

Figure 1: timing-pattern

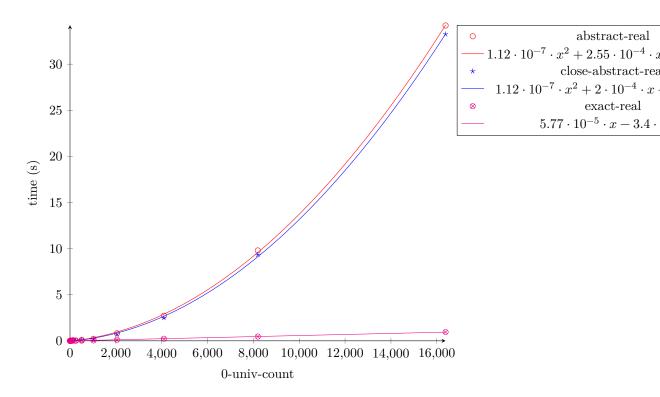
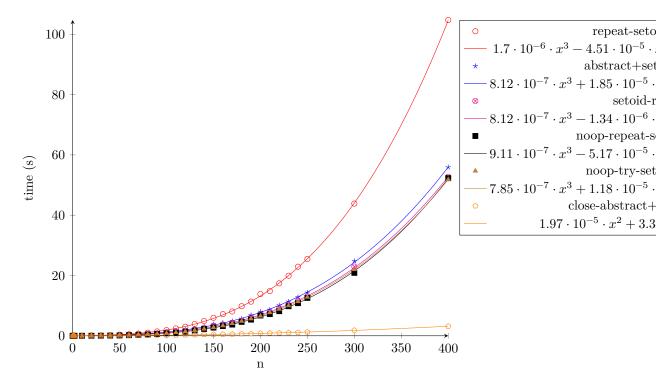
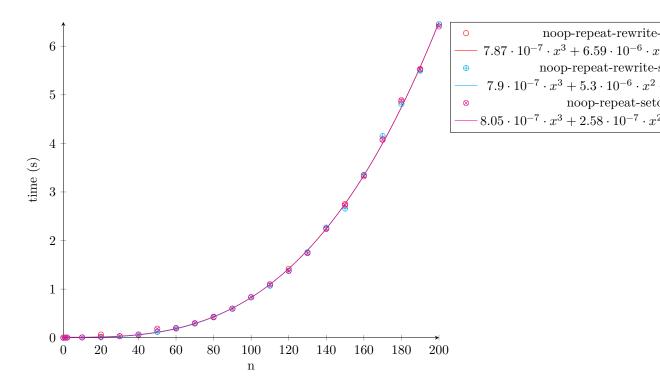


Figure 2: timing-n-polymorphic-universes param-1-n  $\,0\,$ 



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



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

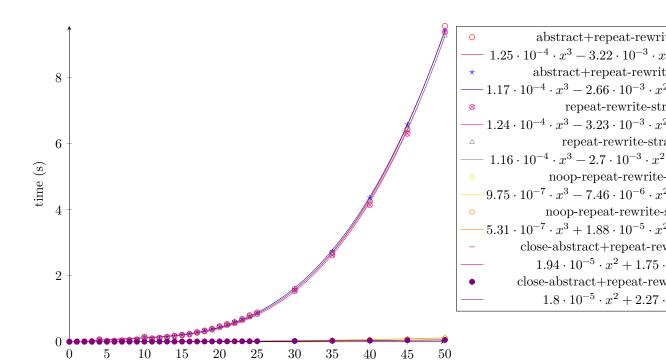
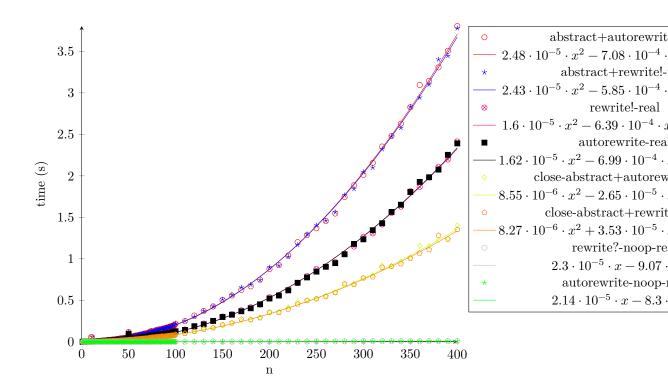
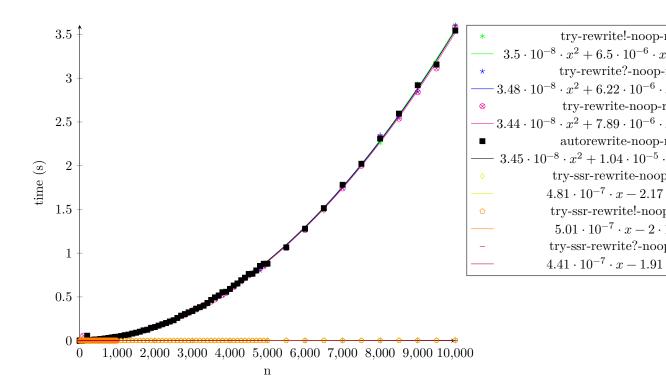


