

Figure 1: timing-pattern

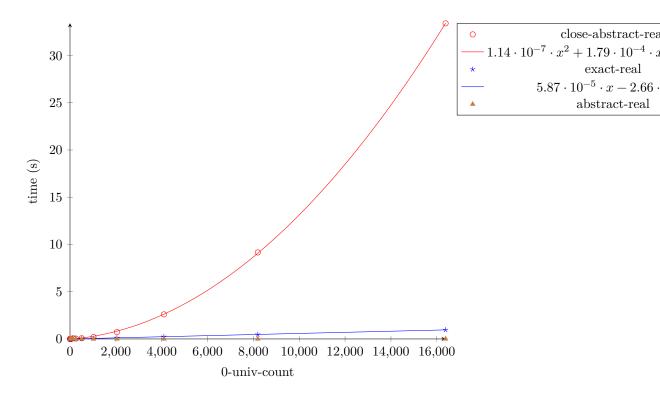
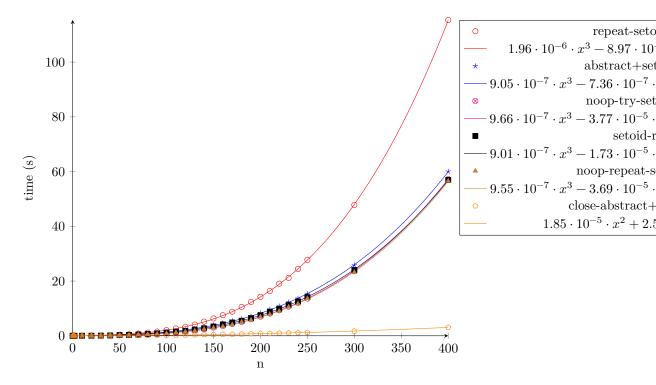


Figure 2: timing-n-polymorphic-universes param-1-n 0



 $Figure \ 3: \ timing-repeat-setoid-rewrite-under-binders$

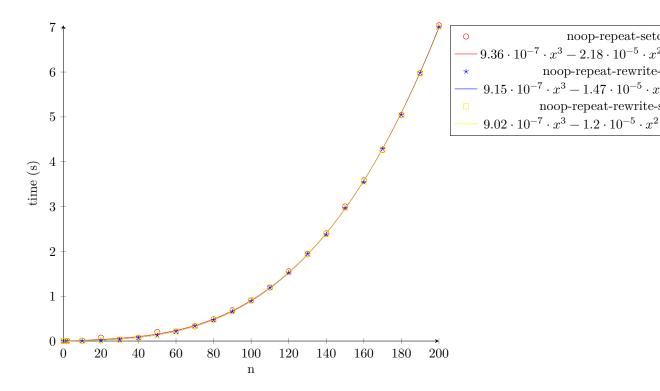
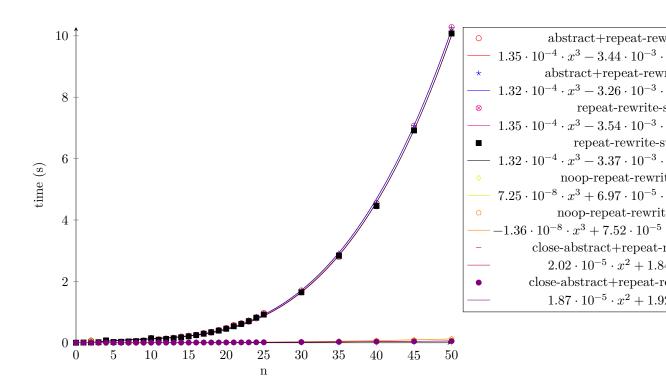
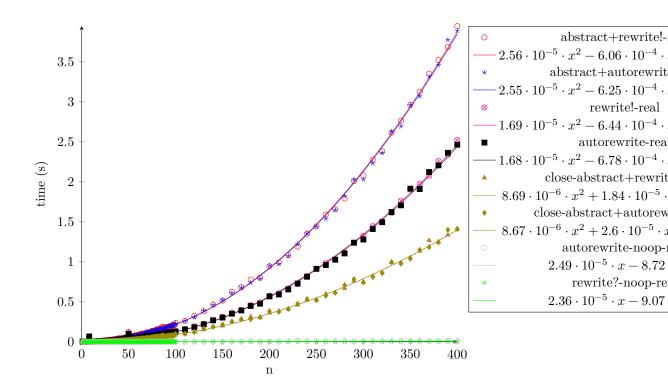


