

Figure 1: timing-pattern

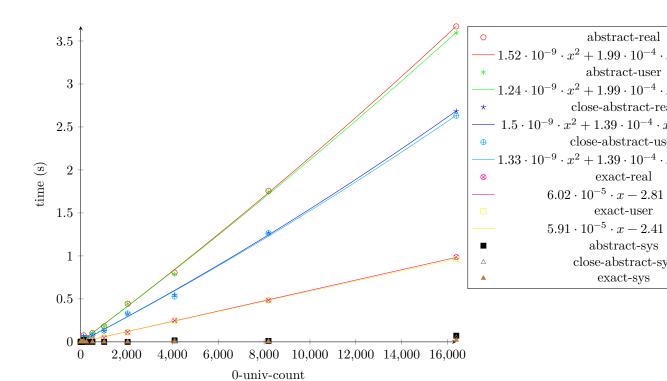


Figure 2: timing-n-polymorphic-universes param-1-n 0

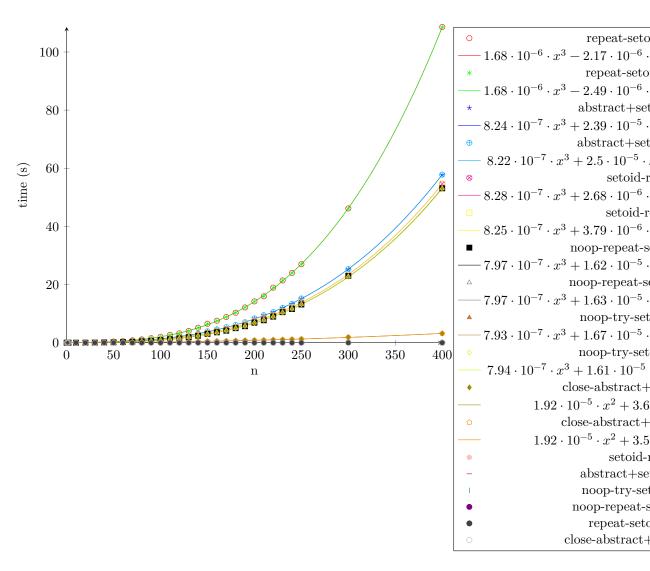
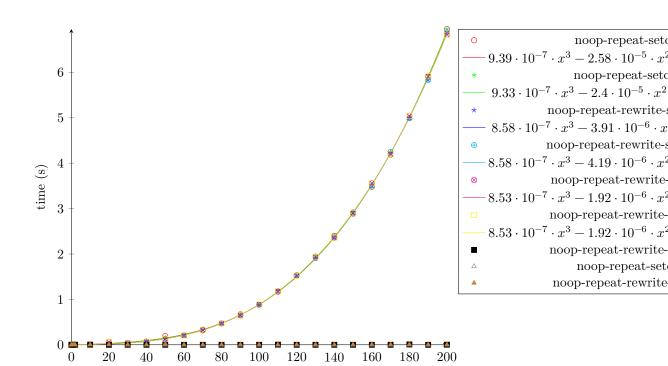