Figure 5: timing-rewrite-strat-under-binders

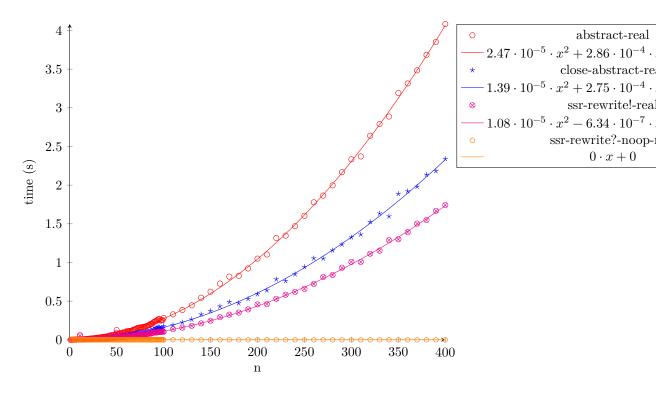
n



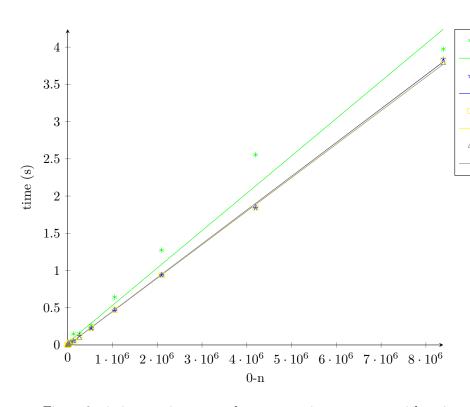
 $Figure \ 6: \ timing-rewrite-repeated-app-autorewrite \\$ 



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



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



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

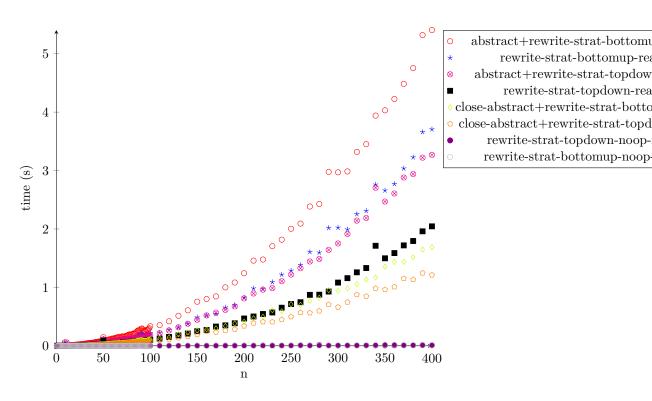
 $5.02 \cdot 10^{-7} \cdot x + 2.89 \cdot 10^{-2}$ try-ssr-rewrite!-noop-real

 $\begin{array}{l} 4.54 \cdot 10^{-7} \cdot x - 2.83 \cdot 10^{-3} \\ \text{try-ssr-rewrite?-noop-real} \end{array}$ 

