A Relational Static Semantics for Call Graph Resolution

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Abstract. The problem of resolving virtual method and interface calls in Object-Oriented languages has been a long standing challenge to the program analysis community. In this paper, we propose a new approach called type flow analysis that represent the propagation of type information between program variables by a group of relations without the help of a heap abstraction. We prove that regarding the precision on reachability of class information to variables, our method produces results equivalent to that one can derive from a points-to analysis. Moreover, in practice, our method consumes lower time and space usage, as supported by the experimental results.

1 Experiment

Table 1. Callsite with different analysis

bench	$\mathbf{CS}_{origin}$	$\mathbf{CS}_{cha}$	$\mathbf{CS}_{pta}$	$\mathbf{CS}_{tfa}$
compress	153	160	18	73
crypto	302	307	62	121
bootstrap	657	801	891	328
commons-codec	1162	1372	270	442
junit	3196	17532	11176	1358
commons-httpclient	6817	17118	567	2927
serializer	4782	9533	1248	1756
xerces	24579	56252	10631	8111
eclipse	23607	95073	70016	9379
derby	69537	180428	85212	16381
xalan	57430	155866	/	18669
antlr	62007	147014	/	17177
jython	129332	466167	/	/
batik	56877	235071	/	20901

Table 2. Time cost with different analysis

bench	$\mathbf{T}_{cha}(s^{-1})$	$\mathbf{T}_{pta}(s^{-1})$	$\mathbf{T}_{tfa}(s^{-1})$	**Relations**
compress	0.17	1.46	0.12	233
crypto	0.12	1.18	0.52	295
bootstrap	240.87	324.04	0.27	545
commons-codec	0.08	0.89	0.64	2235
junit	249.57	324.27	1.55	6501
commons-httpclient	0.08	1.19	2.59	10742
serializer	216.58	304.19	1.62	9126
xerces	224.87	316.98	19.9	63755
eclipse	207.84	391.89	16.78	39984
derby	241.29	484.73	110.77	181272
xalan	785.04	/	27.58	102889
antlr	474.66	/	28.39	90829
jython	3811.02	/	/	/
batik	503.98	/	37.97	140648

Table 3. Optimalization result

bench	$\mathbf{Node}_{origin}$	$\mathbf{Node}_{opt}$	**Reduce**	**Time**(s^{-1})
compress	154	102	33.77%	0.04
crypto	251	120	52.19%	0.06
bootstrap	442	223	49.55%	0.11
commons-codec	1358	639	52.95%	0.87
junit	5566	3099	44.32%	19.65
commons-httpclient	9003	4722	47.55%	44.76
serializer	6292	3478	44.72%	24.40
xerces	37674	/	/	/
eclipse	33101	/	/	/
derby	104315	/	/	/
xalan	74547	/	/	/
antlr	54213	/	/	/
jython	/	/	/	/
batik	83834	/	/	/