

Figure 1: timing-pattern

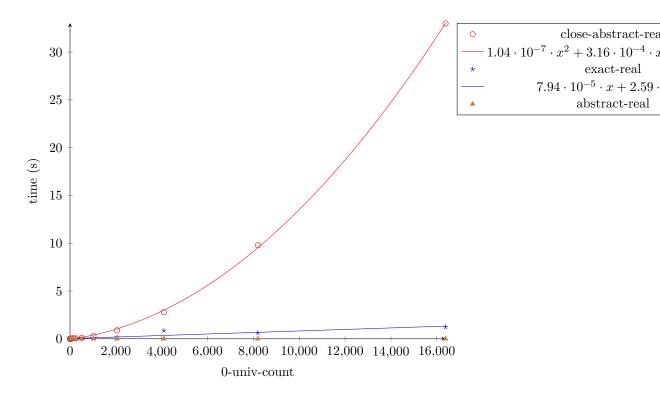
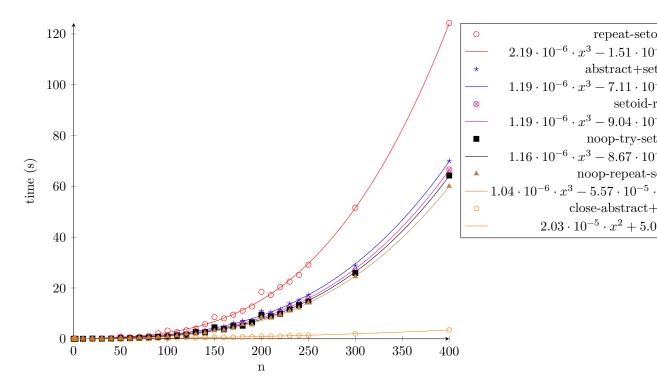


Figure 2: timing-n-polymorphic-universes param-1-n 0



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

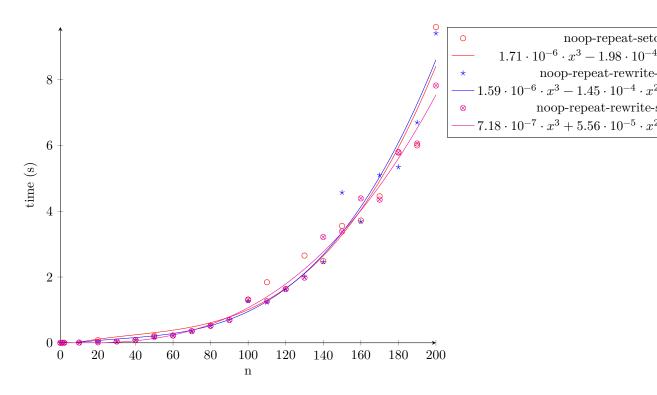
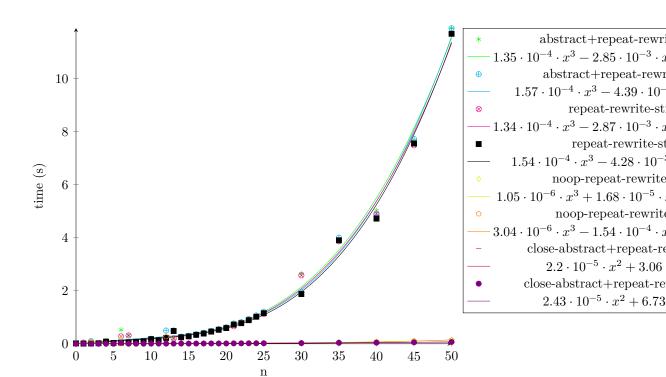
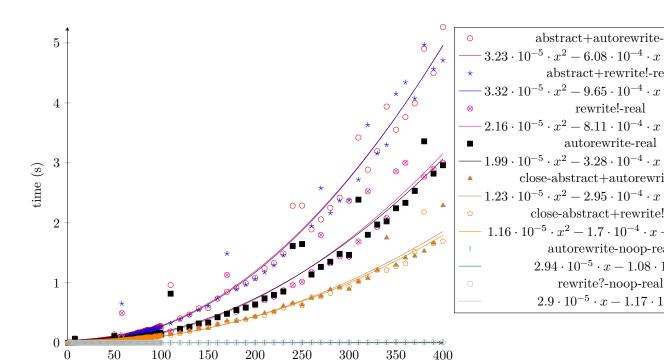


