

Figure 1: timing-pattern

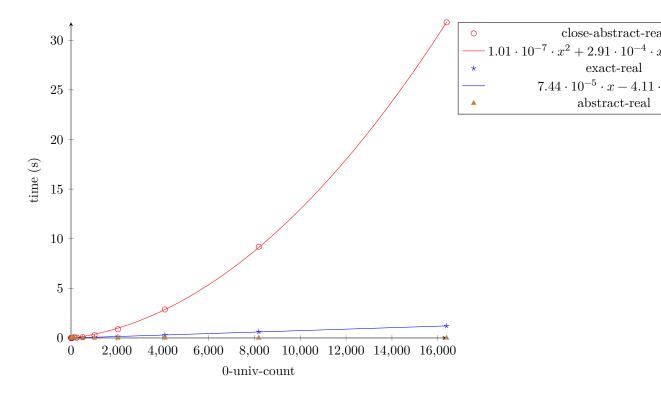
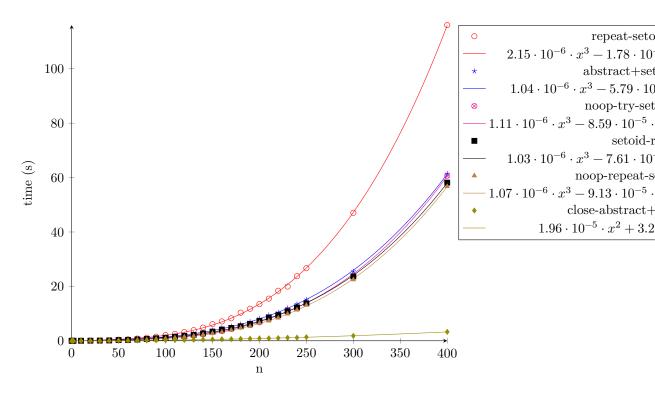


Figure 2: timing-n-polymorphic-universes param-1-n 0



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

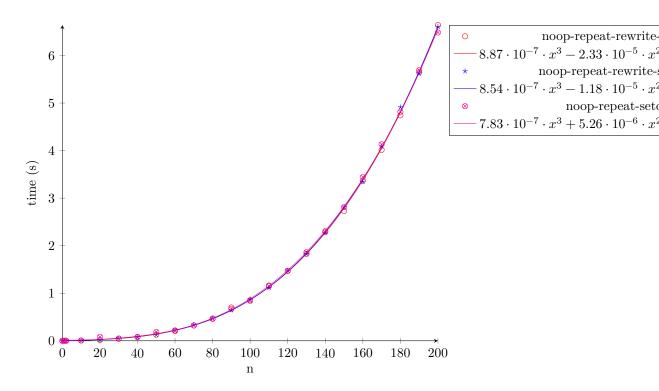
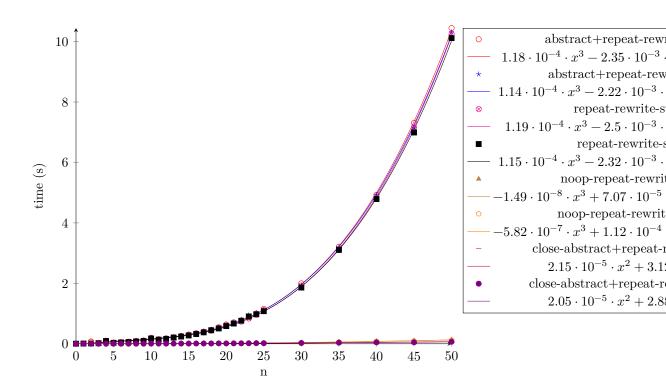
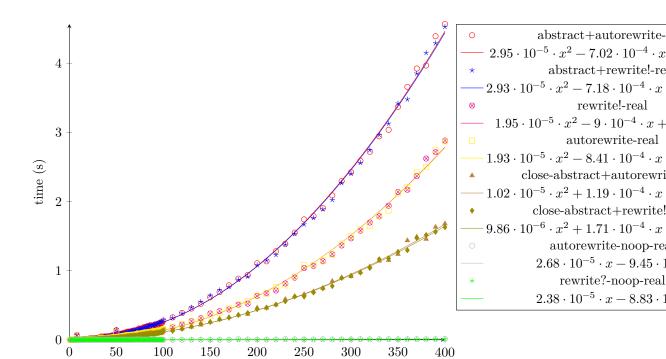


