

Figure 1: timing-pattern

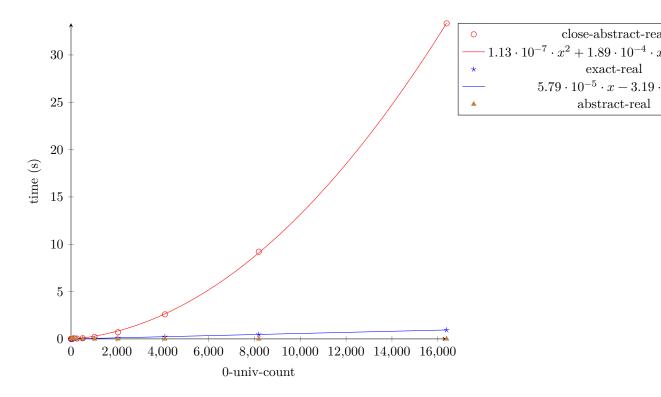


Figure 2: timing-n-polymorphic-universes param-1-n 0

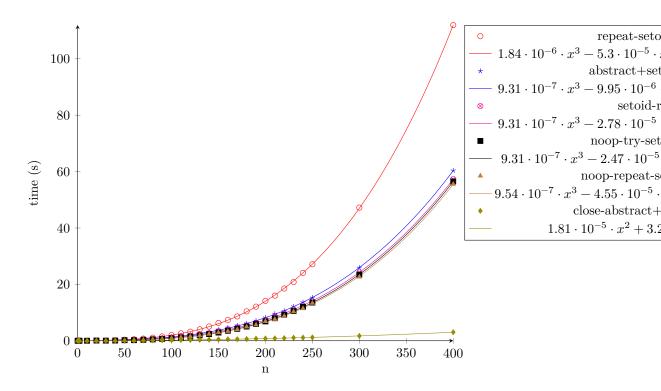


Figure 3: timing-repeat-setoid-rewrite-under-binders

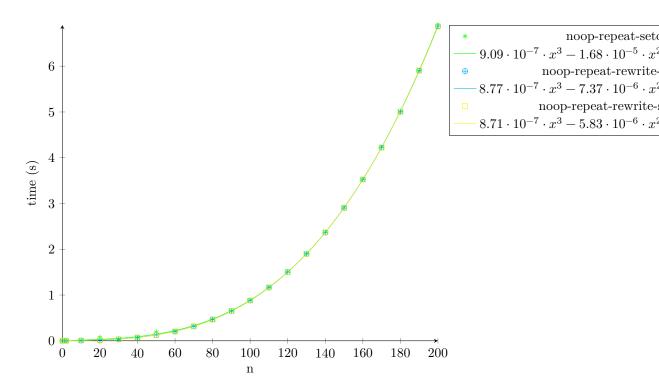


Figure 4: timing-repeat-setoid-rewrite-under-binders-noop

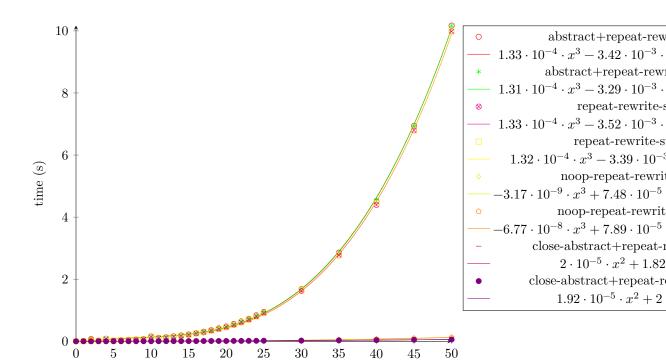
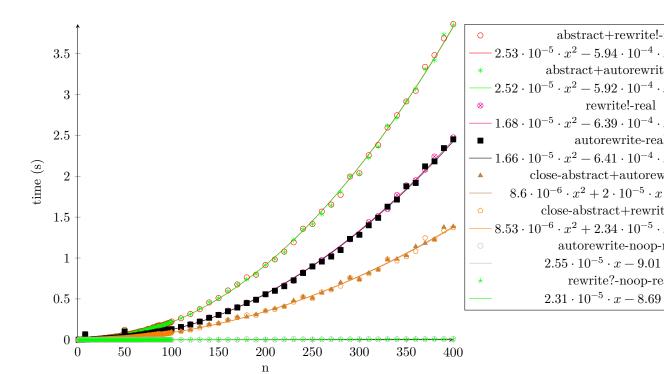
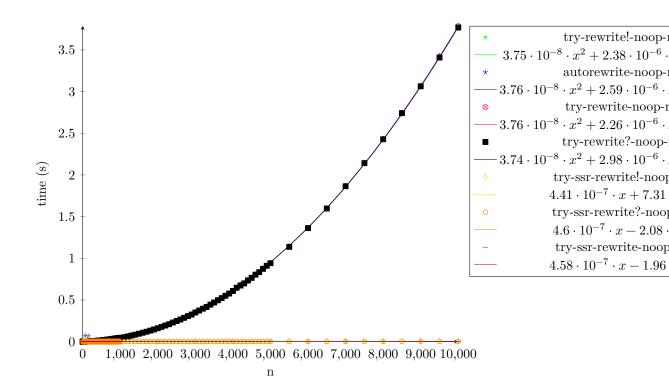


