

Figure 1: timing-pattern

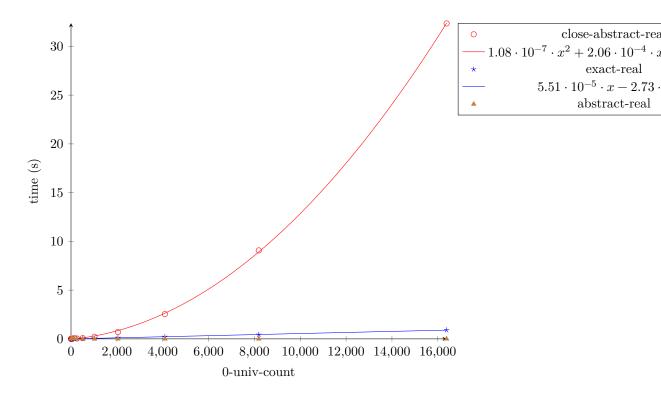
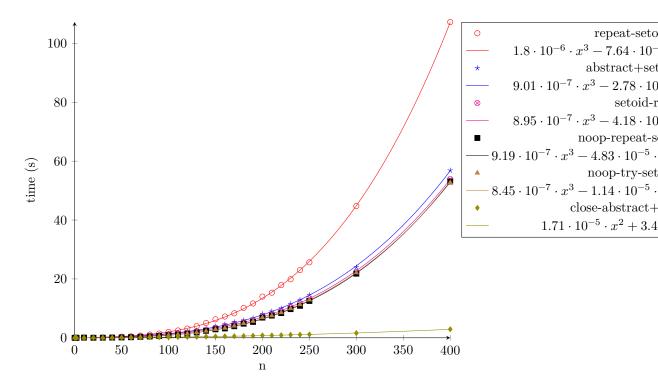
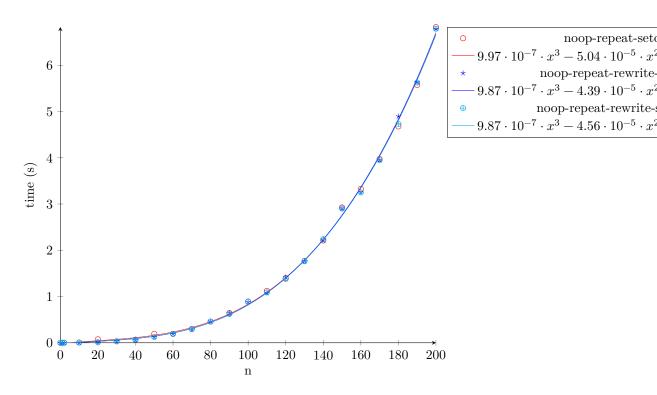


Figure 2: timing-n-polymorphic-universes param-1-n 0



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



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

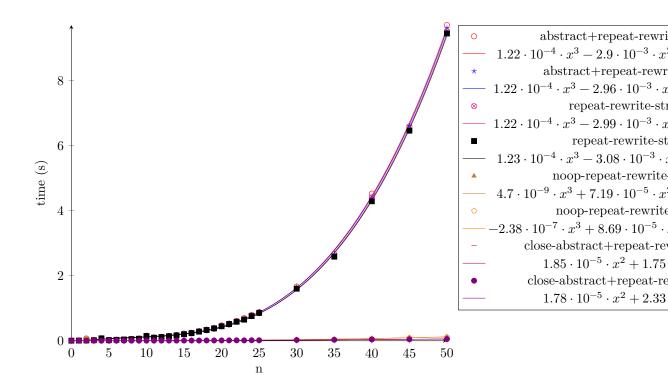
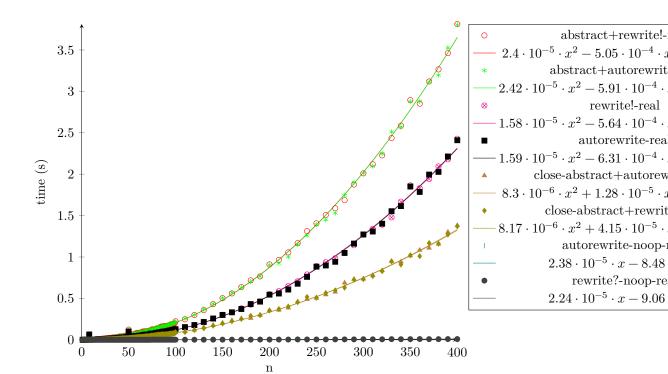


