

Figure 1: timing-pattern

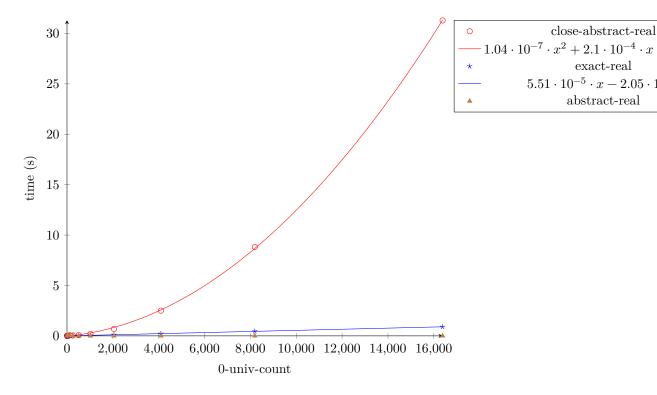
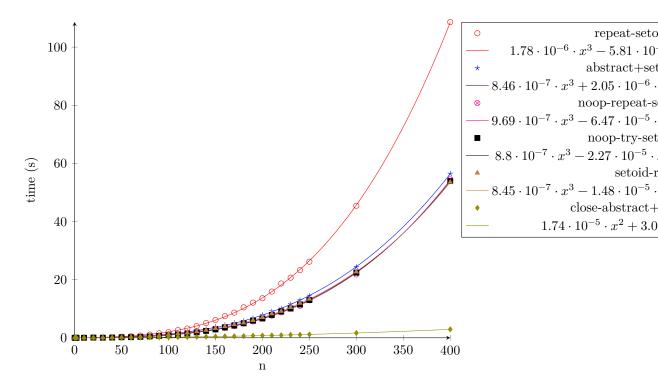


Figure 2: timing-n-polymorphic-universes param-1-n 0



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

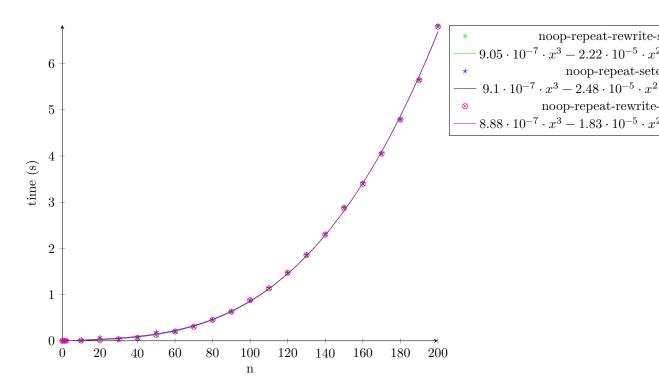
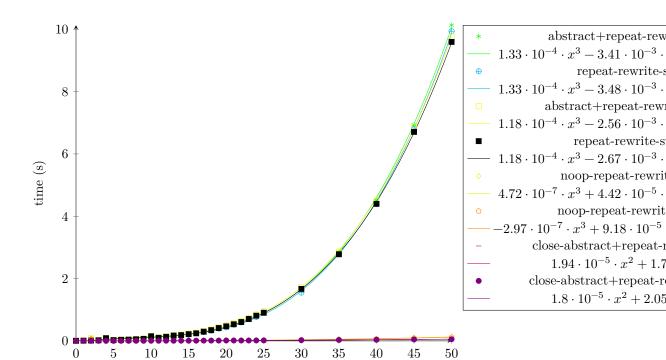
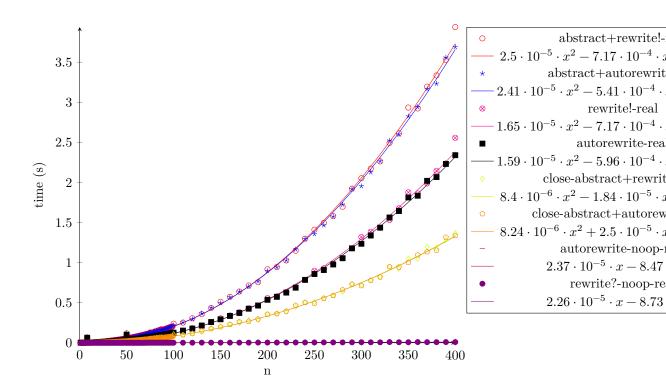