Figure 5: timing-rewrite-strat-under-binders

n



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



 $Figure~7:~timing\mbox{-rewrite-repeated-app-autorewrite-noop}$

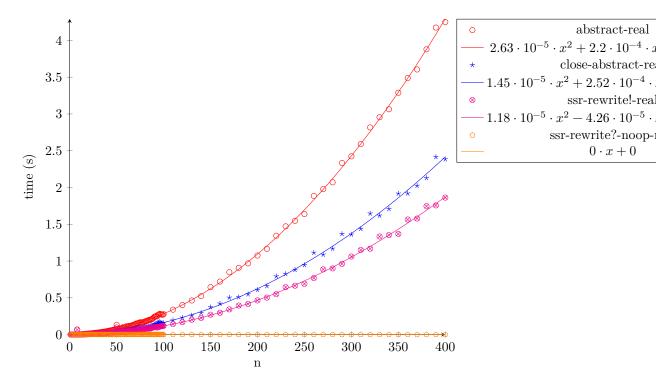


Figure 8: timing-rewrite-repeated-app-ssrrewrite

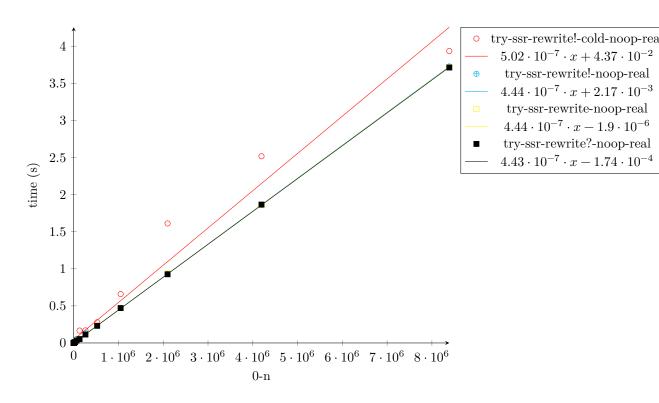
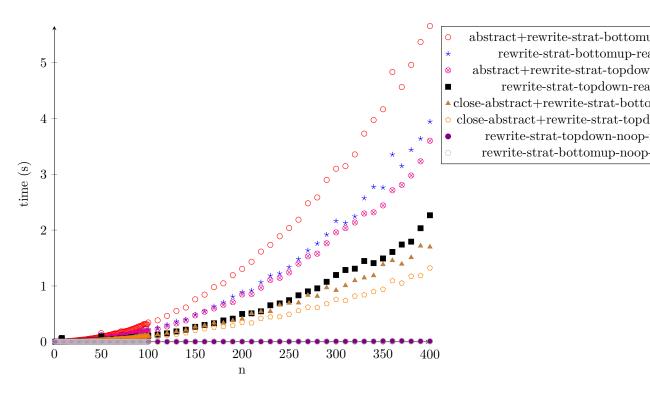