Figure 4: timing-repeat-setoid-rewrite-under-binders-noop

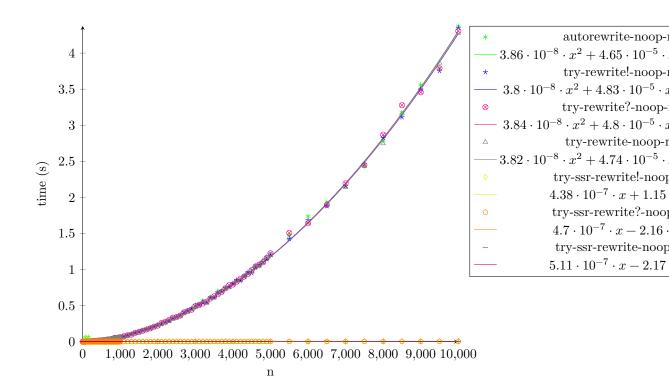


 $Figure\ 5:\ timing-rewrite-strat-under-binders$



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

n



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

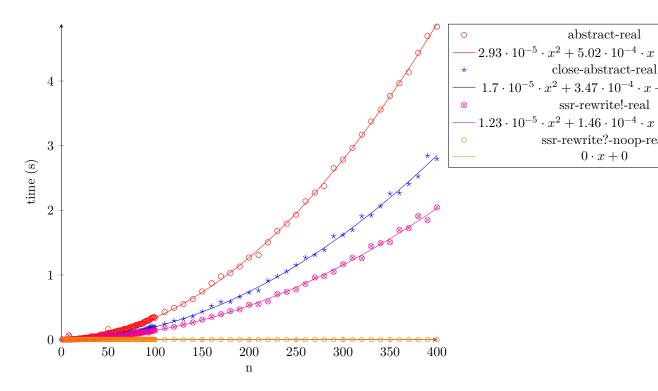
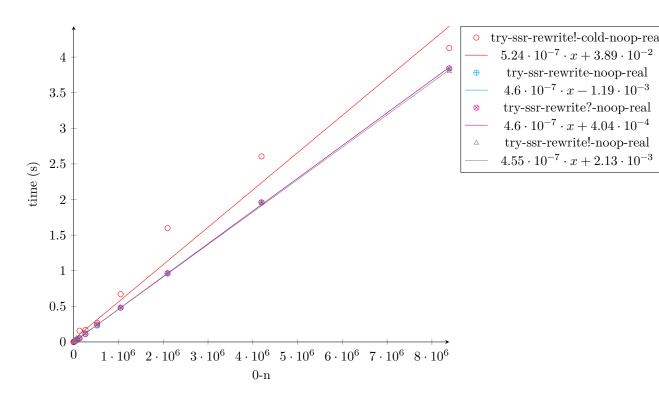


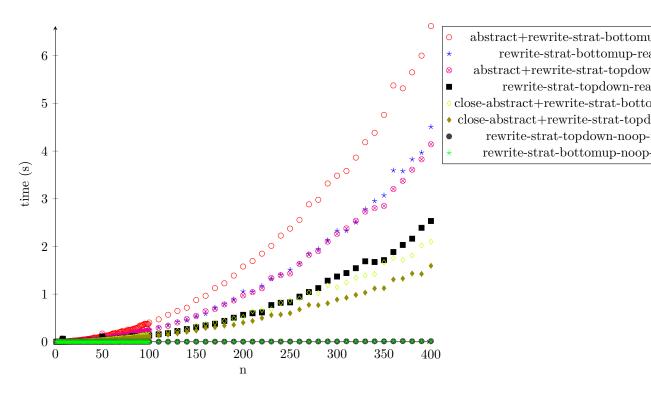
Figure 8: timing-rewrite-repeated-app-ssrrewrite