Figure 4: timing-repeat-setoid-rewrite-under-binders-noop

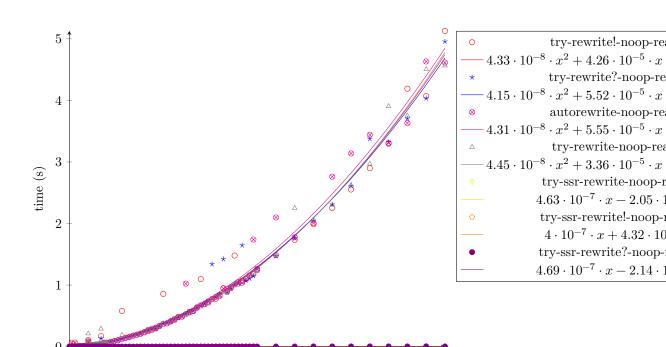


 $Figure\ 5:\ timing-rewrite-strat-under-binders$



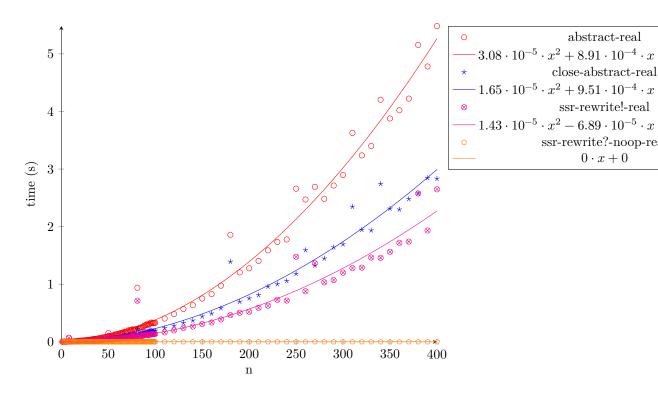
 $Figure \ 6: \ timing-rewrite-repeated-app-autorewrite \\$

n



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

1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000 10,000



 ${\bf Figure~8:~timing\text{-}rewrite\text{-}repeated\text{-}app\text{-}ssrrewrite}$

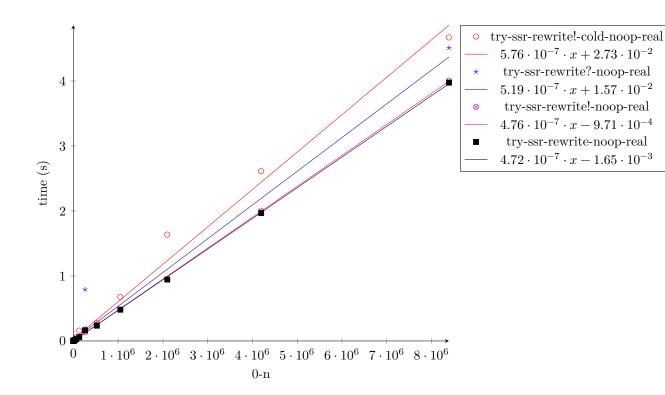
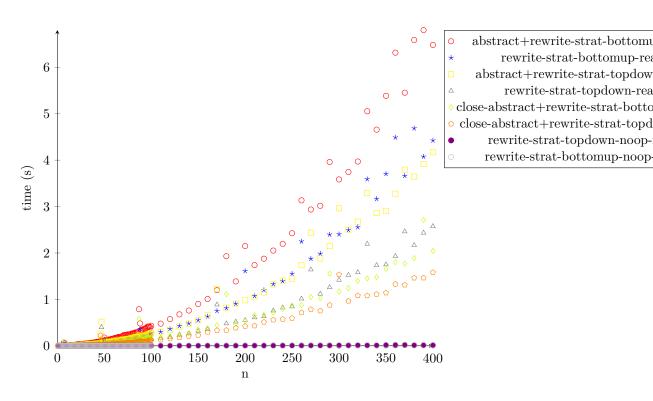