Figure 9: timing-rewrite-repeated-app-ssrrewrite-noop param-1-lgn $\ 1$

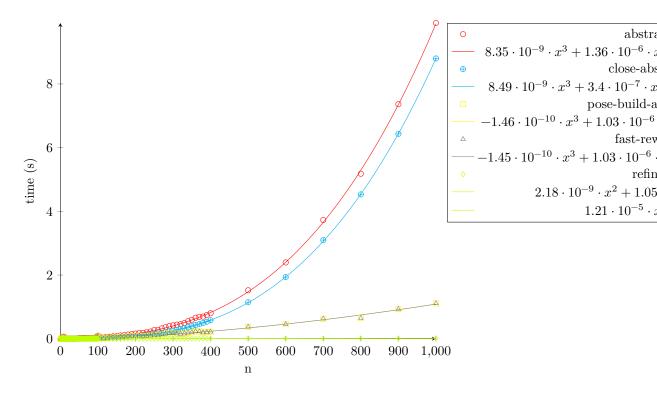


rewrite-strat-bottomup-rea

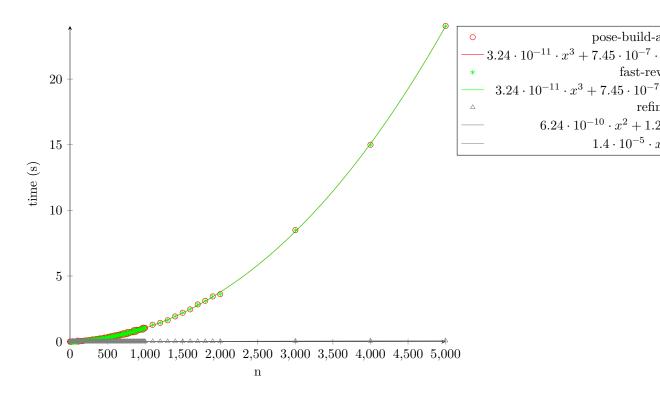
abstract + rewrite - strat - topdowrewrite-strat-topdown-rea

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

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



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



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

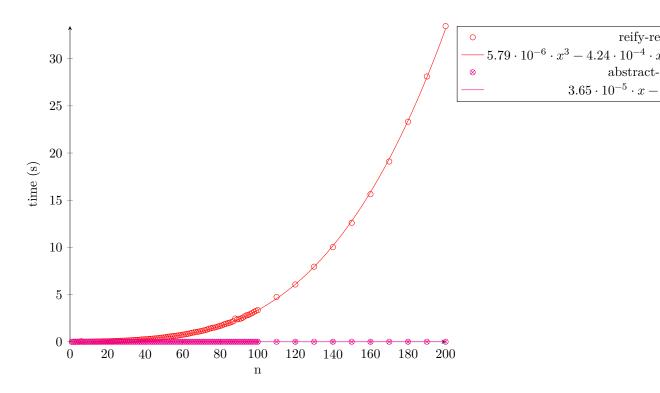
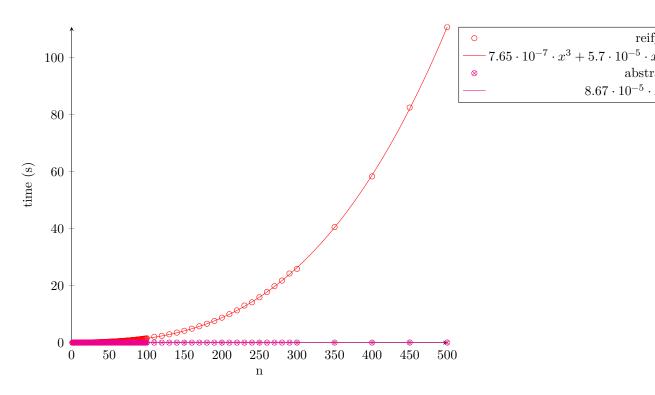
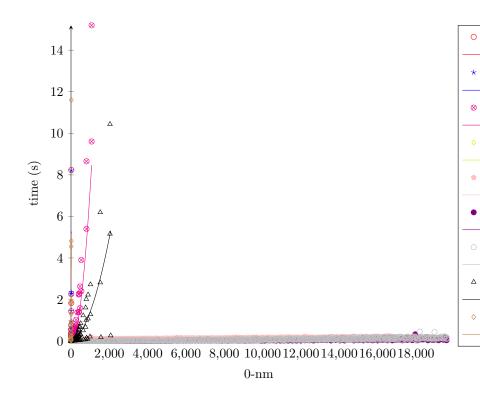


