

Figure 1: timing-pattern

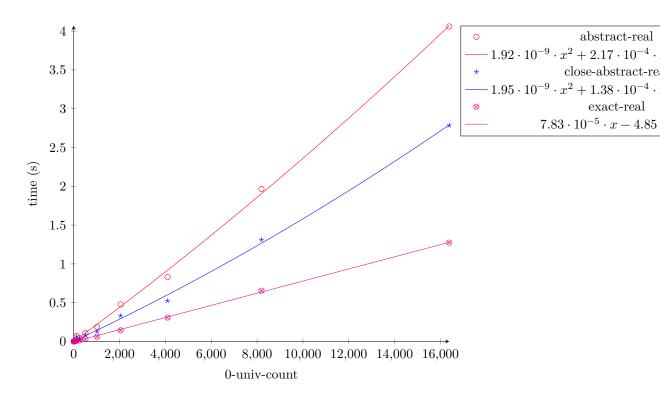
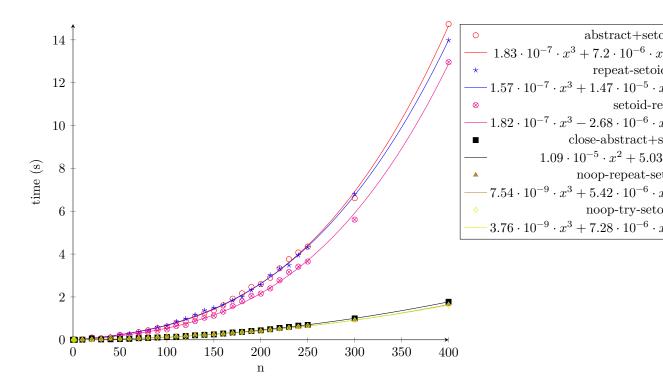
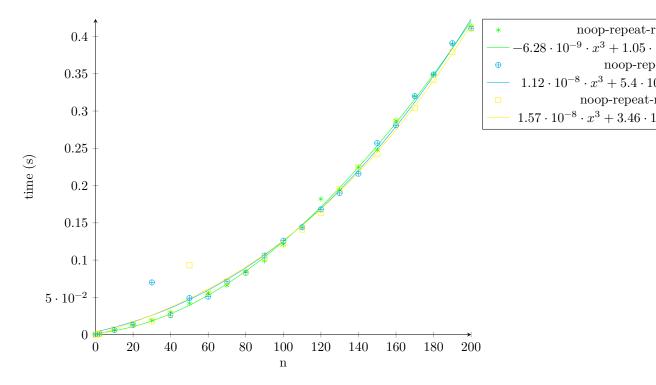


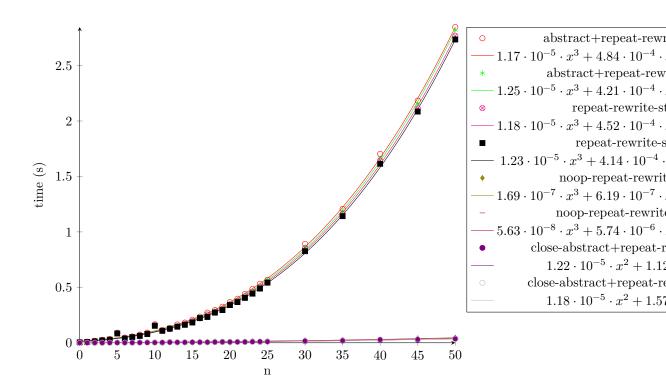
Figure 2: timing-n-polymorphic-universes param-1-n  $\,0\,$ 



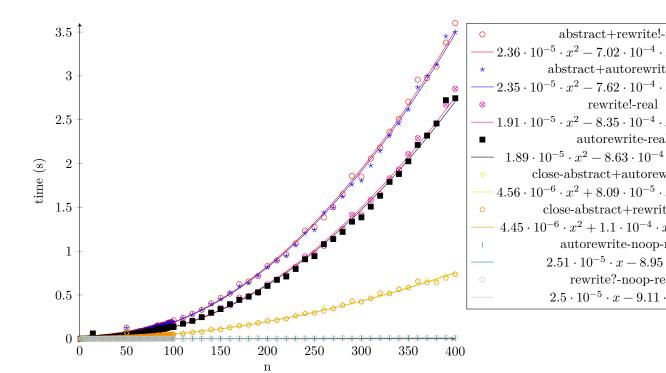
 $Figure \ 3: \ timing-repeat-setoid-rewrite-under-binders$ 