Figure 4: timing-repeat-setoid-rewrite-under-binders-noop

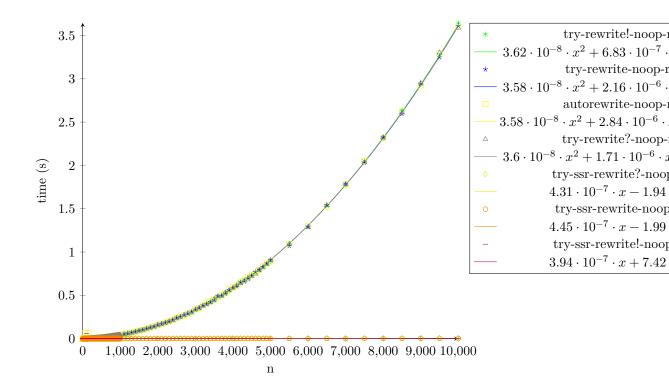


 $Figure \ 5: \ timing-rewrite-strat-under-binders$ 

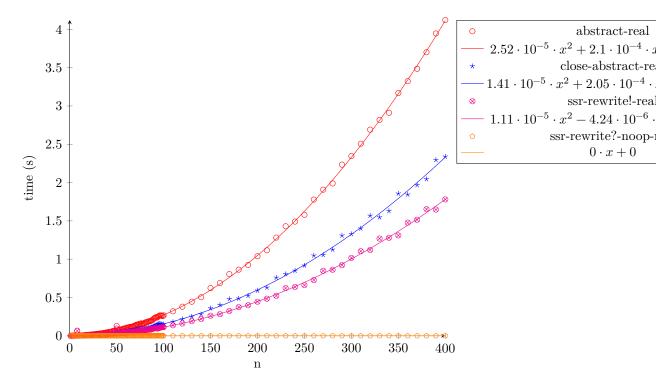
 $\mathbf{n}$ 



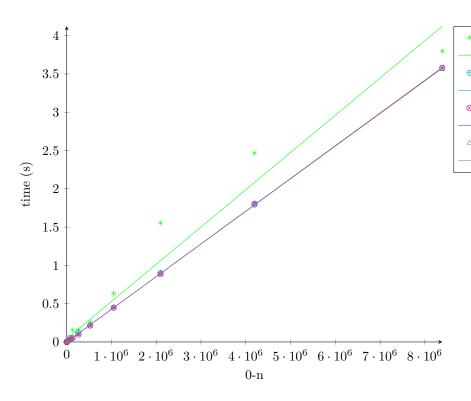
 $Figure \ 6: \ timing-rewrite-repeated-app-autorewrite \\$ 



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



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



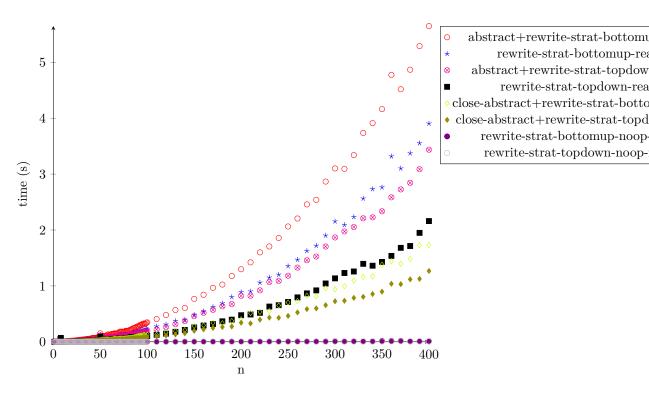
try-ssr-rewrite!-cold-noop-rea  $4.87\cdot 10^{-7}\cdot x + 4.15\cdot 10^{-2}$  try-ssr-rewrite!-noop-real

 $\begin{array}{l} 4.27\cdot 10^{-7}\cdot x + 1.24\cdot 10^{-3}\\ \text{try-ssr-rewrite?-noop-real} \end{array}$ 

 $\begin{array}{l} 4.27 \cdot 10^{-7} \cdot x - 1.64 \cdot 10^{-3} \\ \text{try-ssr-rewrite-noop-real} \end{array}$ 