Figure 5: timing-rewrite-strat-under-binders



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

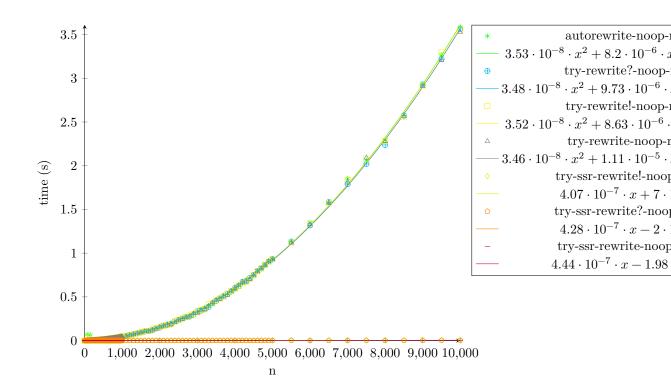
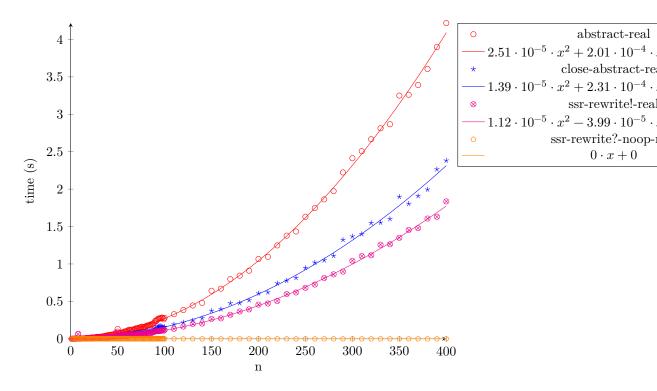
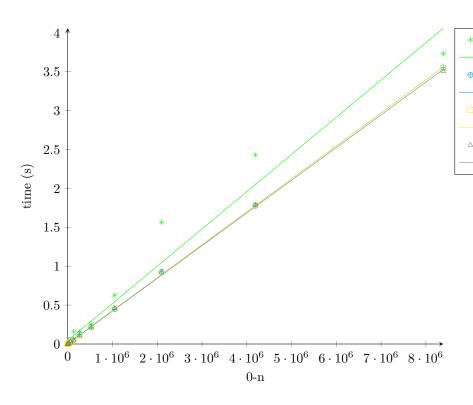


Figure 7: timing-rewrite-repeated-app-autorewrite-noop



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



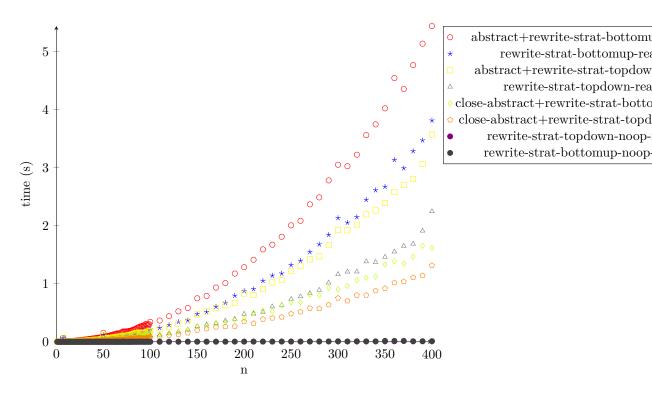
try-ssr-rewrite!-cold-noop-rea $4.79 \cdot 10^{-7} \cdot x + 4.31 \cdot 10^{-2}$

try-ssr-rewrite!-noop-real $4.24 \cdot 10^{-7} \cdot x + 3.04 \cdot 10^{-3}$ try-ssr-rewrite-noop-real

 $\begin{array}{l} 4.24 \cdot 10^{-7} \cdot x + 1.19 \cdot 10^{-3} \\ \text{try-ssr-rewrite?-noop-real} \end{array}$

