

Figure 1: timing-pattern

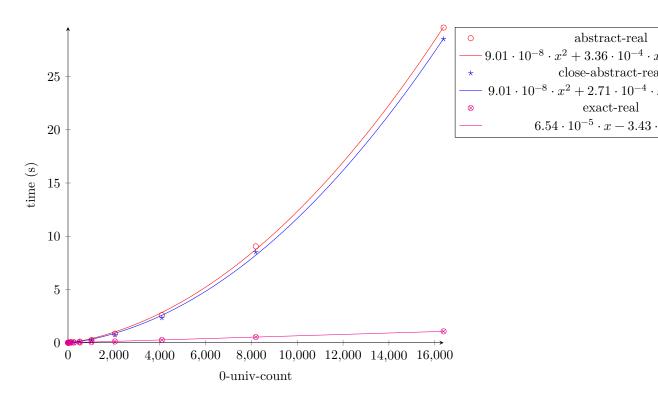
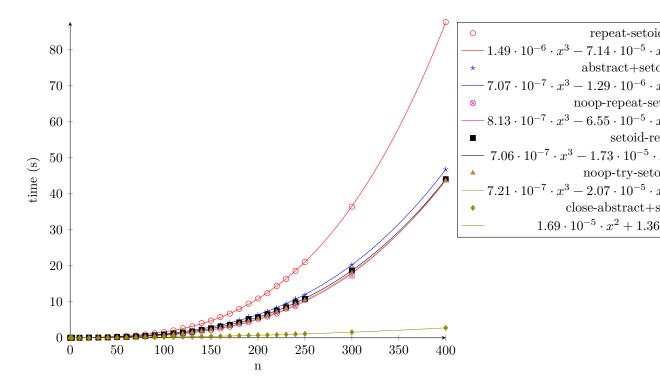


Figure 2: timing-n-polymorphic-universes param-1-n  $\,0\,$ 



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

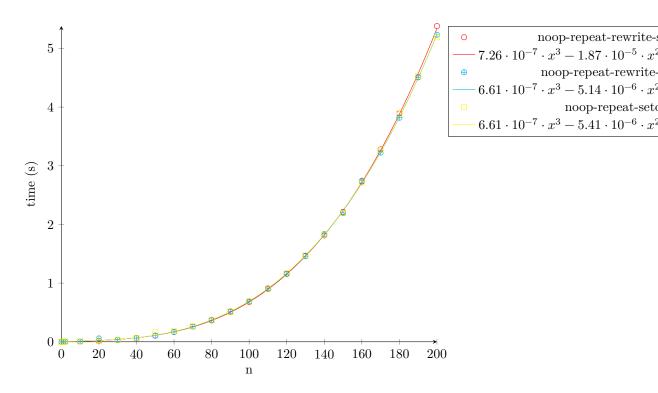
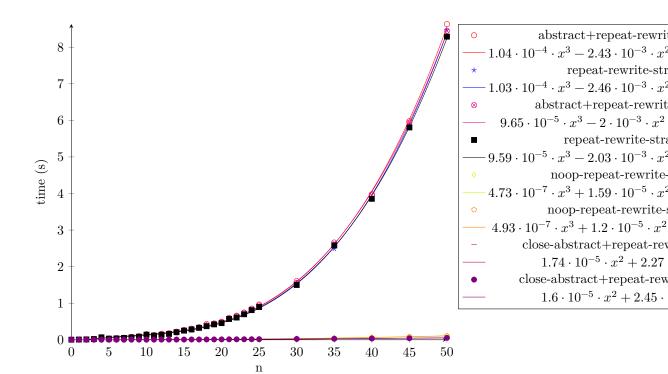
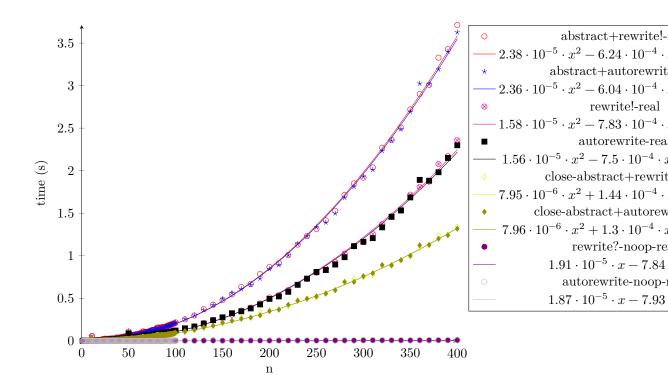


