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Is Software Debloating Useful? - A Comparative Study

Sumit Lahiri, Amit Kumar Sharma

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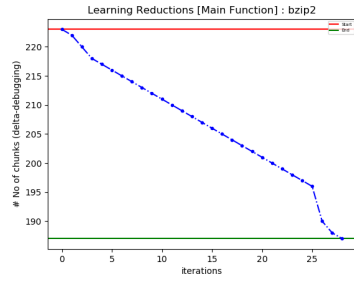
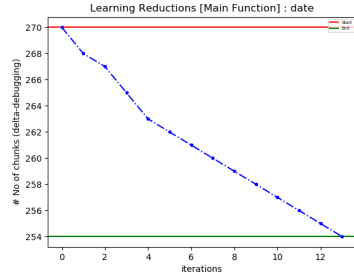
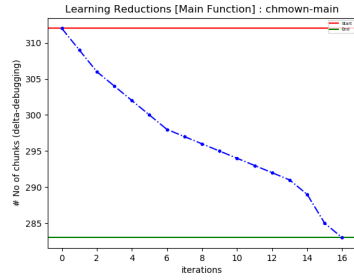
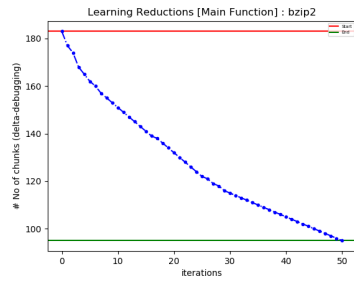
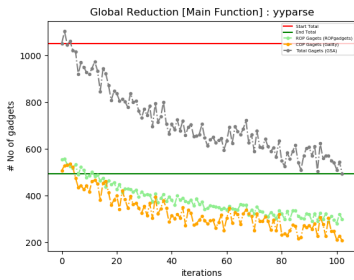
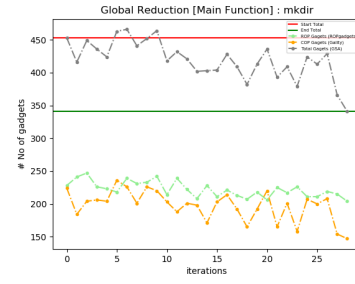
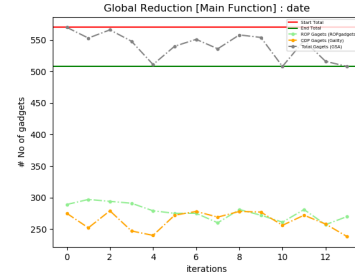
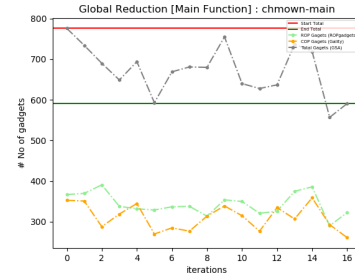
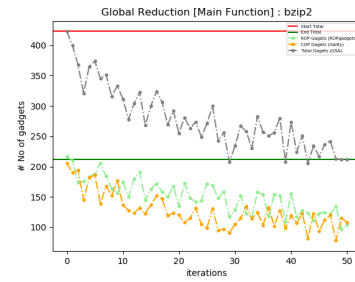
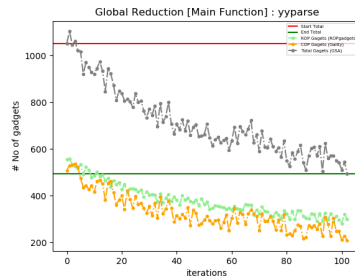
Index Terms—Software Debloating, Software Engineering, Delta Debugging

I. PROJECT OBJECTIVE

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Figure 1: Learning plot for `mkdir`Figure 2: Learning plot for `date`Figure 3: Learning plot for `chown`Figure 4: Learning plot for `bzip2`Figure 5: Gadgets plot for `yyparse`Figure 6: Gadgets plot for `mkdir`Figure 7: Gadgets plot for `date`Figure 8: Gadgets plot for `chown`Figure 9: Gadgets plot for `bzip2`Figure 10: Gadgets plot for `yyparse`

