

Figure 1: Timing of rewrite\_strat and setoid\_rewrite under binders

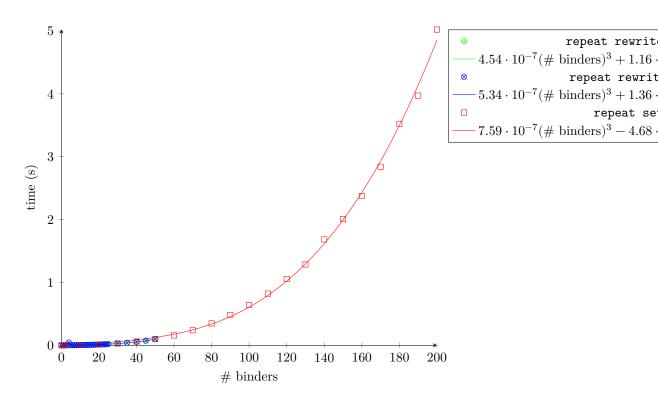
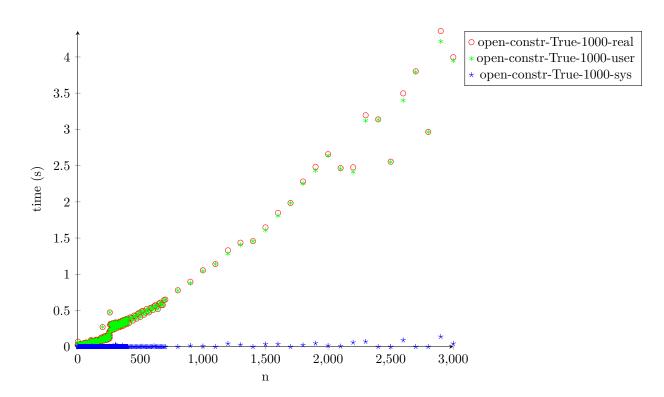
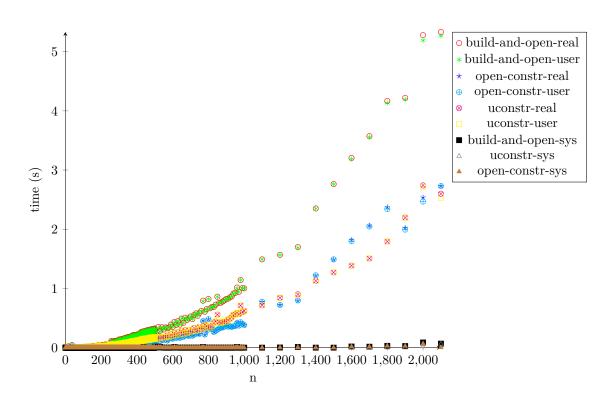


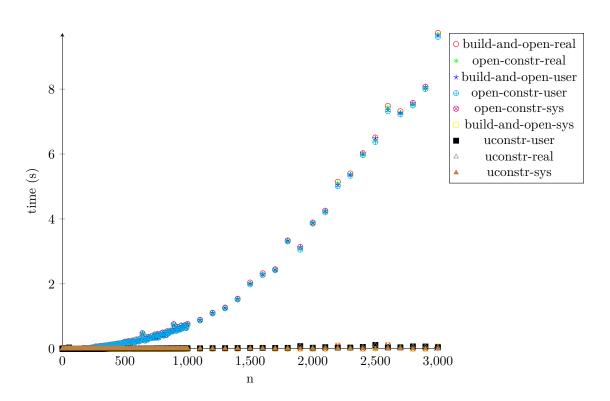
Figure 2: Timing of rewrite\_strat and setoid\_rewrite under binders



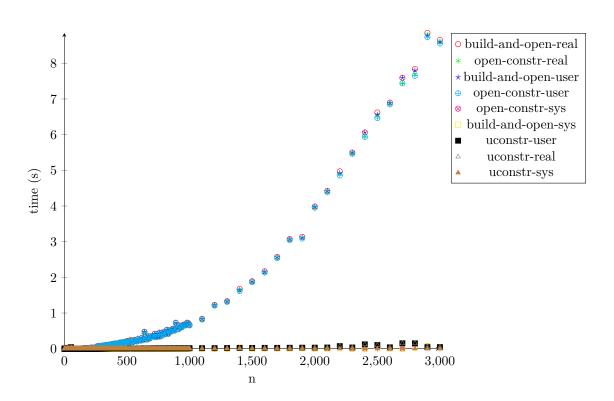
 $\label{eq:Figure 3: timing-do-n-open-constr-True} Figure \ 3: \ timing-do-n-open-constr-True$ 



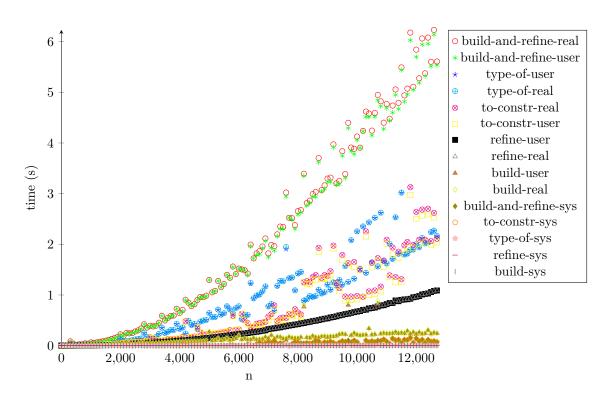
Figure~4:~timing-open-constr-n-lambda-no-types-different-names



Figure~5:~timing-open-constr-n-lambda-no-types-no-names



 $\label{prop:constr-n-lambda-no-types-same-names} Figure \ 6: \ timing-open-constr-n-lambda-no-types-same-names$ 



