

Figure 1: timing-pattern

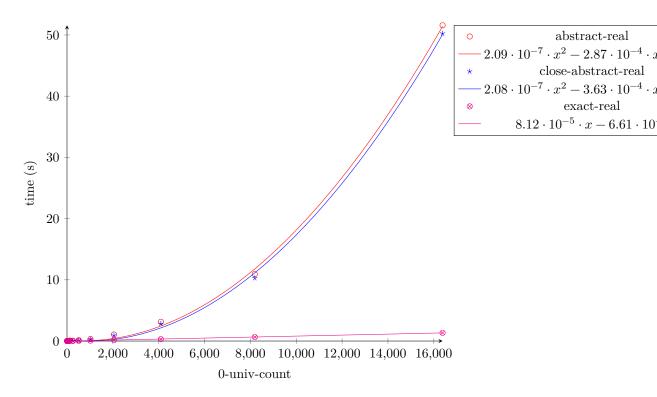
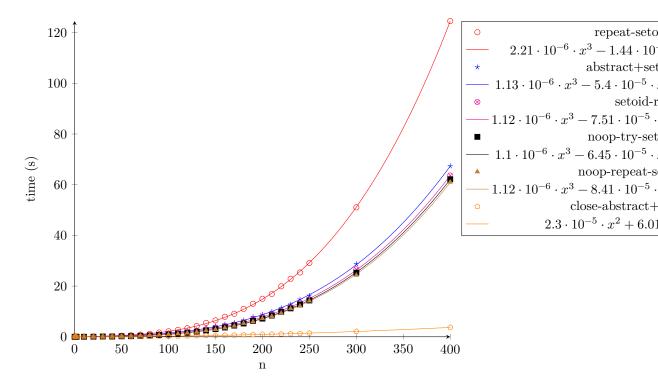


Figure 2: timing-n-polymorphic-universes param-1-n  $\,0\,$ 



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

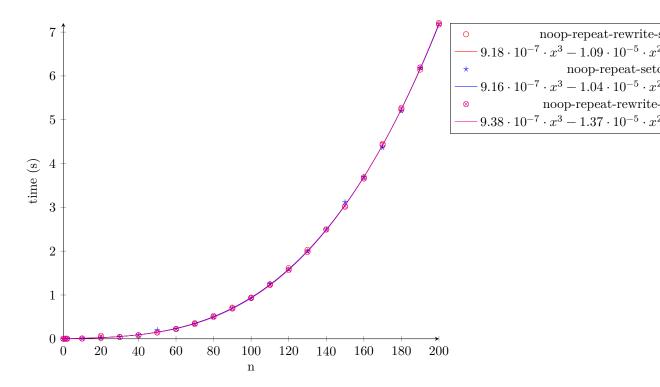
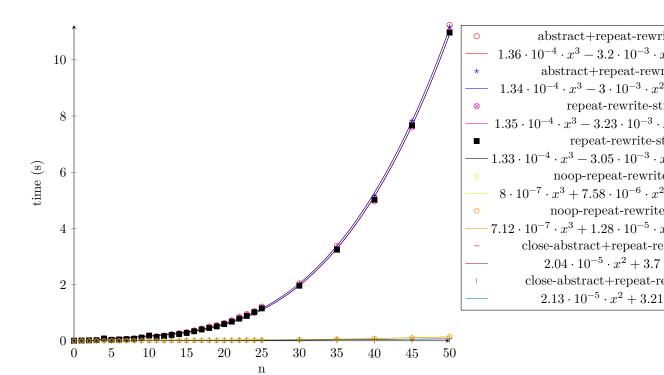
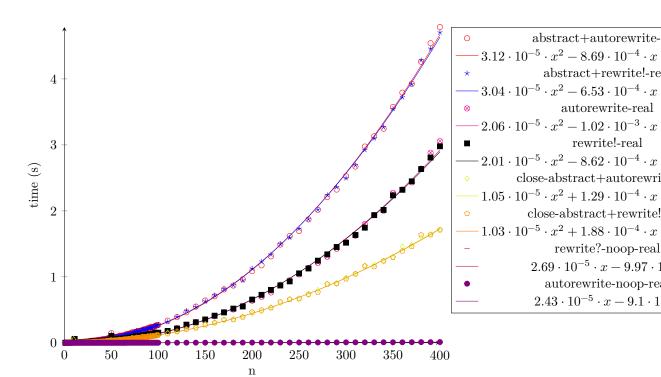


