

Figure 1: timing-pattern

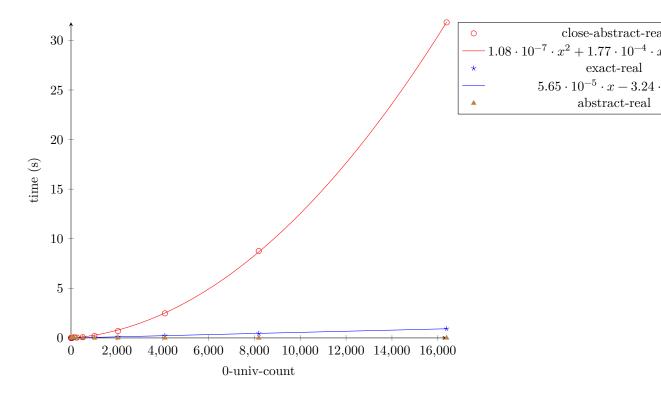
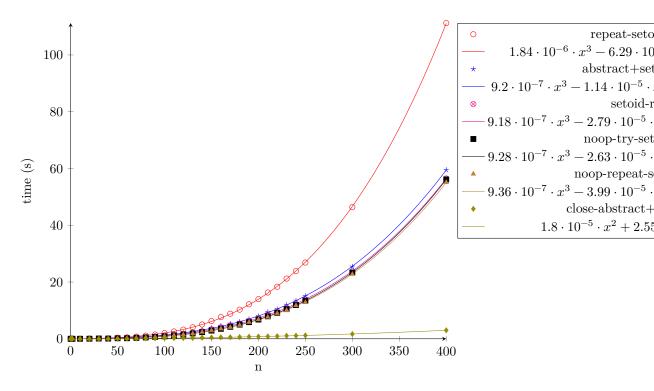
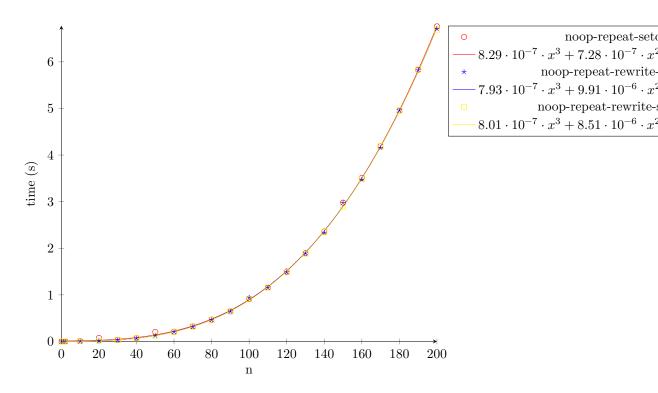


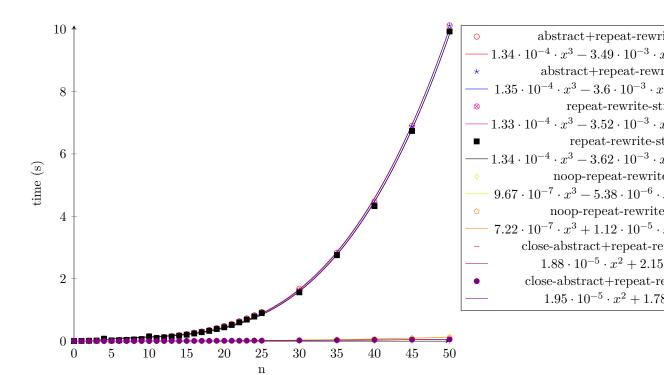
Figure 2: timing-n-polymorphic-universes param-1-n 0