Figure 3: timing-repeat-setoid-rewrite-under-binders



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

n

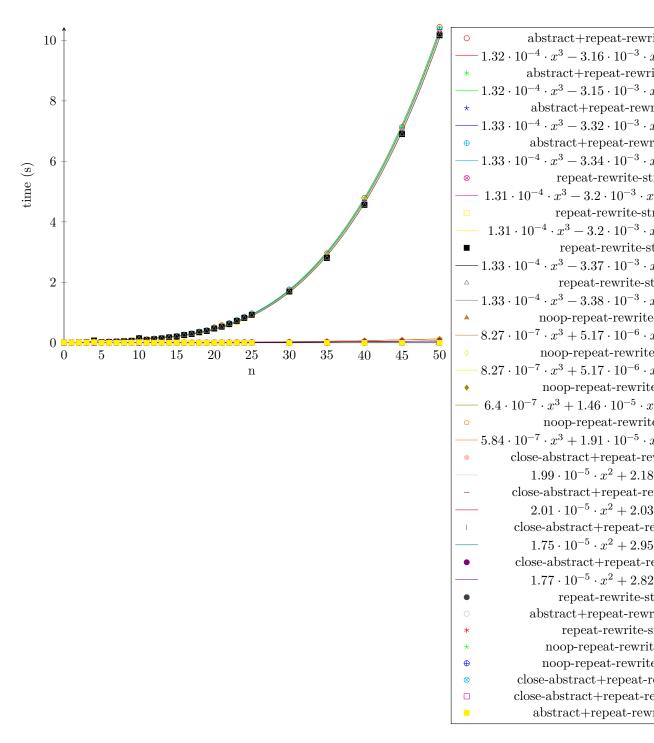
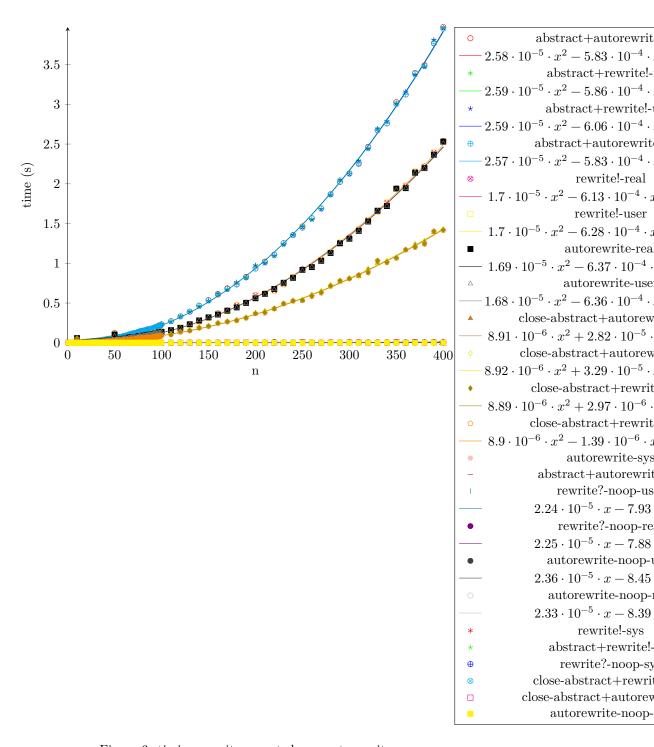


