```
wp2_correctness  THM

⊢  ∀A:ioa{i:l}(), de:sig().
|  tc_ioa(A;de)
|  ⇒
|  ¬ioa_mentions_trace(A)
|  ⇒
|  (∀Q:Fmla, rho:Decl, e:{[[de]] rho}, a:[[A]] rho de e.action
|   , tr:trace_env([[A.da]] rho).
|   trace_consistent_pred(rho;A.da;tr.proj;Q)
|   ⇒
|   single_valued_decls(A.ds)
|   ⇒
|   (∀s,x':[[A]] rho de e.state.
|    tc_pred(Q;A.ds;<>;de)
|    ⇒
|    closed_pred(Q)
|    ⇒
|    covers_pred(A;Q)
|    ⇒
|    [[A]] rho de e.trans(s,a,x')
|    ⇒
|    ...))
| by Auto

|    THEN All (\i. Unfold `ioa_mng` i THEN Reduce i THEN Trivial)

|    THEN Try (Unfold `decl` 0 THEN Auto)

|    THEN Try (BackThruLemma `empty_sts_mng` THEN Auto)
.
|
|\
| 1. A : ioa{i:l}()
| 2. de : sig()
| 3. tc_ioa(A;de)
| 4. ¬ioa_mentions_trace(A)
| 5. Q : Fmla
| 6. rho : Decl
| 7. e : {[[de]] rho}
| 8. a : [[A]] rho de e.action
| 9. tr : trace_env([[A.da]] rho)
| 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| 11. single_valued_decls(A.ds)
| 12. s : [[A]] rho de e.state
| 13. x' : [[A]] rho de e.state
| 14. tc_pred(Q;A.ds;<>;de)
| 15. closed_pred(Q)
| 16. covers_pred(A;Q)
| 17. [[A]] rho de e.trans(s,a,x')
| 18. pred_mng_2(Q; rho; A.ds; <>; de; e; s; x'; ·; tr)
| ⊢  [[wp2(A;kind(a);Q)]] rho A.ds dec_lookup(A.da;...) de e s ... tr
| | by Unfolds ``pred_mng wp2`` 0 THEN
|
| |    Auto THEN Try (Fold `pred` 0 THEN Auto)
```

```
| |
| 1. A : ioa{i:l}()
| 2. de : sig()
| 3. tc_ioa(A;de)
| 4. ¬ioa_mentions_trace(A)
| 5. Q : Fmla
| 6. rho : Decl
| 7. e : {[[de]] rho}
| 8. a : [[A]] rho de e.action
| 9. tr : trace_env([[A.da]] rho)
| 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| 11. single_valued_decls(A.ds)
| 12. s : [[A]] rho de e.state
| 13. x' : [[A]] rho de e.state
| 14. tc_pred(Q;A.ds;<>;de)
| 15. closed_pred(Q)
| 16. covers_pred(A;Q)
| 17. [[A]] rho de e.trans(s,a,x')
| 18. pred_mng_2(Q; rho; A.ds; <>; de; e; s; x'; ·; tr)
| 19. r : rel()
| 20. r ∈ (∪r∈Q.col_subst2(λx.
| |   smts_eff(action_effect(kind(a);A.eff;A.frame);x);r))
| ⊢  [[r]] rho A.ds dec_lookup(A.da;kind(a)) de e s value(a) tr
| | by RW ColMemberC (-1) THEN Fold `wp2_rel` (-1) THEN ExRepD
| |
| 1. A : ioa{i:l}()
| 2. de : sig()
| 3. tc_ioa(A;de)
| 4. ¬ioa_mentions_trace(A)
| 5. Q : Fmla
| 6. rho : Decl
| 7. e : {[[de]] rho}
| 8. a : [[A]] rho de e.action
| 9. tr : trace_env([[A.da]] rho)
| 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| 11. single_valued_decls(A.ds)
| 12. s : [[A]] rho de e.state
| 13. x' : [[A]] rho de e.state
| 14. tc_pred(Q;A.ds;<>;de)
| 15. closed_pred(Q)
| 16. covers_pred(A;Q)
| 17. [[A]] rho de e.trans(s,a,x')
| 18. pred_mng_2(Q; rho; A.ds; <>; de; e; s; x'; ·; tr)
| 19. r : rel()
| 20. r@0 : rel()
| 21. r@0 ∈ Q
| 22. r ∈ wp2_rel(A;kind(a);r@0)
| ⊢  [[r]] rho A.ds dec_lookup(A.da;kind(a)) de e s value(a) tr
| | by Assert
| |     [[wp2_rel(A;kind(a);r@0)]] rho A.ds ... de e s value(a) tr
| |
| |\
| | .....assertion .....