Figure 4: timing-repeat-setoid-rewrite-under-binders-noop



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



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

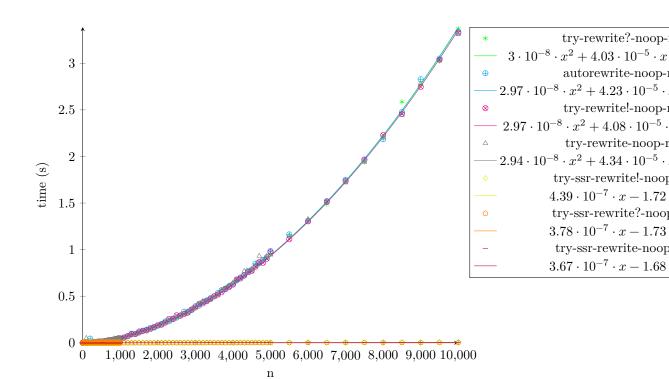
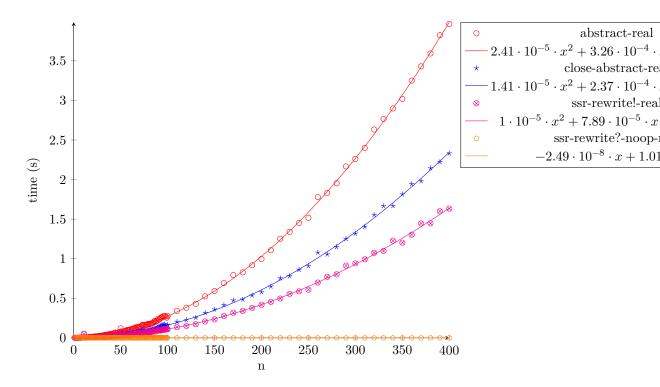
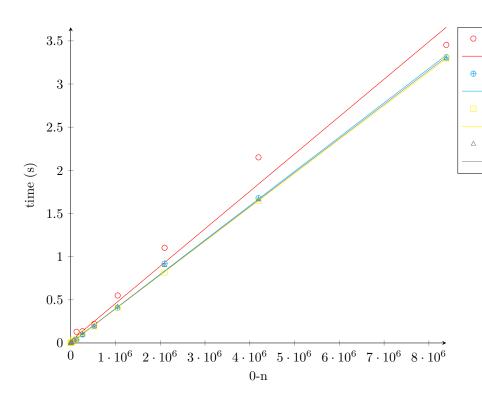