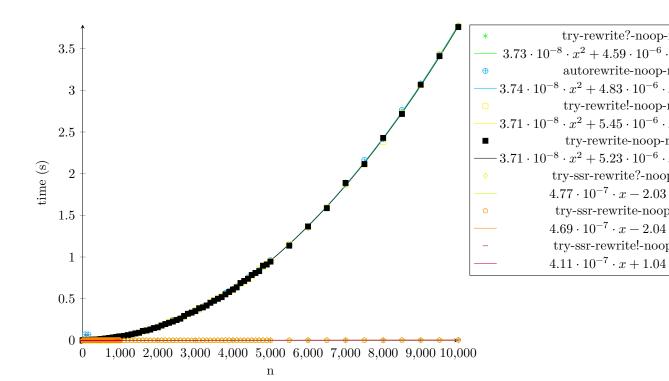
Figure 4: timing-repeat-setoid-rewrite-under-binders-noop



 $Figure\ 5:\ timing-rewrite-strat-under-binders$



 $Figure \ 6: \ timing-rewrite-repeated-app-autorewrite \\$



Figure~7:~timing-rewrite-repeated-app-autorewrite-noop

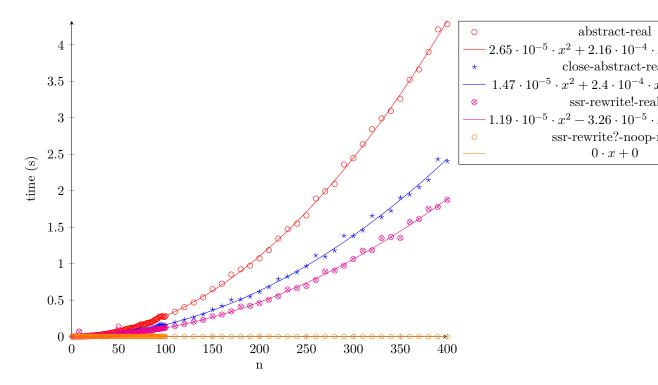


Figure 8: timing-rewrite-repeated-app-ssrrewrite

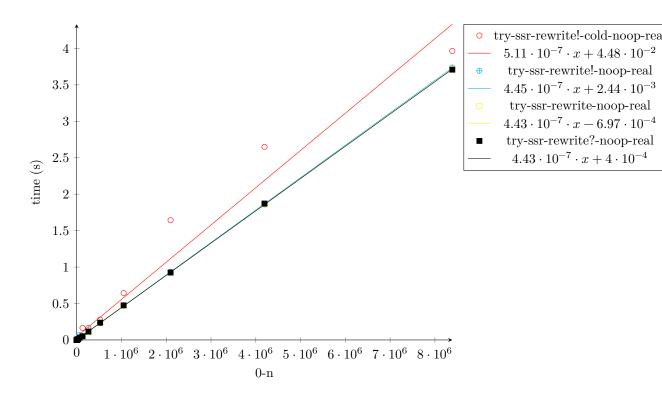
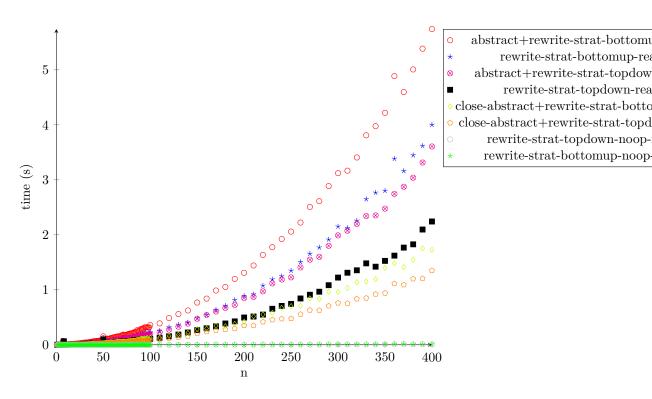


