

Figure 1: timing-pattern

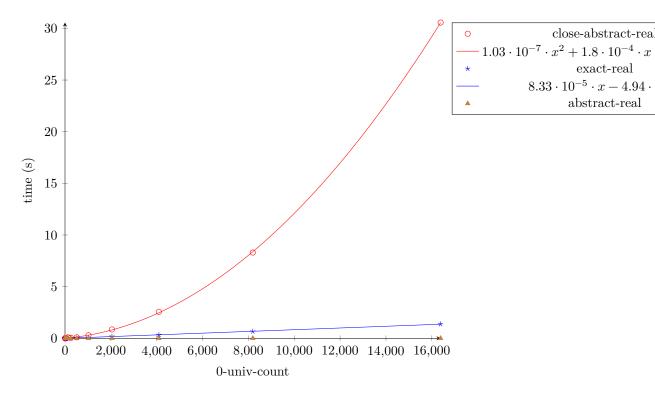
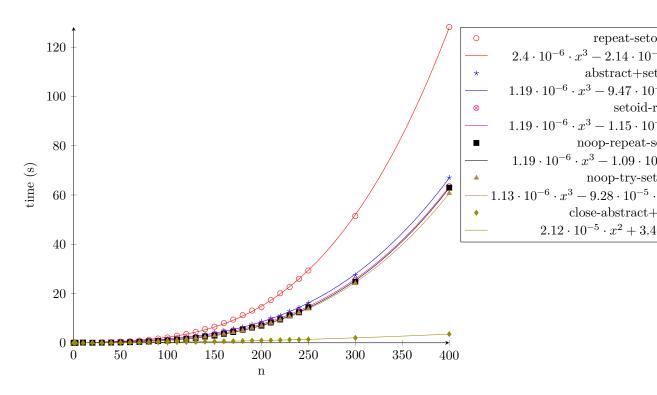
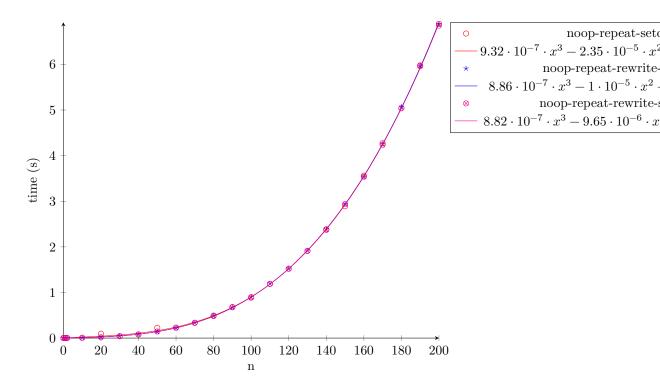


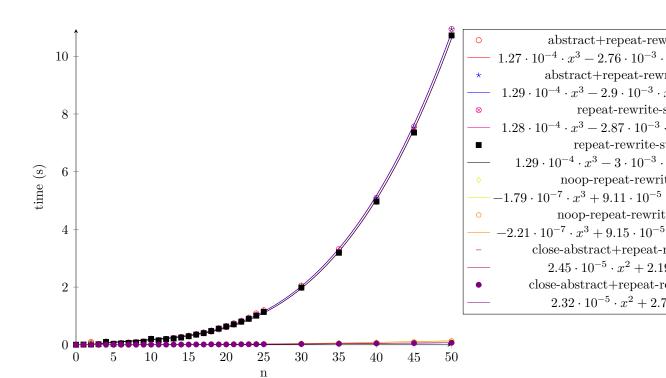
Figure 2: timing-n-polymorphic-universes param-1-n  $\,0\,$ 



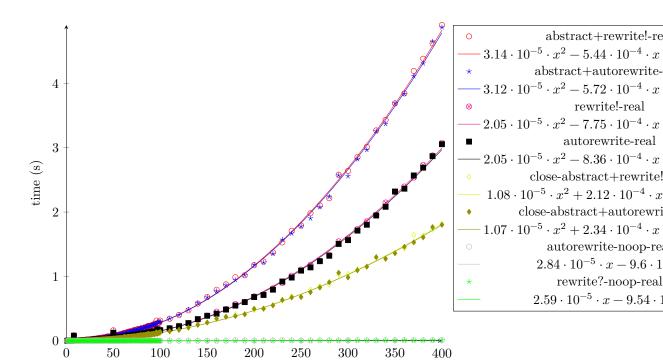
 $Figure \ 3: \ timing-repeat-setoid-rewrite-under-binders$ 