Figure 9: timing-rewrite-repeated-app-ssrrewrite-noop param-1-lgn $\ 1$

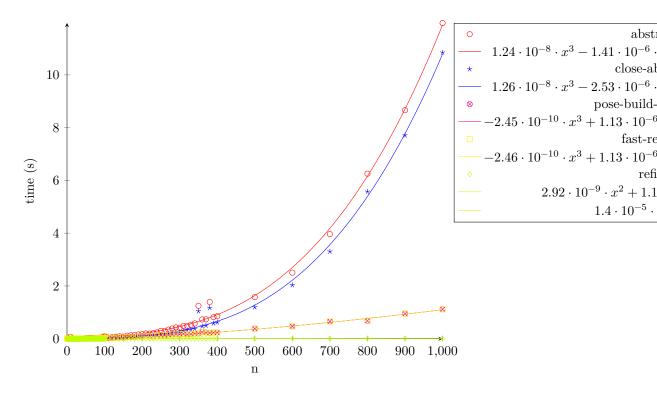


 $abstract + rewrite - strat - bottom \\ \\$ rewrite-strat-bottomup-rea

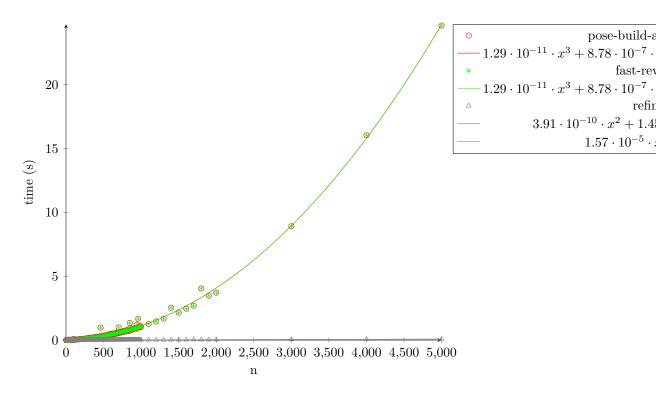
abstract + rewrite - strat - topdowrewrite-strat-topdown-rea

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

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



 $Figure~11:~timing\mbox{-rewrite-repeated-app-fast-rewrite}$



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

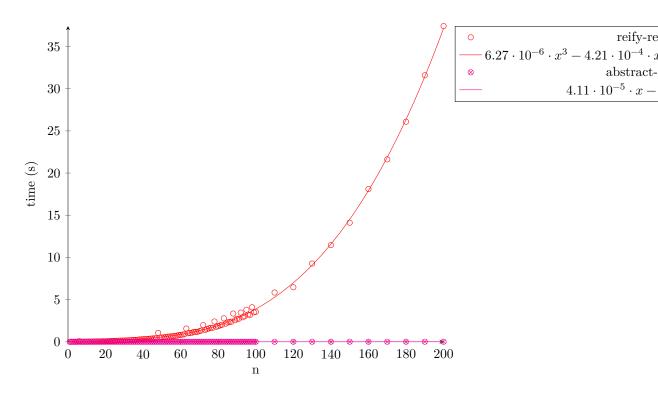


Figure 13: timing-typeclass-reification-let-in-HOAS

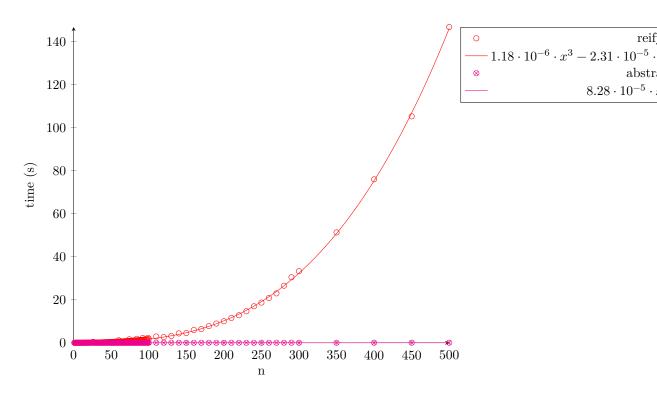
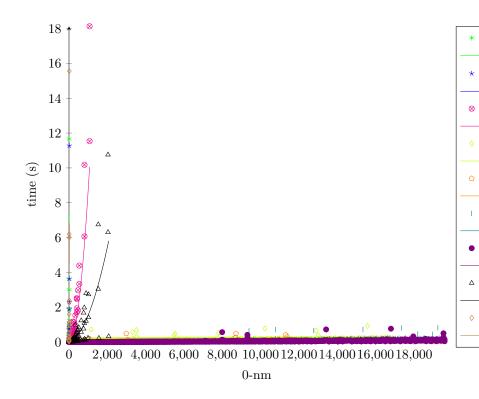