Figure 9: timing-rewrite-repeated-app-ssrrewrite-noop param-1-lgn $\ 1$



rewrite-strat-bottomup-rea

abstract + rewrite - strat - topdowrewrite-strat-topdown-rea

rewrite-strat-topdown-nooprewrite-strat-bottomup-noop-

 $Figure~10:~timing\mbox{-rewrite-repeated-app-rewrite-strat}$

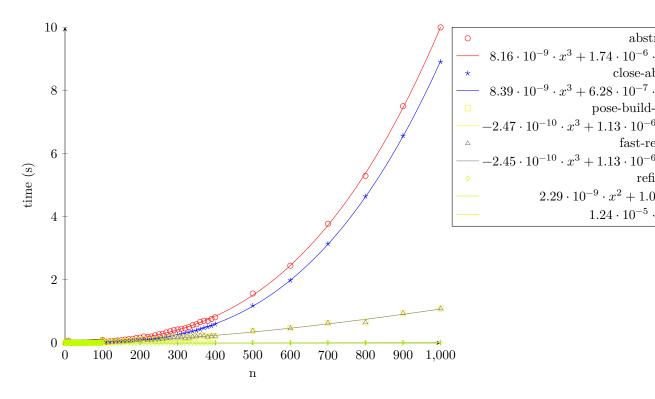
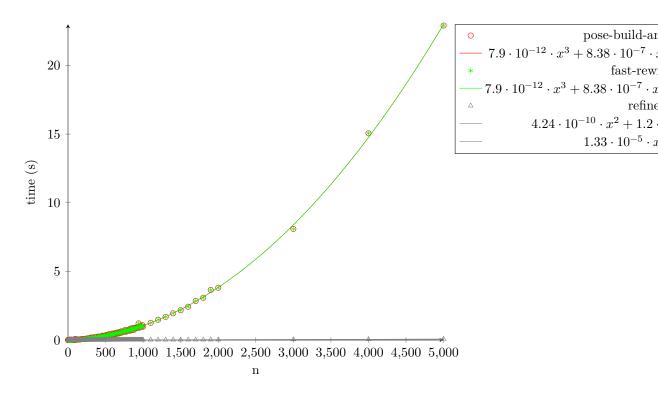


Figure 11: timing-rewrite-repeated-app-fast-rewrite



Figure~12:~timing-rewrite-repeated-app-fast-rewrite-no-abstract

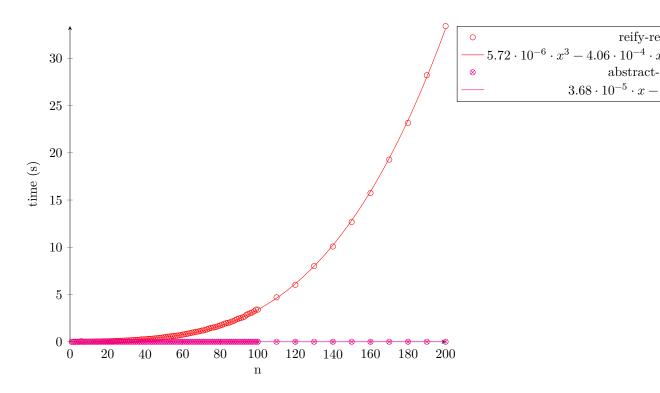
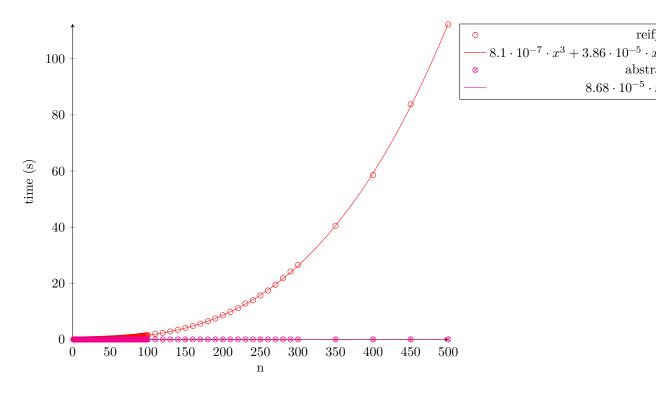
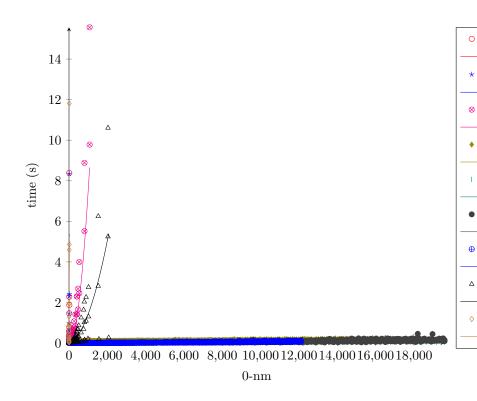