 $4.26\cdot 10^{-7}\cdot x - 4.19\cdot 10^{-4}$ 

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

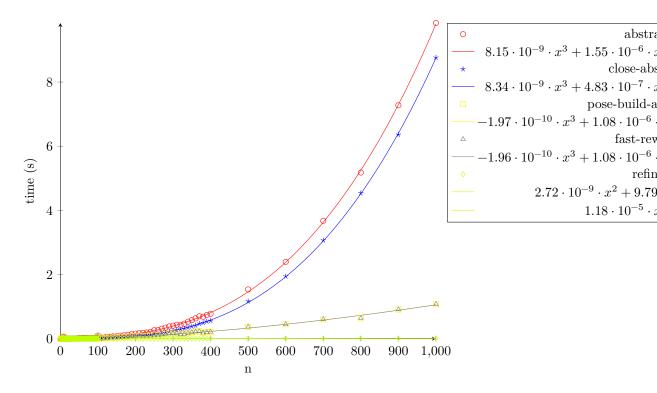


 $abstract + rewrite - strat - bottom \\ \\$ rewrite-strat-bottomup-rea

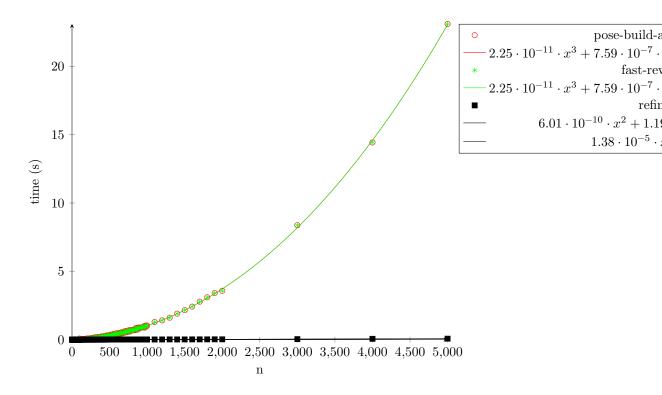
abstract + rewrite - strat - topdowrewrite-strat-topdown-rea

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

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



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



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

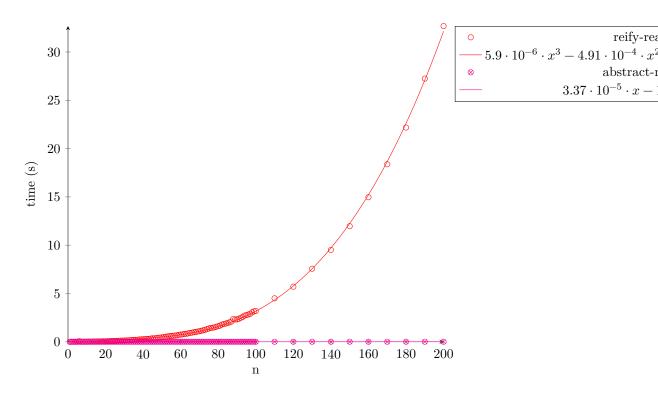
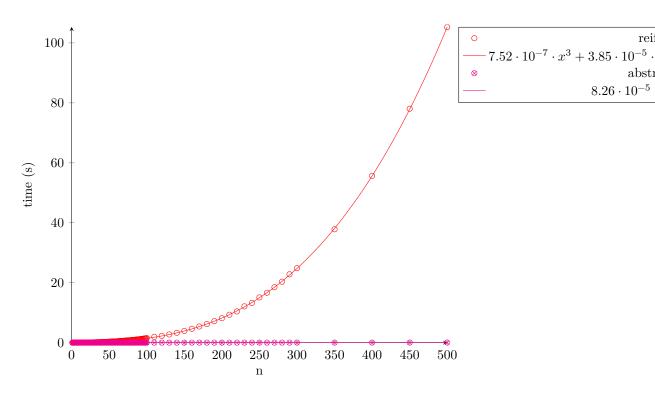
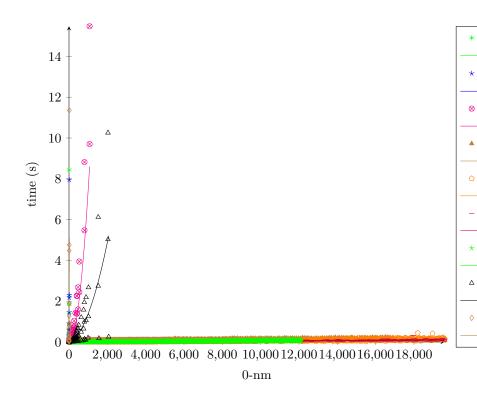