try-ssr-rewrite-noop-real

try-ssr-rewrite!-noop-real

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



rewrite-strat-bottomup-rea

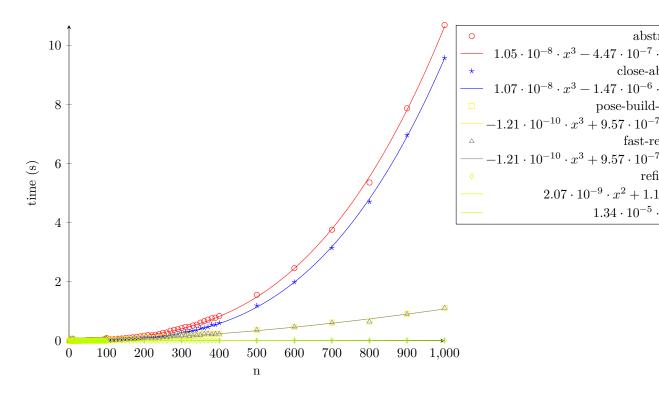
rewrite-strat-topdown-rea

rewrite-strat-topdown-noop-

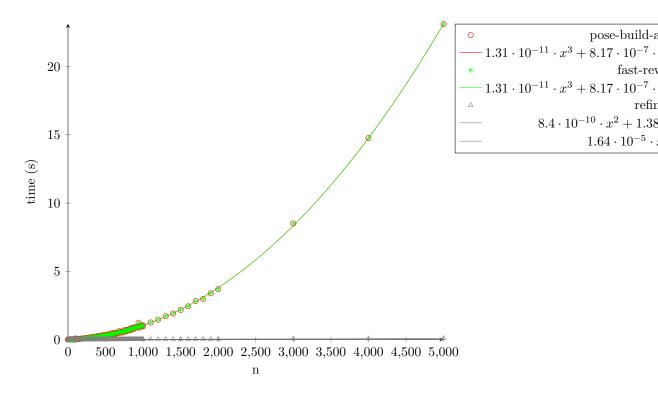
rewrite-strat-bottomup-noop-

abstract + rewrite - strat - topdow

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



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



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

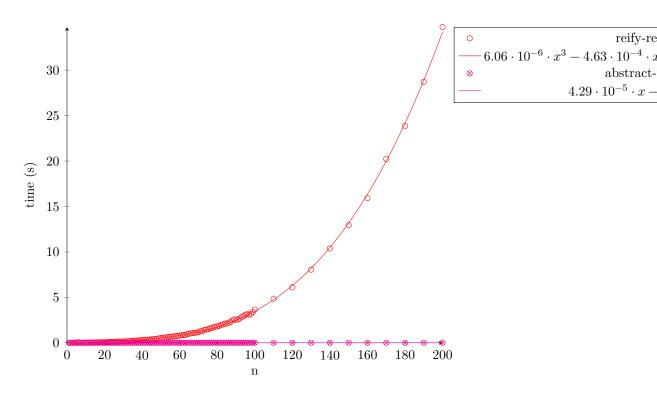
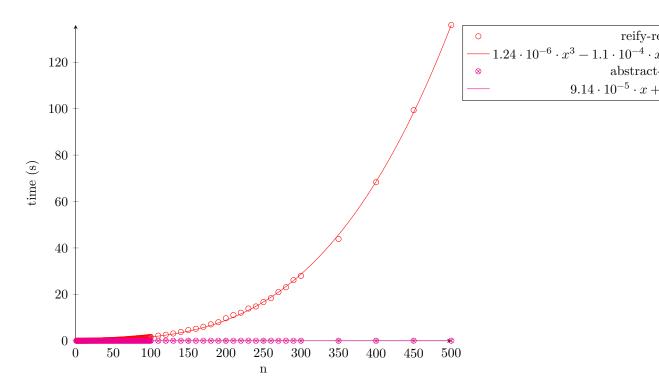
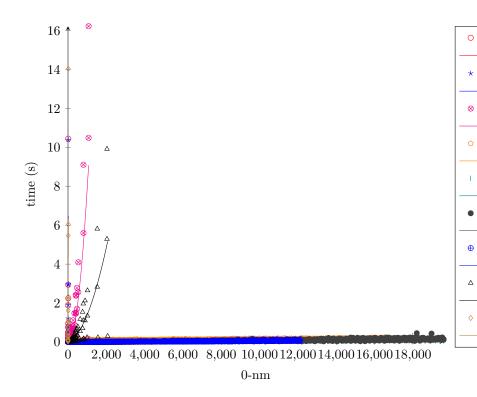


