

Figure 1: timing-pattern

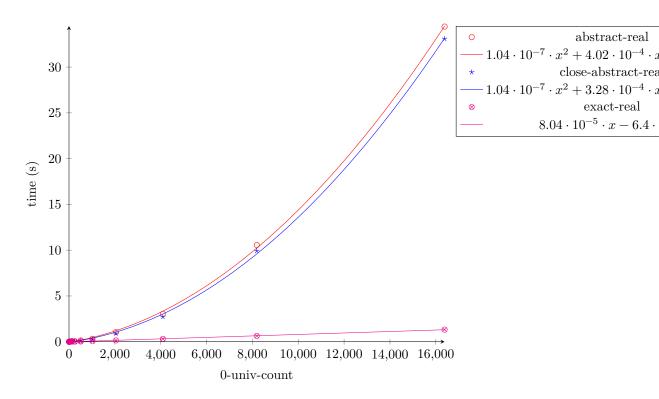
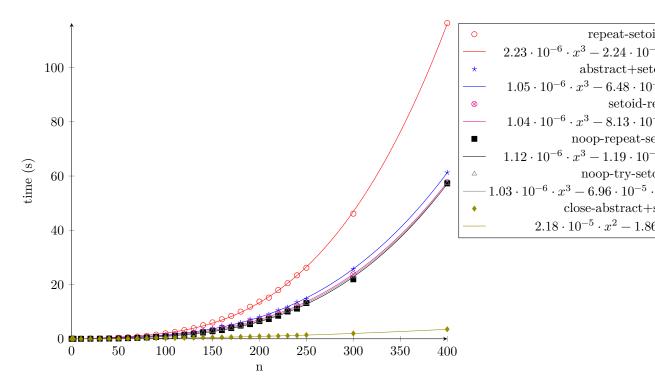


Figure 2: timing-n-polymorphic-universes param-1-n $\,0\,$



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

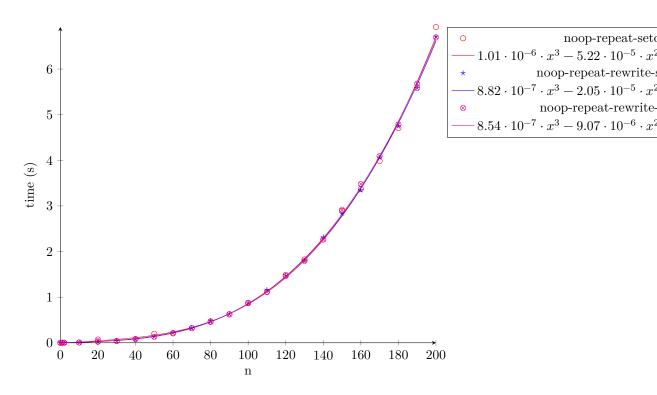
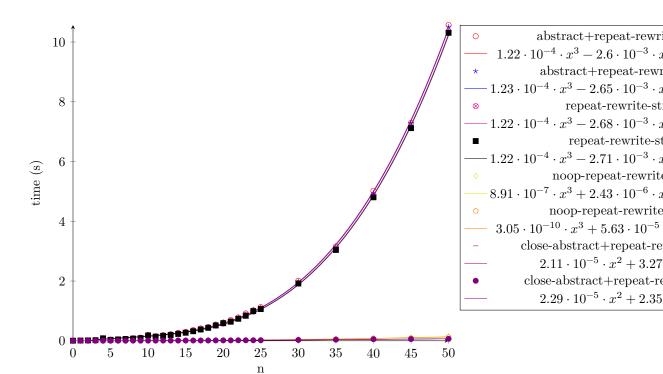
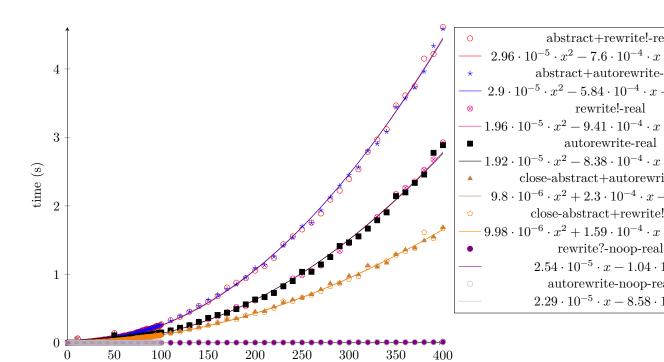