 $4.21 \cdot 10^{-7} \cdot x + 2.22 \cdot 10^{-3}$

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

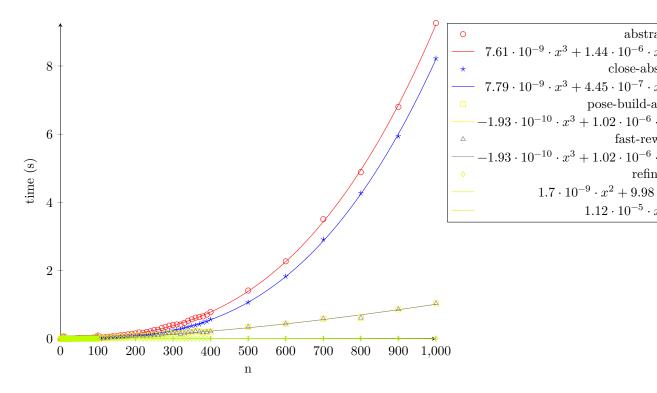


 $abstract + rewrite - strat - bottom \\ \\$

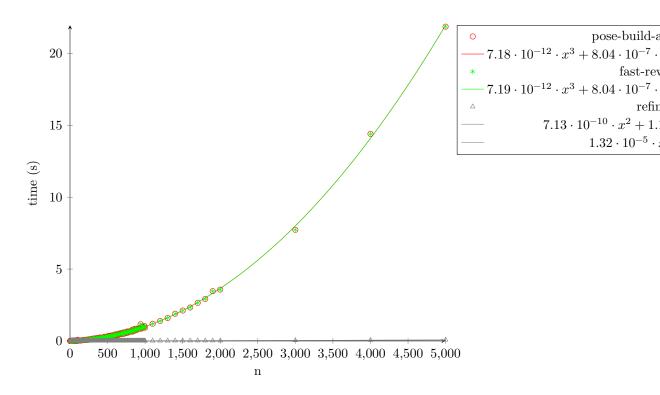
rewrite-strat-bottomup-rea abstract + rewrite - strat - topdowrewrite-strat-topdown-rea

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

 $Figure\ 10:\ timing-rewrite-repeated-app-rewrite-strat$



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



 ${\bf Figure~12:~timing\text{-}rewrite\text{-}repeated\text{-}app\text{-}fast\text{-}rewrite\text{-}no\text{-}abstract}}$

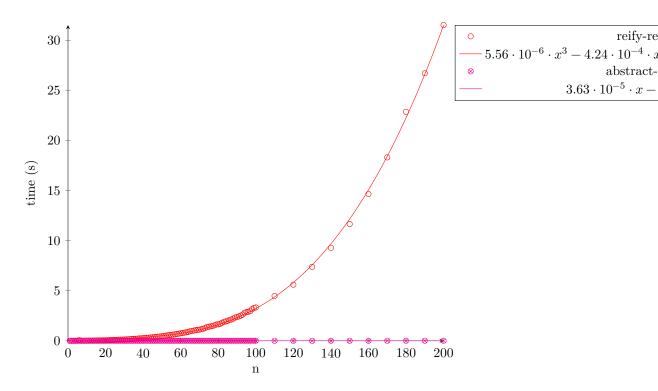
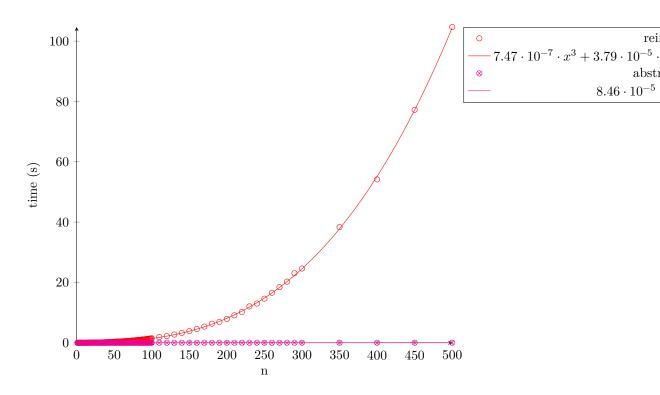
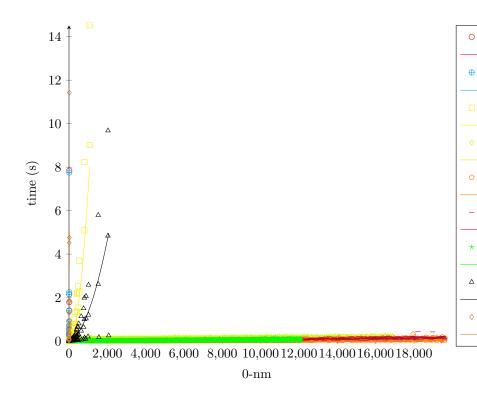