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

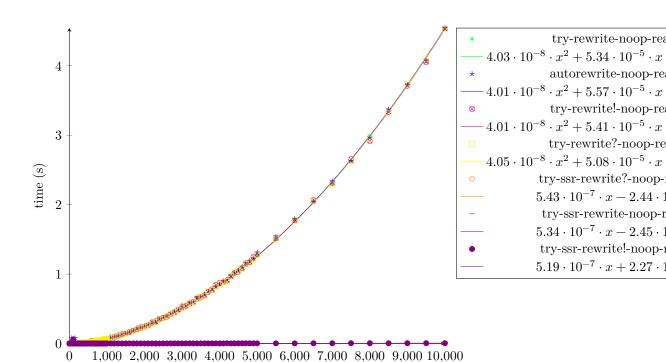


 $Figure\ 5:\ timing-rewrite-strat-under-binders$ 



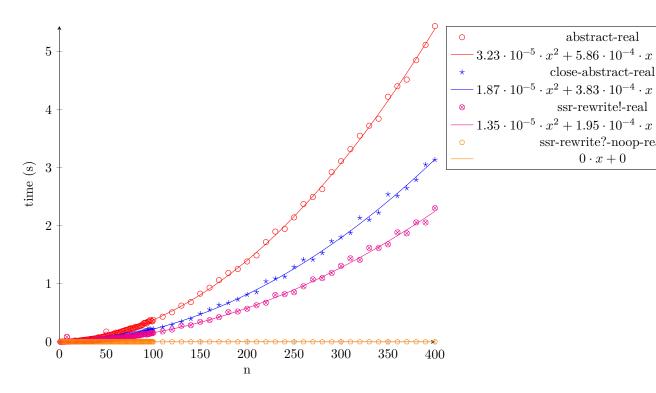
 $Figure \ 6: \ timing-rewrite-repeated-app-autorewrite \\$ 

n



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

n



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

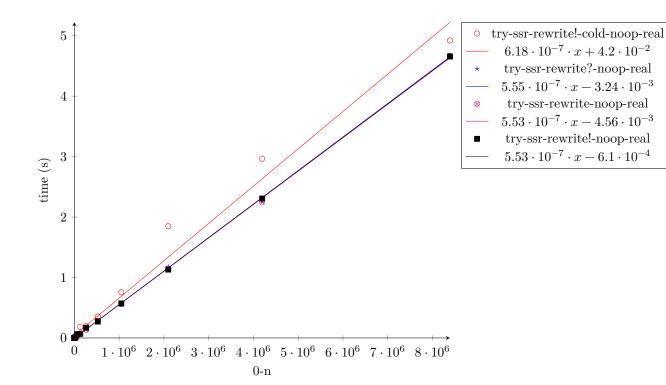
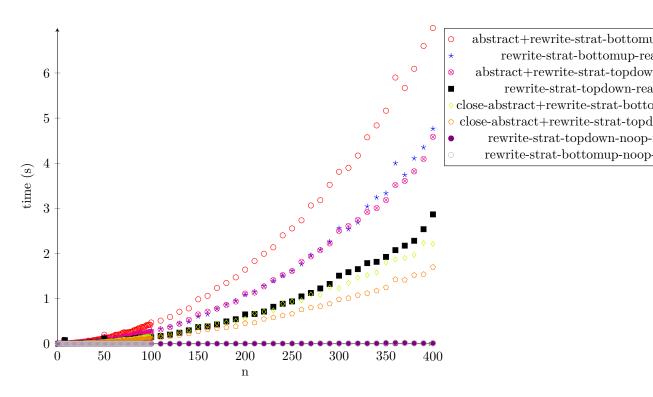