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III. MOTIVATING EXAMPLES

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IV. OCCAM TOOL

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Libraries/Tools	Before	None	Aggressive	DeepOCCAM RL Model	Non-rec Aggressive	Only once	IPDSE/IPSCCP Loop Unrolling
Functions	4	4	3	3	3	4	3
Basic Blocks	451	445	450	450	450	445	448
Instructions Count	2521	2481	2523	2523	2523	2481	2523
Direct Calls	328	327	330	330	330	327	330
External Calls	322	321	326	326	326	321	325
Memory Instructions Load/Store	671	658	672	672	672	658	675

Table I: Comparison of DeepOCCAM with other OCCAM Run settings and OCCAM-T Run (Trimmer)

bzip2							
Libraries/Tools	Before	None	Aggressive	DeepOCCAM RL Model	Non-rec Aggressive	Only once	IPDSE/IPSCCP Loop Unrolling
Functions	61	35	54	54	54	35	54
Basic Blocks	2776	2538	3137	3137	3137	2538	3137
Instructions Count	24412	20540	23769	23769	23769	20540	23769
Direct Calls	4714	621	1011	1011	1011	621	1011
External Calls	4575	515	835	835	835	515	835
Memory Instructions Load/Store	5144	5209	5989	5989	5989	5209	5989

Table II: Comparison of DeepOCCAM with other OCCAM Run settings and OCCAM-T Run (Trimmer)

curl							
Libraries/Tools	Before	None	Aggressive	DeepOCCAM RL Model	Non-rec Aggressive	Only once	IPDSE/IPSCCP Loop Unrolling
Functions	124	59	62	62	52	59	57
Basic Blocks	2823	2764	4256	4375	3369	2764	3369
Instructions Count	11870	11777	17965	18106	14512	11777	15854
Direct Calls	1786	1696	2423	2500	2005	1696	2145
External Calls	1234	1250	1911	1911	1519	1250	1975
Memory Instructions Load/Store	2503	2511	3698	3858	3048	2511	3625

Table III: Comparison of DeepOCCAM with other OCCAM Run settings and OCCAM-T Run (Trimmer)

V. TRIMMER TOOL

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nettest_bsd							
Libraries/Tools	Before	None	Aggressive	DeepOCCAM RL Model	Non-rec Aggressive	Only once	IPDSE/IPSCCP Loop Unrolling
Functions	33	23	24	24	24	24	24
Basic Blocks	979	553	573	573	573	573	573
Instructions Count	6301	3045	3140	3140	3140	3140	3140
Direct Calls	862	402	412	412	412	412	412
External Calls	794	369	377	377	377	377	377
Memory Instructions Load/Store	2859	1350	1396	1396	1396	1396	1396

Table IV: Comparison of DeepOCCAM with other OCCAM Run settings and OCCAM-T Run (Trimmer)

httpd							
Libraries/Tools	Before	None	Aggressive	DeepOCCAM RL Model	Non-rec Aggressive	Only once	IPDSE/IPSCCP Loop Unrolling
Functions	1083	477	428	430	444	416	441
Basic Blocks	12943	11615	12563	13562	12999	11401	12652
Instructions Count	83238	62428	65842	66521	70773	61667	65252
Direct Calls	22603	5279	5152	5259	5932	5175	5869
External Calls	20712	4152	4563	4628	4787	4116	4625
Memory Instructions Load/Store	17071	16334	18345	17056	18347	16188	17854

Table V: Comparison of DeepOCCAM with other OCCAM Run settings and OCCAM-T Run (Trimmer)

GNU Tree							
Libraries/Tools	Before	None	Aggressive	DeepOCCAM RL Model	Non-rec Aggressive	Only once	IPDSE/IPSCCP Loop Unrolling
Functions	52	40	41	44	44	40	42
Basic Blocks	1458	1845	1850	1891	1891	1845	1850
Instructions Count	7442	8957	9152	9286	9286	8957	9365
Direct Calls	1051	1257	1150	1290	1290	1257	1362
External Calls	845	1167	1147	1200	1200	1167	1058
Memory Instructions Load/Store	1944	2362	2344	2344	2344	2222	2452

Table VI: Comparison of DeepOCCAM with other OCCAM Run settings and OCCAM-T Run (Trimmer)