| | 1. A : ioa{i:l}()
| | 2. de : sig()
```

```
| | 3. tc_ioa(A;de)
| | 4. ¬ioa_mentions_trace(A)
| | 5. Q : Fmla
| | 6. rho : Decl
| | 7. e : {[[de]] rho}
| | 8. a : [[A]] rho de e.action
| | 9. tr : trace_env([[A.da]] rho)
| | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | 11. single_valued_decls(A.ds)
| | 12. s : [[A]] rho de e.state
| | 13. x' : [[A]] rho de e.state
| | 14. tc_pred(Q;A.ds;<>;de)
| | 15. closed_pred(Q)
| | 16. covers_pred(A;Q)
| | 17. [[A]] rho de e.trans(s,a,x')
| | 18. pred_mng_2(Q; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | 19. r : rel()
| | 20. r@0 : rel()
| | 21. r@0 ∈ Q
| | 22. r ∈ wp2_rel(A;kind(a);r@0)
| | ⊢  [[wp2_rel(A;kind(a);r@0)]] rho A.ds ... de e s value(a) tr
| | | by Assert rel_mng_2(r@0; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | |
| | |\
| | | .....assertion .....
| | | 1. A : ioa{i:l}()
| | | 2. de : sig()
| | | 3. tc_ioa(A;de)
| | | 4. ¬ioa_mentions_trace(A)
| | | 5. Q : Fmla
| | | 6. rho : Decl
| | | 7. e : {[[de]] rho}
| | | 8. a : [[A]] rho de e.action
| | | 9. tr : trace_env([[A.da]] rho)
| | | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | | 11. single_valued_decls(A.ds)
| | | 12. s : [[A]] rho de e.state
| | | 13. x' : [[A]] rho de e.state
| | | 14. tc_pred(Q;A.ds;<>;de)
| | | 15. closed_pred(Q)
| | | 16. covers_pred(A;Q)
| | | 17. [[A]] rho de e.trans(s,a,x')
| | | 18. pred_mng_2(Q; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | | 19. r : rel()
| | | 20. r@0 : rel()
| | | 21. r@0 ∈ Q
| | | 22. r ∈ wp2_rel(A;kind(a);r@0)
| | | ⊢  rel_mng_2(r@0; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | |   by EasyHypThen Auto
| | |
| | .\
| | . 1. A : ioa{i:l}()
| | . 2. de : sig()
| | . 3. tc_ioa(A;de)
| | . 4. ¬ioa_mentions_trace(A)
```

```
| | . 5. Q : Fmla
| | . 6. rho : Decl
| | . 7. e : {[[de]] rho}
| | . 8. a : [[A]] rho de e.action
| | . 9. tr : trace_env([[A.da]] rho)
| | . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | . 11. single_valued_decls(A.ds)
| | . 12. s : [[A]] rho de e.state
| | . 13. x' : [[A]] rho de e.state
| | . 14. tc_pred(Q;A.ds;<>;de)
| | . 15. closed_pred(Q)
| | . 16. covers_pred(A;Q)
| | . 17. [[A]] rho de e.trans(s,a,x')
| | . 18. pred_mng_2(Q; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | . 19. r : rel()
| | . 20. r@0 : rel()
| | . 21. r@0 ∈ Q
| | . 22. r ∈ wp2_rel(A;kind(a);r@0)
| | . 23. rel_mng_2(r@0; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | . ⊢  [[wp2_rel(A;kind(a);r@0)]] rho A.ds ... de e s value(a) tr
| | . | by InstLemma `wp2_rel_correctness` [A;r@0;rho;de;e;a;tr;s;x']
| | . |
| | . THEN Auto
| | .