Figure~7:~timing-app-n-uconstr

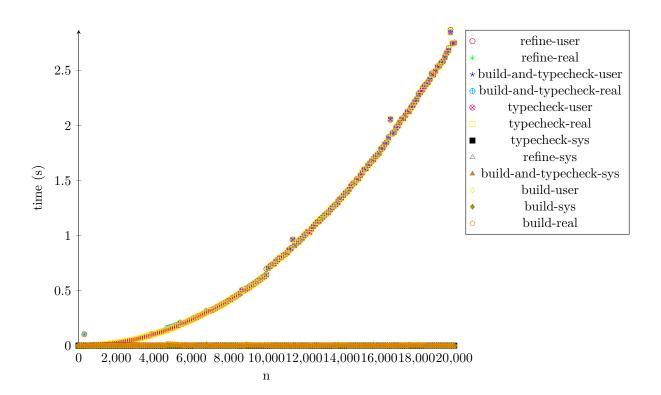


Figure 8: timing-app-n-ltac2  $\,$ 

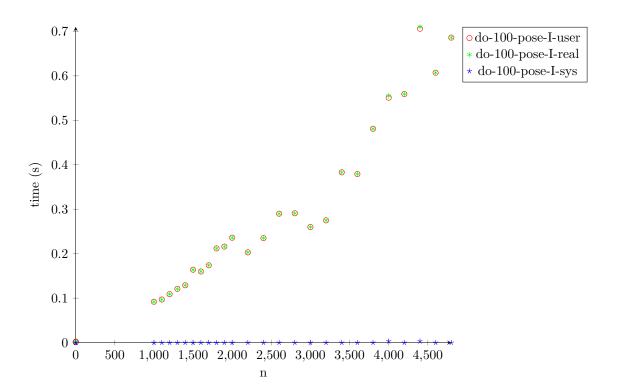


Figure 9: timing-do-n-pose

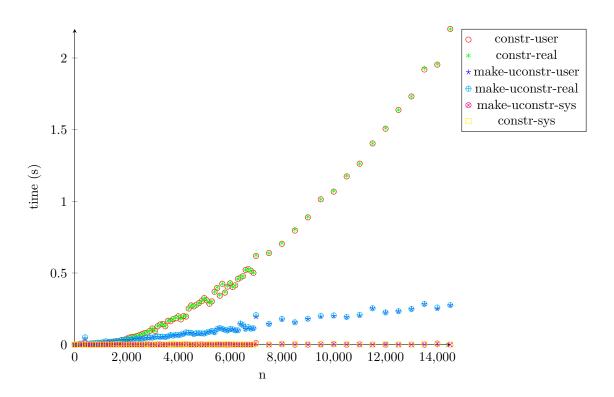


Figure 10: timing-let-n-uconstr

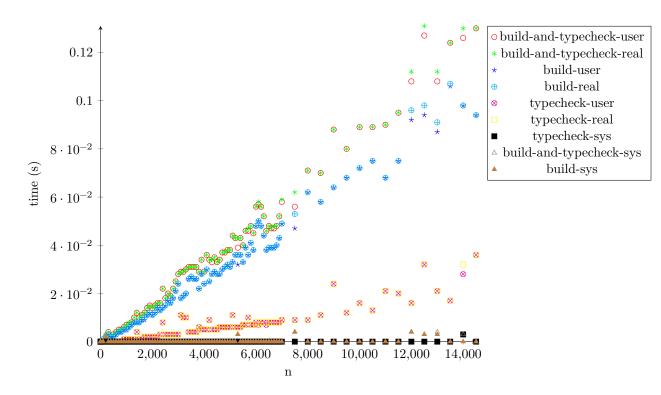
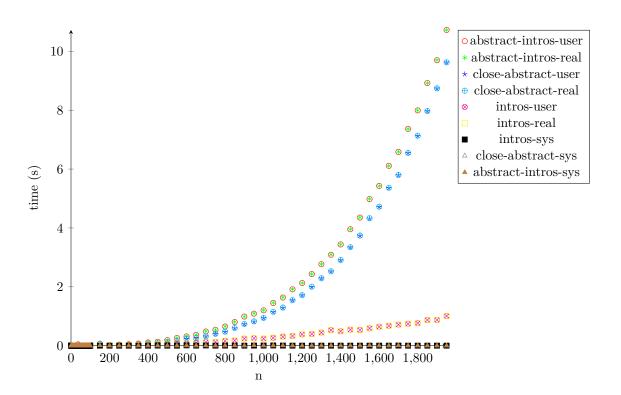


Figure 11: timing-let-n-ltac 2



Figure~12:~timing-intros-n-let

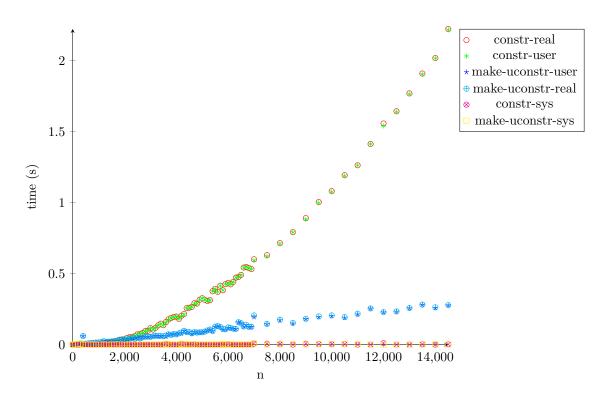


Figure 13: timing-fun-n-uconstr

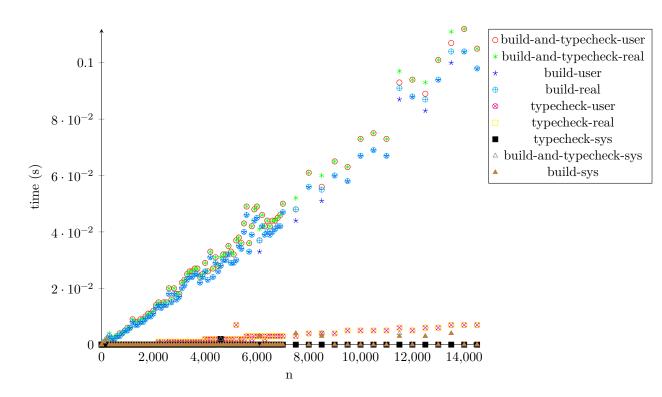


Figure 14: timing-fun-n-ltac2

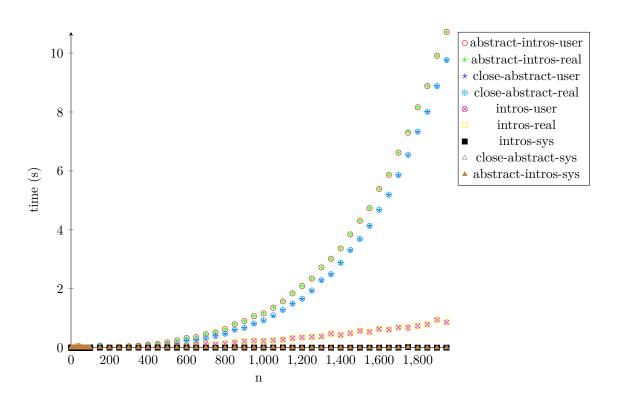
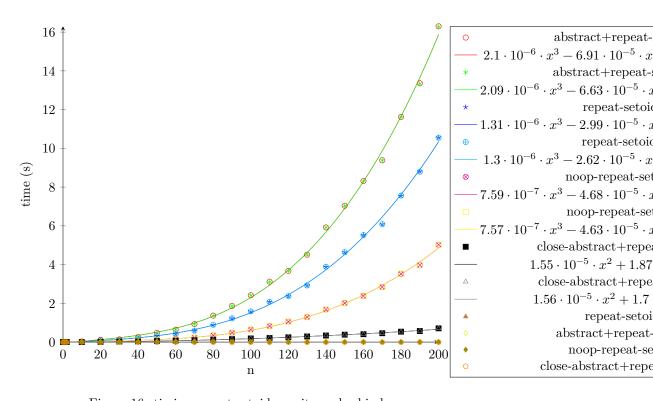
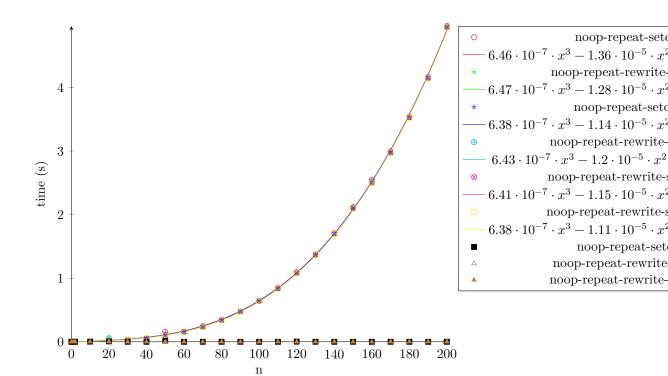