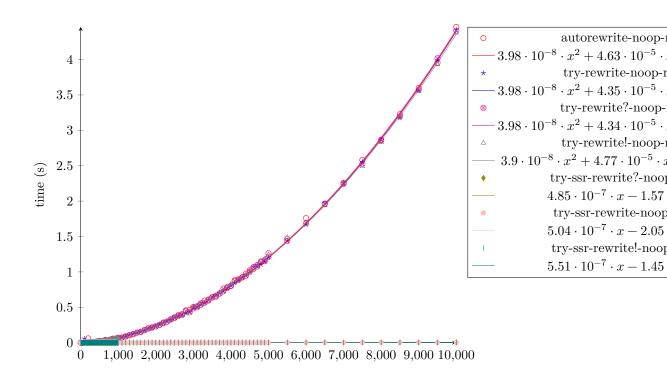
Figure 4: timing-repeat-setoid-rewrite-under-binders-noop



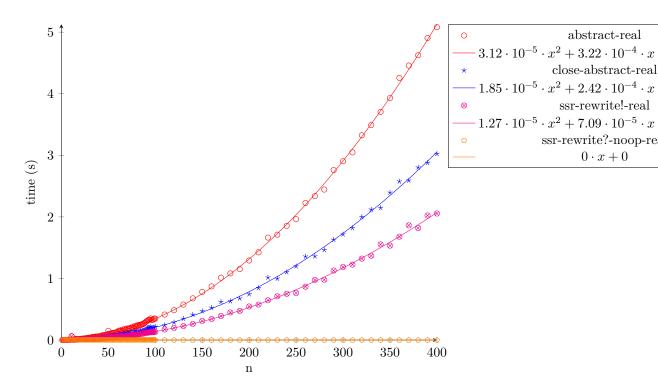
 $Figure\ 5:\ timing-rewrite-strat-under-binders$ 



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



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



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

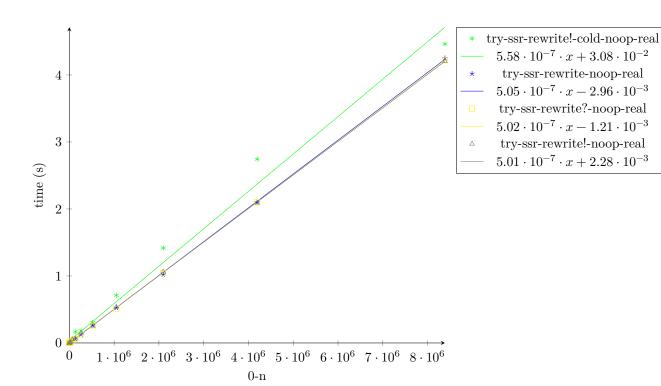
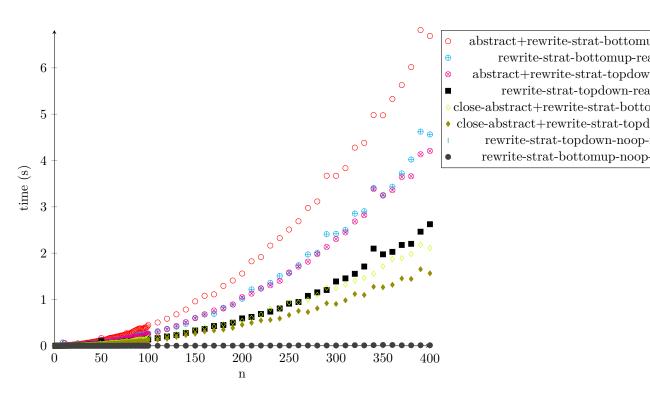


Figure 9: timing-rewrite-repeated-app-ssrrewrite-noop param-1-lgn  $\ 1$ 

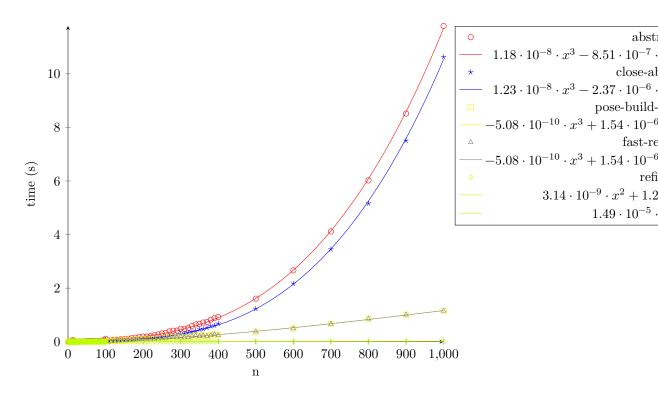


rewrite-strat-bottomup-rea

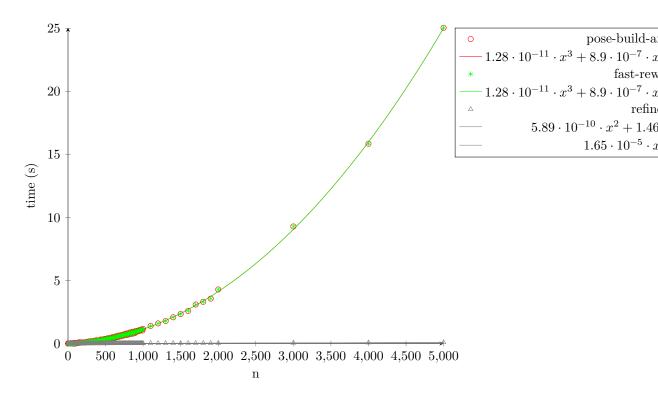
abstract + rewrite - strat - topdowrewrite-strat-topdown-rea