Figure 9: timing-rewrite-repeated-app-ssrrewrite-noop param-1-lgn  $\ 1$ 

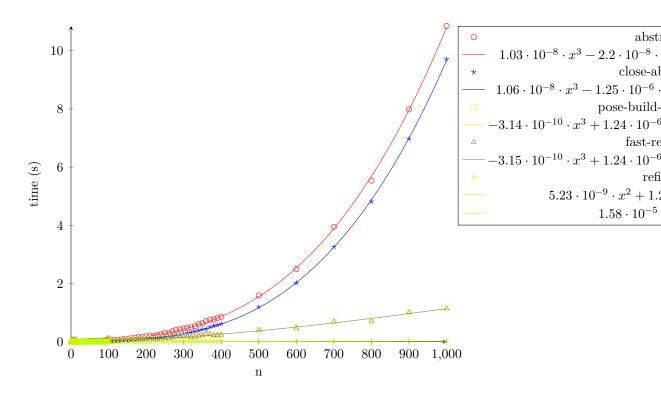


rewrite-strat-bottomup-rea

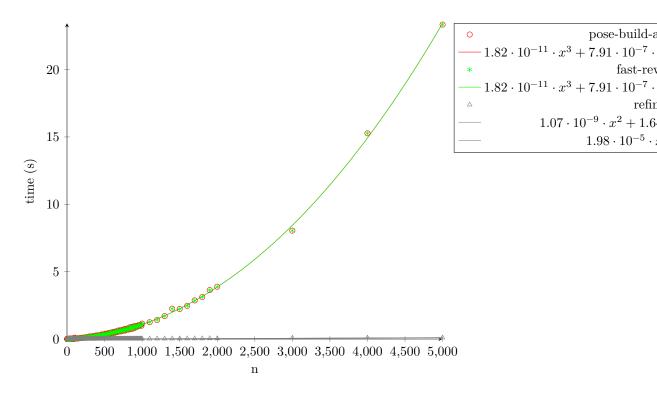
rewrite-strat-topdown-rea

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

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



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



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

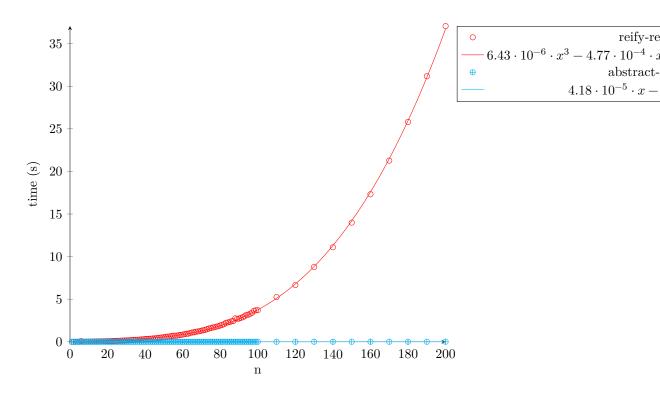


Figure 13: timing-typeclass-reification-let-in-HOAS

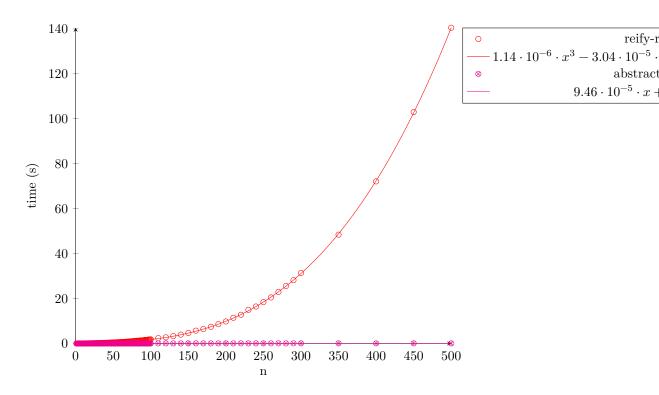
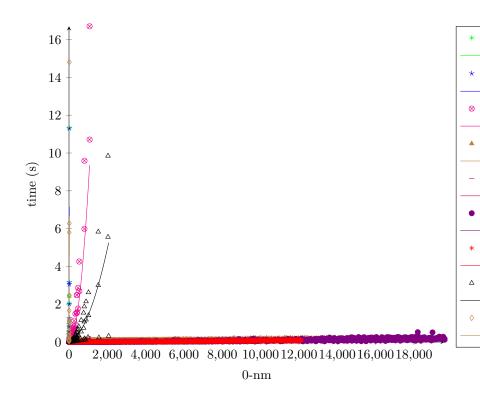


