

## Appendix A: Detailed Refactoring Tables

Below are detailed quantitative results for refactoring activity by agents and humans. All tables were generated directly from the dataset analyses.

### Appendix: Detailed Refactoring Data

agent	total_commits	refactoring_commits	mean_refactorings	median_refactorings	std_refactorings
Claude_Code	37	22	453.513514	5.000000	739.500530
Copilot	1190	156	13.206723	0.000000	126.601290
Cursor	68	7	0.455882	0.000000	1.670051
Devin	41	5	1.707317	0.000000	5.264237
Human	3249	1142	3.122389	0.000000	12.783103
OpenAI_Codex	1290	223	2.789922	0.000000	27.738976

Table 1: Per-agent summary of refactoring activity

Table 2: Per-agent summary of refactoring activity

agent	full_name	total_commits	refactoring_commits	me
Claude_Code	MeteorDevelopment/meteor-client	1	0.000000	
Claude_Code	apache/pulsar	3	2.000000	
Claude_Code	dotCMS/core	32	20.000000	
Claude_Code	hyperledger/besu	1	0.000000	
Copilot	1c-syntax/bsl-language-server	40	15.000000	
Copilot	AutoMQ/automq	1	0.000000	
Copilot	Azure-Samples/azure-search-openai-demo-java	4	0.000000	
Copilot	Azure/azure-sdk-for-java	106	39.000000	
Copilot	CarGuo/GSYVideoPlayer	2	1.000000	
Copilot	EduMIPS64/edumips64	36	6.000000	
Copilot	OWASP/wrongsecrets	26	0.000000	
Copilot	RyanSusana/elepy	8	0.000000	
Copilot	W1LDN16H7/JPL	2	0.000000	
Copilot	YunaiV/ruoyi-vue-pro	5	0.000000	
Copilot	akto-api-security/akto	6	0.000000	
Copilot	apolloconfig/apollo	12	5.000000	
Copilot	binarywang/WxJava	35	5.000000	
Copilot	camunda/camunda	140	40.000000	
Copilot	feiyuchuixue/sz-boot-parent	4	0.000000	
Copilot	geoserver/geoserver	2	0.000000	
Copilot	halo-dev/halo	7	1.000000	
Copilot	hyperxpro/Brotli4j	4	0.000000	
Copilot	jenkinsci/jira-plugin	6	3.000000	
Copilot	microsoft/ApplicationInsights-Java	110	18.000000	
Copilot	microsoft/HydraLab	4	0.000000	
Copilot	microsoft/semantic-kernel-java	2	0.000000	
Copilot	microsoft/typespec	329	10.000000	
Copilot	mixpanel/mixpanel-android	7	2.000000	
Copilot	objectionary/eo	30	3.000000	
Copilot	qaiu/netdisk-fast-download	2	0.000000	
Copilot	tonihele/OpenKeeper	3	1.000000	
Copilot	trinodb/trino	3	0.000000	
Copilot	vaadin/flow	13	3.000000	
Copilot	valkey-io/valkey-glide	211	2.000000	
Copilot	wgzhao/Addax	15	0.000000	
Copilot	wgzhao/dbeaver-agent	4	0.000000	
Copilot	wso2/product-is	3	0.000000	
Copilot	yegor256/cactoos	8	2.000000	
Cursor	StarRocks/starrocks	30	5.000000	
Cursor	YunaiV/ruoyi-vue-pro	3	0.000000	
Cursor	YunaiV/yudao-cloud	1	1.000000	
Cursor	datahub-project/datahub	20	0.000000	
Cursor	jbangdev/jbang	3	0.000000	
Cursor	liyupi/yu-ai-agent	1	0.000000	2
Cursor	lunasaw/gb28181-proxy	3	0.000000	
Cursor	sakaiproject/sakai	6	0.000000	
Cursor	why168/LoonViewPagerLayout	1	1.000000	

agent	count	mean	std	min	25%	50%	75%	m
Claude_Code	37.000000	453.510000	739.500000	0.000000	0.000000	5.000000	884.000000	2320.0000
Copilot	1190.000000	13.210000	126.600000	0.000000	0.000000	0.000000	0.000000	2646.0000
Cursor	68.000000	0.460000	1.670000	0.000000	0.000000	0.000000	0.000000	10.0000
Devin	41.000000	1.710000	5.260000	0.000000	0.000000	0.000000	0.000000	24.0000
Human	3734.000000	3.120000	12.780000	0.000000	0.000000	0.000000	1.000000	214.0000
OpenAI_Codex	1290.000000	2.790000	27.740000	0.000000	0.000000	0.000000	0.000000	771.0000