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VI. CHISEL TOOL

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E. 1-minimal Program

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VII. DEEPOCCAM TOOL

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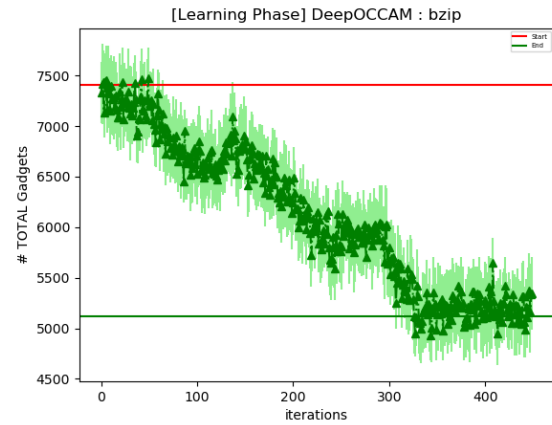


Figure 11: **DeepOCCAM Total**

450 iterations **bzip - HF**

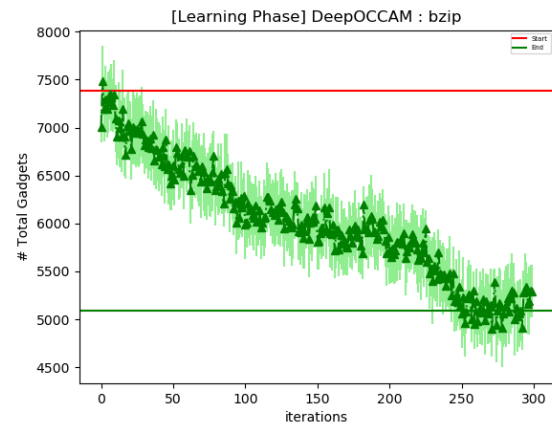


Figure 12: **DeepOCCAM Total**

300 iterations **bzip - inst2vec bzip embedding**

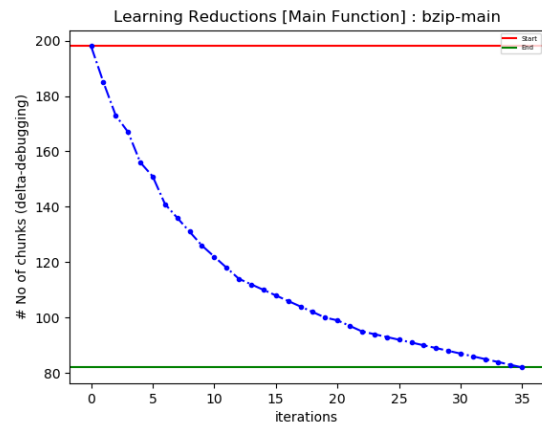
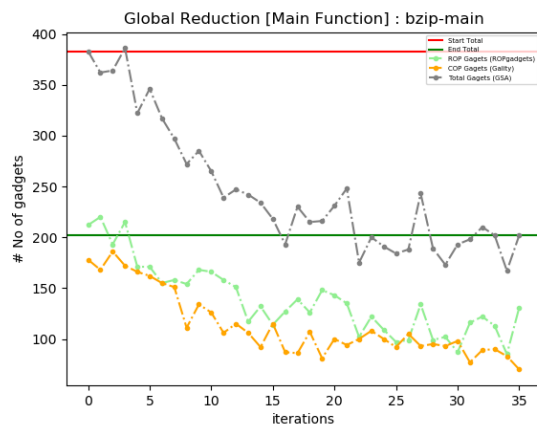
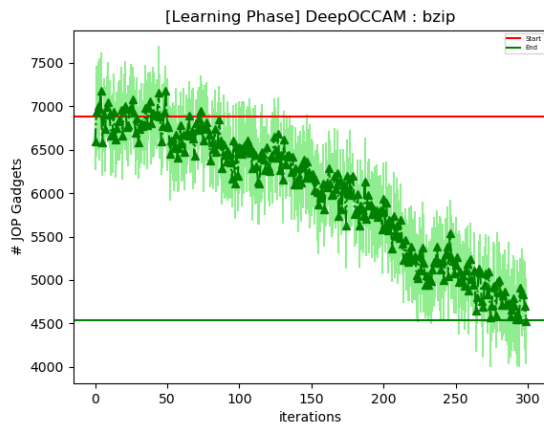
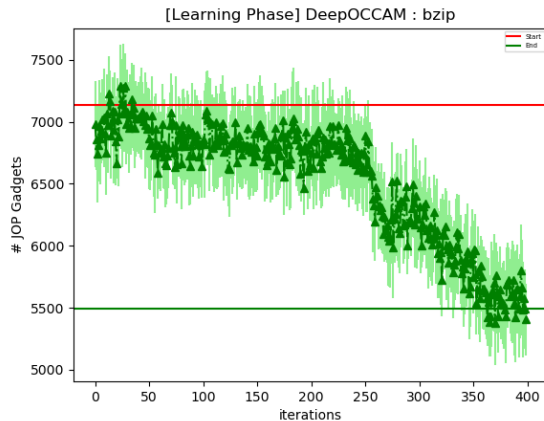