Figure 4: timing-repeat-setoid-rewrite-under-binders-noop

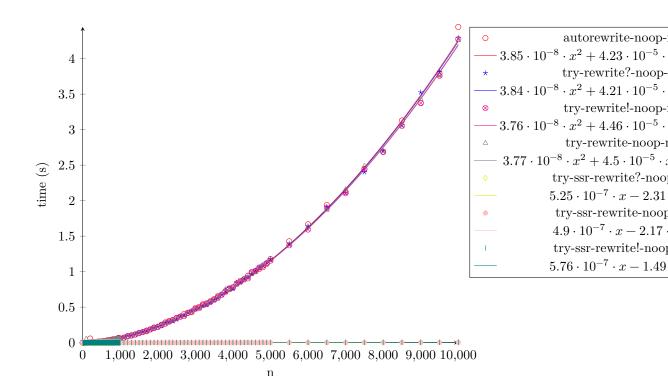


 $Figure\ 5:\ timing-rewrite-strat-under-binders$



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

n



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

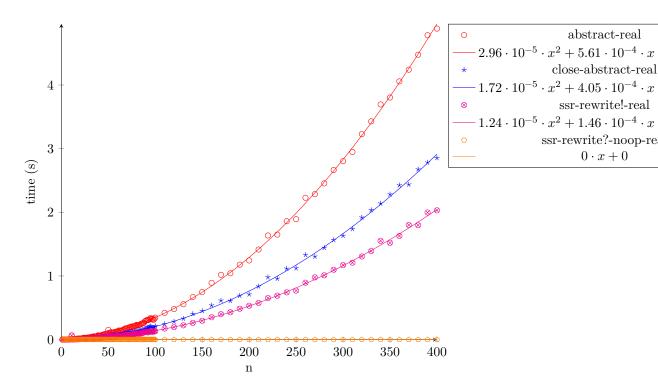


Figure 8: timing-rewrite-repeated-app-ssrrewrite

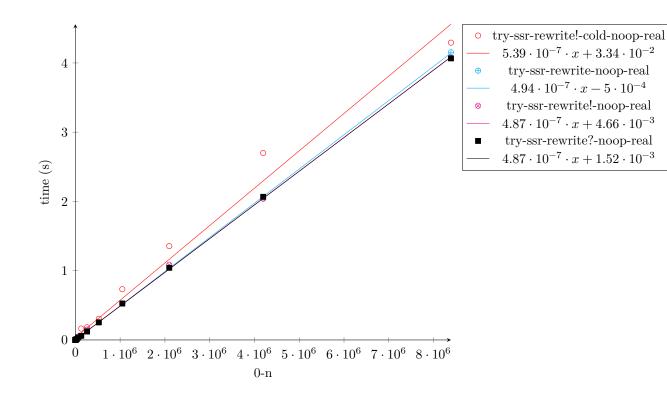
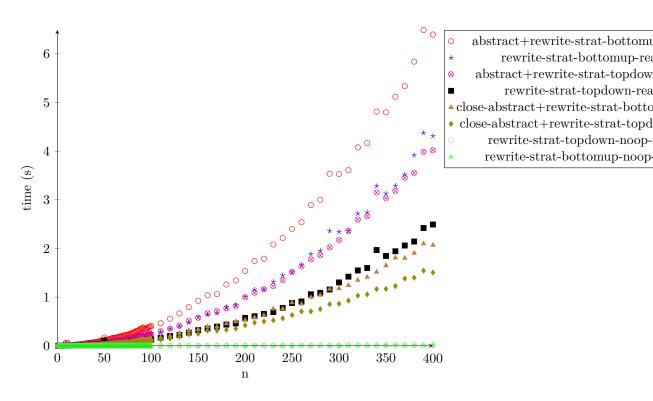


Figure 9: timing-rewrite-repeated-app-ssrrewrite-noop param-1-lgn $\ 1$



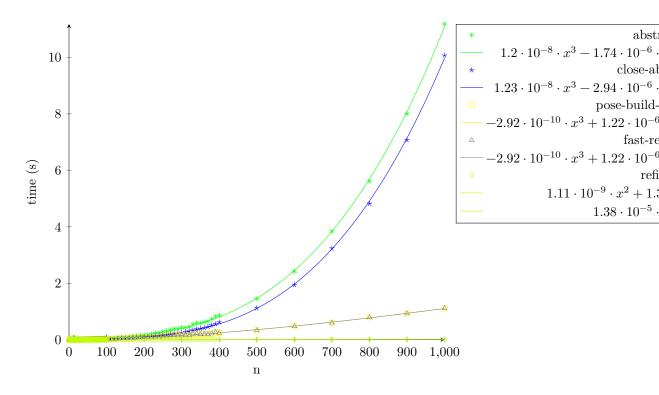
 $abstract + rewrite - strat - bottom \\ \\$

