

Figure 1: timing-pattern

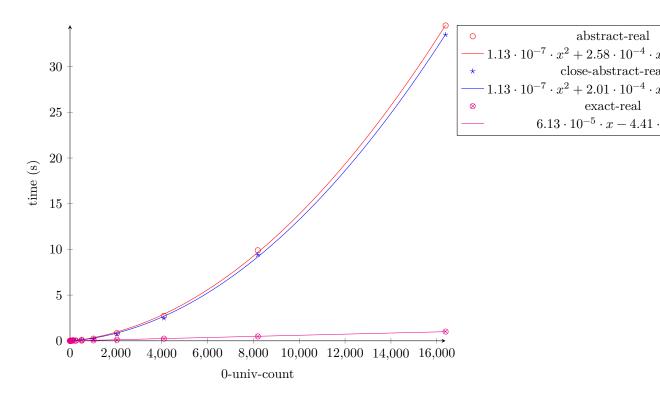
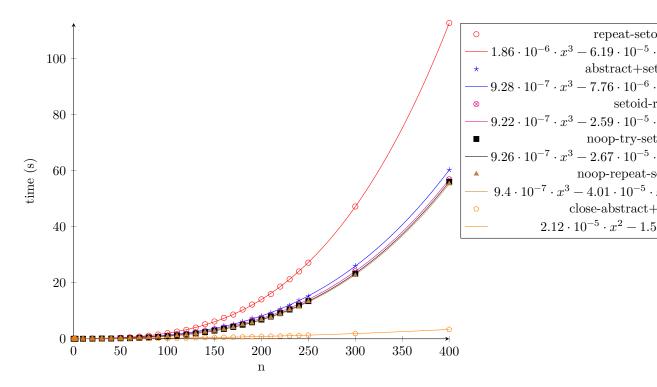
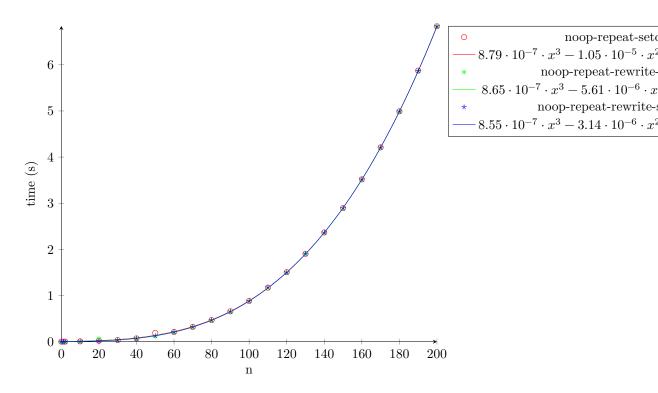


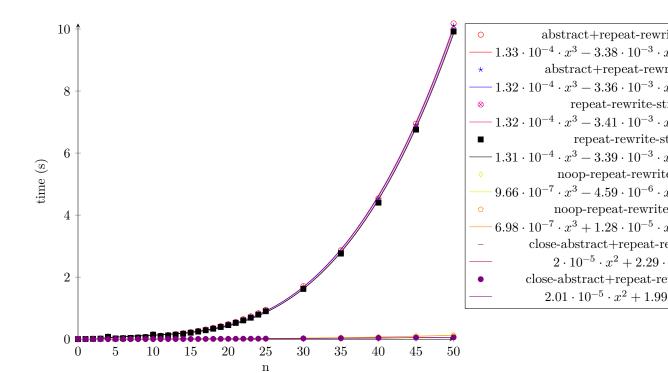
Figure 2: timing-n-polymorphic-universes param-1-n $\,0\,$