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



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



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

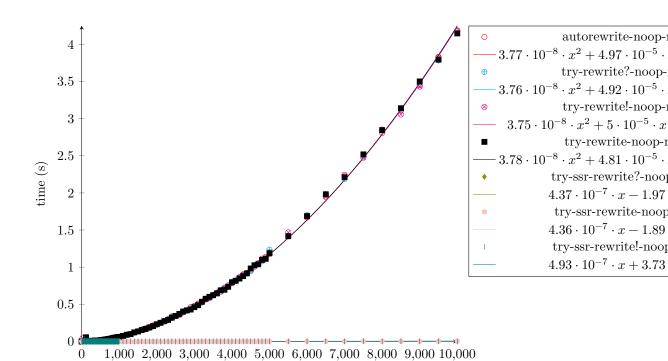
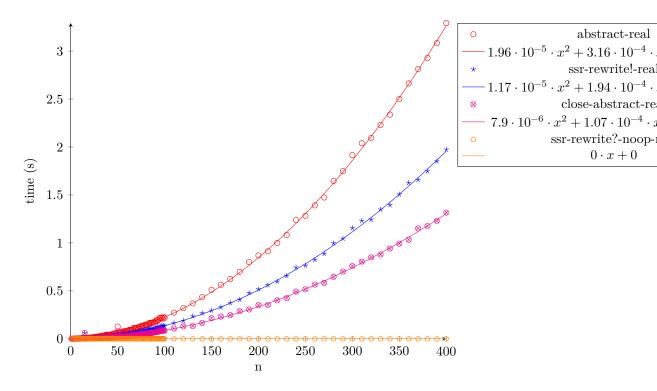
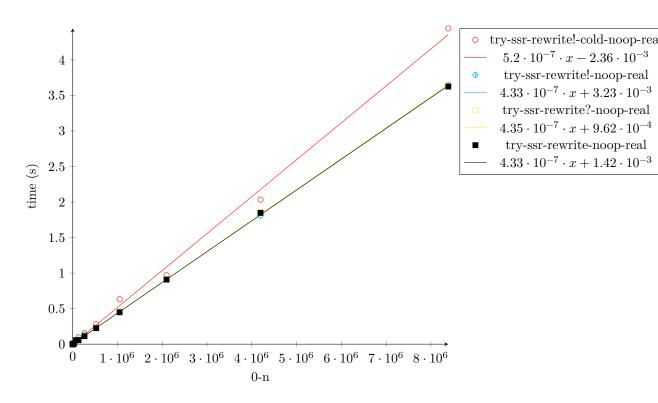


Figure 7: timing-rewrite-repeated-app-autorewrite-noop

n



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



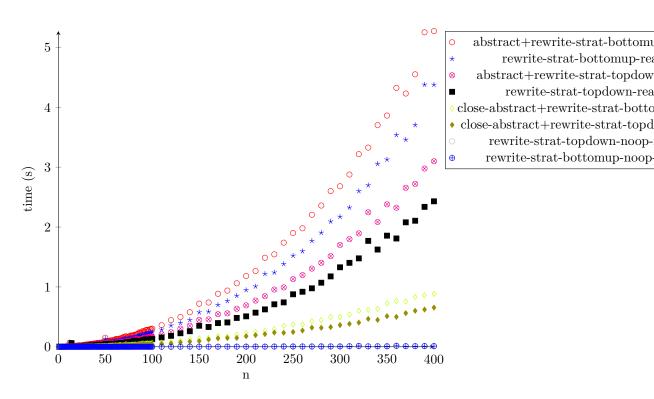
 $5.2 \cdot 10^{-7} \cdot x - 2.36 \cdot 10^{-3}$ 