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

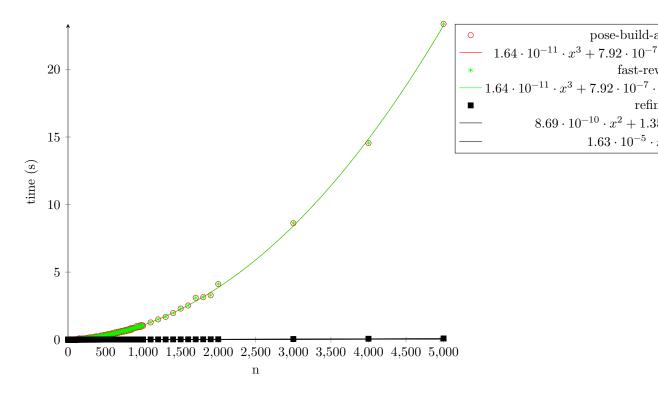
rewrite-strat-topdown-noop-

rewrite-strat-bottomup-noop-

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



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



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

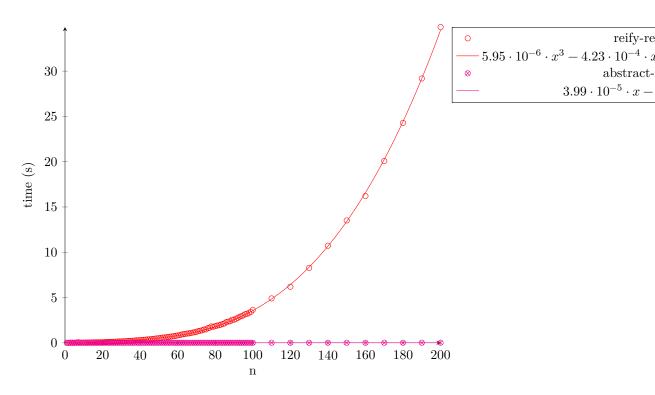
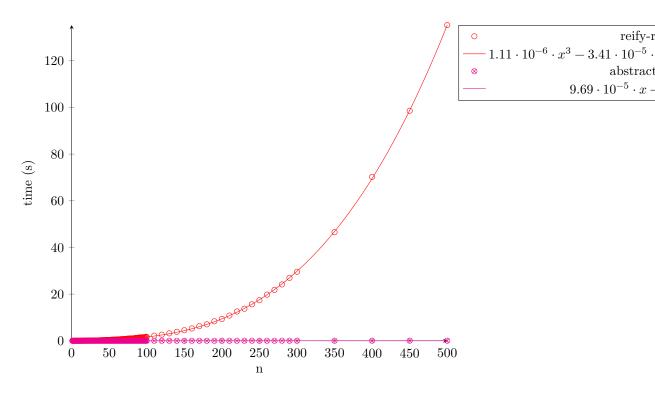
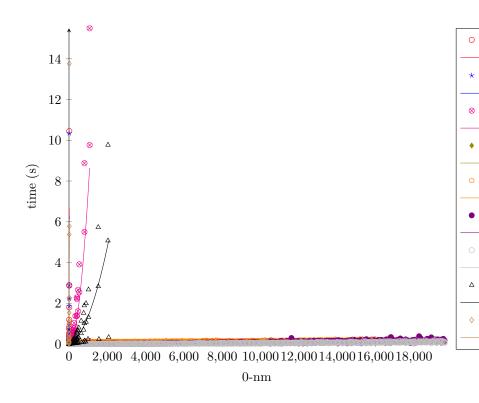


Figure 13: timing-typeclass-reification-let-in-HOAS



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



rewrite-strat(topdown-bot) $7.05 \cdot 10^{-3} exp(0.46 \cdot ($

rewrite-strat (bottomup-bot 6.87 \cdot 10⁻³ exp (0.45 \cdot (

 $7.59 \cdot 10^{-6} \cdot x^2 - 1.53 \cdot 10^{-4} \cdot x^2 + 1.53 \cdot 10^{-4} \cdot x^2$