Figure 5: timing-rewrite-strat-under-binders



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

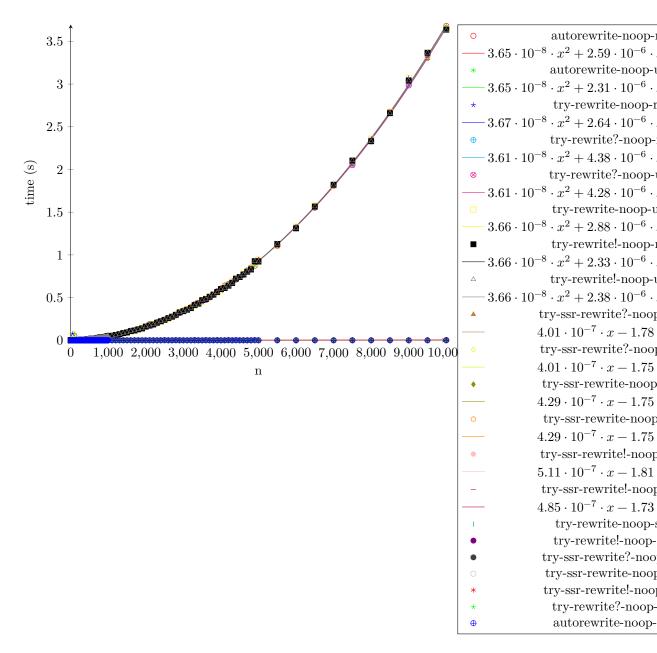


Figure 7: timing-rewrite-repeated-app-autorewrite-noop

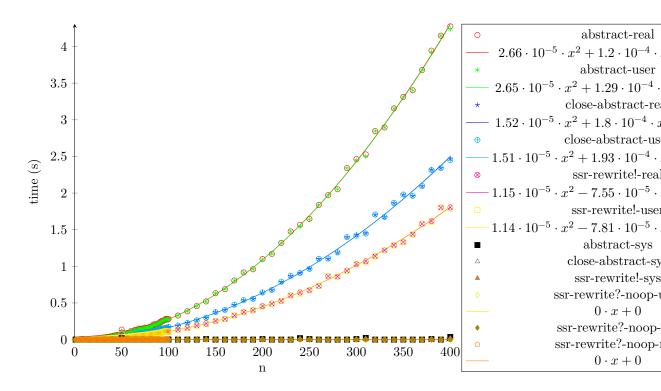


Figure 8: timing-rewrite-repeated-app-ssrrewrite

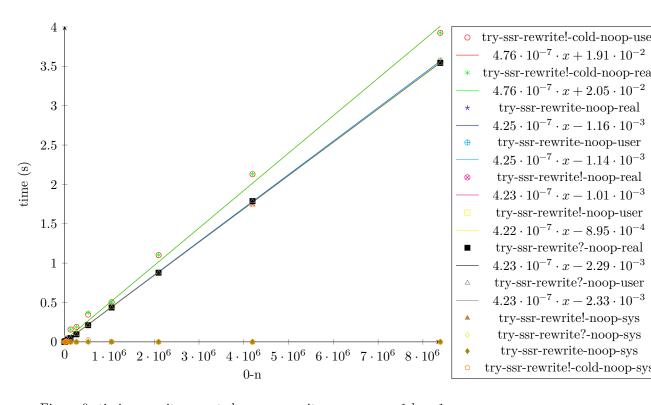


Figure 9: timing-rewrite-repeated-app-ssrrewrite-noop param-1-lgn  $\ 1$ 