Table 5: Distribution of refactorings per commit by agent

Table 6: Distribution of refactorings per commit by agent

agent	refactoring_type	count
Claude.Code	Add Method Annotation	25233
Claude.Code	Add Parameter Annotation	16755
Claude.Code	Modify Method Annotation	13343
Claude.Code	Add Class Annotation	2281
Claude.Code	Modify Class Annotation	1375
Claude.Code	Remove Method Annotation	654
Claude.Code	Change Variable Type	377
Claude.Code	Change Return Type	269
Claude.Code	Remove Parameter Annotation	128
Claude.Code	Remove Thrown Exception Type	109
Claude.Code	Add Method Modifier	100
Claude.Code	Add Parameter	90
Claude.Code	Reorder Parameter	50
Claude.Code	Modify Parameter Annotation	48
Claude.Code	Rename Method	37
Claude.Code	Extract Variable	26
Claude.Code	Remove Parameter	11
Claude.Code	Rename Variable	9
Claude.Code	Inline Variable	5
Claude.Code	Add Variable Modifier	3
Claude.Code	Add Parameter Modifier	2
Claude.Code	Change Attribute Type	2
Claude.Code	Extract Method	2
Claude.Code	Add Attribute Modifier	1
Claude.Code	Move Source Folder	1
Claude.Code	Remove Attribute Modifier	1
Claude.Code	Remove Method Modifier	1
Claude.Code	Rename Attribute	1
Copilot	Remove Parameter	1432
Copilot	Move Class	1375
Copilot	Remove Method Annotation	1234
Copilot	Modify Class Annotation	1171
Copilot	Change Variable Type	1079
Copilot	Add Method Annotation	862
Copilot	Rename Variable	774
Copilot	Inline Variable	668
Copilot	Add Attribute Annotation	599
Copilot	Move Attribute	584
Copilot	Remove Attribute Annotation	573
Copilot	Change Return Type	551
Copilot	Extract Variable	494
Copilot	Add Parameter	480
Copilot	Rename Attribute	473
Copilot	Move Method	405
Copilot	Change Attribute Type	287
Copilot	Rename Parameter	282
Copilot	Rename Method	276

agent	refactoring_type	count	agent_total	share_pct
Claude.Code	Add Method Annotation	25233	60914	41.423975
Claude.Code	Add Parameter Annotation	16755	60914	27.505992
Claude.Code	Modify Method Annotation	13343	60914	21.904652
Claude.Code	Add Class Annotation	2281	60914	3.744624
Claude.Code	Modify Class Annotation	1375	60914	2.257281
Claude.Code	Remove Method Annotation	654	60914	1.073645
Claude.Code	Change Variable Type	377	60914	0.618905
Claude.Code	Change Return Type	269	60914	0.441606
Claude.Code	Remove Parameter Annotation	128	60914	0.210132
Claude.Code	Remove Thrown Exception Type	109	60914	0.178941
Claude.Code	Add Method Modifier	100	60914	0.164166
Claude.Code	Add Parameter	90	60914	0.147749
Claude.Code	Reorder Parameter	50	60914	0.082083
Claude.Code	Modify Parameter Annotation	48	60914	0.078800
Claude.Code	Rename Method	37	60914	0.060741
Claude.Code	Extract Variable	26	60914	0.042683
Claude.Code	Remove Parameter	11	60914	0.018058
Claude.Code	Rename Variable	9	60914	0.014775
Claude.Code	Inline Variable	5	60914	0.008208
Claude.Code	Add Variable Modifier	3	60914	0.004925
Claude.Code	Add Parameter Modifier	2	60914	0.003283
Claude.Code	Change Attribute Type	2	60914	0.003283
Claude.Code	Extract Method	2	60914	0.003283
Claude.Code	Add Attribute Modifier	1	60914	0.001642
Claude.Code	Move Source Folder	1	60914	0.001642
Claude.Code	Remove Attribute Modifier	1	60914	0.001642
Claude.Code	Remove Method Modifier	1	60914	0.001642
Claude.Code	Rename Attribute	1	60914	0.001642
Copilot	Remove Parameter	1432	15806	9.059851
Copilot	Move Class	1375	15806	8.699228
Copilot	Remove Method Annotation	1234	15806	7.807162
Copilot	Modify Class Annotation	1171	15806	7.408579
Copilot	Change Variable Type	1079	15806	6.826522
Copilot	Add Method Annotation	862	15806	5.453625
Copilot	Rename Variable	774	15806	4.896875
Copilot	Inline Variable	668	15806	4.226243
Copilot	Add Attribute Annotation	599	15806	3.789700
Copilot	Move Attribute	584	15806	3.694799
Copilot	Remove Attribute Annotation	573	15806	3.625206
Copilot	Change Return Type	551	15806	3.486018
Copilot	Extract Variable	494	15806	3.125395
Copilot	Add Parameter	480	15806	3.036821
Copilot	Rename Attribute	473	15806	2.992534
Copilot	Move Method	405	15806	2.562318
Copilot	Change Attribute Type	287	15806	1.815766
Copilot	Rename Parameter	282	15806	1.784133
Copilot	Rename Method	276	15806	1.746172