Figure 13: timing-typeclass-reification-let-in-HOAS



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



rewrite-strat(bottomup-bot $7.33 \cdot 10^{-3} exp(0.45 \cdot ($

rewrite-strat(topdown-bot) $5.88 \cdot 10^{-3} exp(0.47 \cdot ($

 $8.05 \cdot 10^{-6} \cdot x^2 - 2.48 \cdot 10^{-4} \cdot x^2$

 $3.14 \cdot 10^{-11} \cdot x^2 + 6.29 \cdot 10^{-6}$

 $1.19 \cdot 10^{-10} \cdot x^2 + 3.66 \cdot 10^{-6} \cdot$

 $2.29 \cdot 10^{-10} \cdot x^2 + 4.87 \cdot 10^{-6} \cdot \\$

 $1.67 \cdot 10^{-10} \cdot x^2 + 4.86 \cdot 10^{-6}$

 $1.03 \cdot 10^{-6} \cdot x^2 + 3.81 \cdot 10^{-4}$

 $-8.19 \cdot 10^{-3} \cdot x^3 + 0.26 \cdot x^2 -$

cps+cbn-real

 $\operatorname{cps+cbv-real}$

 $\operatorname{cps+lazy-real}$

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

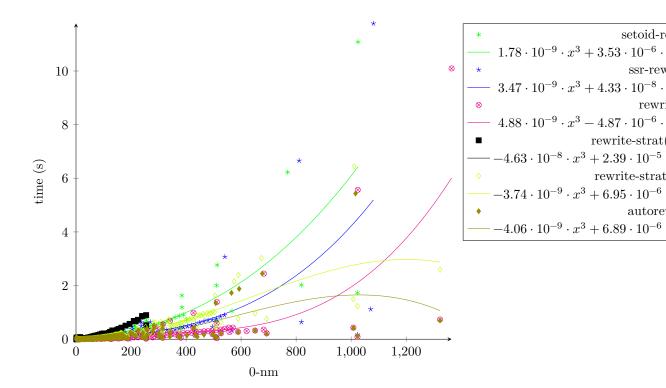
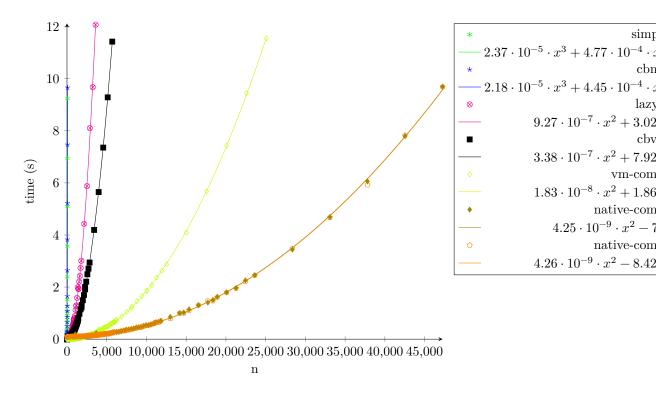


Figure 16: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1



simp

 $9.27 \cdot 10^{-7} \cdot x^2 + 3.02$ cbv $3.38 \cdot 10^{-7} \cdot x^2 + 7.92$

vm-com $1.83 \cdot 10^{-8} \cdot x^2 + 1.86$

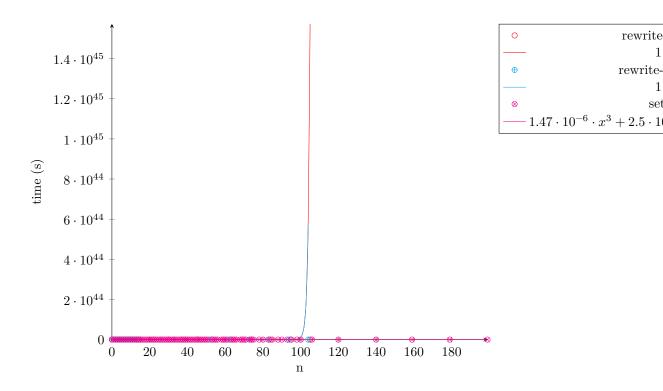
 $4.25 \cdot 10^{-9} \cdot x^2 - 7$

 $4.26 \cdot 10^{-9} \cdot x^2 - 8.42$

native-com

native-com

Figure 17: timing-sieve-of-eratosthenes



rewrite

rewrite-

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