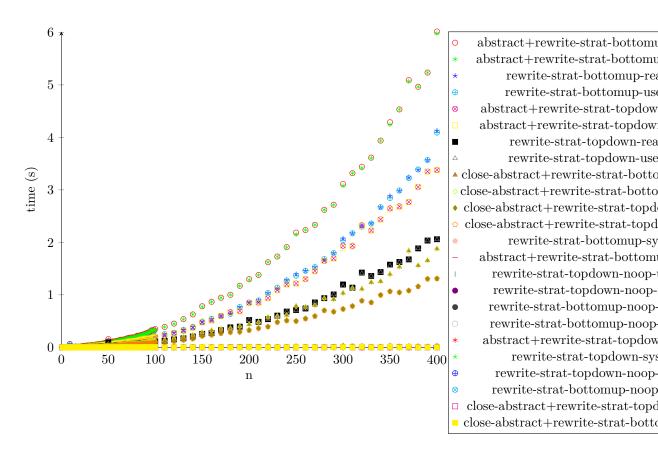


Figure 10: timing-rewrite-repeated-app-rewrite-strat

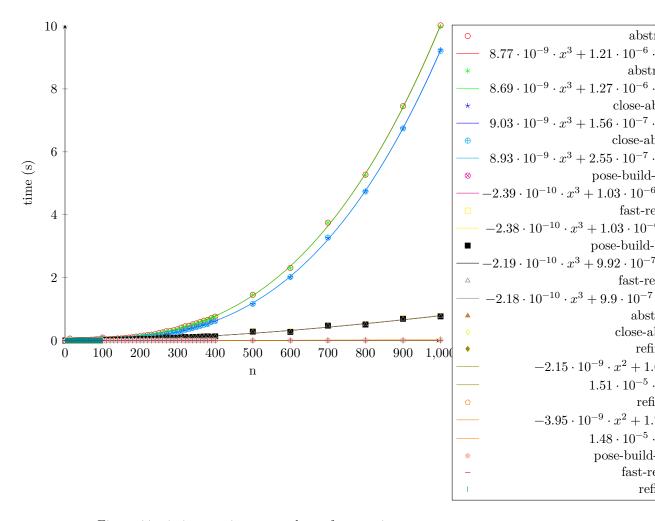
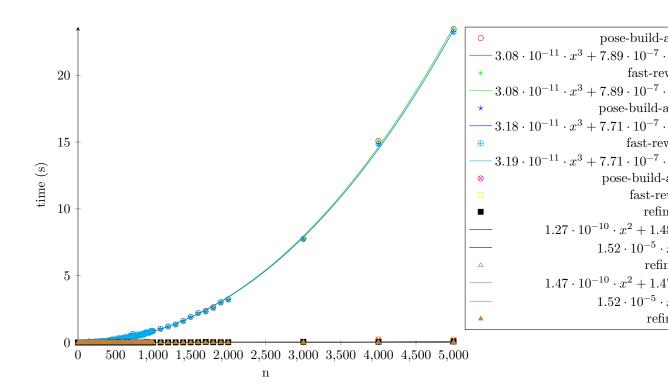
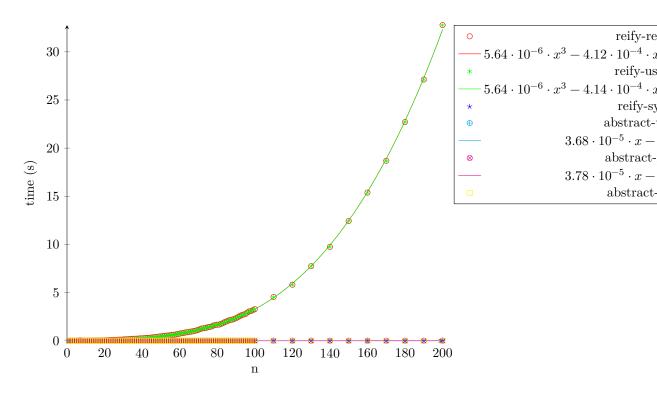


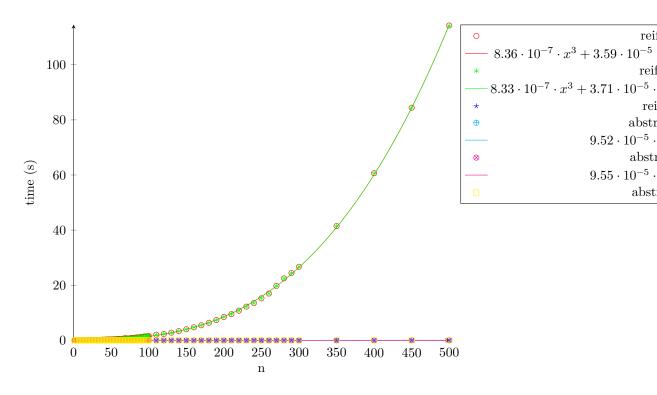
Figure 11: timing-rewrite-repeated-app-fast-rewrite



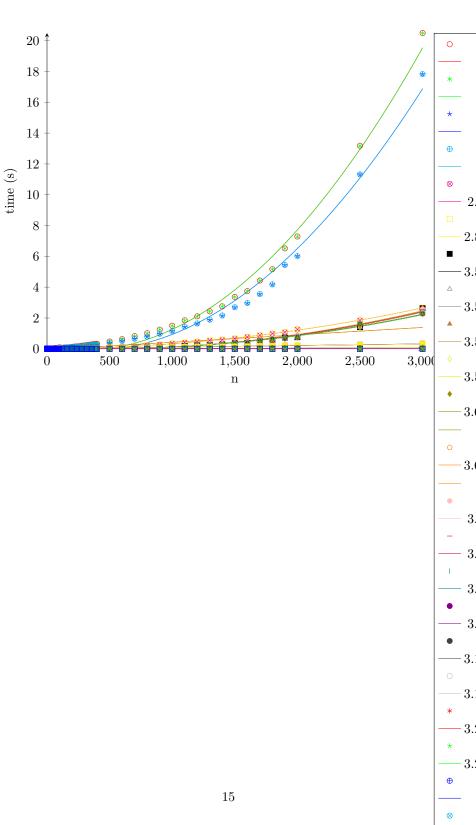
 $Figure~12:~timing\mbox{-rewrite-repeated-app-fast-rewrite-no-abstract}$ 