Figure 13: timing-typeclass-reification-let-in-HOAS



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



rewrite-strat(bottomup-bot

 $7.01 \cdot 10^{-6} \cdot x^2 - 8.79 \cdot 10^{-5} \cdot x^2 = 8.79 \cdot 10^{-5} \cdot x^2 - 10^{-5} \cdot x^2 -$

 $6.88\cdot 10^{-11}\cdot x^2 + 5.53\cdot 10^{-6}\cdot \\$

 $1.03 \cdot 10^{-10} \cdot x^2 + 3.46 \cdot 10^{-6} \cdot$

 $2.1 \cdot 10^{-10} \cdot x^2 + 4.53 \cdot 10^{-6} \cdot x^2$

 $9.59 \cdot 10^{-11} \cdot x^2 + 5.32 \cdot 10^{-6} \cdot \\$

 $9.81 \cdot 10^{-7} \cdot x^2 + 3.67 \cdot 10^{-4}$

 $-6.63 \cdot 10^{-3} \cdot x^3 + 0.21 \cdot x^2 - \\$

 $4.95 \cdot 10^{-3} \exp{(0.46 \cdot ($ rewrite-strat(topdown-bot

 $5.58 \cdot 10^{-3} exp (0.45 \cdot ($

cps+native-compute

cps+cbn-real

cps+cbv-real

cps+lazy-real

cps+simpl-real

setoid-rewrite-re

cps+vm-compute-

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

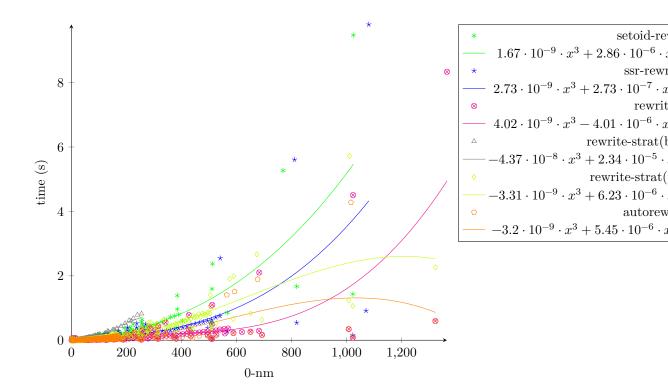
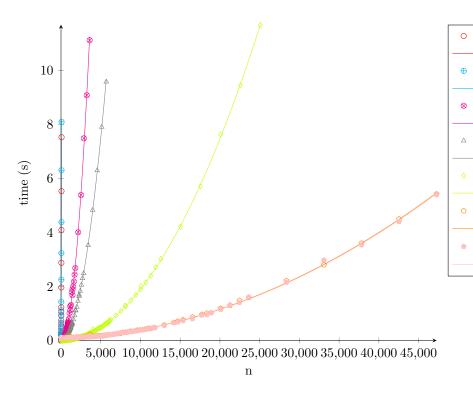


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

vm-com

native-com

native-com

 $2.07 \cdot 10^{-5} \cdot x^3 + 2.14 \cdot 10^{-4} \cdot x^3$

 $1.79 \cdot 10^{-5} \cdot x^3 + 3.8 \cdot 10^{-4} \cdot x$

 $8.76 \cdot 10^{-7} \cdot x^2 - 3.48$

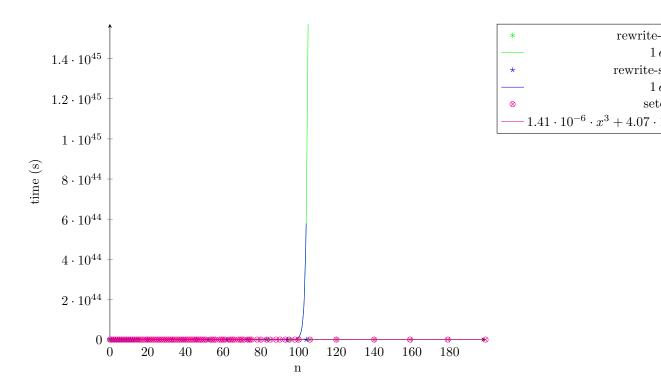
 $2.87 \cdot 10^{-7} \cdot x^2 + 6.46$

 $1.83 \cdot 10^{-8} \cdot x^2 + 7.92$

 $2.2 \cdot 10^{-9} \cdot x^2 + 9.8$

 $2.2 \cdot 10^{-9} \cdot x^2 + 9.16$

Figure 17: timing-sieve-of-eratosthenes



rewrite-

rewrite-s

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