Figure 13: timing-typeclass-reification-let-in-HOAS



 ${\bf Figure~14:~timing-type class-reification-let-in-PHOAS}$



rewrite-strat(bottomup-bot $5.09 \cdot 10^{-3} exp(0.46 \cdot ($

rewrite-strat (topdown-bot) $5.6 \cdot 10^{-3} \exp{(0.46 \cdot (0.46 \cdot$

 $7.59 \cdot 10^{-6} \cdot x^2 - 1.32 \cdot 10^{-4} \cdot x^2 + 1.00 \cdot 10^{-4} \cdot x^2$

 $4.08\cdot 10^{-11}\cdot x^2 + 6.04\cdot 10^{-6}\cdot \\$

 $1.06 \cdot 10^{-10} \cdot x^2 + 3.61 \cdot 10^{-6} \cdot$

 $2.03 \cdot 10^{-10} \cdot x^2 + 5.09 \cdot 10^{-6} \cdot$

 $1.38 \cdot 10^{-10} \cdot x^2 + 5.12 \cdot 10^{-6} \cdot \\$

 $1.09 \cdot 10^{-6} \cdot x^2 + 3.57 \cdot 10^{-4} \cdot x^2$

 $-6.84 \cdot 10^{-3} \cdot x^3 + 0.22 \cdot x^2 -$

cps+cbn-real

cps+cbv-real

 $\operatorname{cps+lazy-real}$

cps+simpl-real

setoid-rewrite-re

cps+vm-compute-

cps+native-compute

Figure 15: timing-rewrite-lift-lets-map param-1-n 1, param-2-m 1

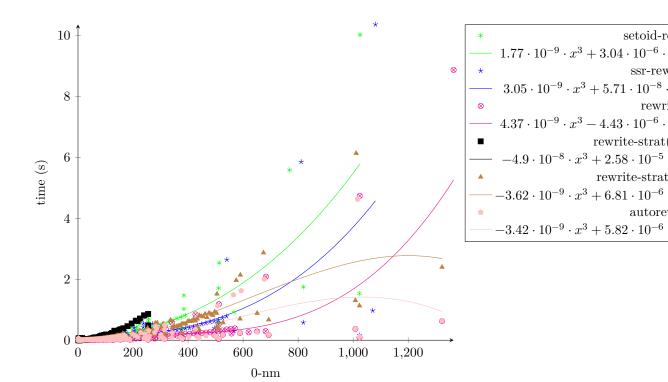
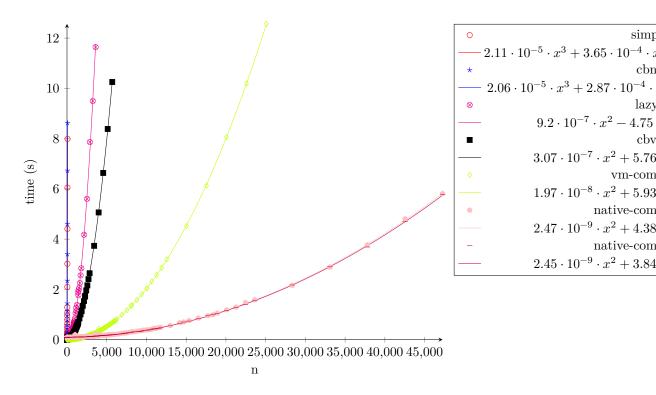


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

vm-com

native-com

native-com

 $9.2\cdot 10^{-7}\cdot x^2 - 4.75$

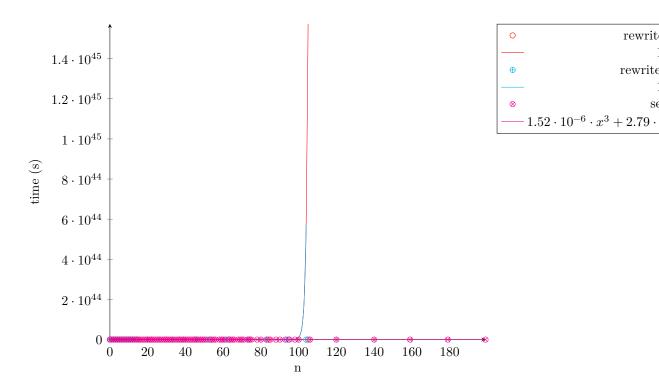
 $3.07 \cdot 10^{-7} \cdot x^2 + 5.76$

 $1.97 \cdot 10^{-8} \cdot x^2 + 5.93$

 $2.47 \cdot 10^{-9} \cdot x^2 + 4.38$

 $2.45 \cdot 10^{-9} \cdot x^2 + 3.84$

Figure 17: timing-sieve-of-eratosthenes



rewrite

Figure 18: timing-rewrite-under-lets-plus-0 $\,$