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

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



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



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

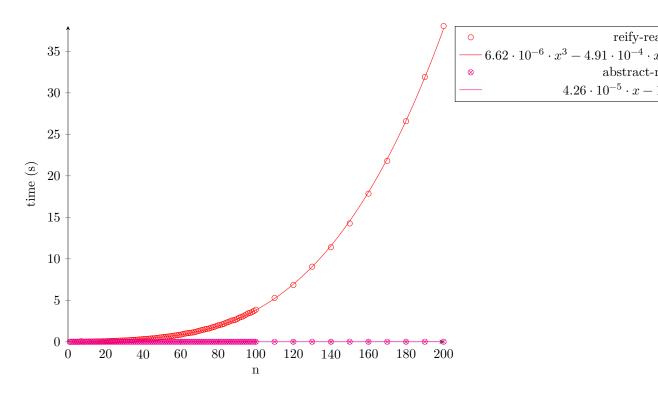


Figure 13: timing-typeclass-reification-let-in-HOAS

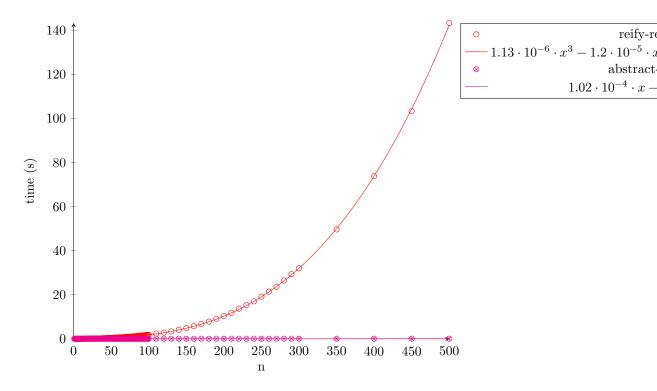
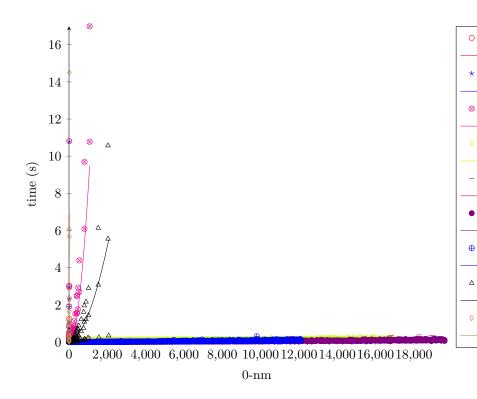


Figure 14: timing-typeclass-reification-let-in-PHOAS



rewrite-strat (top down-bot)

 $8.33\cdot 10^{-6}\cdot x^2 - 1.59\cdot 10^{-4}\cdot x^2 - 1.59\cdot 10^{-4}\cdot x^2 + 1.59\cdot 1$ 