Figure 13: timing-typeclass-reification-let-in-HOAS



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



rewrite-strat(bottomup-bot  $4.98 \cdot 10^{-3} exp(0.46 \cdot ($ 

rewrite-strat (topdown-bot)  $5.47\cdot 10^{-3} \exp{(0.46\cdot ($ 

 $7.57 \cdot 10^{-6} \cdot x^2 - 1.69 \cdot 10^{-4} \cdot x^2 + 1.69 \cdot 10^{-4} \cdot x^2$ 

 $4.7 \cdot 10^{-11} \cdot x^2 + 5.72 \cdot 10^{-6} \cdot x^2$ 

 $2.15 \cdot 10^{-10} \cdot x^2 + 4.48 \cdot 10^{-6}$ 

 $8.21\cdot 10^{-11}\cdot x^2 + 3.94\cdot 10^{-6}\cdot$ 

 $1.1 \cdot 10^{-10} \cdot x^2 + 5.44 \cdot 10^{-6} \cdot x^2$ 

 $1.05 \cdot 10^{-6} \cdot x^2 + 3.55 \cdot 10^{-4} \cdot x^2 + 3.55 \cdot 10^{-4}$ 

 $-6.62 \cdot 10^{-3} \cdot x^3 + 0.21 \cdot x^2 -$ 

cps+cbn-real

cps+lazy-real

cps+cbv-real

cps+vm-compute-

cps+simpl-real

setoid-rewrite-re

cps+native-compute

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

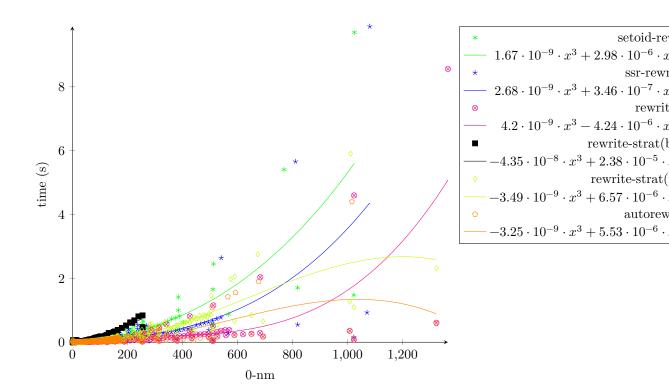
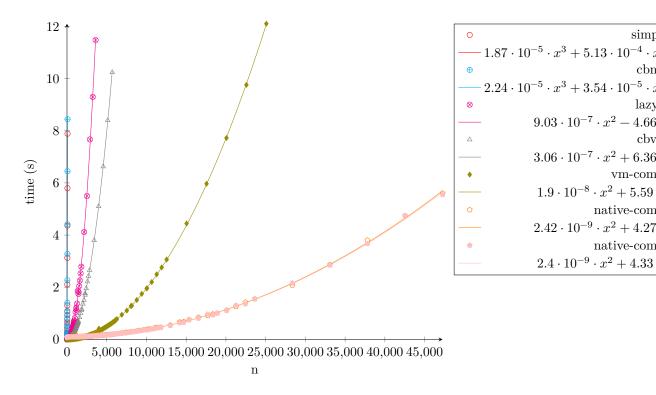


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

vm-com

native-com

native-com

 $9.03 \cdot 10^{-7} \cdot x^2 - 4.66$ 

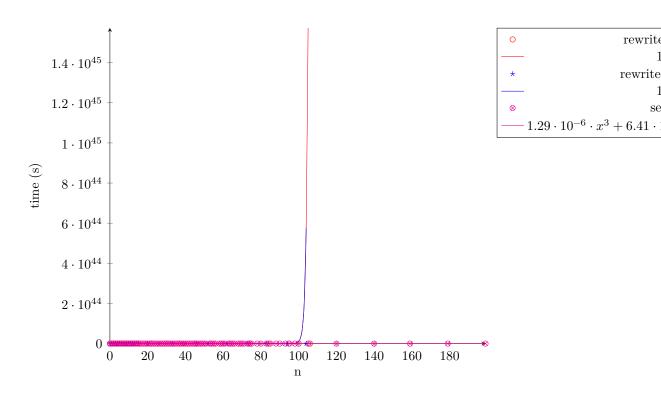
 $3.06 \cdot 10^{-7} \cdot x^2 + 6.36$ 

 $1.9 \cdot 10^{-8} \cdot x^2 + 5.59$ 

 $2.42 \cdot 10^{-9} \cdot x^2 + 4.27$ 

 $2.4\cdot 10^{-9}\cdot x^2 + 4.33$ 

Figure 17: timing-sieve-of-eratosthenes



rewrite

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