Figure 14: timing-typeclass-reification-let-in-PHOAS



rewrite-strat (topdown-bott $8.13 \cdot 10^{-3} \exp{(0.45 \cdot ($

rewrite-strat(bottomup-bot $9.73 \cdot 10^{-3} exp(0.44 \cdot ($

 $8.8 \cdot 10^{-6} \cdot x^2 - 1.37 \cdot 10^{-4} \cdot x^2$

 $8.4 \cdot 10^{-11} \cdot x^2 + 5.96 \cdot 10^{-6} \cdot x^2$

 $1.84\cdot 10^{-10}\cdot x^2 + 5.19\cdot 10^{-6}\cdot$

 $2.51 \cdot 10^{-10} \cdot x^2 + 5.07 \cdot 10^{-6} \cdot$

 $1.03\cdot 10^{-10}\cdot x^2 + 4.39\cdot 10^{-6}\cdot$

 $1.18 \cdot 10^{-6} \cdot x^2 + 3.73 \cdot 10^{-4} \cdot x^2$

 $-9.16 \cdot 10^{-3} \cdot x^3 + 0.29 \cdot x^2 -$

cps+cbn-real

cps+native-compute

cps+vm-compute-

 $\operatorname{cps+lazy-real}$

 $_{\rm cps+cbv\text{-}real}$

cps+simpl-real

setoid-rewrite-re

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

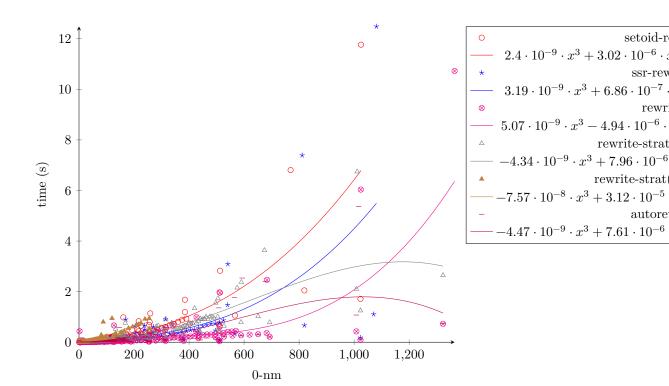
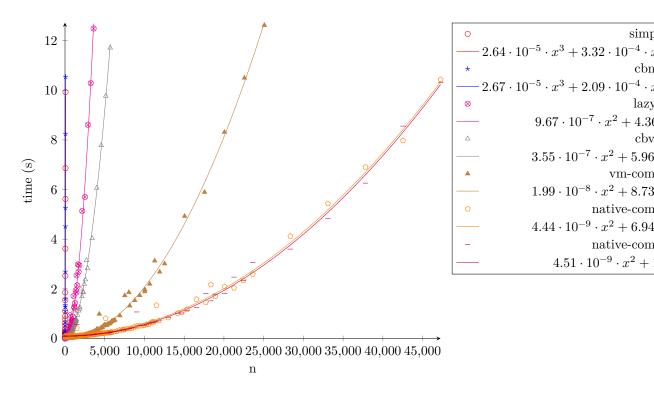


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

lazy

vm-com

native-com

native-com $4.51 \cdot 10^{-9} \cdot x^2 + 1$

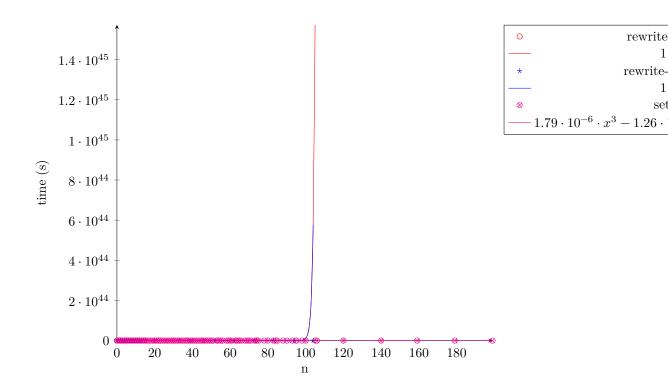
 $9.67 \cdot 10^{-7} \cdot x^2 + 4.36$

 $3.55 \cdot 10^{-7} \cdot x^2 + 5.96$

 $1.99 \cdot 10^{-8} \cdot x^2 + 8.73$

 $4.44 \cdot 10^{-9} \cdot x^2 + 6.94$

 ${\bf Figure~17:~timing\hbox{-}sieve\hbox{-}of\hbox{-}eratosthenes}$



rewrite

rewrite-

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