Figure 13: **Chisel Learning bzip main()**



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C. DeepOCCAM Pipeline

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XI. ANALYSIS METRICS

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XII. COMPARISON METRICS

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NET UUID Program							
Libraries/Tools	Before	None	Aggressive	Machine Learning	Non-rec Aggressive	Only once	IPDSE/IPSSCP Loop Unrolling
Functions	10	9	9	9	9	9	9
Basic Blocks	38	34	34	34	34	34	34
Instructions Count	349	304	304	304	304	304	304
Direct Calls	23	20	20	20	20	20	20
External Calls	12	9	9	9	9	9	9
Memory Instructions Load/Store	141	128	128	128	128	128	128

Table IX: Comparison of DeepOCCAM with other OCCAM Run settings and OCCAM-T Run (Trimmer)

netsh Program Program							
Libraries/Tools	Before	None	Aggressive	Machine Learning	Non-rec Aggressive	Only once	IPDSE/IPSSCP Loop Unrolling
Functions	12	11	13	13	13	11	11
Basic Blocks	313	312	332	332	332	312	312
Instructions Count	1319	1315	1417	1417	1417	1315	1315
Direct Calls	195	194	196	196	196	194	194
External Calls	172	171	173	173	173	171	171
Memory Instructions Load/Store	433	431	481	481	481	431	431

Table X: Comparison of DeepOCCAM with other OCCAM Run settings and OCCAM-T Run (Trimmer)

Chisel Tool (Final)	bzip		date		mkdir		rm		tree	
Binary Metrics	Before	After	Before	After	Before	After	Before	After	Before	After
ROP Gadgets	646	313	408	166	210	84	485	111	567	405
COP Gadgets	97	55	39	8	7	5	44	5	50	9
JOP Gadgets	6728	1562	5214	877	2282	176	4476	190	2126	775
Total Unique Gadgets (Excluding SYS & Chain)	7374	1930	5626	1046	2492	260	4965	301	2693	1187