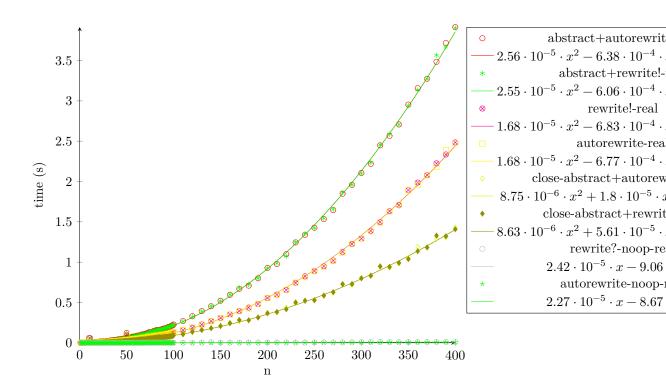
 $Figure \ 3: \ timing-repeat-setoid-rewrite-under-binders$



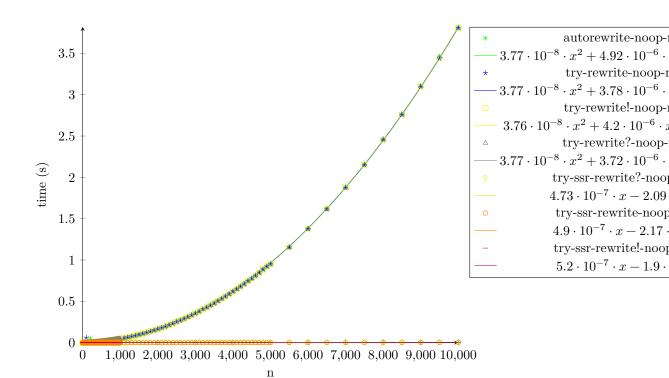
 $Figure\ 4:\ timing-repeat-setoid-rewrite-under-binders-noop$



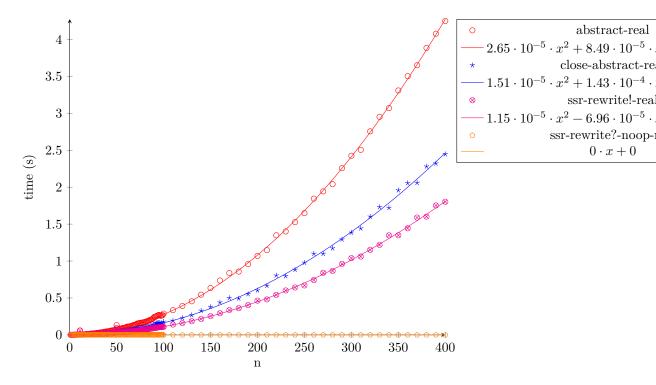
 $Figure\ 5:\ timing-rewrite-strat-under-binders$



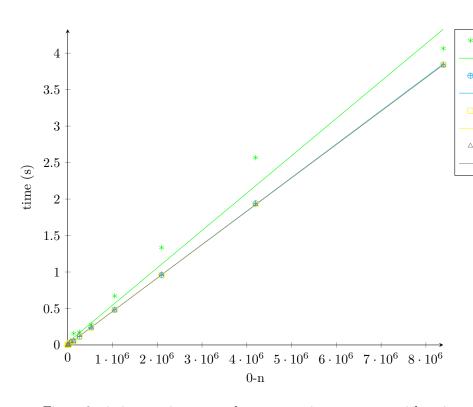
 $Figure \ 6: \ timing-rewrite-repeated-app-autorewrite \\$



