	10.6%	18.05%
G, E	133	604	5	806	18.05%	96.38%	F, E	133	604	5	806	10.6%	18.05%
E, D	133	604	5	806	18.05%	96.38%	G, E	133	604	5	806	10.6%	18.05%
B, F	130	607	12	799	17.64%	91.55%	E, D	133	604	5	806	10.6%	18.05%
B, G	130	607	12	799	17.64%	91.55%	B, F	130	607	12	799	10.24%	17.64%
B, D	130	607	12	799	17.64%	91.55%	B, G	130	607	12	799	10.24%	17.64%
G, D	143	594	61	750	19.4%	70.1%	B, D	130	607	12	799	10.24%	17.64%
F, D	143	594	61	750	19.4%	70.1%	F, D	18	719	121	690	1.07%	2.44%
F, G	18	719	121	690	2.44%	12.95%	F, G	18	719	121	690	1.07%	2.44%
		A - Se	mgrep	B - Sn	ıyk C - Fort	ify D - Spotl	ougs E - Kiu	uwan]	F - Syn	ospys l	G - Ho	orusec	

Table 4.18: Ranking of combinations of 2 SAST tools regarding their performance in category A9: Security Logging and Monitoring Failures - Business and Heightened Critical Scenarios

					A9: Secur	ity Logging a	nd Monitorii	ng Failı	ıres				
	Best	Effort			Metric	Tiebreaker	1	Minimu	ım Effc	rt		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.	TP	FN	FP	TN	Markedness	Precision
					Improp	er Output Ne	utralization f	or Log	S				
C, A	379	358	245	566	55.69%	51.42%	C, A	180	557	1	810	79.35%	99.45%
C, E	379	358	245	566	55.69%	51.42%	B, A	180	557	1	810	79.35%	99.45%
B, C	362	375	245	566	53.87%	49.12%	A, F	180	557	1	810	79.35%	99.45%
C, D	345	392	245	566	52.0%	46.81%	A, G	180	557	1	810	79.35%	99.45%
C, F	345	392	245	566	52.0%	46.81%	A, E	180	557	1	810	79.35%	99.45%
C, G	345	392	245	566	52.0%	46.81%	A, D	180	557	1	810	79.35%	99.45%
B, A	180	557	1	810	39.22%	24.42%	C, E	133	604	5	806	76.77%	96.38%
A, F	180	557	1	810	39.22%	24.42%	B, E	133	604	5	806	76.77%	96.38%
A, G	180	557	1	810	39.22%	24.42%	F, E	133	604	5	806	76.77%	96.38%
A, E	180	557	1	810	39.22%	24.42%	G, E	133	604	5	806	76.77%	96.38%
A, D	180	557	1	810	39.22%	24.42%	E, D	133	604	5	806	76.77%	96.38%
G, D	143	594	61	750	30.39%	19.4%	B, C	130	607	12	799	74.19%	91.55%
B, E	133	604	5	806	30.4%	18.05%	B, F	130	607	12	799	74.19%	91.55%
F, E	133	604	5	806	30.4%	18.05%	B, G	130	607	12	799	74.19%	91.55%
G, E	133	604	5	806	30.4%	18.05%	B, D	130	607	12	799	74.19%	91.55%

E, D	133	604	5	806	30.4%	18.05%	C, D	143	594	61	750	62.95%	70.1%
B, F	130	607	12	799	29.58%	17.64%	G, D	143	594	61	750	62.95%	70.1%
B, G	130	607	12	799	29.58%	17.64%	F, D	143	594	61	750	62.95%	70.1%
B, D	130	607	12	799	29.58%	17.64%	C, F	345	392	245	566	58.78%	58.47%
F, D	18	719	121	690	4.11%	2.44%	C, G	345	392	245	566	58.78%	58.47%
F, G	18	719	121	690	4.11%	2.44%	F, G	18	719	121	690	30.96%	12.95%
		A - Se	mgrep	B - Sr	yk C - Forti	fy D - Spot	bugs E - Kit	ıwan I	F - Syn	ospys l	G - Ho	rusec	

Table 4.19: Ranking of combinations of 2 SAST tools regarding their performance in category A9: Security Logging and Monitoring Failures - Best and Minimum Effort Scenarios