try-ssr-rewrite!-noop-real  $4.33\cdot 10^{-7}\cdot x + 3.23\cdot 10^{-3}$ 

try-ssr-rewrite?-noop-real  $4.35 \cdot 10^{-7} \cdot x + 9.62 \cdot 10^{-4}$ 

try-ssr-rewrite-noop-real  $4.33\cdot 10^{-7}\cdot x + 1.42\cdot 10^{-3}$ 

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

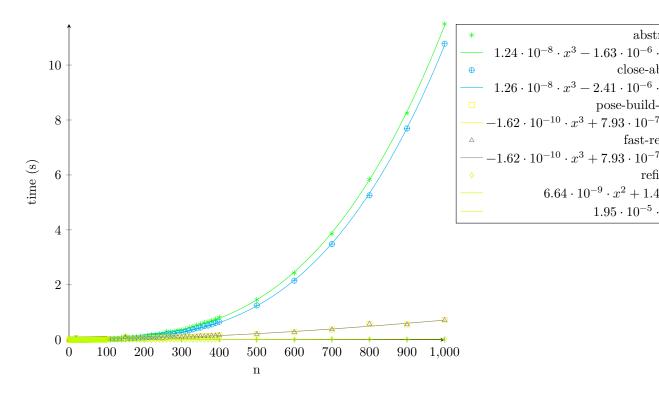


rewrite-strat-bottomup-real

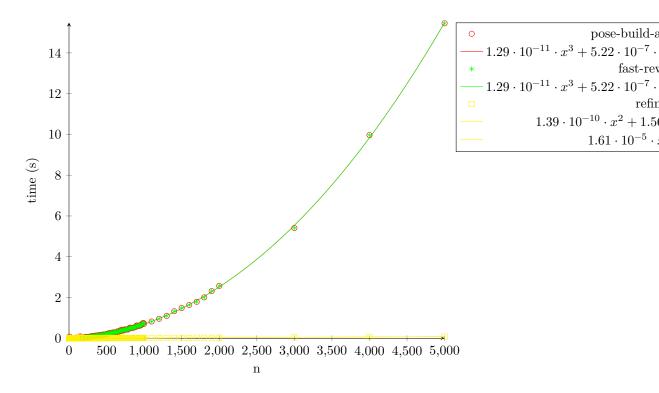
rewrite-strat-topdown-rea

rewrite-strat-topdown-nooprewrite-strat-bottomup-noop-

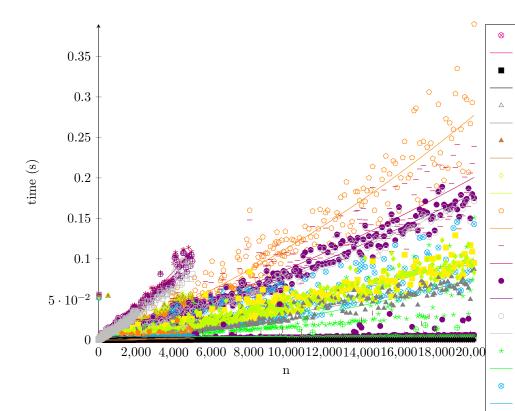
 $Figure\ 10:\ timing-rewrite-repeated-app-rewrite-strat$ 



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



Figure~12:~timing-rewrite-repeated-app-fast-rewrite-no-abstract



eval-lazy-for-be  $6.7 \cdot 10^{-11} \cdot x^{2}$ cbv-for-beta-P  $8.17 \cdot 10^{-11} \cdot x^{2}$ actual-reif-for-beta  $2.98 \cdot 10^{-10} \cdot x^{2}$ norm-reif-for-beta  $3.06 \cdot 10^{-10} \cdot x^{2}$ reif-for-beta-P  $3\cdot 10^{-10}\cdot x^2$ reif-for-Para  $2.64 \cdot 10^{-10} \cdot x^{2}$ norm-reif-for-Pa  $1.37\cdot 10^{-10}\cdot x$ reif-for-Parame  $1.13 \cdot 10^{-10} \cdot x^{2}$ norm-reif-for-Para  $1.15 \cdot 10^{-10} \cdot x^{2}$ lazy-beta-iota-for- $1.27 \cdot 10^{-10} \cdot x^{2}$ eval-lazy-for-Pa  $7.55 \cdot 10^{-11} \cdot x$ actual-reif-for-P  $6.25 \cdot 10^{-11} \cdot x$ eval-lazy-for-Para  $4.28 \cdot 10^{-11} \cdot x^{2}$ 

actual-reif-for-Par  $7.32 \cdot 10^{-11} \cdot x^{2}$ cbv-for-beta- $9.66 \cdot 10^{-11} \cdot x^{2}$ cbv-for-Parame  $7.63\cdot 10^{-12}\cdot x$ cbv-for-Para