| | . |    ...
| | . THEN EasyHypThen Auto
| | . |
| | . 1. A : ioa{i:l}()
| | . 2. de : sig()
| | . 3. tc_ioa(A;de)
| | . 4. ¬ioa_mentions_trace(A)
| | . 5. Q : Fmla
| | . 6. rho : Decl
| | . 7. e : {[[de]] rho}
| | . 8. a : [[A]] rho de e.action
| | . 9. tr : trace_env([[A.da]] rho)
| | . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | . 11. single_valued_decls(A.ds)
| | . 12. s : [[A]] rho de e.state
| | . 13. x' : [[A]] rho de e.state
| | . 14. tc_pred(Q;A.ds;<>;de)
| | . 15. closed_pred(Q)
| | . 16. covers_pred(A;Q)
| | . 17. [[A]] rho de e.trans(s,a,x')
| | . 18. pred_mng_2(Q; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | . 19. r : rel()
| | . 20. r@0 : rel()
| | . 21. r@0 ∈ Q
| | . 22. r ∈ wp2_rel(A;kind(a);r@0)
| | . 23. rel_mng_2(r@0; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | . ⊢  covers_rel(A;r@0)
| | . | by Unfold `covers_rel` 0
| | .
| | . |    THEN AllHyps (\h. Unfold `covers_pred` h
| | .
```

```
| | . |                  THEN ParallelOp h)
| | . THEN ParallelOp (-1)
| | . |
| | . .....antecedent .....
| | . 1. A : ioa{i:l}()
| | . 2. de : sig()
| | . 3. tc_ioa(A;de)
| | . 4. ¬ioa_mentions_trace(A)
| | . 5. Q : Fmla
| | . 6. rho : Decl
| | . 7. e : {[[de]] rho}
| | . 8. a : [[A]] rho de e.action
| | . 9. tr : trace_env([[A.da]] rho)
| | . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | . 11. single_valued_decls(A.ds)
| | . 12. s : [[A]] rho de e.state
| | . 13. x' : [[A]] rho de e.state
| | . 14. tc_pred(Q;A.ds;<>;de)
| | . 15. closed_pred(Q)
| | . 16. ∀x:Label. pred_mentions(Q;x) ⇒ covers_var(A;x)
| | . 17. [[A]] rho de e.trans(s,a,x')
| | . 18. pred_mng_2(Q; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | . 19. r : rel()
| | . 20. r@0 : rel()
| | . 21. r@0 ∈ Q
| | . 22. r ∈ wp2_rel(A;kind(a);r@0)
| | . 23. rel_mng_2(r@0; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | . 24. x : Label
| | . 25. rel_mentions(r@0;x)
| | . ⊢  pred_mentions(Q;x)
| | . | by Unfold `pred_mentions` 0 THEN InstConcl [r@0] THEN Auto
| | . |
| | . .....subterm .....