Figure 15: timing-intros-n-fun



 $Figure\ 16:\ timing-repeat-setoid-rewrite-under-binders$ 



 $Figure~17:~timing\mbox{-repeat-setoid-rewrite-under-binders-noop}$ 

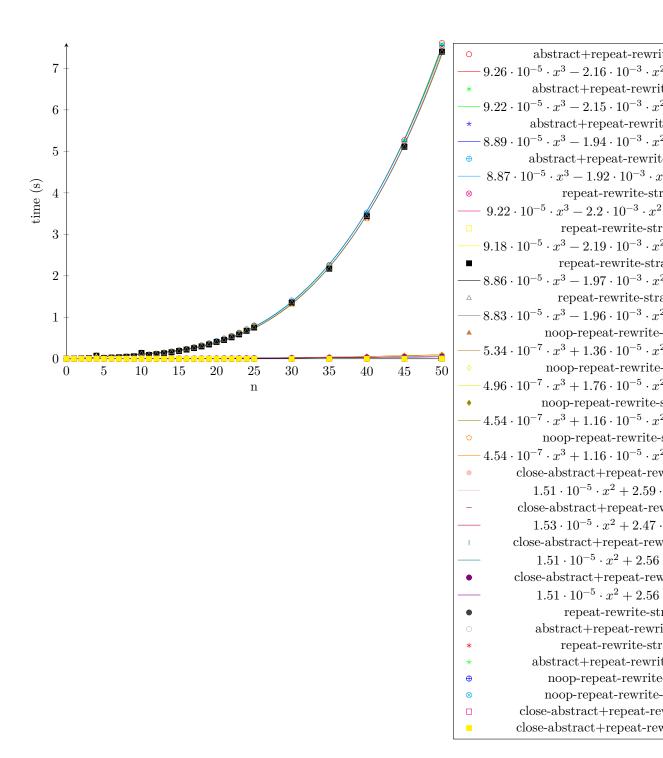
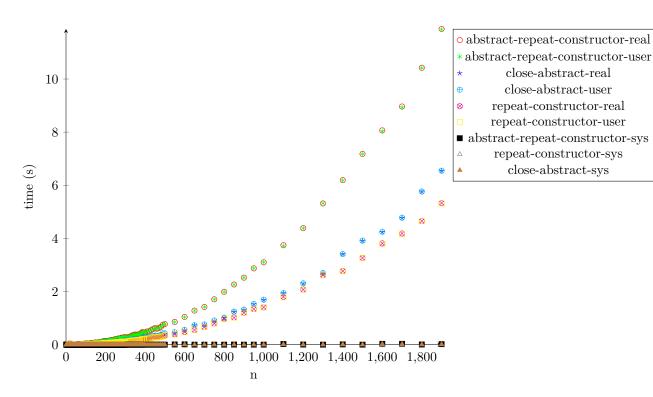


Figure 18: timing-rewrite-strat-under-binders



 ${\it close-abstract-real}$ 

close-abstract-user  ${\bf repeat\text{-}constructor\text{-}real}$  $repeat\hbox{-}constructor\hbox{-}user$ 