dataset	refactoring_type	count	dataset_total	share_pct
Agentic	Add Method Annotation	26350	80492	32.736173
Agentic	Add Parameter Annotation	16763	80492	20.825672
Agentic	Modify Method Annotation	13513	80492	16.788004
Agentic	Modify Class Annotation	2548	80492	3.165532
Agentic	Add Class Annotation	2423	80492	3.010237
Agentic	Remove Method Annotation	2068	80492	2.569199
Agentic	Change Variable Type	1797	80492	2.232520
Agentic	Remove Parameter	1459	80492	1.812602
Agentic	Move Class	1377	80492	1.710729
Agentic	Rename Variable	987	80492	1.226209
Agentic	Change Return Type	877	80492	1.089549
Agentic	Rename Parameter	838	80492	1.041097
Agentic	Add Attribute Annotation	797	80492	0.990161
Agentic	Remove Attribute Annotation	727	80492	0.903195
Agentic	Inline Variable	697	80492	0.865925
Agentic	Extract Variable	627	80492	0.778959
Agentic	Add Parameter	613	80492	0.761566
Agentic	Move Attribute	594	80492	0.737962
Agentic	Rename Attribute	559	80492	0.694479
Agentic	Rename Method	509	80492	0.632361
Agentic	Change Attribute Type	500	80492	0.621180
Agentic	Change Method Access Modifier	419	80492	0.520549
Agentic	Move Method	412	80492	0.511852
Agentic	Remove Thrown Exception Type	348	80492	0.432341
Agentic	Change Parameter Type	327	80492	0.406252
Agentic	Extract Method	315	80492	0.391343
Agentic	Remove Attribute Modifier	203	80492	0.252199
Agentic	Add Attribute Modifier	158	80492	0.196293
Agentic	Remove Parameter Annotation	142	80492	0.176415
Agentic	Rename Class	132	80492	0.163991
Agentic	Move And Rename Method	131	80492	0.162749
Agentic	Add Method Modifier	125	80492	0.155295
Agentic	Change Attribute Access Modifier	99	80492	0.122994
Agentic	Extract And Move Method	79	80492	0.098146
Agentic	Remove Class Annotation	76	80492	0.094419
Agentic	Add Thrown Exception Type	66	80492	0.081996
Agentic	Change Class Access Modifier	62	80492	0.077026
Agentic	Inline Method	50	80492	0.062118
Agentic	Reorder Parameter	50	80492	0.062118
Agentic	Modify Parameter Annotation	49	80492	0.060876
Agentic	Add Variable Modifier	39	80492	0.048452
Agentic	Parameterize Variable	38	80492	0.047210
Agentic	Move And Rename Class	37	80492	0.045967
Agentic	Pull Up Method	37	80492	0.045967
Agentic	Extract Class	35	80492	0.043483
Agentic	Remove Variable Modifier	34	80492	0.042240
Agentic	Encapsulate Attribute	30	80492	0.037271

refactoring_type	count
Add Method Annotation	26769
Add Parameter Annotation	16912
Modify Method Annotation	13529
Modify Class Annotation	2597
Add Class Annotation	2492
Remove Method Annotation	2192
Change Variable Type	2188
Move Class	2121
Remove Parameter	1662
Change Return Type	1338
Rename Variable	1240
Rename Parameter	1155
Rename Method	1046
Add Parameter	1011
Extract Variable	974
Change Method Access Modifier	926
Add Attribute Annotation	921
Extract Method	909
Change Attribute Type	902
Rename Attribute	902
Change Parameter Type	838
Inline Variable	832
Change Attribute Access Modifier	829
Move Attribute	792
Remove Attribute Annotation	788
Move Method	657
Add Attribute Modifier	542
Extract And Move Method	368
Add Method Modifier	361
Remove Thrown Exception Type	356
Rename Class	313
Remove Attribute Modifier	300
Move And Rename Method	241
Add Parameter Modifier	180
Pull Up Method	179
Change Class Access Modifier	167
Remove Parameter Annotation	159
Add Variable Modifier	135
Move And Rename Class	132
Encapsulate Attribute	122
Pull Up Attribute	118
Extract Class	108
Add Thrown Exception Type	105
Remove Class Annotation	100
Parameterize Variable	92
Add Class Modifier	90
Inline Method	85