 $8.24 \cdot 10^{-12} \cdot x^{2}$ lazy-beta-iota-for- $1.22 \cdot 10^{-10} \cdot x^{2}$ lazy-beta-iota-for-P

 $2.48 \cdot 10^{-12} \cdot x^{2}$ eval-lazy-for-beta

 $8.68 \cdot 10^{-11} \cdot x^{2}$ ▲ transitivity-(Denote-rv)- $8.68 \cdot 10^{-11} \cdot x^{2}$ 

transitivity-(Denote-rv 0

 $8.68 \cdot 10^{-11} \cdot x^{2}$ 

transitivity-(Denote-rv)- $8.68 \cdot 10^{-11} \cdot x^{2}$ 

transitivity-(Denote-rv  $8.68 \cdot 10^{-11} \cdot x^{2}$ 

pre-for-beta-P  $8.68\cdot 10^{-11}\cdot x^{2}$ 

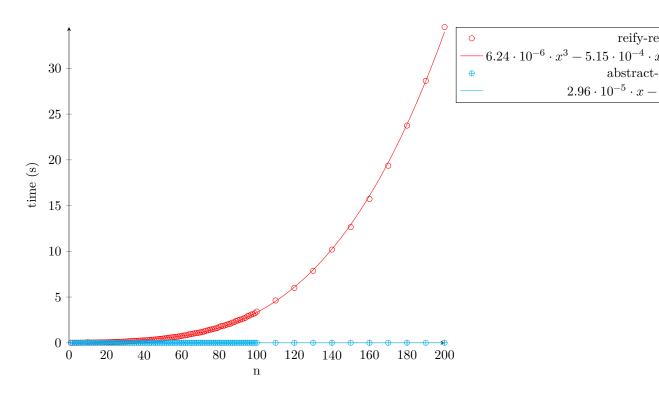
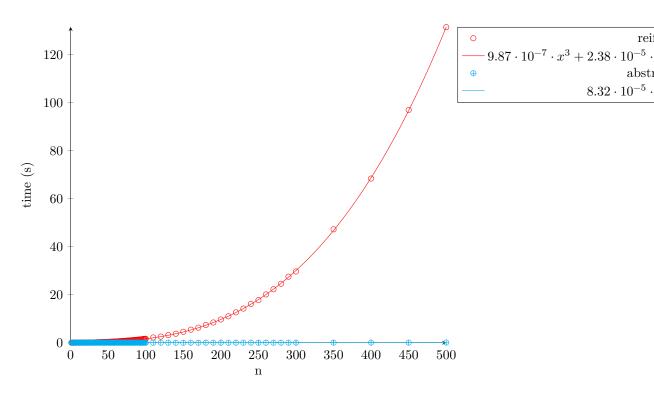