 $4.53\cdot 10^{-7}\cdot x - 3.75\cdot 10^{-3}$  try-ssr-rewrite-noop-real

 $4.5\cdot 10^{-7}\cdot x - 3.17\cdot 10^{-3}$ 

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-

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

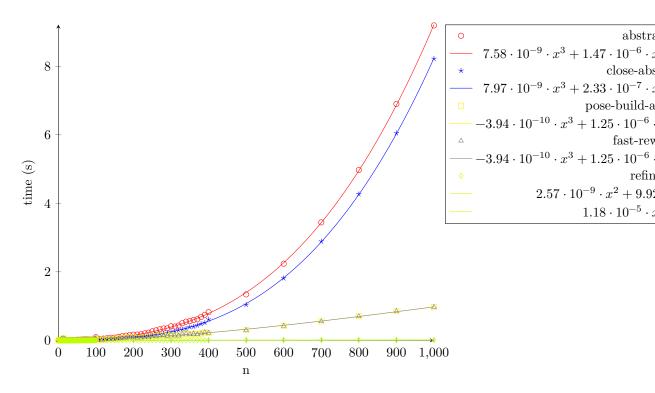


Figure 11: timing-rewrite-repeated-app-fast-rewrite

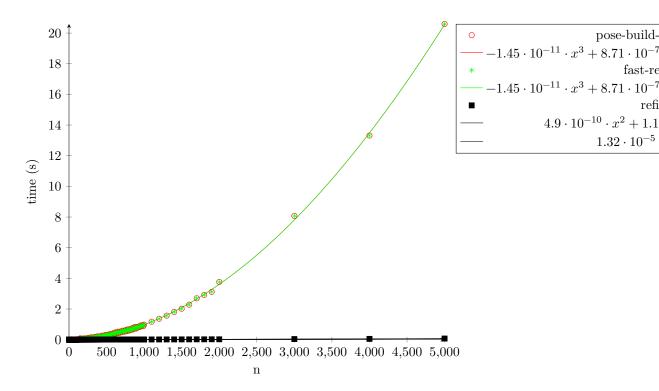


Figure 12: timing-rewrite-repeated-app-fast-rewrite-no-abstract

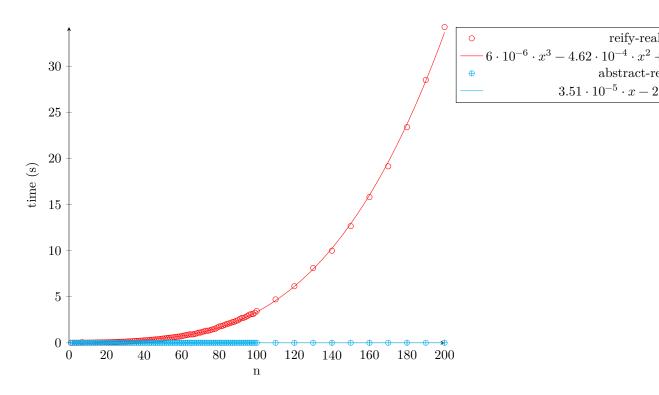
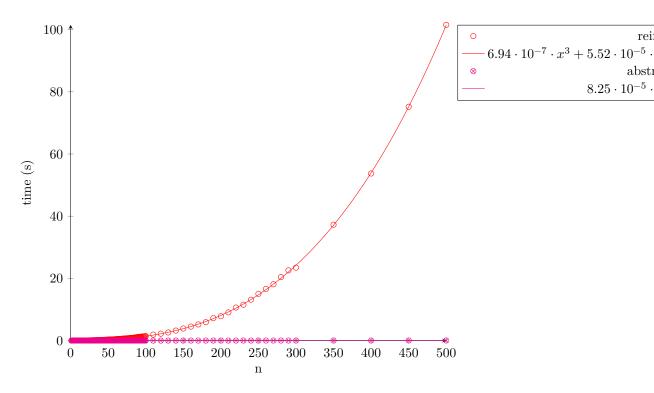
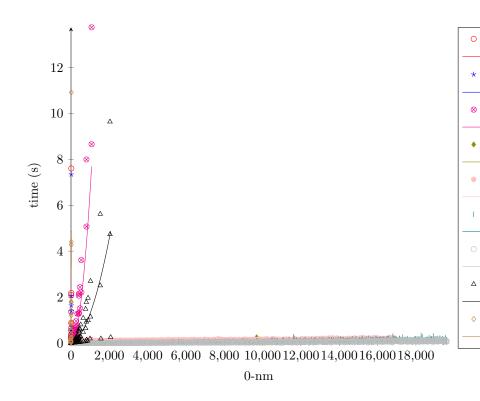