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



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



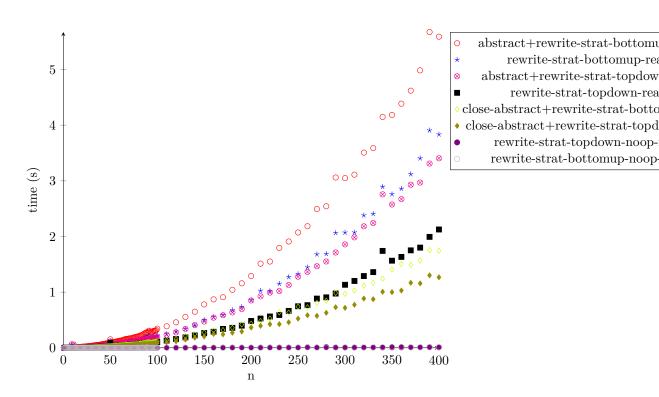
try-ssr-rewrite!-cold-noop-rea

 $5.12 \cdot 10^{-7} \cdot x + 3.26 \cdot 10^{-2}$ try-ssr-rewrite-noop-real

 $4.59 \cdot 10^{-7} \cdot x - 7.4\overline{1\cdot 10^{-4}}$ try-ssr-rewrite?-noop-real

 $\begin{aligned} &4.58 \cdot 10^{-7} \cdot x - 9.21 \cdot 10^{-4} \\ &\text{try-ssr-rewrite!-noop-real} \\ &4.58 \cdot 10^{-7} \cdot x + 2.02 \cdot 10^{-3} \end{aligned}$

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



rewrite-strat-topdown-rea

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

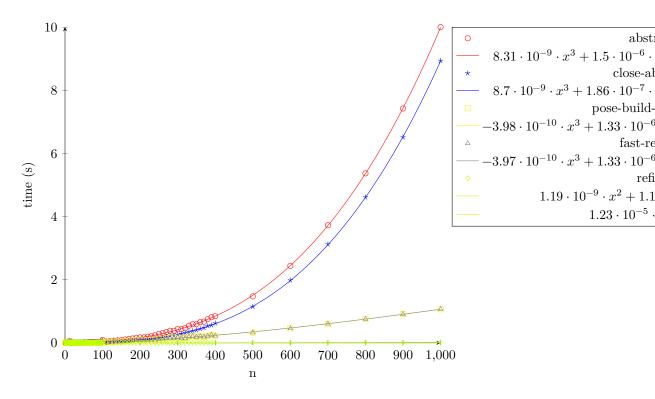
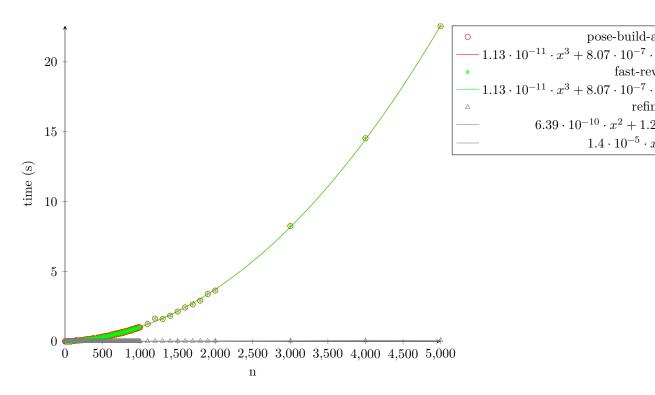


Figure 11: timing-rewrite-repeated-app-fast-rewrite



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

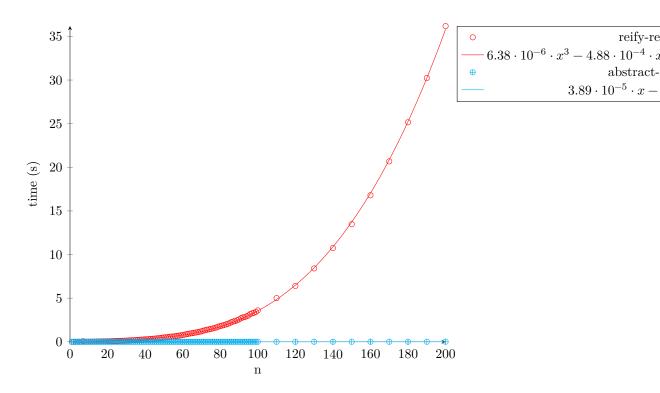
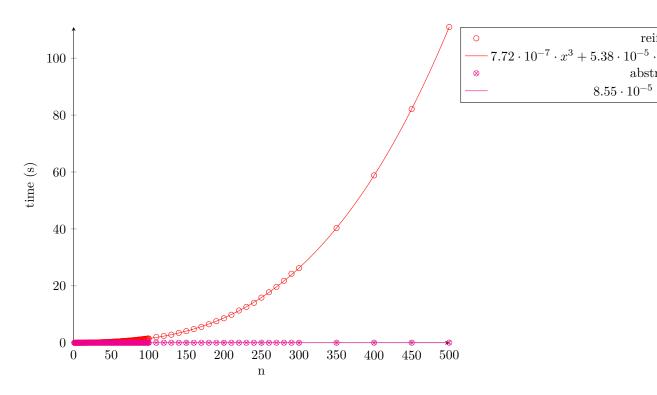