repeat-constructor-sys

 ${\it close-abstract-sys}$ 

Figure 19: timing-conj-True-repeat-constructor

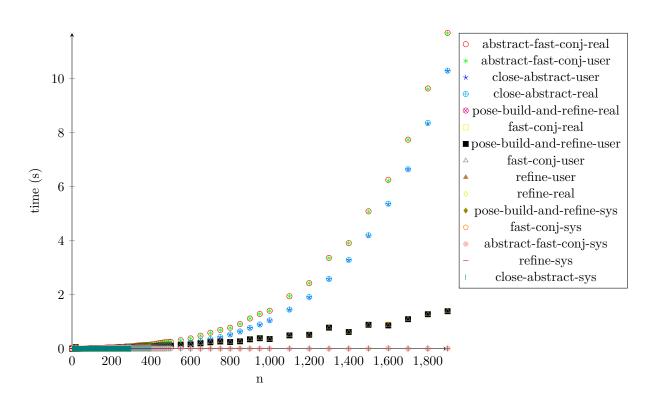


Figure 20: timing-conj-True-fast-conj

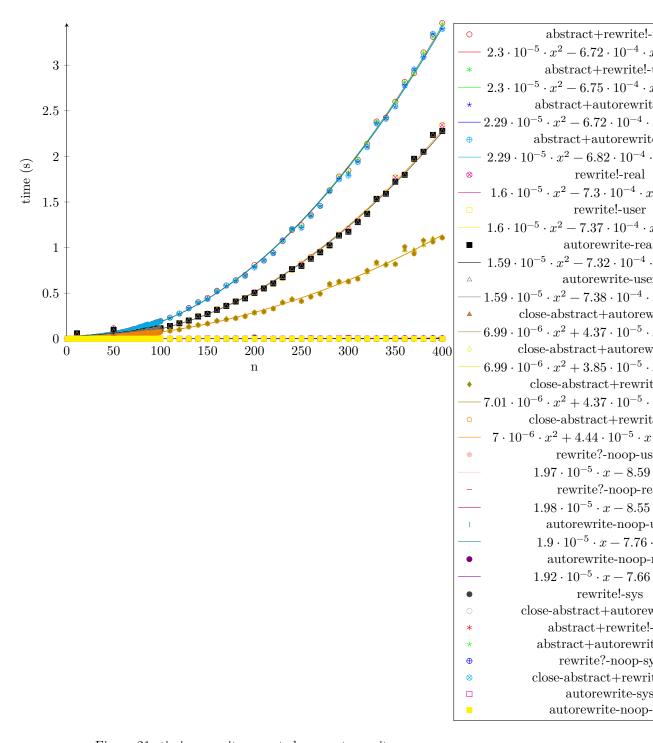


Figure 21: timing-rewrite-repeated-app-autorewrite

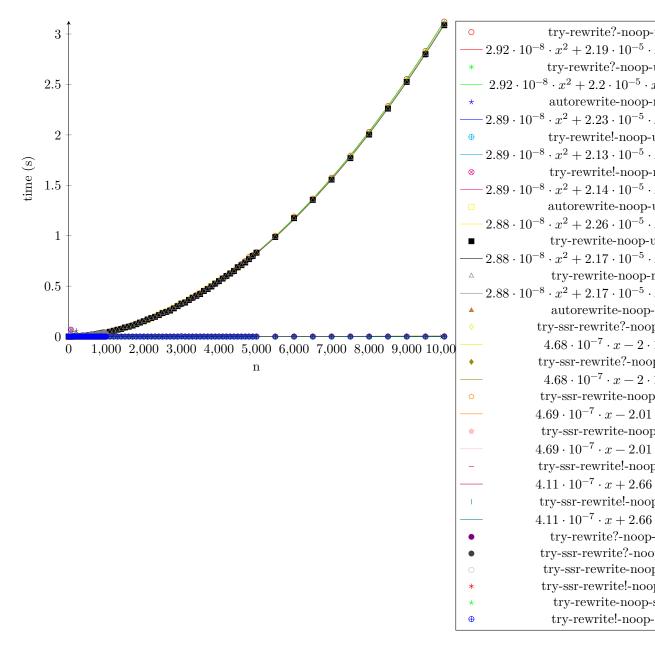


Figure 22: timing-rewrite-repeated-app-autorewrite-noop

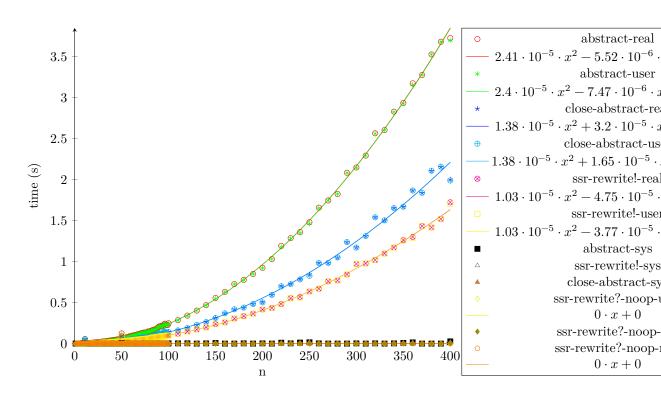


Figure 23: timing-rewrite-repeated-app-ssrrewrite

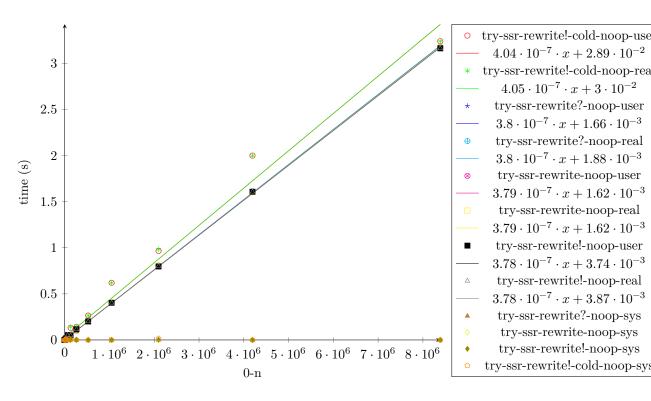
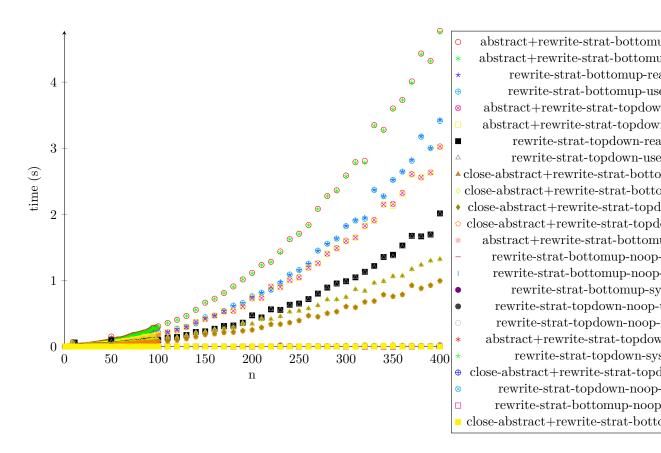


Figure 24: timing-rewrite-repeated-app-ssrrewrite-noop param-1-lgn  $\ 1$ 



 $Figure\ 25:\ timing-rewrite-repeated-app-rewrite-strat$ 

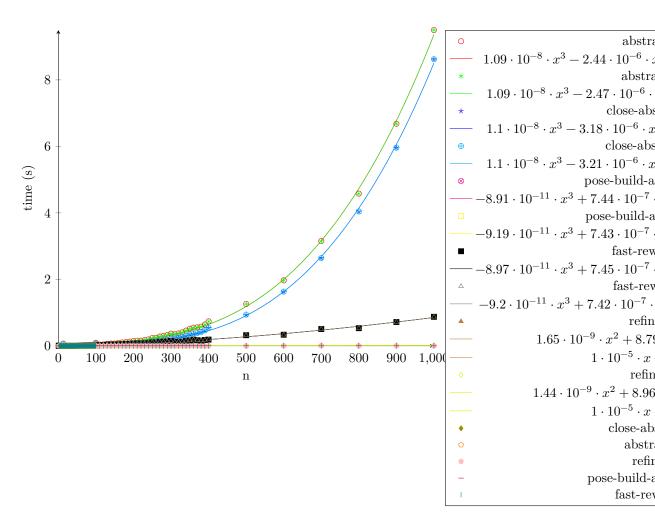
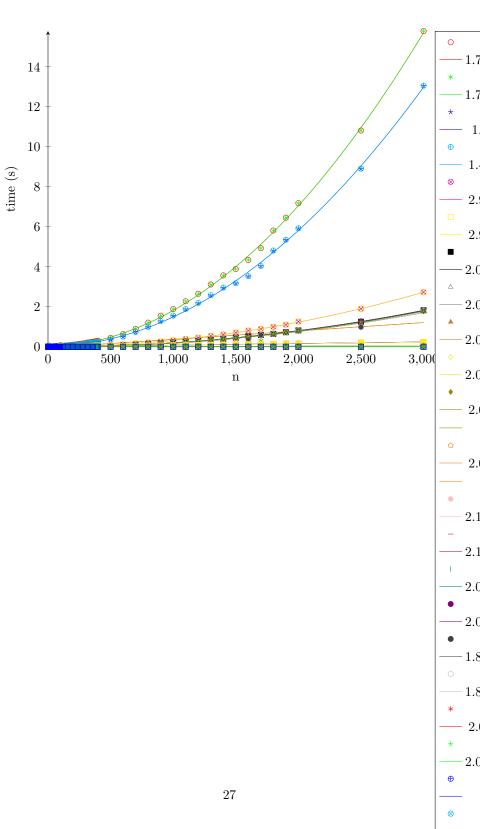