Figure 13: timing-typeclass-reification-let-in-HOAS



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



rewrite-strat(bottomup-bot

 $7.43\cdot 10^{-6}\cdot x^2 - 1.39\cdot 10^{-4}\cdot x^{-2} + 1.39\cdot x^{-2} + 1.39\cdot 10^{-4}\cdot x$

 $1.09 \cdot 10^{-10} \cdot x^2 + 5.4 \cdot 10^{-6} \cdot x^$

 $6.48 \cdot 10^{-11} \cdot x^2 + 5.46 \cdot 10^{-6} \cdot$

 $1.05 \cdot 10^{-10} \cdot x^2 + 3.64 \cdot 10^{-6} \cdot$

 $2.12\cdot 10^{-10}\cdot x^2 + 4.63\cdot 10^{-6}\cdot \\$

 $1.07 \cdot 10^{-6} \cdot x^2 + 3.61 \cdot 10^{-4}$

 $-6.75 \cdot 10^{-3} \cdot x^3 + 0.22 \cdot x^2 -$

 $2.61\cdot 10^{-3}\exp{(0.5\cdot (0.5))}$ rewrite-strat (topdown-bottom) $5.43\cdot 10^{-3}\exp{(0.46\cdot (0.45))}$

cps+cbn-real

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

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

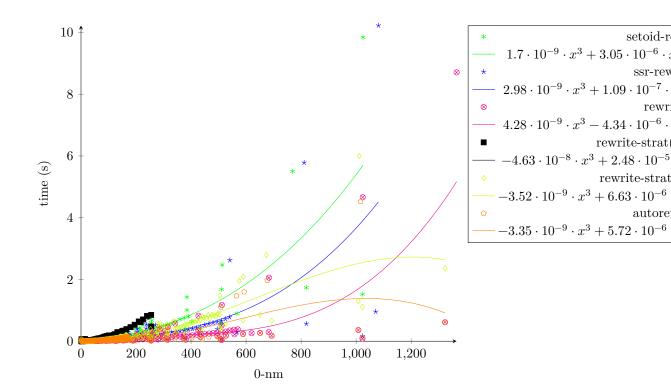
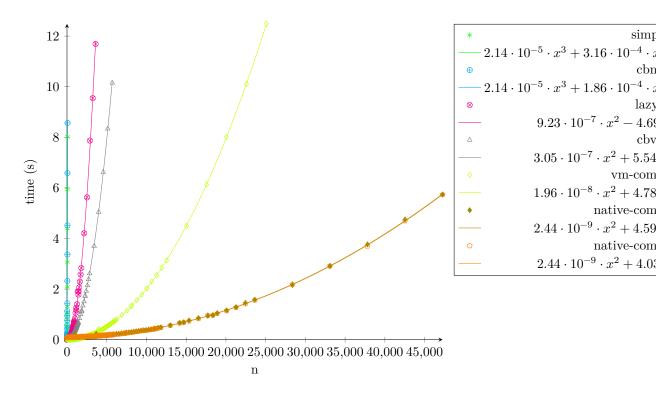


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

vm-com

native-com

native-com

 $9.23 \cdot 10^{-7} \cdot x^2 - 4.69$

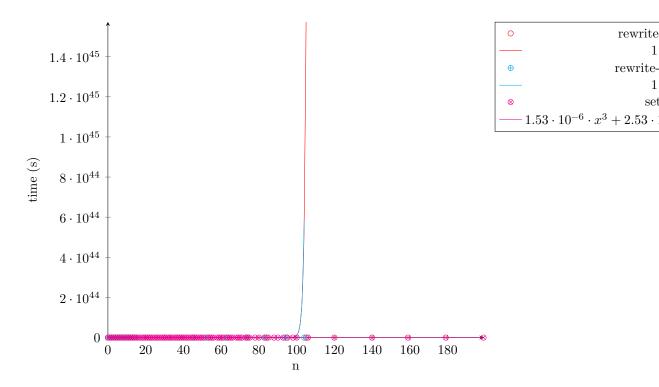
 $3.05 \cdot 10^{-7} \cdot x^2 + 5.54$

 $1.96 \cdot 10^{-8} \cdot x^2 + 4.78$

 $2.44 \cdot 10^{-9} \cdot x^2 + 4.59$

 $2.44 \cdot 10^{-9} \cdot x^2 + 4.03$

Figure 17: timing-sieve-of-eratosthenes



rewrite

rewrite-

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