

Figure 1: timing-pattern

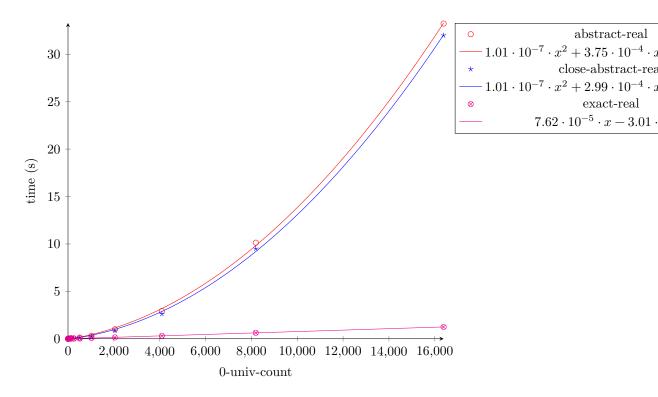
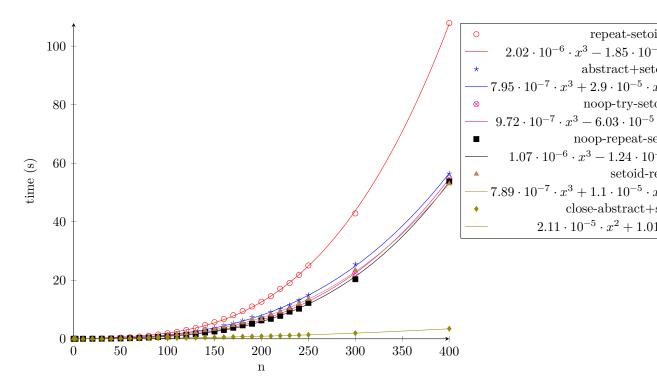
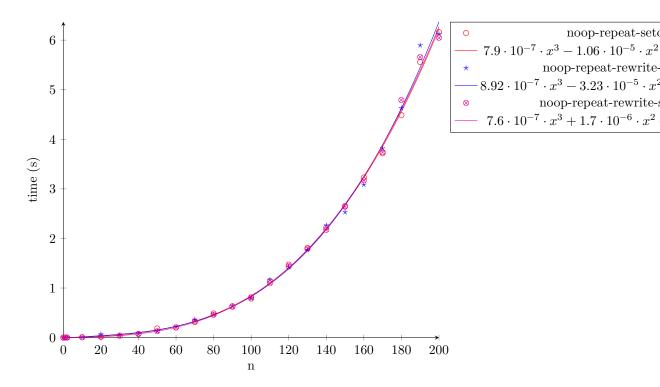


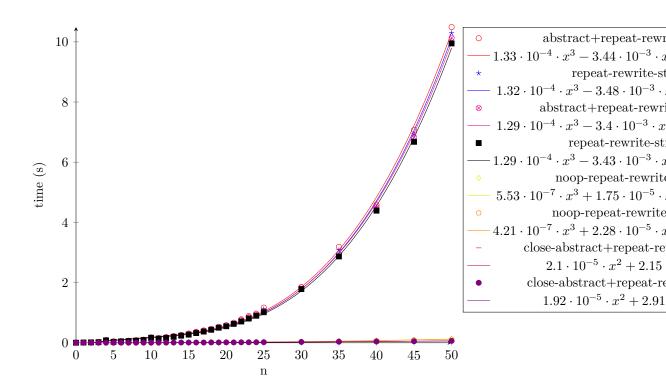
Figure 2: timing-n-polymorphic-universes param-1-n $\,0\,$