Figure 14: timing-typeclass-reification-let-in-HOAS



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

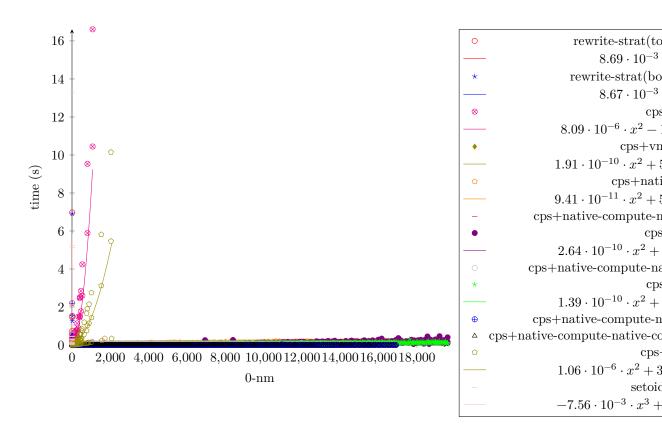


Figure 16: timing-rewrite-lift-lets-map param-1-n 1, param-2-m 1  $\,$ 

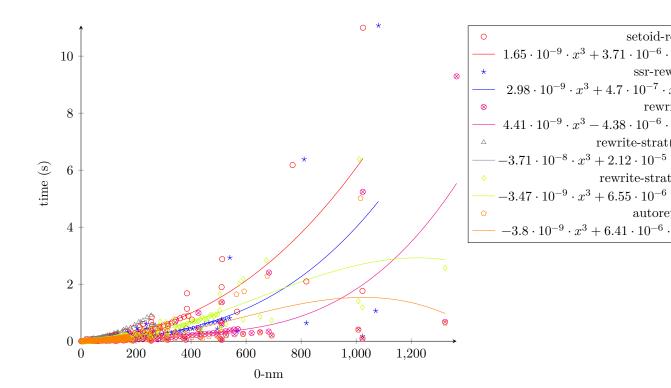


Figure 17: timing-rewrite-plus-0-tree param-1-n 0, param-2-m 1, param-3-input-size 5, param-4-output-size 3, param-5-num-rewrites 1

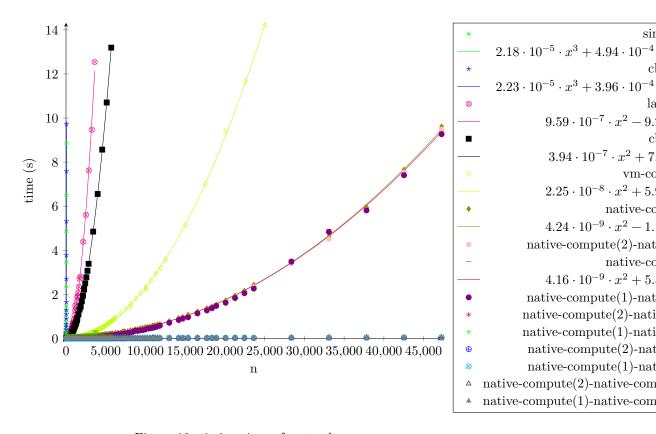
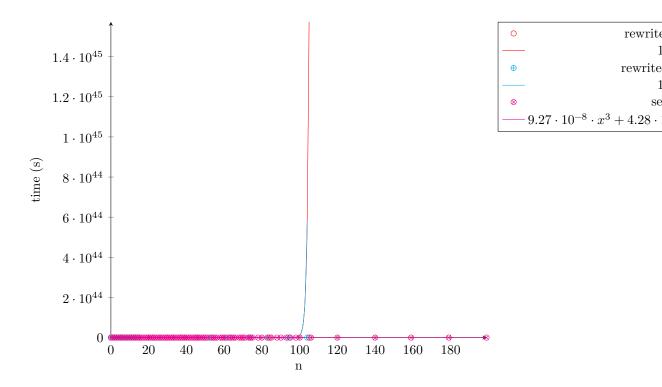


Figure 18: timing-sieve-of-eratosthenes



rewrite

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

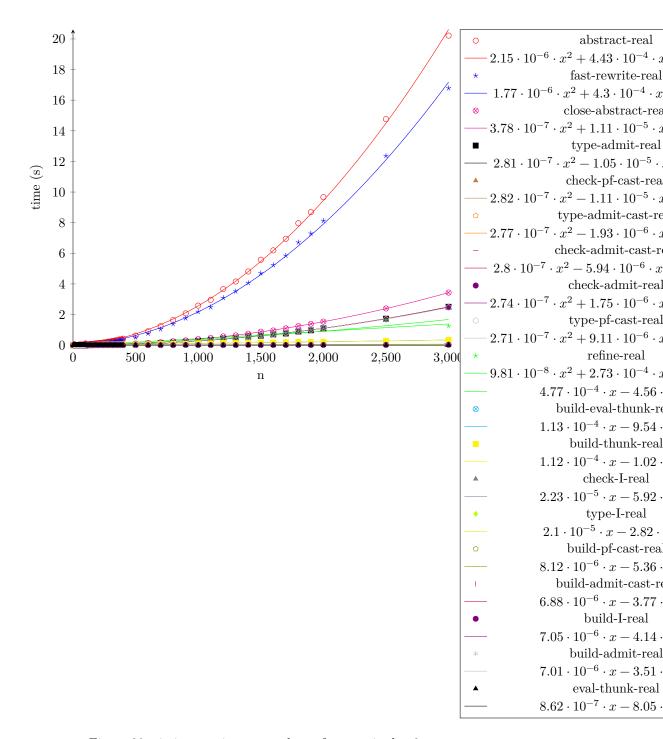


Figure 20: timing-rewrite-repeated-app-fast-rewrite-ltac2