 $9.55 \cdot 10^{-11} \cdot x^2 + 5.7 \cdot 10^{-6} \cdot x^$ 

 $2.49 \cdot 10^{-10} \cdot x^2 + 4.49 \cdot 10^{-6} \cdot$ 

 $1.08 \cdot 10^{-10} \cdot x^2 + 3.82 \cdot 10^{-6}$ 

 $1.87 \cdot 10^{-10} \cdot x^2 + 6.43 \cdot 10^{-6} \cdot$ 

 $1.1 \cdot 10^{-6} \cdot x^2 + 3.94 \cdot 10^{-4} \cdot x^2$ 

 $-8.42 \cdot 10^{-3} \cdot x^3 + 0.27 \cdot x^2 -$ 

 $7.26\cdot 10^{-3}\exp{(0.46\cdot ($  rewrite-strat(bottomup-bot

 $5.05 \cdot 10^{-3} \exp{(0.48 \cdot ($ 

cps+native-compute

cps+cbn-real

cps+lazy-real

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

cps+simpl-real

setoid-rewrite-re

cps+vm-compute-

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

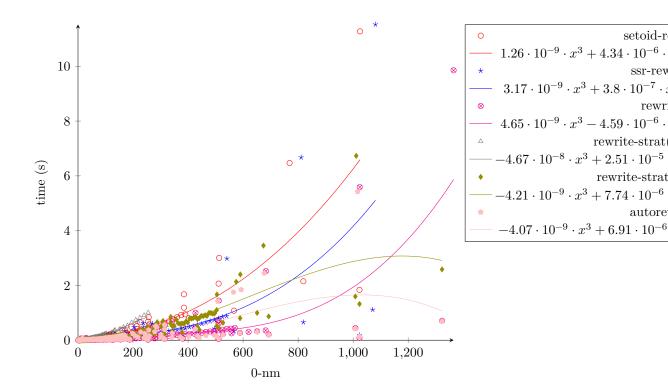
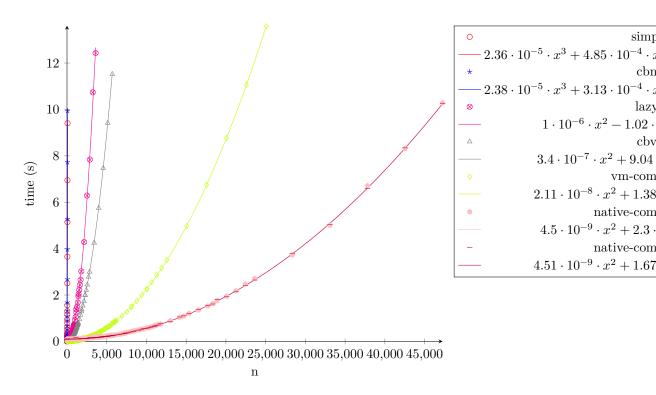


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

vm-com

native-com

native-com

 $1 \cdot 10^{-6} \cdot x^2 - 1.02 \cdot$ 

 $3.4 \cdot 10^{-7} \cdot x^2 + 9.04$ 

 $2.11 \cdot 10^{-8} \cdot x^2 + 1.38$ 

 $4.5 \cdot 10^{-9} \cdot x^2 + 2.3 \cdot$ 

 $4.51 \cdot 10^{-9} \cdot x^2 + 1.67$ 

Figure 17: timing-sieve-of-eratosthenes

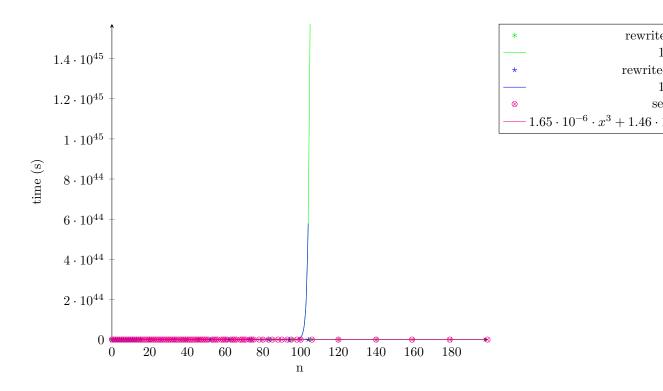


Figure 18: timing-rewrite-under-lets-plus-0  $\,$ 

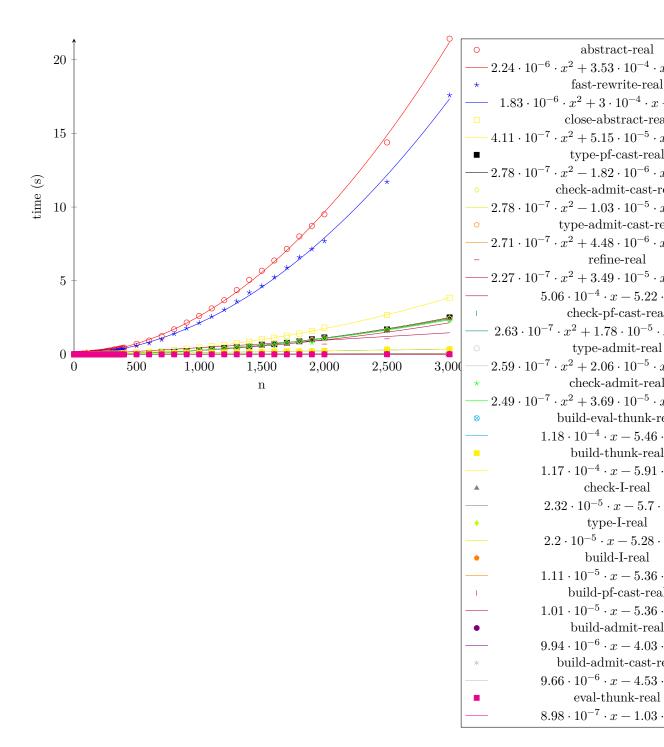


Figure 19: timing-rewrite-repeated-app-fast-rewrite-ltac2