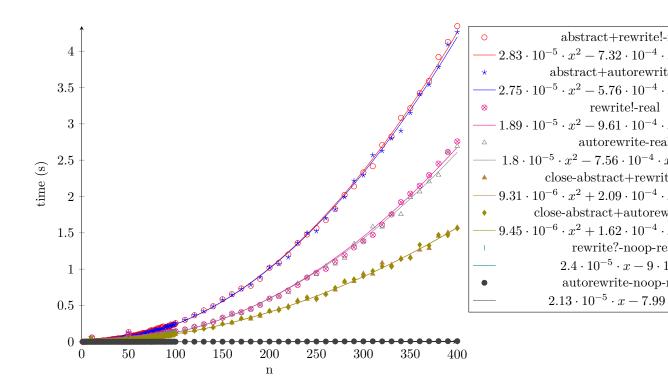
 $Figure \ 3: \ timing-repeat-setoid-rewrite-under-binders$



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



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



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

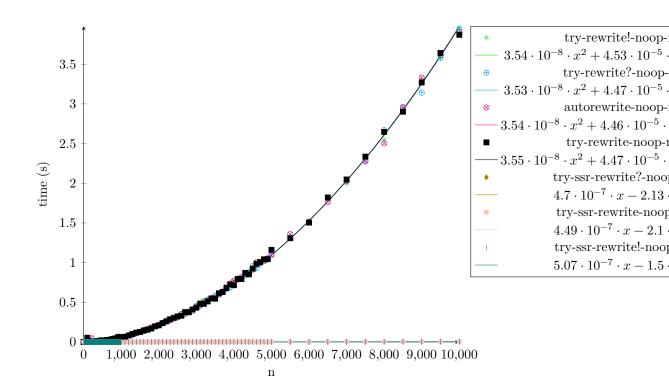


Figure 7: timing-rewrite-repeated-app-autorewrite-noop

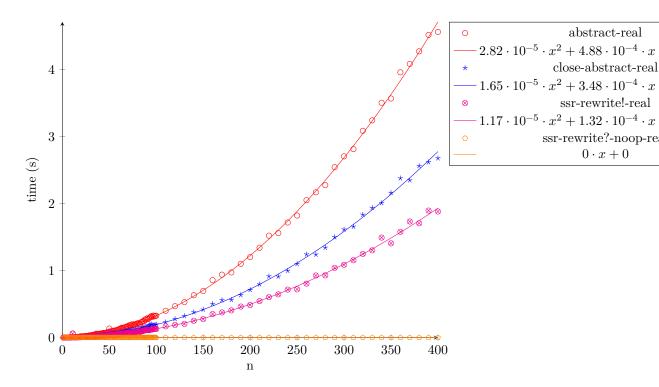
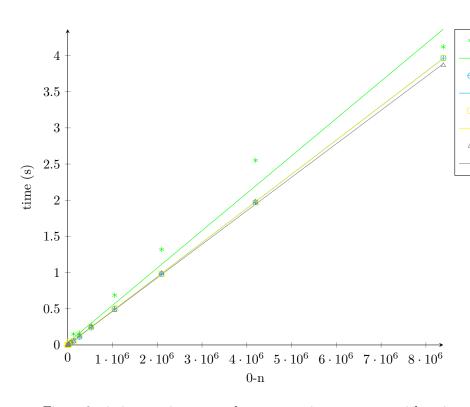


Figure 8: timing-rewrite-repeated-app-ssrrewrite



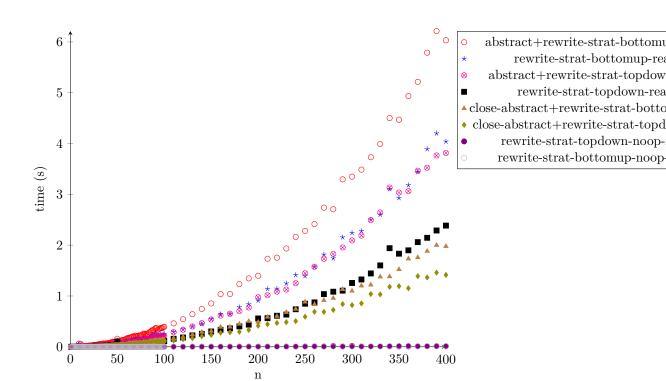
try-ssr-rewrite!-cold-noop-rea

 $\begin{aligned} &5.17\cdot 10^{-7}\cdot x + 2.99\cdot 10^{-2}\\ &\text{try-ssr-rewrite-noop-real}\\ &4.72\cdot 10^{-7}\cdot x - 1.83\cdot 10^{-3} \end{aligned}$

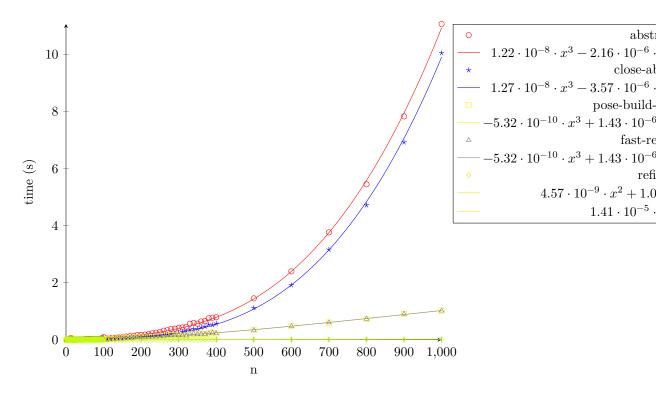
try-ssr-rewrite!-noop-real $4.71\cdot 10^{-7}\cdot x + 1.59\cdot 10^{-3}$

try-ssr-rewrite?-noop-real $4.63\cdot 10^{-7}\cdot x + 9.65\cdot 10^{-4}$

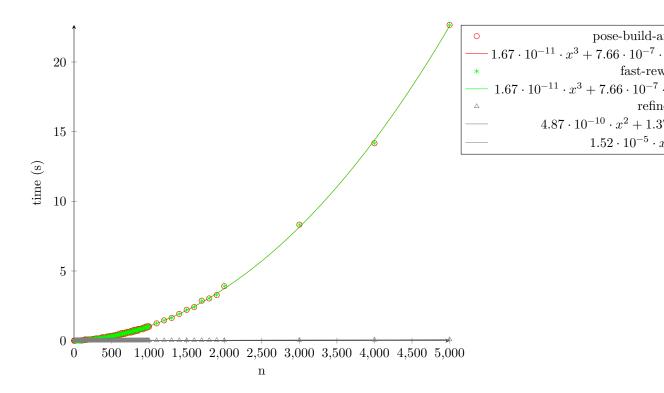
Figure 9: timing-rewrite-repeated-app-ssrrewrite-noop param-1-lgn $\ 1$



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



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



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

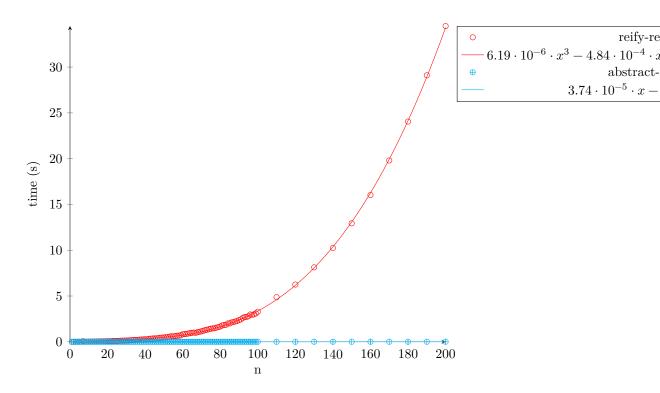
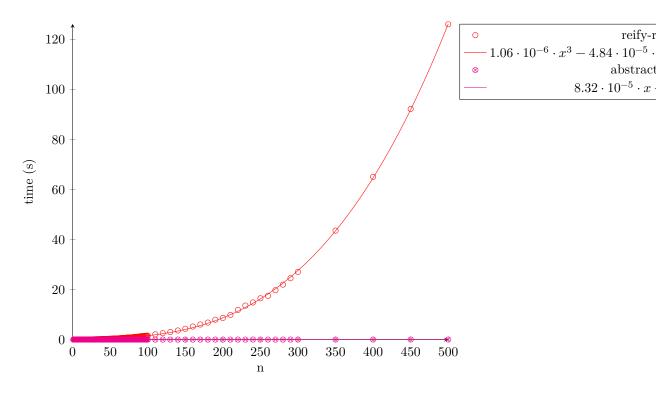


Figure 13: timing-typeclass-reification-let-in-HOAS



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

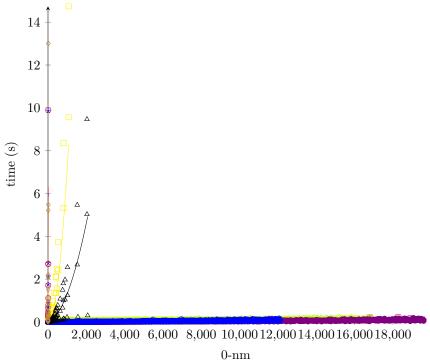


Figure 15: timing-rewrite-lift-lets-map param-1-n 1, param-2-m 1

```
rewrite\text{-}strat (top down\text{-}bot
                                                                                                                                                                                                                   6.26 \cdot 10^{-3} exp (0.46 \cdot (
                                                                           rewrite-strat(bottomup-bot
                                                                                                                                                                                                                   6.63 \cdot 10^{-3} \exp{(0.45 \cdot (
                                                                                                                                                                                                                                                                                                                                                                                                                                      cps+cbn-real
              7.35\cdot 10^{-6}\cdot x^2 - 2.23\cdot 10^{-4}\cdot x^2 - 2.23\cdot 10^{-4}\cdot x^2 + 2.23\cdot 1
                                                                                                                                                                                                                                                                           cps+native-compute
8.35\cdot 10^{-11}\cdot x^2 + 5.35\cdot 10^{-6}\cdot \\
                                                                                                                                                                                                                                                                                                                                                                                                                            cps+lazy-real
              2.27 \cdot 10^{-10} \cdot x^2 + 4.3 \cdot 10^{-6} \cdot x^
                                                                                                                                                                                                                                                                                                                                                                                                                                          cps+cbv-real
1.18 \cdot 10^{-10} \cdot x^2 + 3.21 \cdot 10^{-6} \cdot
                                                                                                                                                                                                                                                                                                                cps+vm-compute-
              2.3 \cdot 10^{-10} \cdot x^2 + 5.18 \cdot 10^{-6} \cdot x^2
                                                                                                                                                                                                                                                                                                                                                                                                         cps+simpl-real
         9.86 \cdot 10^{-7} \cdot x^2 + 3.46 \cdot 10^{-4} \cdot x^2
                                                                                                                                                                                                                                                                                                                                                                    setoid-rewrite-re
              -7.59 \cdot 10^{-3} \cdot x^3 + 0.24 \cdot x^2 -
```

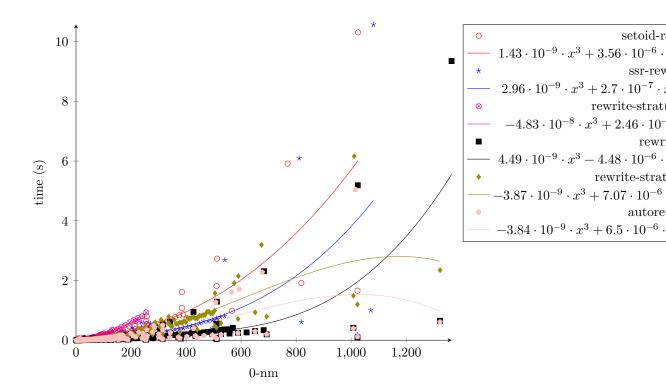
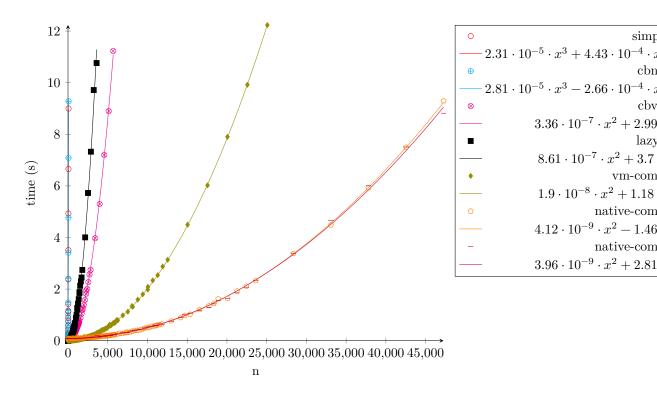


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

vm-com

native-com

native-com

 $3.36 \cdot 10^{-7} \cdot x^2 + 2.99$

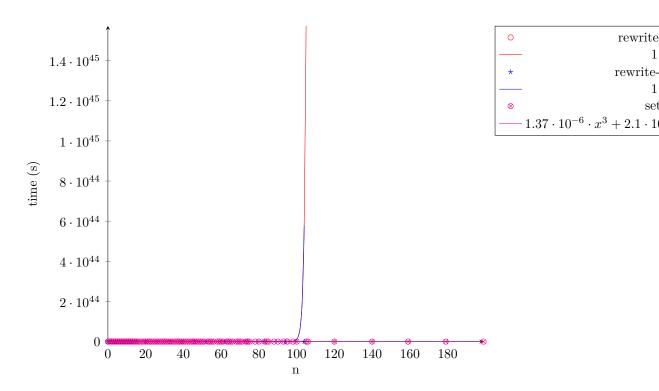
 $8.61 \cdot 10^{-7} \cdot x^2 + 3.7$

 $1.9 \cdot 10^{-8} \cdot x^2 + 1.18$

 $4.12 \cdot 10^{-9} \cdot x^2 - 1.46$

 $3.96 \cdot 10^{-9} \cdot x^2 + 2.81$

Figure 17: timing-sieve-of-eratosthenes



rewrite

rewrite-

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

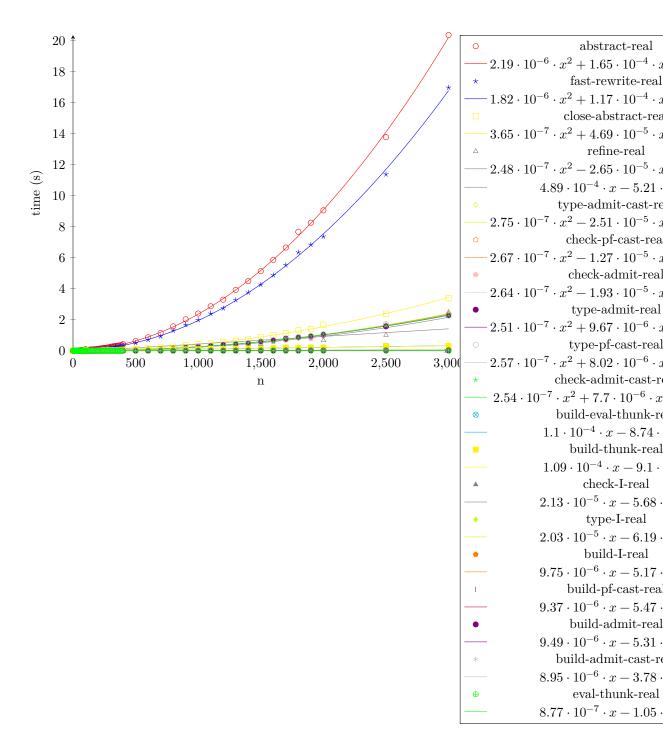


Figure 19: timing-rewrite-repeated-app-fast-rewrite-ltac2