Figure 26: timing-rewrite-repeated-app-fast-rewrite



 $-1.71 \cdot 10^{-6} \cdot x^2 + 9.68 \cdot 10^{-5} \cdot x^2$  $1.71 \cdot 10^{-6} \cdot x^2 + 9.57 \cdot 10^{-5} \cdot x^2$  $1.42 \cdot 10^{-6} \cdot x^2 + 6.4 \cdot 10^{-5} \cdot x^2$  $1.42 \cdot 10^{-6} \cdot x^2 + 6.5 \cdot 10^{-5} \cdot x$  $2.93 \cdot 10^{-7} \cdot x^2 + 3.08 \cdot 10^{-5}$  $2.93 \cdot 10^{-7} \cdot x^2 + 3.1 \cdot 10^{-5} \cdot x$  $2.04 \cdot 10^{-7} \cdot x^2 - 4.54 \cdot 10^{-6} \cdot x^2$  $2.04 \cdot 10^{-7} \cdot x^2 - 4.33 \cdot 10^{-6} \cdot x^2$  $2.04 \cdot 10^{-7} \cdot x^2 - 6.74 \cdot 10^{-6} \cdot x^2$  $2.04 \cdot 10^{-7} \cdot x^2 - 6.74 \cdot 10^{-6} \cdot x^2$  $2.03 \cdot 10^{-7} \cdot x^2 - 3.2 \cdot 10^{-6} \cdot x$  $4.19 \cdot 10^{-4} \cdot x - 4.56 \cdot$  $2.03 \cdot 10^{-7} \cdot x^2 - 3.18 \cdot 10^{-6}$  $4.19 \cdot 10^{-4} \cdot x - 4.56 \cdot$  $2.14 \cdot 10^{-7} \cdot x^2 - 4.23 \cdot 10^{-5} \cdot x^2 = 4.23 \cdot 10^{-5} \cdot x^2 + 10^{-5}$  $2.14\cdot 10^{-7}\cdot x^2 - 4.15\cdot 10^{-5}\cdot x^2 - 4.15\cdot 10^{-5}\cdot x^2 + 2.14\cdot 1$  $2.04 \cdot 10^{-7} \cdot x^2 - 5.02 \cdot 10^{-6} \cdot x^2$  $2.04 \cdot 10^{-7} \cdot x^2 - 5.02 \cdot 10^{-6} \cdot x^2$  $1.88 \cdot 10^{-7} \cdot x^2 + 5.15 \cdot 10^{-6} \cdot x^2$  $1.88 \cdot 10^{-7} \cdot x^2 + 5.13 \cdot 10^{-6} \cdot x^2$  $2.02 \cdot 10^{-7} \cdot x^2 - 1.65 \cdot 10^{-5}$  $2.02 \cdot 10^{-7} \cdot x^2 - 1.61 \cdot 10^{-5} \cdot x^2$  $8.1 \cdot 10^{-5} \cdot x - 5.75 \cdot$  $8.1 \cdot 10^{-5} \cdot x - 4.06 \cdot$ 

abstract-real

abstract-user

fast-rewrite-user

fast-rewrite-real

close-abstract-use

close-abstract-rea

check-pf-cast-rea

check-pf-cast-use

type-admit-user

type-admit-real

refine-user

refine-real

type-pf-cast-user

type-pf-cast-real

type-admit-cast-us

type-admit-cast-re

check-admit-user

check-admit-real

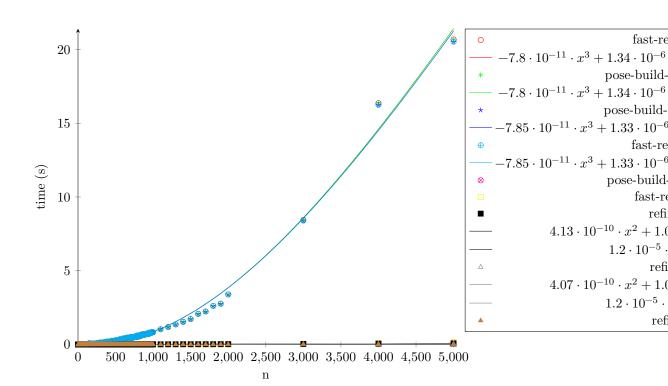
check-admit-cast-u

check-admit-cast-r

build-eval-thunk-ua

build-eval-thunk-re

build-thunk-user  $8.02 \cdot 10^{-5} \cdot x - 6.59$ build-thunk-real  $8.02 \cdot 10^{-5} \cdot x - 4.98 \cdot$ abaal, I ...aa



Figure~28:~timing-rewrite-repeated-app-fast-rewrite-no-abstract

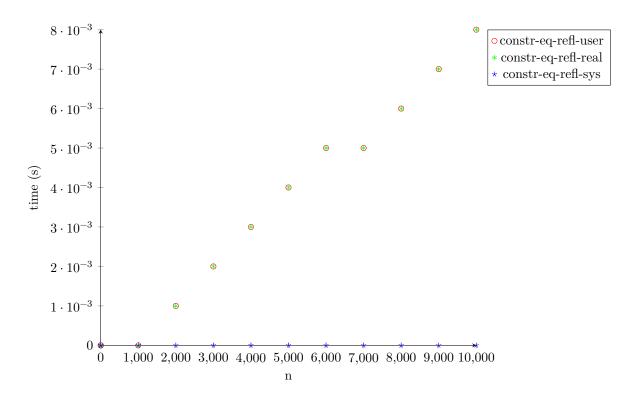


Figure 29: timing-constr-eq-alpha

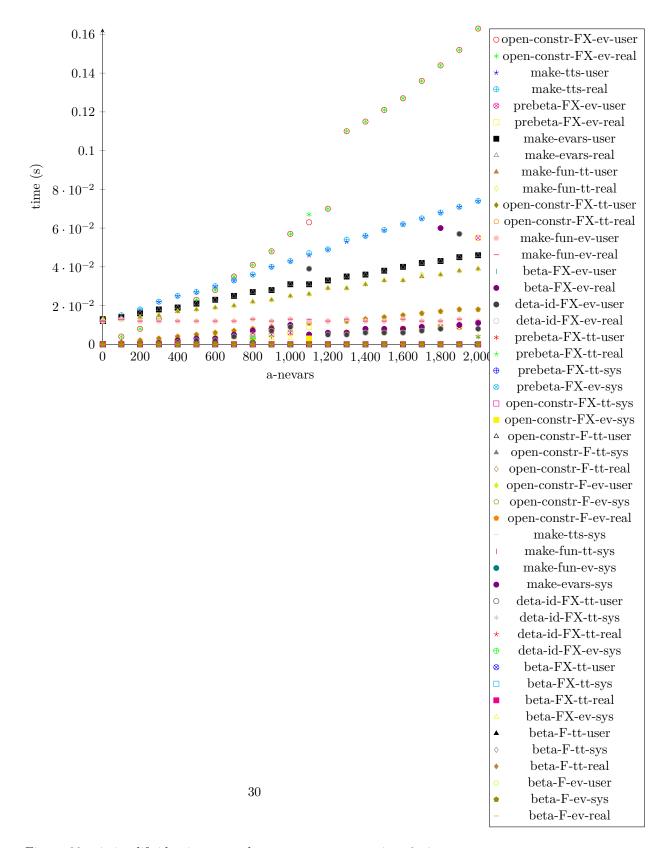


Figure 30: timing-lift-identity-evar-subst-nevars param-ctx-size  $\ 0,\ 1,\$ param-extra-binders  $\ 0,\ 1$ 