Table XI: Dynamic Binary Analysis results for Chisel for Gadgets Count

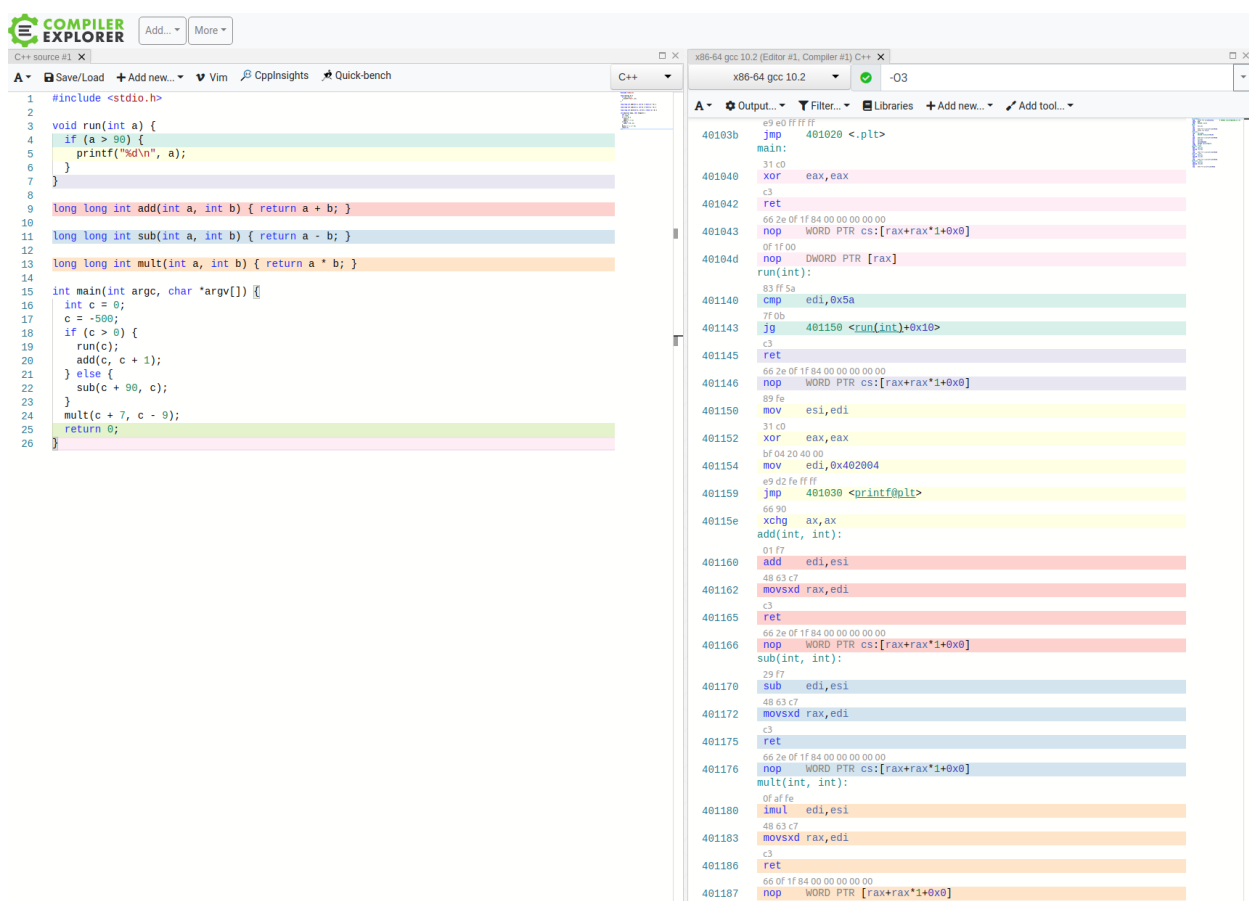


Figure 17: **C** Code Example **before** Chisel tool processing

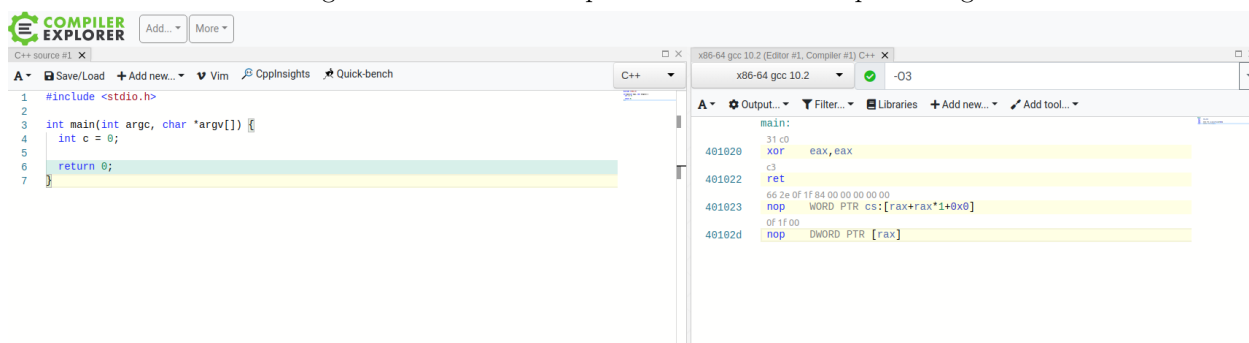


Figure 18: **C** Code Example **after Chisel** tool processing

B. Comparision : Dynamic Analysis

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XIII. OBSERVATIONS

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A. Insights

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XIV. CONCLUSION

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A. But finally, Who Won?

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XV. OTHER TOOLS

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XVI. PROJECT ASSETS

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A. Docker Images

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B. GitHub Repositories

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