| | . 1. A : ioa{i:l}()
| | . 2. de : sig()
| | . 3. tc_ioa(A;de)
| | . 4. ¬ioa_mentions_trace(A)
| | . 5. Q : Fmla
| | . 6. rho : Decl
| | . 7. e : {[[de]] rho}
| | . 8. a : [[A]] rho de e.action
| | . 9. tr : trace_env([[A.da]] rho)
| | . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | . 11. single_valued_decls(A.ds)
| | . 12. s : [[A]] rho de e.state
| | . 13. x' : [[A]] rho de e.state
| | . 14. tc_pred(Q;A.ds;<>;de)
| | . 15. closed_pred(Q)
| | . 16. ∀x:Label. pred_mentions(Q;x) ⇒ covers_var(A;x)
| | . 17. [[A]] rho de e.trans(s,a,x')
| | . 18. pred_mng_2(Q; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | . 19. r : rel()
| | . 20. r@0 : rel()
| | . 21. r@0 ∈ Q
| | . 22. r ∈ wp2_rel(A;kind(a);r@0)
```

```
| | . 23. rel_mng_2(r@0; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | . 24. x : Label
| | . 25. rel_mentions(r@0;x)
| | . 26. rel()
| | . ⊢  Q ∈ Collection(rel())  by Fold `pred` 0 THEN Auto
| |
| .\
| . 1. A : ioa{i:l}()
| . 2. de : sig()
| . 3. tc_ioa(A;de)
| . 4. ¬ioa_mentions_trace(A)
| . 5. Q : Fmla
| . 6. rho : Decl
| . 7. e : {[[de]] rho}
| . 8. a : [[A]] rho de e.action
| . 9. tr : trace_env([[A.da]] rho)
| . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| . 11. single_valued_decls(A.ds)
| . 12. s : [[A]] rho de e.state
| . 13. x' : [[A]] rho de e.state
| . 14. tc_pred(Q;A.ds;<>;de)
| . 15. closed_pred(Q)
| . 16. covers_pred(A;Q)
| . 17. [[A]] rho de e.trans(s,a,x')
| . 18. pred_mng_2(Q; rho; A.ds; <>; de; e; s; x'; ·; tr)
| . 19. r : rel()
| . 20. r@0 : rel()
| . 21. r@0 ∈ Q
| . 22. r ∈ wp2_rel(A;kind(a);r@0)
| . 23. [[wp2_rel(A;kind(a);r@0)]] rho A.ds ... de e s value(a) tr
| . ⊢  [[r]] rho A.ds dec_lookup(A.da;kind(a)) de e s value(a) tr
| .   by EasyHypThen Auto
|
|\
| 1. A : ioa{i:l}()
| 2. de : sig()
| 3. tc_ioa(A;de)
| 4. ¬ioa_mentions_trace(A)
| 5. Q : Fmla
| 6. rho : Decl
| 7. e : {[[de]] rho}
| 8. a : [[A]] rho de e.action
| 9. tr : trace_env([[A.da]] rho)
| 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| 11. single_valued_decls(A.ds)
| 12. s : [[A]] rho de e.state
| 13. x' : [[A]] rho de e.state
| 14. tc_pred(Q;A.ds;<>;de)
| 15. closed_pred(Q)
| 16. covers_pred(A;Q)
| 17. [[A]] rho de e.trans(s,a,x')
| 18. [[wp2(A;kind(a);Q)]] rho A.ds dec_lookup(A.da;...) de e s ... tr
| ⊢  pred_mng_2(Q; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | by Unfolds ``pred_mng_2 wp2`` 0 THEN

|
```

```
| |    Auto THEN Try (Fold `pred` 0 THEN Auto)
| |
| 1. A : ioa{i:l}()
| 2. de : sig()
| 3. tc_ioa(A;de)
| 4. ¬ioa_mentions_trace(A)
| 5. Q : Fmla
| 6. rho : Decl
| 7. e : {[[de]] rho}
| 8. a : [[A]] rho de e.action
| 9. tr : trace_env([[A.da]] rho)
| 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| 11. single_valued_decls(A.ds)
| 12. s : [[A]] rho de e.state
| 13. x' : [[A]] rho de e.state
| 14. tc_pred(Q;A.ds;<>;de)
| 15. closed_pred(Q)
| 16. covers_pred(A;Q)
| 17. [[A]] rho de e.trans(s,a,x')
| 18. [[wp2(A;kind(a);Q)]] rho A.ds dec_lookup(A.da;...) de e s ... tr
| 19. r : rel()
| 20. r ