

Figure 1: timing-pattern

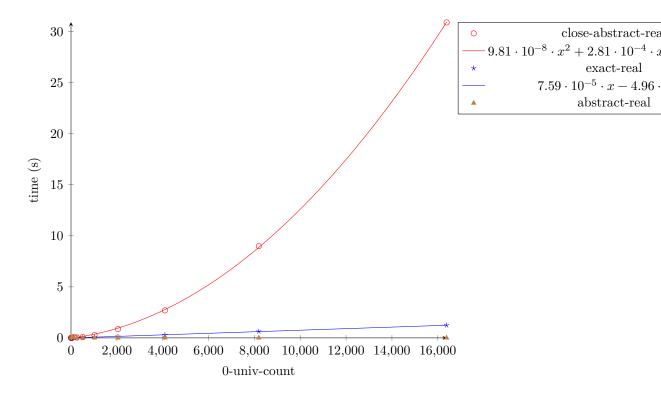
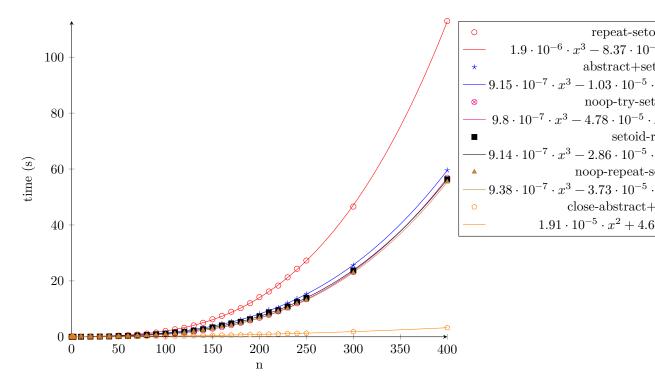
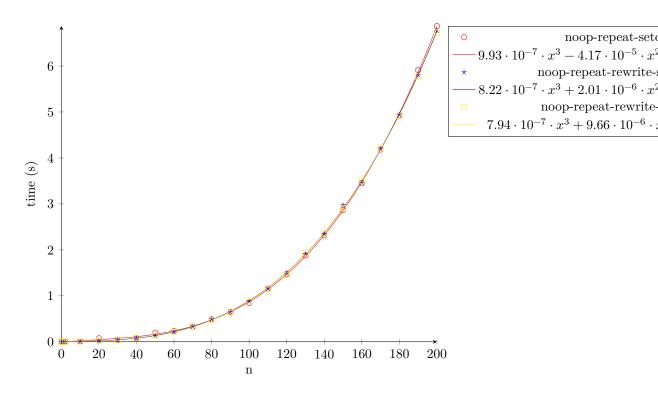


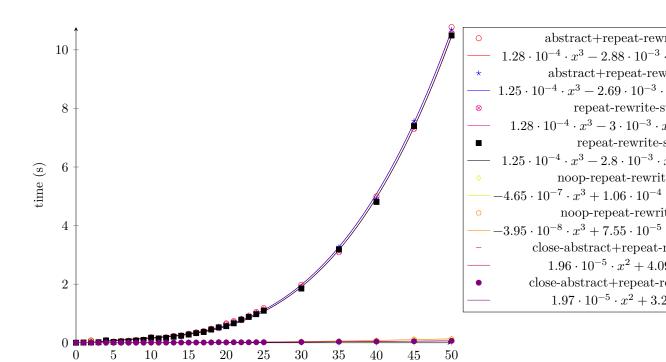
Figure 2: timing-n-polymorphic-universes param-1-n 0



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

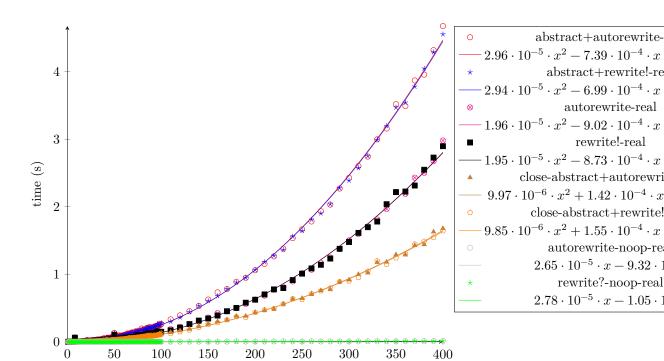


 $Figure\ 4:\ timing-repeat-setoid-rewrite-under-binders-noop$



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

n



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

n

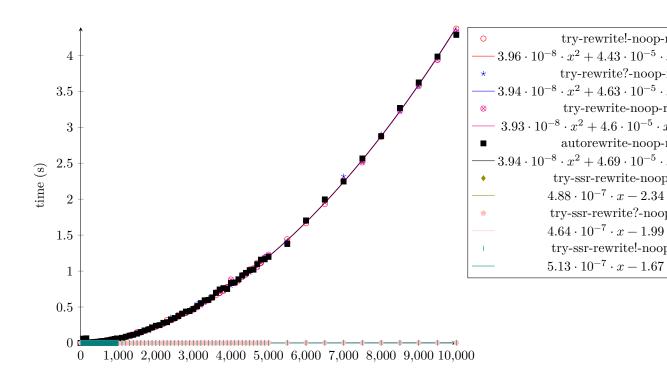
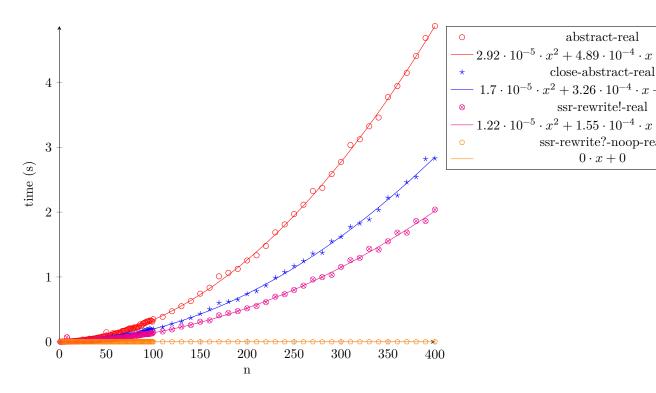
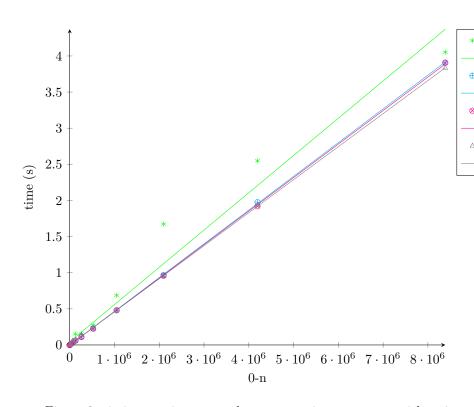


Figure 7: timing-rewrite-repeated-app-autorewrite-noop



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



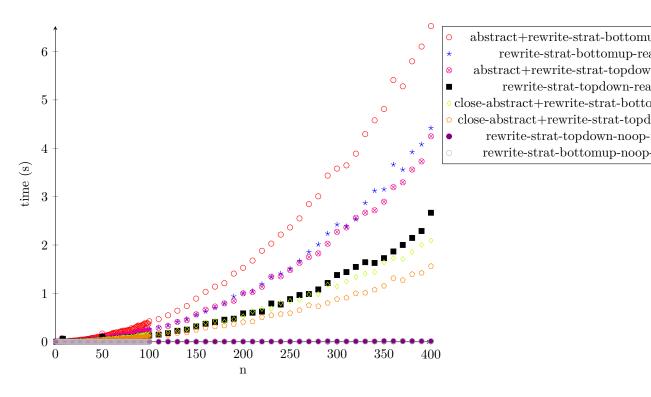
try-ssr-rewrite!-cold-noop-rea $5.16\cdot 10^{-7}\cdot x + 4.27\cdot 10^{-2}$

try-ssr-rewrite-noop-real $4.67\cdot 10^{-7}\cdot x - 1.83\cdot 10^{-3}$

try-ssr-rewrite?-noop-real $4.64\cdot 10^{-7}\cdot x - 3.15\cdot 10^{-3}$

try-ssr-rewrite!-noop-real $4.57\cdot 10^{-7}\cdot x + 1.46\cdot 10^{-3}$

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

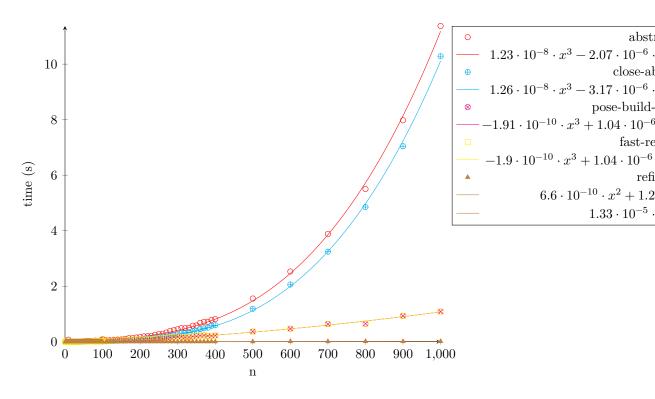


rewrite-strat-bottomup-rea abstract + rewrite - strat - topdowrewrite-strat-topdown-rea

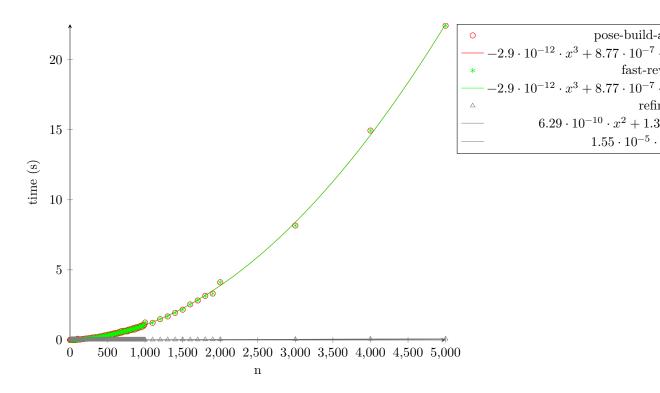
rewrite-strat-topdown-noop-

rewrite-strat-bottomup-noop-

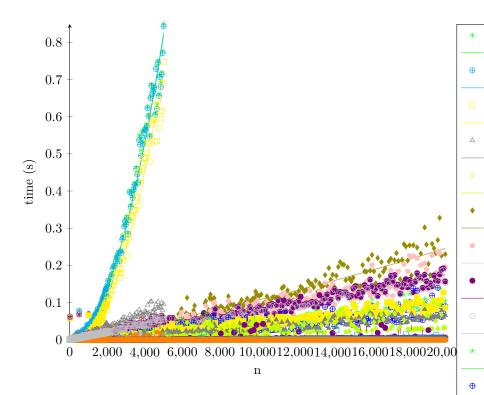
 $Figure~10:~timing\mbox{-rewrite-repeated-app-rewrite-strat}$



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



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



reif-for-beta-Para $3.17\cdot 10^{-8}\cdot x^2 + 6$ norm-reif-for-beta-I $3.17 \cdot 10^{-8} \cdot x^2 + 5$ eval-lazy-for-beta-F $3.1 \cdot 10^{-8} \cdot x^2 - 1.$ actual-reif-for-beta- $6.73 \cdot 10^{-10} \cdot x^2 + 1$ cbv-for-beta-Paran $1.08 \cdot 10^{-10} \cdot x^2 + 2$ reif-for-Parametr $1.68 \cdot 10^{-10} \cdot x^2 + 8$ norm-reif-for-Param $1.23 \cdot 10^{-10} \cdot x^2 + 6$ reif-for-Parametric $9.94 \cdot 10^{-11} \cdot x^2 + 6$ norm-reif-for-Paramet $1.03 \cdot 10^{-10} \cdot x^2 + 6$ actual-reif-for-Paran $5.2 \cdot 10^{-11} \cdot x^2 + 3$ eval-lazy-for-Param $7.13 \cdot 10^{-11} \cdot x^2 + 2$ actual-reif-for-Paramet $7.19 \cdot 10^{-11} \cdot x^2 + 3$ eval-lazy-for-Paramet $3.27 \cdot 10^{-11} \cdot x^2 + 2$ lazy-beta-iota-for-Para $4.37 \cdot 10^{-11} \cdot x^2 + 2$ cbv-for-beta-Par $1.59 \cdot 10^{-10} \cdot x^2 + 1$

cbv-for-Parametric $1.31 \cdot 10^{-11} \cdot x^2 + 5$ cbv-for-Parametr $-4.7 \cdot 10^{-12} \cdot x^2 + 5$ lazy-beta-iota-for-beta $1.19 \cdot 10^{-10} \cdot x^2 + 7$

lazy-beta-iota-for-Param $9.05 \cdot 10^{-13} \cdot x^2 + 2$ eval-lazy-for-beta-Param $9.04 \cdot 10^{-11} \cdot x^2 + 3$

9.04 · 10^{-11} · $x^2 + 3^{-11}$ · $x^2 - 3^$

transitivity-(Denote-rv)-for-b $1.58 \cdot 10^{-10} \cdot x^2 - 5$

* transitivity-(Denote-rv)-for $1.58 \cdot 10^{-10} \cdot x^2 - 5$

1.38 · 10 · $x^2 - 3$ transitivity-(Denote-rv)-for-F

0

 $1.58 \cdot 10^{-10} \cdot x^2 - 5$ transitivity-(Denote-rv)-for

 $1.58 \cdot 10^{-10} \cdot x^2 - 5$

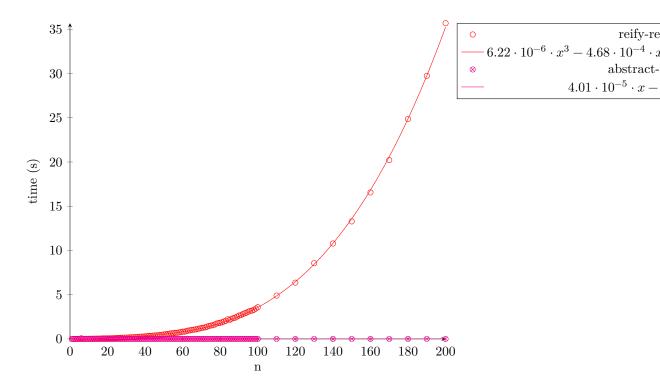
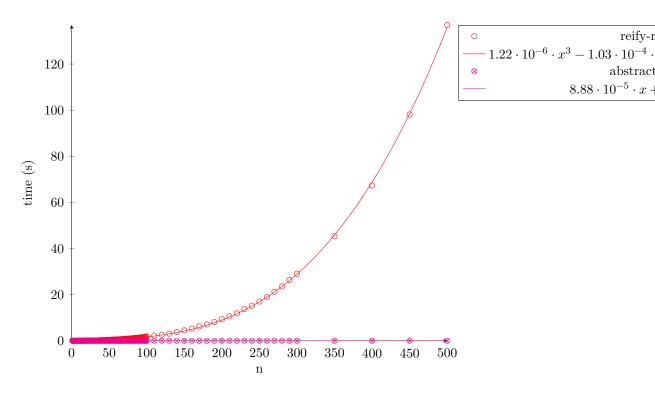
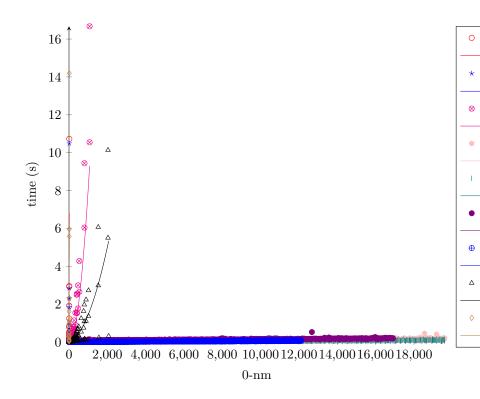


Figure 14: timing-typeclass-reification-let-in-HOAS



 ${\bf Figure~15:~timing-type class-reification-let-in-PHOAS}$



rewrite-strat (top down-bot)

 $8.09 \cdot 10^{-6} \cdot x^2 - 7.24 \cdot 10^{-5} \cdot x^2 = 1.00 \cdot 10^{-5}$