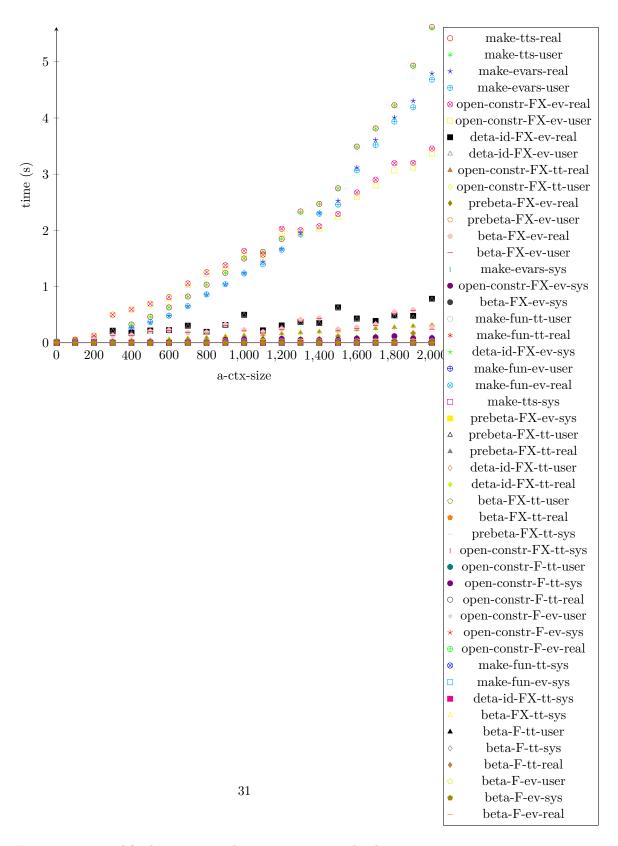


Figure 31: timing-lift-identity-evar-subst-ctx param-extra-binders  $\ 0, \ 1, \ param-evars \ 0, \ 1$ 

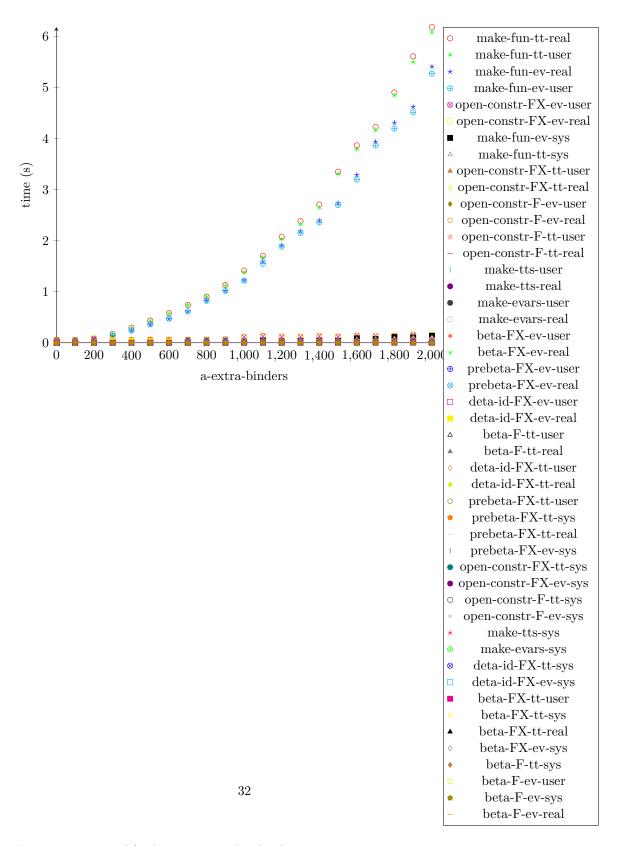


Figure 32: timing-lift-identity-evar-subst-binders param-ctx-size  $\ 0,\ 1,\ param-nevars\ 0,\ 1$ 

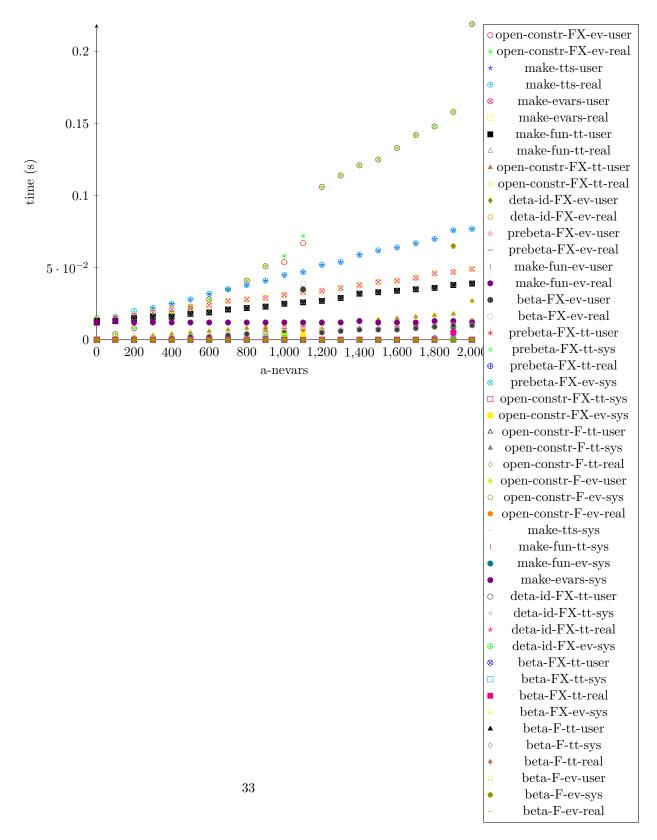


Figure 33: timing-lift-non-identity-evar-subst-nevars param-ctx-size  $0,\ 1,$  param-extra-binders  $0,\ 1$ 

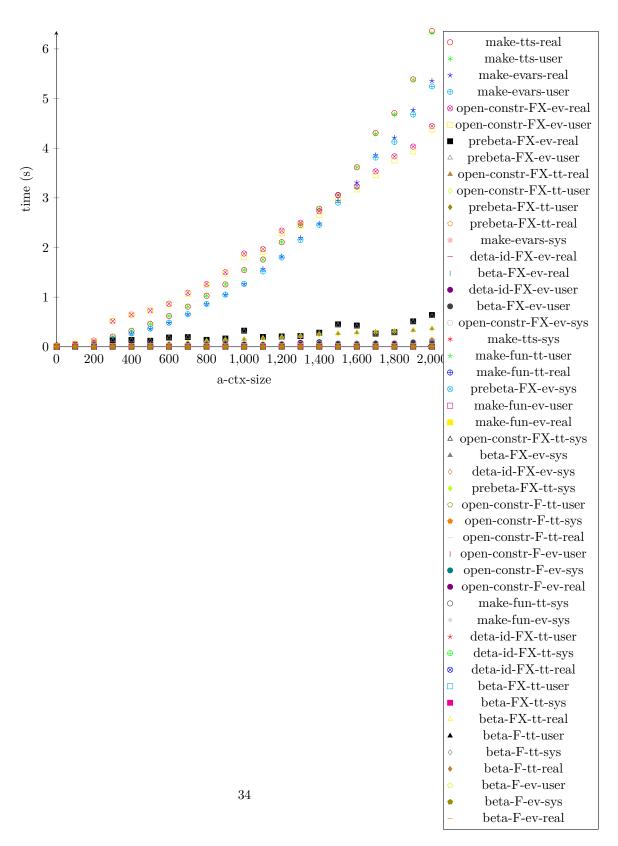


Figure 34: timing-lift-non-identity-evar-subst-ctx param-extra-binders 0, 1, param-nevars 0, 1