Figure 13: timing-typeclass-reification-let-in-HOAS



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

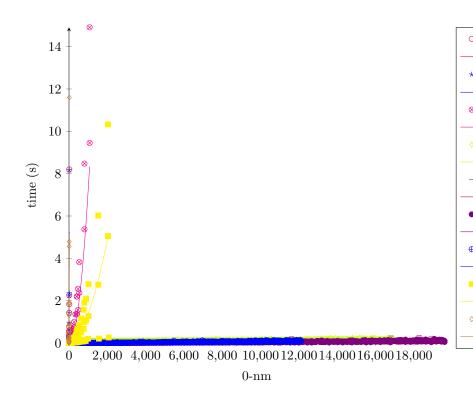


Figure 15: timing-rewrite-lift-lets-map param-1-n 1, param-2-m 1

rewrite-strat(bottomup-bot

 $7.3\cdot 10^{-6}\cdot x^2 - 1.3\cdot 10^{-4}\cdot x$

 $6.63 \cdot 10^{-11} \cdot x^2 + 5.76 \cdot 10^{-6} \cdot$

 $2.35 \cdot 10^{-10} \cdot x^2 + 4.15 \cdot 10^{-6} \cdot$

 $1.08 \cdot 10^{-10} \cdot x^2 + 3.45 \cdot 10^{-6} \cdot$

 $1.64 \cdot 10^{-10} \cdot x^2 + 5.82 \cdot 10^{-6} \cdot$

 $1.06 \cdot 10^{-6} \cdot x^2 + 3.44 \cdot 10^{-4} \cdot x^2$

 $-6.71 \cdot 10^{-3} \cdot x^3 + 0.21 \cdot x^2 -$

 $5.1 \cdot 10^{-3} \exp{(0.46 \cdot (0.46 \cdot (0.4$

 $5.39 \cdot 10^{-3} \exp{(0.46 \cdot ($

cps+native-compute

cps+cbn-real

cps+lazy-real

 $\operatorname{cps+cbv-real}$

cps+simpl-real

setoid-rewrite-re

cps+vm-compute-

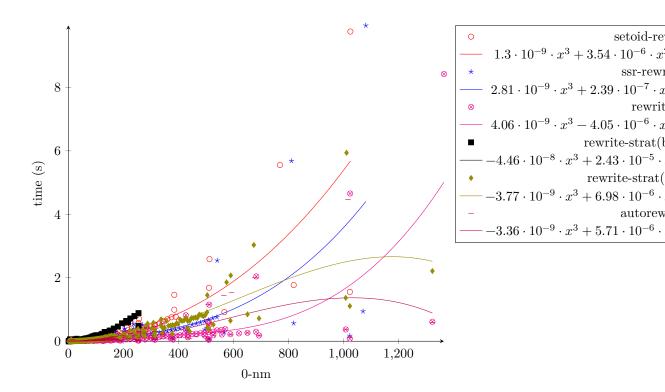
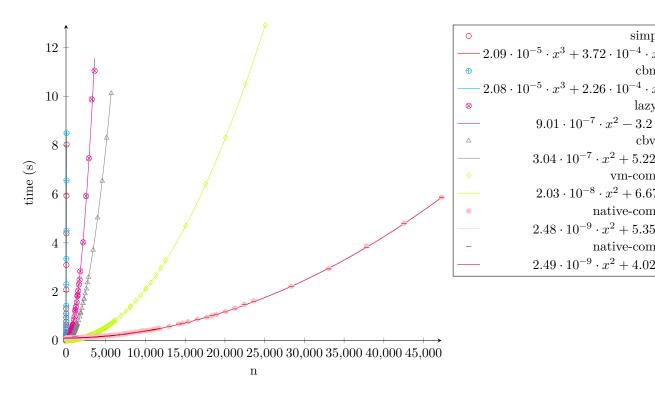