Figure 14: timing-typeclass-reification-let-in-PHOAS



rewrite-strat(bottomup-bot

 $8.23\cdot 10^{-6}\cdot x^2 - 1.68\cdot 10^{-4}\cdot x^2 + 1.68\cdot 1$ 

 $8.83 \cdot 10^{-11} \cdot x^2 + 6.45 \cdot 10^{-6} \cdot$ 

 $1.42 \cdot 10^{-10} \cdot x^2 + 4.18 \cdot 10^{-6}$ 

 $2.86\cdot 10^{-10}\cdot x^2 + 5.36\cdot 10^{-6}\cdot$ 

 $2.12\cdot 10^{-10}\cdot x^2 + 5.48\cdot 10^{-6}\cdot \\$ 

 $1.05 \cdot 10^{-6} \cdot x^2 + 3.81 \cdot 10^{-4} \cdot x^2 + 3.81 \cdot 10^{-4}$ 

 $-8.63 \cdot 10^{-3} \cdot x^3 + 0.28 \cdot x^2 -$ 

 $5.96\cdot 10^{-3} \exp{(0.47\cdot ($ rewrite-strat(topdown-both

 $8.06 \cdot 10^{-3} \exp{(0.45 \cdot ($ 

cps+native-compute

cps+cbn-real

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

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

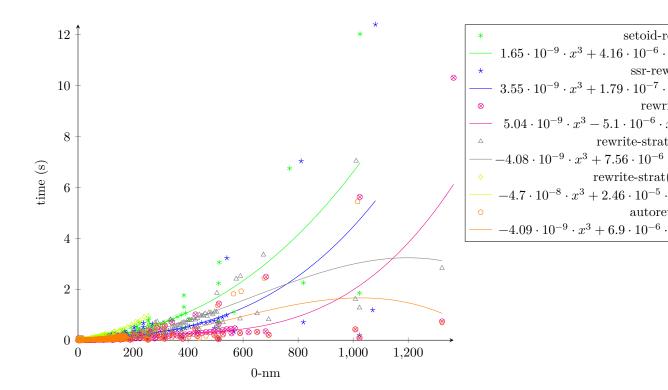
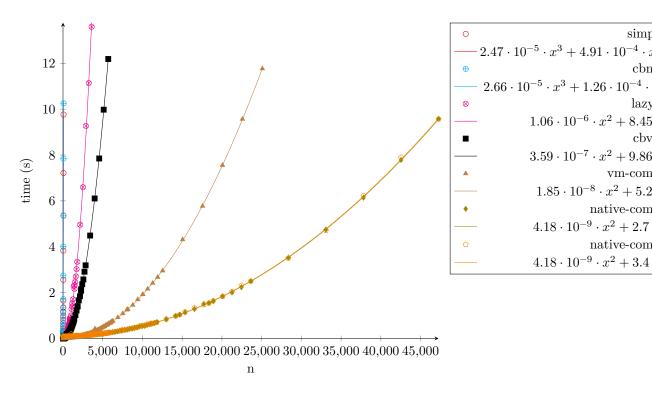


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

lazy

vm-com

native-com

native-com

 $1.06 \cdot 10^{-6} \cdot x^2 + 8.45$ 

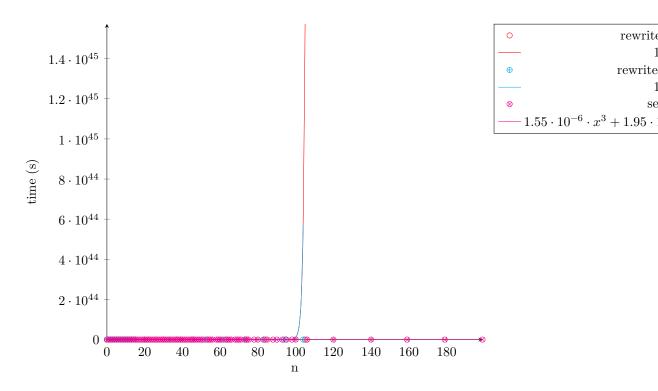
 $3.59 \cdot 10^{-7} \cdot x^2 + 9.86$ 

 $1.85 \cdot 10^{-8} \cdot x^2 + 5.2$ 

 $4.18\cdot 10^{-9}\cdot x^2 + 2.7$ 

 $4.18\cdot 10^{-9}\cdot x^2 + 3.4$ 

 $Figure\ 17:\ timing\mbox{-sieve-of-eratos} thenes$ 



rewrite

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