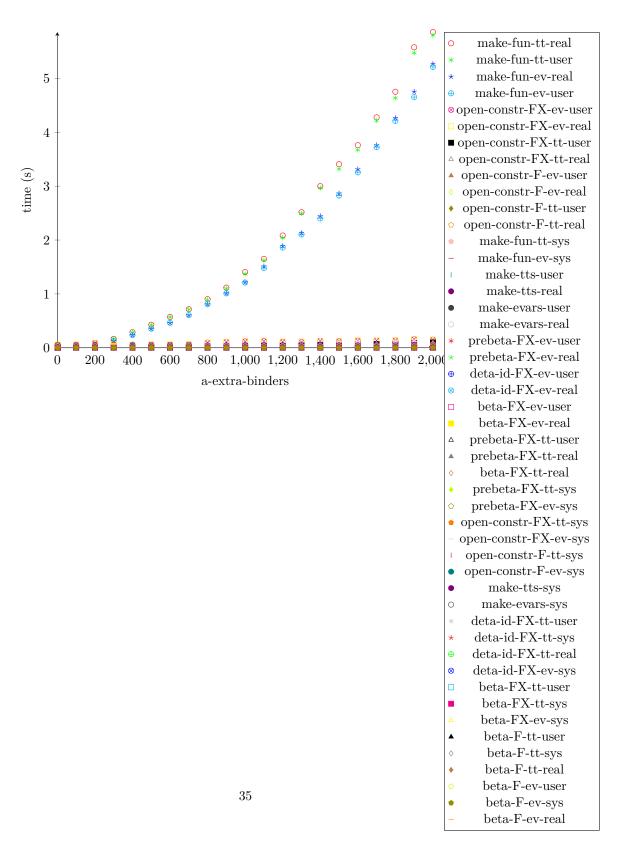
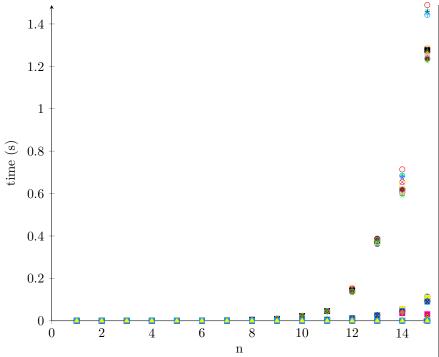
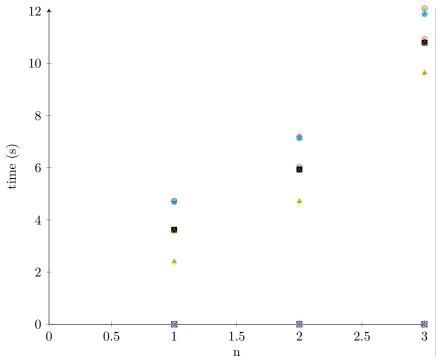


Figure 35: timing-lift-non-identity-evar-subst-binders param-ctx-size 0, 1, param-nevars 0, 1



o unify-delta-1-fast-real \* unify-delta-1-slow-real  $\star$  unify-delta-1-fast-user • unify-delta-1-slow-user ⊗ unify-zeta-1-fast-real unify-beta-1-fast-real ■ unify-zeta-1-fast-user △ unify-beta-1-fast-user ▲ unify-zeta-2-slow-real unify-zeta-2-slow-user • unify-beta-2-slow-user o unify-beta-2-slow-real unify-beta-2-fast-real - unify-zeta-2-fast-real unify-beta-2-fast-user • unify-zeta-1-slow-user • unify-zeta-1-slow-real o unify-beta-1-slow-real \* unify-beta-1-slow-user unify-zeta-2-fast-user delta-1-fast-user delta-1-fast-real delta-1-slow-user delta-1-slow-real beta-2-slow-user beta-2-slow-real zeta-1-fast-user zeta-1-fast-real beta-1-slow-user beta-1-slow-real zeta-2-slow-user zeta-2-slow-real zeta-2-fast-user zeta-2-fast-real beta-1-fast-user beta-1-fast-real zeta-1-slow-user zeta-1-slow-real beta-2-fast-user beta-2-fast-real unify-delta-1-fast-sys unify-delta-1-slow-sys unify-zeta-2-fast-sys unify-beta-1-fast-sys unify-zeta-1-fast-sys unify-beta-2-fast-sys unify-zeta-2-slow-sys unify-beta-1-slow-sys zeta-2-slow-sys zeta-2-fast-sys zeta-1-slow-sys

zeta-1-fast-sysunify-zeta-1-slow-sys



o abstract-unify-beta-2-slow-real \* abstract-unify-beta-2-slow-user \* abstract-unify-zeta-2-slow-real • abstract-unify-zeta-2-slow-user ⊗ abstract-unify-zeta-1-slow-real abstract-unify-zeta-1-slow-user ■ abstract-unify-beta-1-slow-real  $\triangle$  abstract-unify-beta-1-slow-user ▲ abstract-unify-delta-1-slow-real ♦ abstract-unify-delta-1-slow-user • abstract-unify-zeta-1-slow-sys • abstract-unify-beta-2-slow-sys abstract-unify-beta-1-slow-sys abstract-unify-delta-1-slow-sys abstract-unify-zeta-2-slow-sys • abstract-unify-zeta-2-fast-user abstract-unify-zeta-2-fast-real abstract-unify-zeta-1-fast-user \* abstract-unify-zeta-1-fast-real \* abstract-unify-delta-1-fast-user • abstract-unify-delta-1-fast-real abstract-unify-beta-2-fast-user  $\square$  abstract-unify-beta-2-fast-real abstract-unify-beta-1-fast-user △ abstract-unify-beta-1-fast-real zeta-2-slow-user zeta-2-slow-sys zeta-2-slow-real zeta-2-fast-user zeta-2-fast-sys zeta-2-fast-real zeta-1-slow-user zeta-1-slow-sys zeta-1-slow-real zeta-1-fast-user zeta-1-fast-sys zeta-1-fast-real Ф unify-zeta-2-slow-user 8 unify-zeta-2-slow-sys

> unify-zeta-2-slow-real unify-zeta-2-fast-user unify-zeta-2-fast-sys unify-zeta-2-fast-real unify-zeta-1-slow-user unify-zeta-1-slow-sys

unify-zeta-1-slow-real unify-zeta-1-fast-user unify-zeta-1-fast-sys unify-zeta-1-fast-real unify-delta-1-slow-user unify-delta-1-slow-real unify-delta-1-fast-user