 ${\bf Figure~13:~timing-type class-reification-let-in-HOAS}$ 



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



 $2.4 \cdot 10^{-6} \cdot x^2 - 1.62 \cdot 10^{-3}$  $2.4 \cdot 10^{-6} \cdot x^2 - 1.62 \cdot 10^{-3}$  $2.82 \cdot 10^{-7} \cdot x^2 + 3.92 \cdot 10^{-5}$  $2.82 \cdot 10^{-7} \cdot x^2 + 4.06 \cdot 10^{-5} \cdot x^2 + 4.06 \cdot 10^{-5}$  $3.55 \cdot 10^{-7} \cdot x^2 - 2.81 \cdot 10^{-4} \cdot x^2$  $3.55 \cdot 10^{-7} \cdot x^2 - 2.81 \cdot 10^{-4} \cdot x^2$  $3.56 \cdot 10^{-7} \cdot x^2 - 2.82 \cdot 10^{-4} \cdot x^2$  $3.56 \cdot 10^{-7} \cdot x^2 - 2.82 \cdot 10^{-4} \cdot x^2$  $3.62 \cdot 10^{-7} \cdot x^2 - 2.71 \cdot 10^{-4} \cdot x^2$  $3.62 \cdot 10^{-7} \cdot x^2 - 2.71 \cdot 10^{-4} \cdot x^2$  $3.6 \cdot 10^{-7} \cdot x^2 - 2.83 \cdot 10^{-4} \cdot x$  $3.59 \cdot 10^{-7} \cdot x^2 - 2.82 \cdot 10^{-4}$  $3.21 \cdot 10^{-7} \cdot x^2 - 2.2 \cdot 10^{-4} \cdot x$  $3.21 \cdot 10^{-7} \cdot x^2 - 2.2 \cdot 10^{-4} \cdot x$  $3.17 \cdot 10^{-7} \cdot x^2 - 2.14 \cdot 10^{-4} \cdot x^2$  $3.17 \cdot 10^{-7} \cdot x^2 - 2.14 \cdot 10^{-4} \cdot x^2$  $3.21 \cdot 10^{-7} \cdot x^2 - 2.32 \cdot 10^{-4} \cdot x^2$  $3.21 \cdot 10^{-7} \cdot x^2 - 2.32 \cdot 10^{-4} \cdot x^2$ 

abstract-real

abstract-user

fast-rewrite-real

fast-rewrite-user

close-abstract-use

close-abstract-rea

type-pf-cast-user

type-pf-cast-real

type-admit-cast-us

type-admit-cast-re

 $4.81 \cdot 10^{-4} \cdot x - 5.83 \cdot$ refine-user

 $4.81 \cdot 10^{-4} \cdot x - 5.83 \cdot$ check-pf-cast-rea

check-pf-cast-use

check-admit-user

check-admit-real

check-admit-cast-u

check-admit-cast-r

type-admit-user

type-admit-real

build-eval-thunk-u

 $1.06 \cdot 10^{-4} \cdot x - 6.7$ build-eval-thunk-re  $1.07 \cdot 10^{-4} \cdot x - 6.27 \cdot$ build-thunk-user  $1.05 \cdot 10^{-4} \cdot x - 7.81 \cdot$ build-thunk-real  $1.06 \cdot 10^{-4} \cdot x - 7.31$ obook I waan

refine-real

 $2.68 \cdot 10^{-6} \cdot x^2 - 1.58 \cdot 10^{-8}$ 

 $2.68 \cdot 10^{-6} \cdot x^2 - 1.58 \cdot 10^{-8}$