Figure 13: timing-typeclass-reification-let-in-HOAS



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



rewrite-strat(topdown-bot)  $5.2 \cdot 10^{-3} exp(0.46 \cdot (0.46 \cdot$ 

rewrite-strat (bottomup-bot 5.4  $\cdot$  10<sup>-3</sup> exp (0.45  $\cdot$  (0

 $6.58 \cdot 10^{-6} \cdot x^2 + 5.47 \cdot 10^{-5}$ 

 $1.61 \cdot 10^{-10} \cdot x^2 + 5.35 \cdot 10^{-6} \cdot$ 

 $7.94 \cdot 10^{-11} \cdot x^2 + 5.37 \cdot 10^{-6} \cdot$ 

 $2.39 \cdot 10^{-10} \cdot x^2 + 3.66 \cdot 10^{-6} \cdot$ 

 $1.02\cdot 10^{-10}\cdot x^2 + 3.18\cdot 10^{-6}\cdot \\$ 

 $9.84 \cdot 10^{-7} \cdot x^2 + 3.27 \cdot 10^{-4} \cdot x^2$ 

 $-6.28 \cdot 10^{-3} \cdot x^3 + 0.2 \cdot x^2 -$ 

cps+cbn-real

cps+lazy-real

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

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

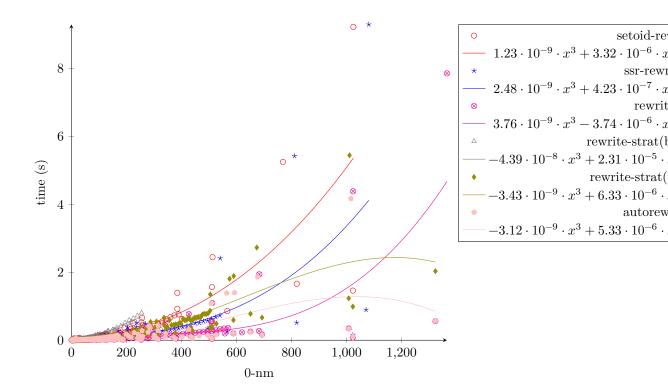
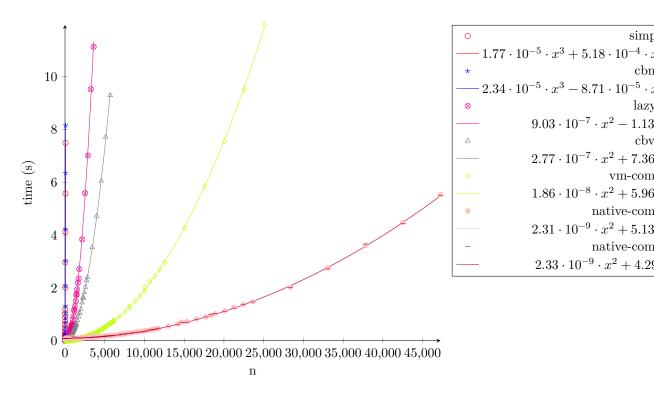


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

vm-com

native-com

native-com

 $9.03 \cdot 10^{-7} \cdot x^2 - 1.13$ 

 $2.77 \cdot 10^{-7} \cdot x^2 + 7.36$ 

 $1.86 \cdot 10^{-8} \cdot x^2 + 5.96$ 

 $2.31 \cdot 10^{-9} \cdot x^2 + 5.13$ 

 $2.33 \cdot 10^{-9} \cdot x^2 + 4.29$ 

Figure 17: timing-sieve-of-eratosthenes

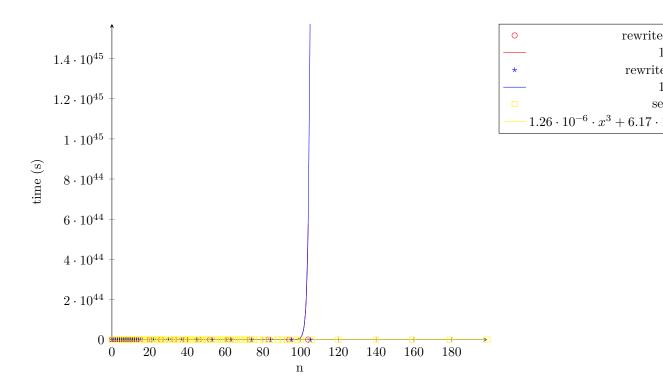


Figure 18: timing-rewrite-under-lets-plus-0  $\,$ 

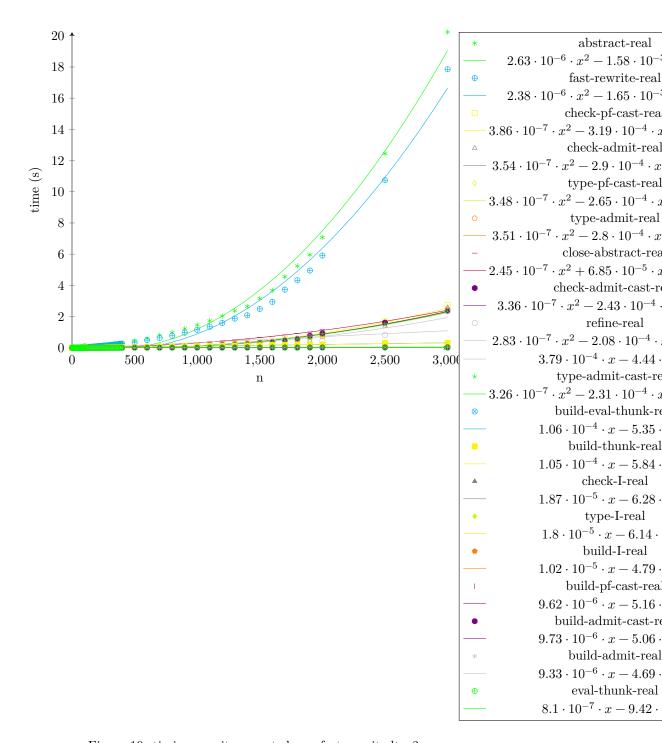


Figure 19: timing-rewrite-repeated-app-fast-rewrite-ltac 2