Figure 7: timing-rewrite-repeated-app-autorewrite-noop



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



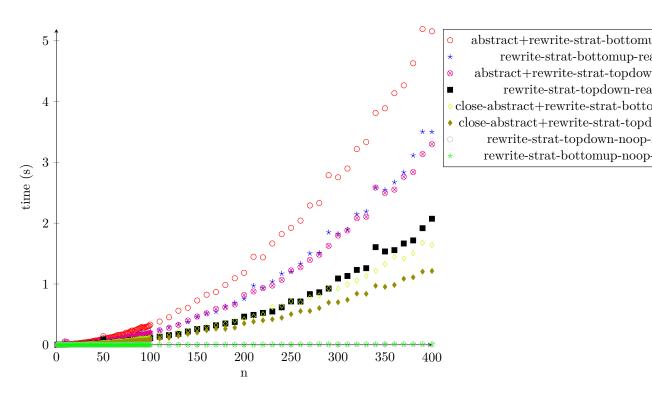
try-ssr-rewrite!-cold-noop-rea

 $4.33\cdot 10^{-7}\cdot x + 2.34\cdot 10^{-2}$  try-ssr-rewrite-noop-real

 $\begin{array}{l} 3.97 \cdot 10^{-7} \cdot x + 1.14 \cdot 10^{-3} \\ \text{try-ssr-rewrite!-noop-real} \\ 3.93 \cdot 10^{-7} \cdot x - 4.24 \cdot 10^{-4} \end{array}$ 