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



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



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

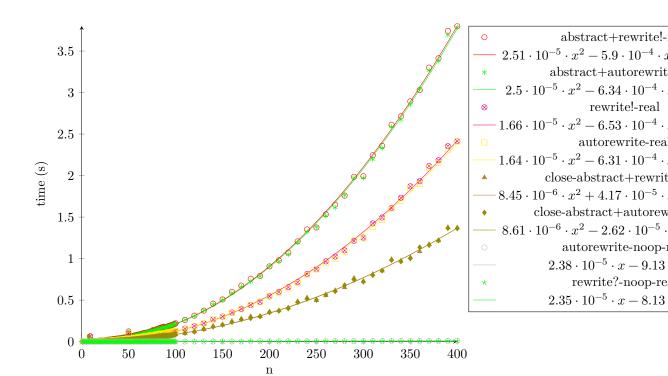
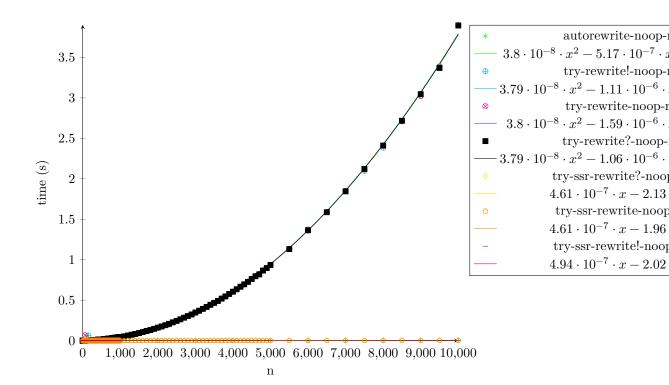
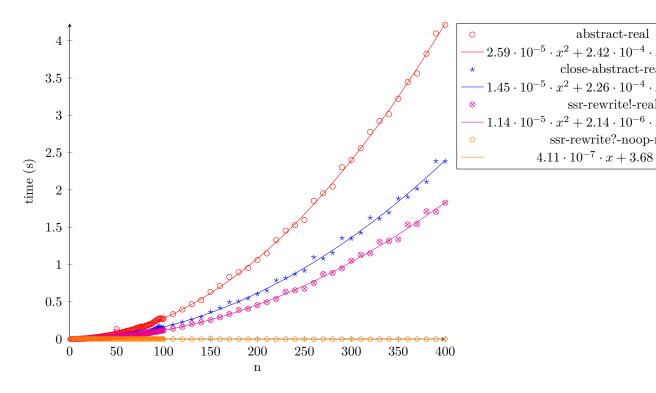


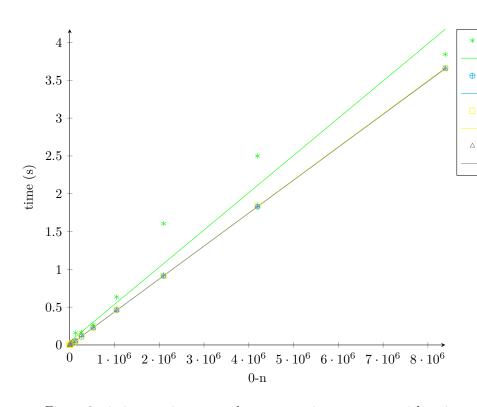
Figure 6: timing-rewrite-repeated-app-autorewrite



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



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



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

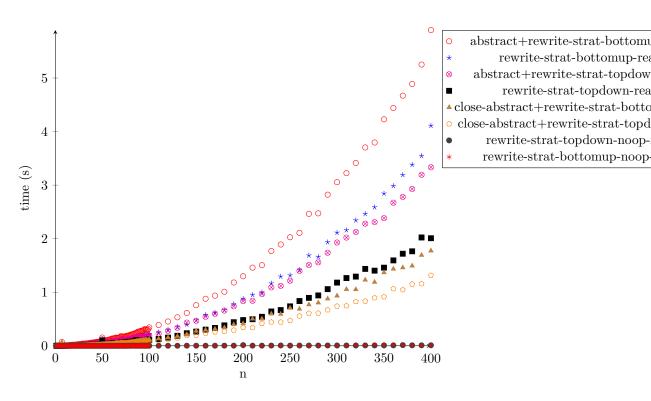
 $\begin{array}{l} 4.93 \cdot 10^{-7} \cdot x + 4.37 \cdot 10^{-2} \\ \text{try-ssr-rewrite?-noop-real} \end{array}$ 

 $\begin{array}{l} 4.36 \cdot 10^{-7} \cdot x - 9.98 \cdot 10^{-4} \\ \text{try-ssr-rewrite-noop-real} \end{array}$ 

 $\begin{array}{l} 4.37 \cdot 10^{-7} \cdot x - 2.64 \cdot 10^{-4} \\ \text{try-ssr-rewrite!-noop-real} \end{array}$ 