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

lazy

vm-com

native-com

native-com

 $9.01 \cdot 10^{-7} \cdot x^2 - 3.2$

cbv $3.04 \cdot 10^{-7} \cdot x^2 + 5.22$

 $2.03 \cdot 10^{-8} \cdot x^2 + 6.67$

 $2.48 \cdot 10^{-9} \cdot x^2 + 5.35$

 $2.49 \cdot 10^{-9} \cdot x^2 + 4.02$

Figure 17: timing-sieve-of-eratosthenes

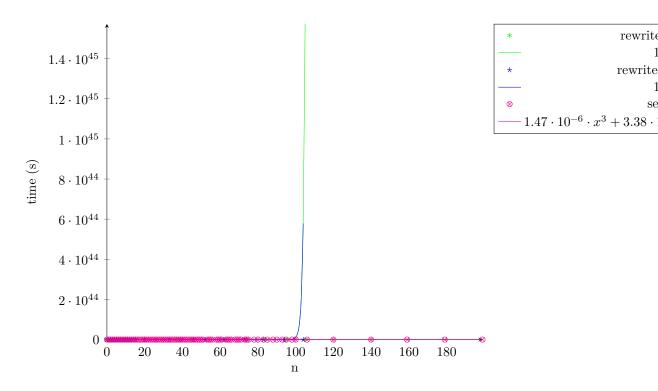


Figure 18: timing-rewrite-under-lets-plus-0 $\,$

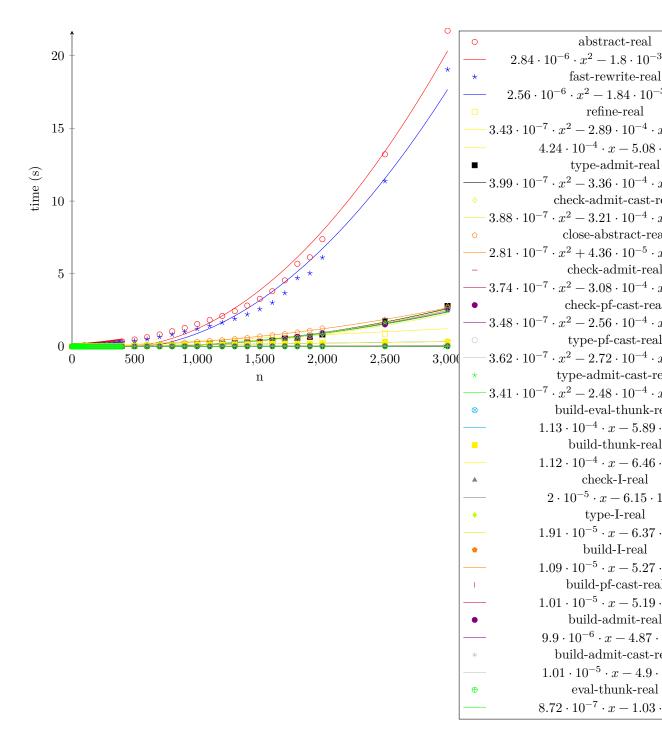


Figure 19: timing-rewrite-repeated-app-fast-rewrite-ltac2