 $1.8 \cdot 10^{-10} \cdot x^2 + 6.05 \cdot 10^{-6} \cdot x^2$

 $7.66 \cdot 10^{-11} \cdot x^2 + 5.84 \cdot 10^{-6} \cdot$

 $2.61\cdot 10^{-10}\cdot x^2 + 4.18\cdot 10^{-6}\cdot \\$

 $1.1 \cdot 10^{-10} \cdot x^2 + 3.66 \cdot 10^{-6} \cdot x^2 + 3.66 \cdot x^$

 $1 \cdot 10^{-6} \cdot x^2 + 3.8 \cdot 10^{-4} \cdot x$

 $-7.97 \cdot 10^{-3} \cdot x^3 + 0.25 \cdot x^2 -$

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

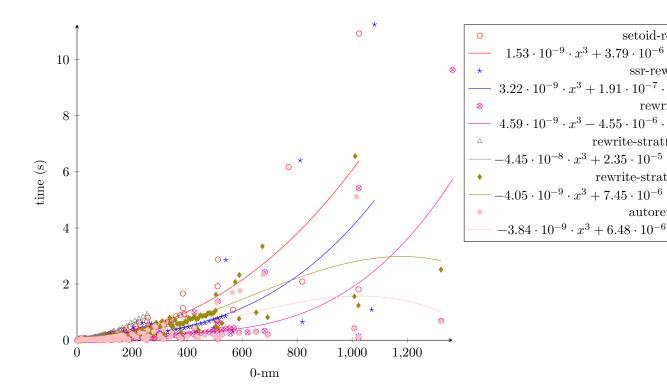
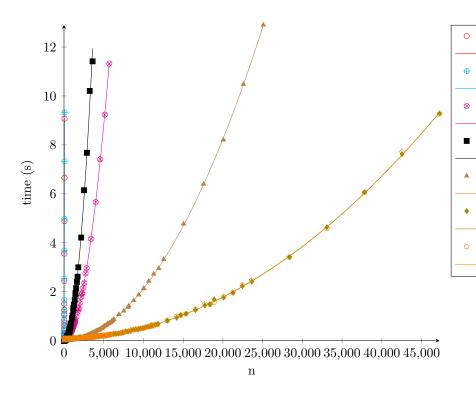


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

vm-com

native-com

native-com

 $2.31 \cdot 10^{-5} \cdot x^3 + 4.34 \cdot 10^{-4} \cdot x^3$

 $2.15 \cdot 10^{-5} \cdot x^3 + 3.74 \cdot 10^{-4} \cdot x^3$

 $3.34 \cdot 10^{-7} \cdot x^2 + 9.54$

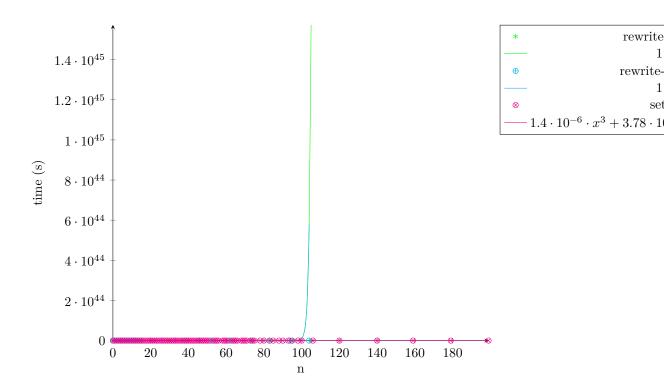
 $9.19 \cdot 10^{-7} \cdot x^2 + 1.03$

 $1.99 \cdot 10^{-8} \cdot x^2 + 1.34$

 $4.07 \cdot 10^{-9} \cdot x^2 + 2.84$

 $4.06 \cdot 10^{-9} \cdot x^2 + 3.93$

Figure 17: timing-sieve-of-eratosthenes



rewrite

rewrite-

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

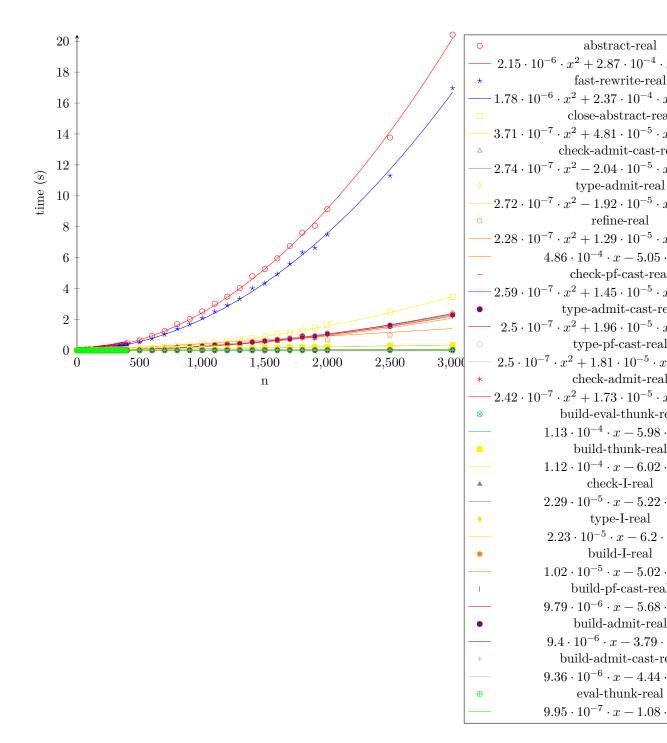


Figure 19: timing-rewrite-repeated-app-fast-rewrite-ltac2