 $4.35\cdot 10^{-7}\cdot x + 1.67\cdot 10^{-3}$ 

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

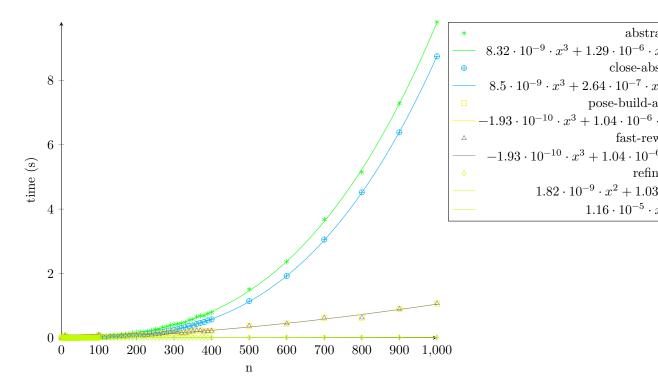


rewrite-strat-bottomup-realabstract + rewrite - strat - topdow

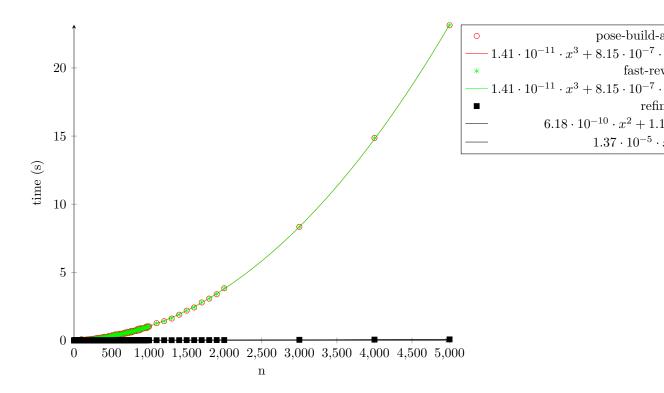
rewrite-strat-topdown-rea

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

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



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



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

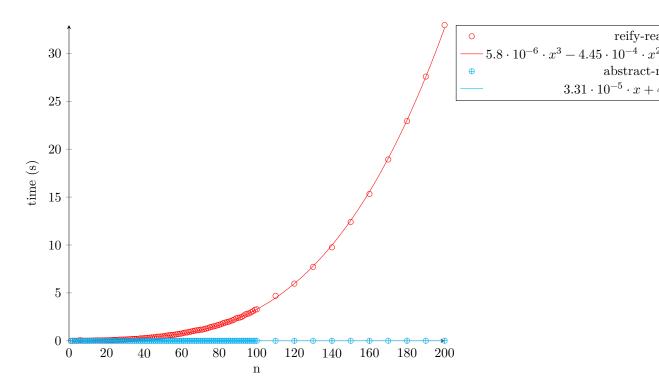
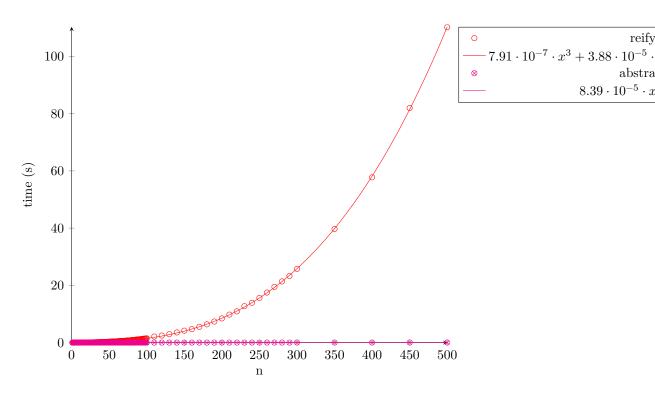
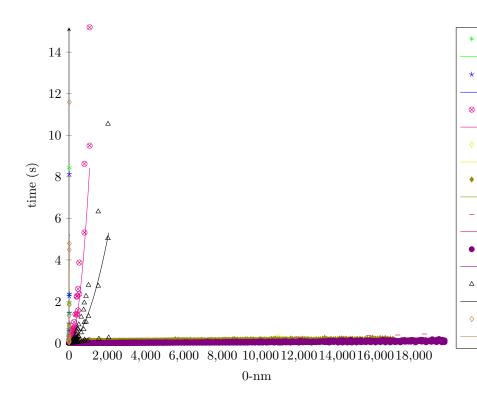