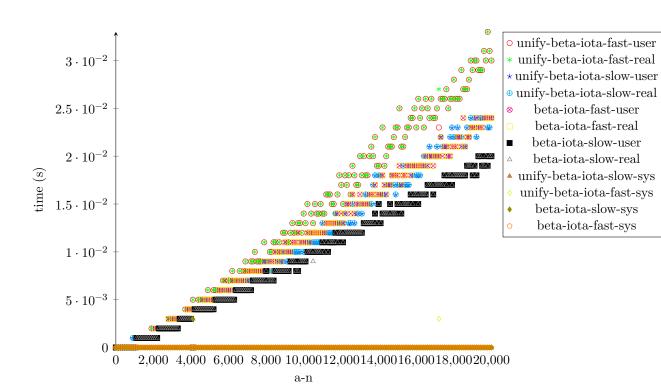


Figure 38: timing-iota-reduction-fact8 param-fact-n  $\,\,8\,$ 

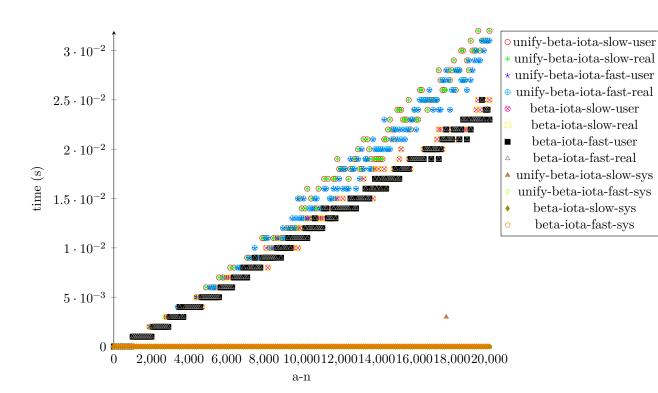


Figure 39: timing-iota-reduction-fact9 param-fact-n  $\ 9$ 

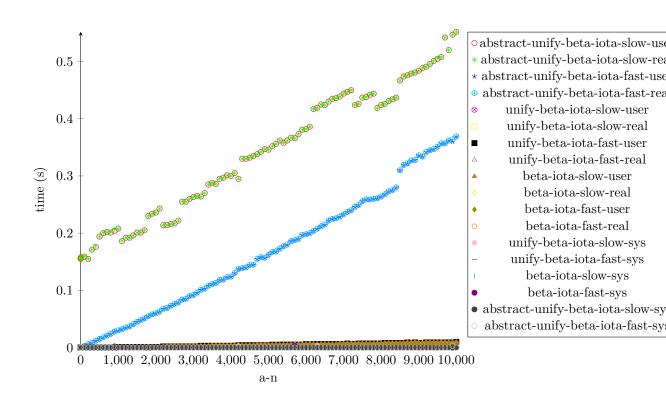


Figure 40: timing-iota-reduction-with-abstract-fact8 param-fact-n  $\,\,8\,$ 

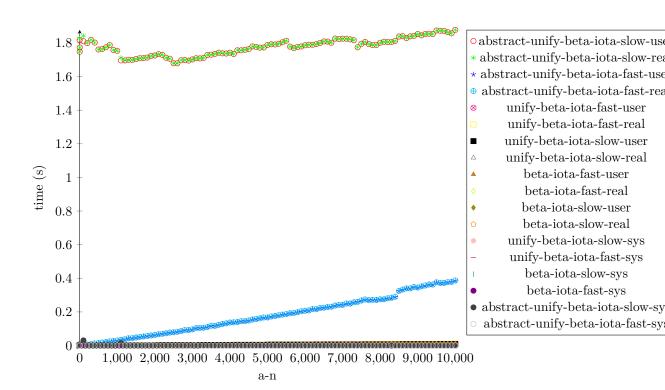


Figure 41: timing-iota-reduction-with-abstract-fact9 param-fact-n  $\,\,9$ 

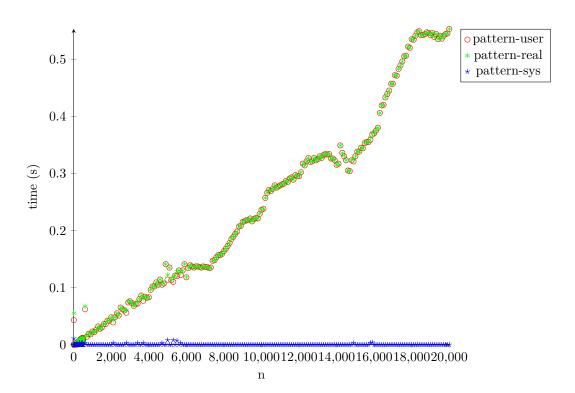


Figure 42: timing-pattern

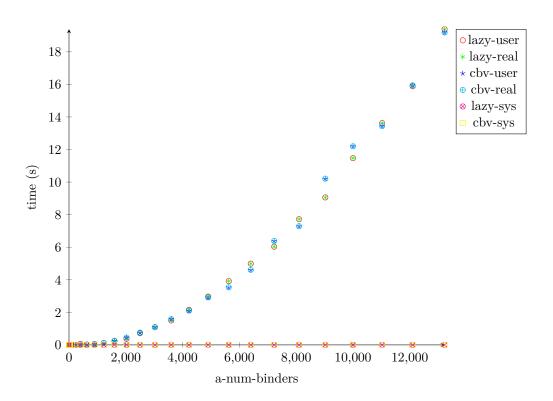


Figure 43: timing-quadratic-cbv-lazy-PHOAS param-n $\,\,0\,\,$ 

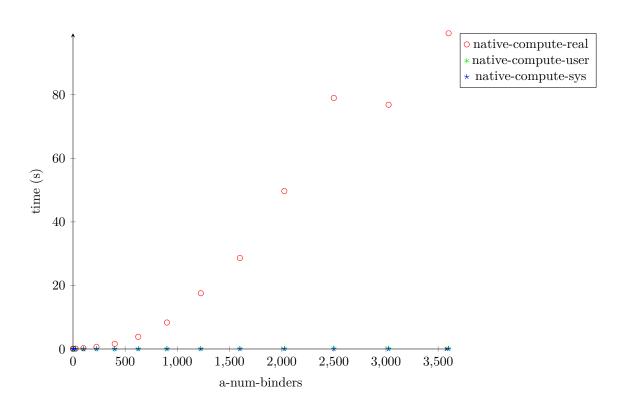


Figure 44: timing-quadratic-native-PHOAS param-n  $\,0\,$ 

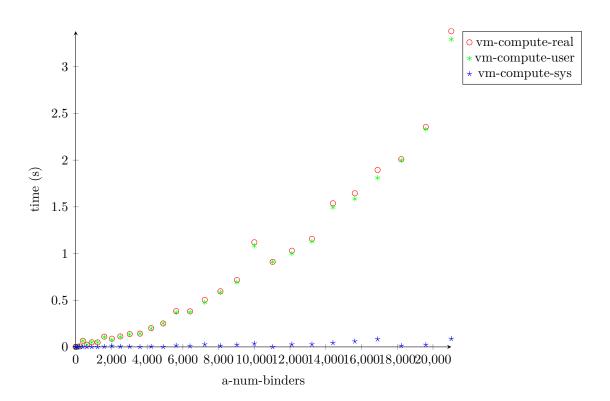


Figure 45: timing-quadratic-vm-PHOAS param-n  $\,0\,$