 $2.16 \cdot 10^{-10} \cdot x^2 + 4.74 \cdot 10^{-6}$

 $8.36 \cdot 10^{-11} \cdot x^2 + 4.02 \cdot 10^{-6}$

 $6.97 \cdot 10^{-11} \cdot x^2 + 5.83 \cdot 10^{-6}$

 $1.44\cdot 10^{-10}\cdot x^2 + 5.07\cdot 10^{-6}\cdot \\$

 $1.06 \cdot 10^{-6} \cdot x^2 + 3.9 \cdot 10^{-4} \cdot x^2$

 $-8.25 \cdot 10^{-3} \cdot x^3 + 0.26 \cdot x^2 -$

 $7.5\cdot 10^{-3}\exp{(0.45\cdot (0.45\cdot (0.45\cdot$

 $6.21 \cdot 10^{-3} exp (0.46 \cdot ($

cps+cbn-real

cps+lazy-real

cps+cbv-real

cps+native-compute

cps+vm-compute-

cps+simpl-real

setoid-rewrite-re

Figure 16: timing-rewrite-lift-lets-map param-1-n 1, param-2-m 1

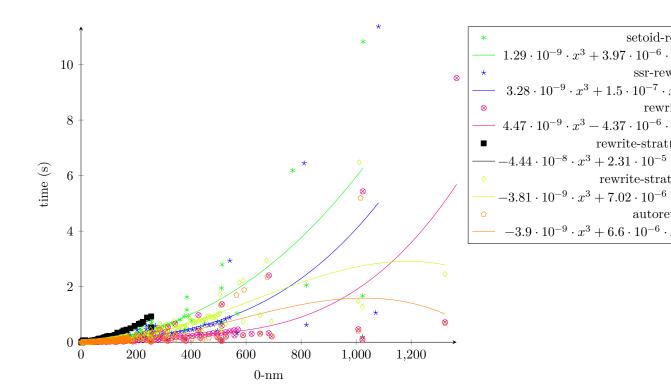
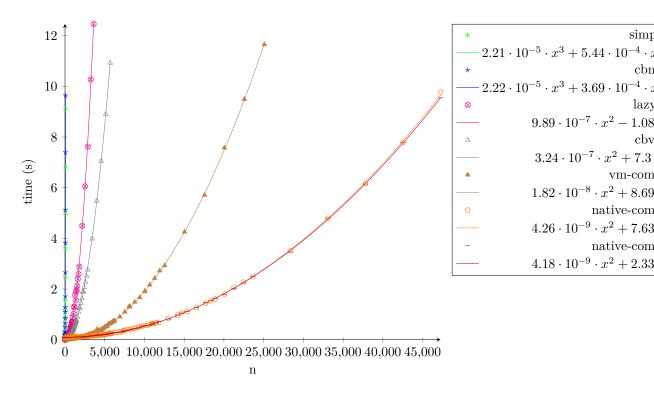


Figure 17: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

vm-com

native-com

native-com

 $9.89 \cdot 10^{-7} \cdot x^2 - 1.08$

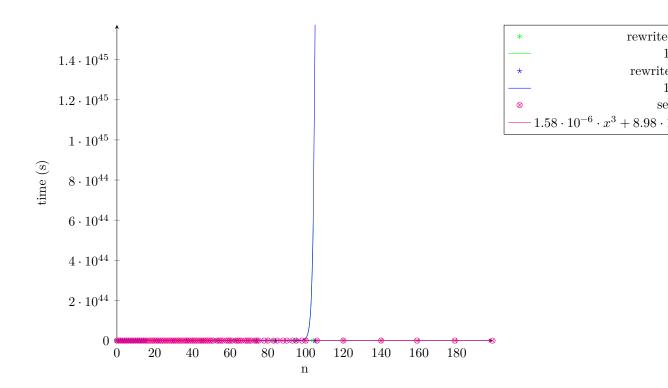
 $3.24 \cdot 10^{-7} \cdot x^2 + 7.3$

 $1.82 \cdot 10^{-8} \cdot x^2 + 8.69$

 $4.26 \cdot 10^{-9} \cdot x^2 + 7.63$

 $4.18 \cdot 10^{-9} \cdot x^2 + 2.33$

Figure 18: timing-sieve-of-eratosthenes



rewrite

rewrite

Figure 19: timing-rewrite-under-lets-plus-0 $\,$