try-ssr-rewrite?-noop-real  $3.95\cdot 10^{-7}\cdot x + 1.35\cdot 10^{-3}$ 

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



rewrite-strat-bottomup-rea

rewrite-strat-topdown-rea

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

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

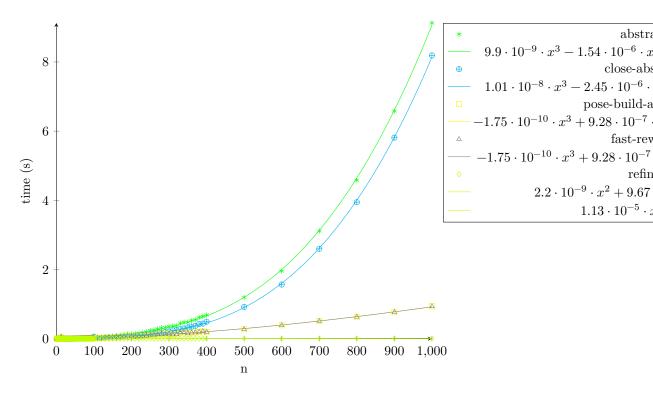


Figure 11: timing-rewrite-repeated-app-fast-rewrite

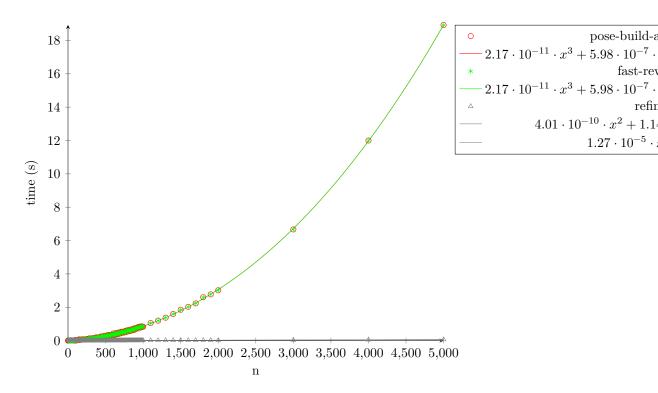


Figure 12: timing-rewrite-repeated-app-fast-rewrite-no-abstract

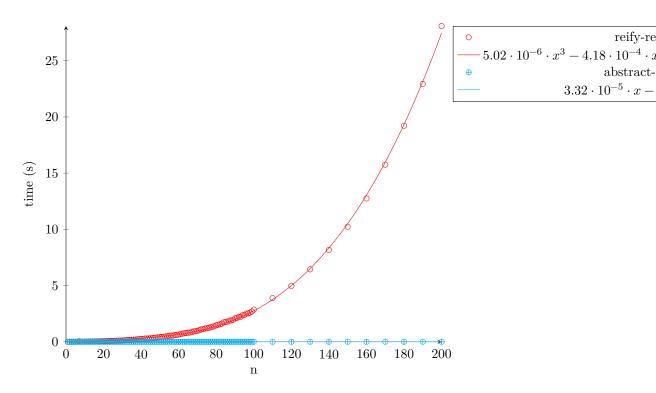


Figure 13: timing-typeclass-reification-let-in-HOAS

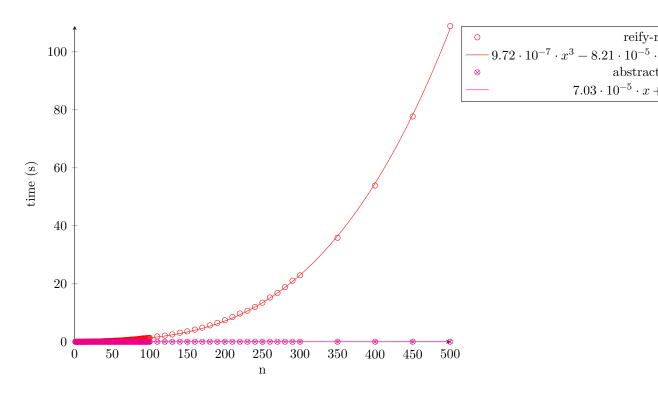
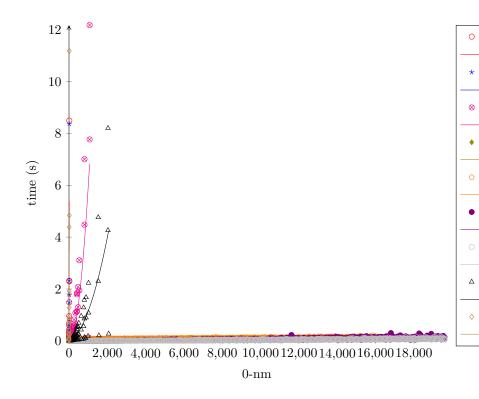


Figure 14: timing-typeclass-reification-let-in-PHOAS



rewrite-strat (topdown-bot  $5.72\cdot 10^{-3}\exp{(0.46\cdot ($  rewrite-strat (bottomup-bot

 $5.98 \cdot 10^{-6} \cdot x^2 - 9.58 \cdot 10^{-5} \cdot$ 

 $1.49 \cdot 10^{-10} \cdot x^2 + 4.53 \cdot 10^{-6} \cdot$ 

 $5.35\cdot 10^{-11}\cdot x^2 + 4.83\cdot 10^{-6}\cdot \\$ 

 $1.96 \cdot 10^{-10} \cdot x^2 + 3.45 \cdot 10^{-6} \cdot$ 

 $9.19 \cdot 10^{-11} \cdot x^2 + 2.75 \cdot 10^{-6}$ 

 $8.48 \cdot 10^{-7} \cdot x^2 + 3.02 \cdot 10^{-4} \cdot x^2$ 

 $-6.54 \cdot 10^{-3} \cdot x^3 + 0.21 \cdot x^2 - \\$ 

 $5.5 \cdot 10^{-3} exp(0.45 \cdot 0.45)$ 

cps+vm-compute-

cps+native-compute

 $\operatorname{cps+lazy-real}$ 

cps+cbv-real

cps+simpl-real

setoid-rewrite-re

cps+cbn-real

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

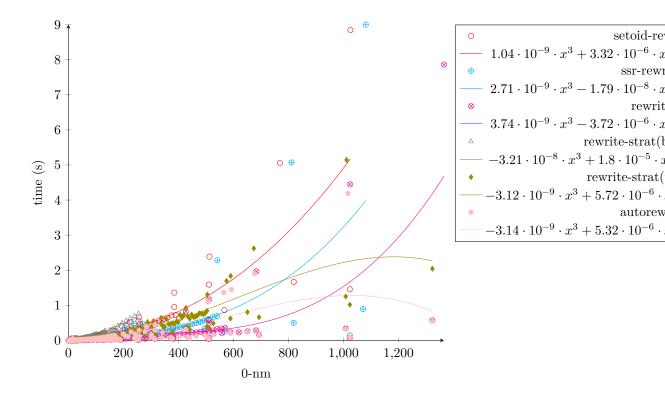
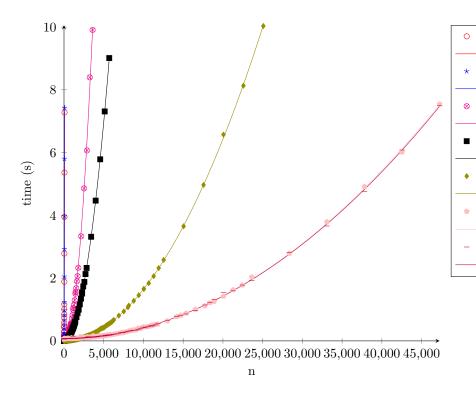