Figure 13: timing-typeclass-reification-let-in-HOAS



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



rewrite-strat(bottomup-bot

 $7.4 \cdot 10^{-6} \cdot x^2 - 1.47 \cdot 10^{-4} \cdot x^2$ 

 $1.25\cdot 10^{-10}\cdot x^2 + 5.26\cdot 10^{-6}\cdot$ 

 $4.7 \cdot 10^{-11} \cdot x^2 + 5.81 \cdot 10^{-6} \cdot x^2$ 

 $2.12\cdot 10^{-10}\cdot x^2 + 4.66\cdot 10^{-6}\cdot \\$ 

 $1.14\cdot 10^{-10}\cdot x^2 + 3.38\cdot 10^{-6}\cdot \\$ 

 $1.06 \cdot 10^{-6} \cdot x^2 + 3.72 \cdot 10^{-4} \cdot x^2$ 

 $-6.68 \cdot 10^{-3} \cdot x^3 + 0.21 \cdot x^2 -$ 

 $5.16\cdot 10^{-3}\exp{(0.46\cdot ($  rewrite-strat(top down-bott  $5.48\cdot 10^{-3}\exp{(0.46\cdot (}$ 

cps+cbn-real

cps+lazy-real

cps+cbv-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

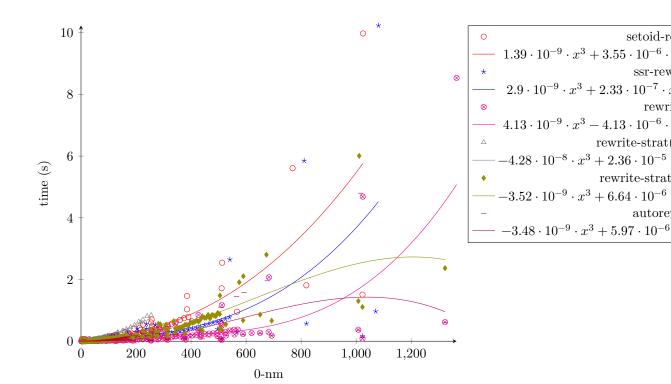
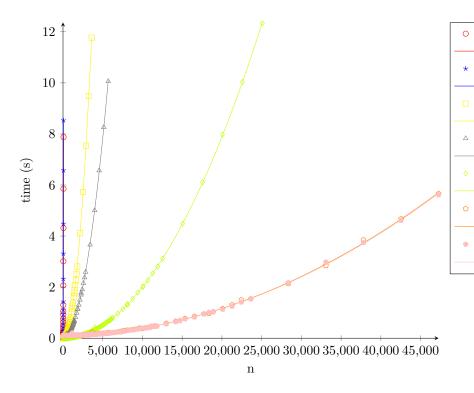


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

vm-com

native-comp

native-comp

 $+2.07 \cdot 10^{-5} \cdot x^3 + 3.47 \cdot 10^{-4} \cdot x^3$ 

 $2.18 \cdot 10^{-5} \cdot x^3 + 1.27 \cdot 10^{-4} \cdot$ 

 $9.29 \cdot 10^{-7} \cdot x^2 - 8.27$ 

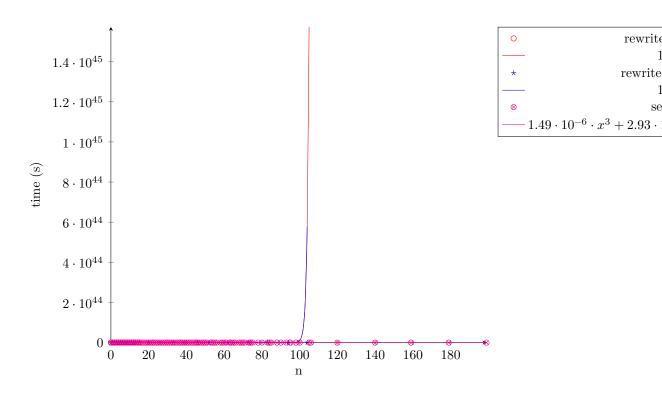
 $3.01 \cdot 10^{-7} \cdot x^2 + 6.2 \cdot$ 

 $1.94 \cdot 10^{-8} \cdot x^2 + 5.94$ 

 $2.39 \cdot 10^{-9} \cdot x^2 + 5.89$ 

 $2.38 \cdot 10^{-9} \cdot x^2 + 5.59$ 

Figure 17: timing-sieve-of-eratosthenes



rewrite

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