Results obtained in A10: Server-Side Request Forgery

					A10	: Server-Side	Request For	gery					
F	Busines	s Critic	al		Metric	Tiebreaker	Не	eighten	ed Crit	ical		Metric	Tiebreaker
Comb.	TP	FN	FP	TN	Recall	Precison	Comb.	TP	FN	FP	TN	Rec.*Infor.	Recall
					S	erver-Side Re	equest Forger	y					
C, D	14	3	29	1	82.35%	32.56%	C, D	14	3	29	1	35.28%	82.35%
G, D	14	3	29	1	82.35%	32.56%	G, D	14	3	29	1	35.28%	82.35%
A, F	6	11	11	19	35.29%	35.29%	A, F	6	11	11	19	17.4%	35.29%
A, E	6	11	11	19	35.29%	35.29%	A, E	6	11	11	19	17.4%	35.29%
B, A	6	11	11	19	35.29%	35.29%	B, A	6	11	11	19	17.4%	35.29%
A, G 6 11 11 19 35.29% 35.29% A, G 6 11 11 19 17.4% 3.										35.29%			
A, G 6 11 11 19 35.29% 35.29% A, G 6 11 11 19 17.4% 3 A, D 6 11 11 19 35.29% A, D 6 11 11 19 17.4% 3							35.29%						
A, G 6 11 11 19 35.29% 35.29% A, G 6 11 11 19 17.4% 3 A, D 6 11 11 19 35.29% 35.29% A, D 6 11 11 19 17.4% 3 B, F 5 12 7 23 29.41% 41.67% B, F 5 12 7 23 15.6% 3						35.29%							
A, G 6 11 11 19 35.29% 35.29% A, G 6 11 11 19 17.4% 3 A, D 6 11 11 19 35.29% 35.29% A, D 6 11 11 19 17.4% 3 B, F 5 12 7 23 29.41% 41.67% B, F 5 12 7 23 15.6% 2								29.41%					
B, C	5	12	7	23	29.41%	41.67%	B, C	5	12	7	23	15.6%	29.41%
B, G	5	12	7	23	29.41%	41.67%	B, G	5	12	7	23	15.6%	29.41%
B, E	5	12	7	23	29.41%	41.67%	B, E	5	12	7	23	15.6%	29.41%
B, D	5	12	7	23	29.41%	41.67%	B, D	5	12	7	23	15.6%	29.41%
F, E	2	15	1	29	11.76%	66.67%	F, E	2	15	1	29	6.38%	11.76%
C, E	2	15	1	29	11.76%	66.67%	C, E	2	15	1	29	6.38%	11.76%
G, E	2	15	1	29	11.76%	66.67%	G, E	2	15	1	29	6.38%	11.76%
E, D	2	15	1	29	11.76%	66.67%	E, D	2	15	1	29	6.38%	11.76%
C, F	1	16	0	30	5.88%	100.0%	C, F	1	16	0	30	3.11%	5.88%
F, G	1	16	0	30	5.88%	100.0%	F, G	1	16	0	30	3.11%	5.88%
F, D	1	16	0	30	5.88%	100.0%	F, D	1	16	0	30	3.11%	5.88%
C, G	0	17	0	30	0.0%	0.00%	C, G	0	17	0	30	0.0%	0.0%
		A - Se	mgrep	B - Sr	nyk C - Fort	ify D - Spotl	ougs E - Kiu	iwan 🗀	F - Syn	ospys I	G - Ho	orusec	

Table 4.20: Ranking of combinations of 2 SAST tools regarding their performance in category A10: Server-Side Request Forgery - Business and Heightened Critical Scenarios

A10: Server-Side Request Forgery													
	Best	Effort			Metric	Tiebreaker	Minimum Effort				Metric	Tiebreaker	
Comb.	TP	FN	FP	TN	F-measure	Recall	Comb.	TP	FN	FP	TN	Markedness	Precision
Server-Side Request Forgery													
C, D	14	3	29	1	46.67%	82.35%	A, F	1	16	0	30	82.61%	100.0%
G, D	14	3	29	1	46.67%	82.35%	B, F	1	16	0	30	82.61%	100.0%
A, F	6	11	11	19	35.29%	35.29%	F, E	1	16	0	30	82.61%	100.0%
A, E	6	11	11	19	35.29%	35.29%	C, F	1	16	0	30	82.61%	100.0%
В, А	6	11	11	19	35.29%	35.29%	F, G	1	16	0	30	82.61%	100.0%
C, A	6	11	11	19	35.29%	35.29%	F, D	1	16	0	30	82.61%	100.0%
A, G	6	11	11	19	35.29%	35.29%	A, E	2	15	1	29	66.29%	66.67%
A, D	6	11	11	19	35.29%	35.29%	C, E	2	15	1	29	66.29%	66.67%
B, F	5	12	7	23	34.48%	29.41%	G, E	2	15	1	29	66.29%	66.67%
B, C	5	12	7	23	34.48%	29.41%	E, D	2	15	1	29	66.29%	66.67%
B, G	5	12	7	23	34.48%	29.41%	В, А	5	12	7	23	53.69%	41.67%
В, Е	5	12	7	23	34.48%	29.41%	В, С	5	12	7	23	53.69%	41.67%
B, D	5	12	7	23	34.48%	29.41%	B, G	5	12	7	23	53.69%	41.67%

F, E	2	15	1	29	20.0%	11.76%	B, E	5	12	7	23	53.69%	41.67%
C, E	2	15	1	29	20.0%	11.76%	B, D	5	12	7	23	53.69%	41.67%
G, E	2	15	1	29	20.0%	11.76%	C, A	6	11	11	19	49.31%	35.29%
E, D	2	15	1	29	20.0%	11.76%	A, G	6	11	11	19	49.31%	35.29%
C, F	1	16	0	30	11.11%	5.88%	A, D	6	11	11	19	49.31%	35.29%
F, G	1	16	0	30	11.11%	5.88%	C, D	14	3	29	1	28.78%	32.56%
F, D	1	16	0	30	11.11%	5.88%	G, D	14	3	29	1	28.78%	32.56%
C, G	0	17	0	30	0.0%	0.0%	C, G	0	17	0	30	0.00%	0.00%
A - Semgrep B - Snyk C - Fortify D - Spotbugs E - Kiuwan F - Synospys G - Horusec													

Table 4.21: Ranking of combinations of 2 SAST tools regarding their performance in category A10: Server-Side Request Forgery - Best and Minimum Effort Scenarios