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

vm-com

native-com

native-com

 $2.02 \cdot 10^{-5} \cdot x^3 + 2.01 \cdot 10^{-4} \cdot x^3$ 

 $1.74 \cdot 10^{-5} \cdot x^3 + 2.86 \cdot 10^{-4}$ 

 $8 \cdot 10^{-7} \cdot x^2 - 1.18 \cdot$ 

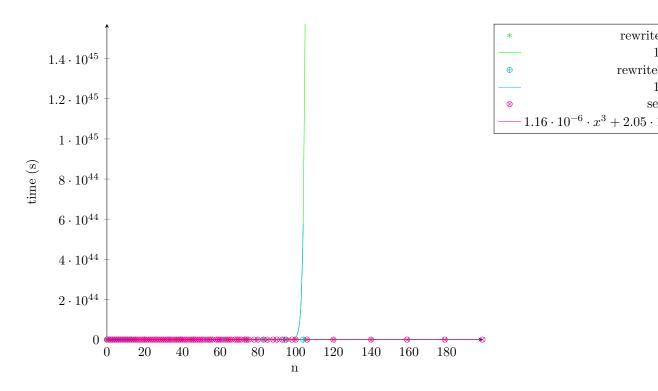
 $2.67 \cdot 10^{-7} \cdot x^2 + 6.08$ 

 $1.57 \cdot 10^{-8} \cdot x^2 + 7.81$ 

 $3.28 \cdot 10^{-9} \cdot x^2 + 2.48$ 

 $3.26 \cdot 10^{-9} \cdot x^2 + 2.45$ 

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



rewrite

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

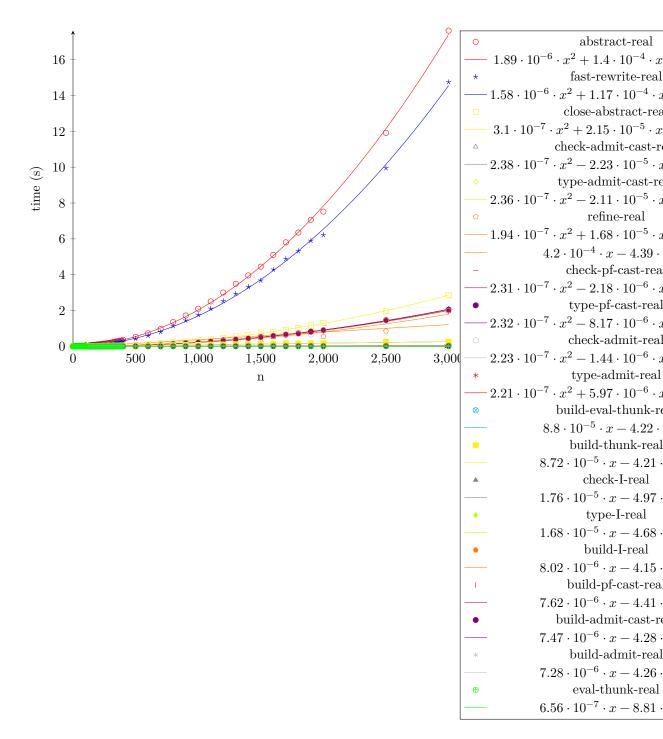


Figure 19: timing-rewrite-repeated-app-fast-rewrite-ltac2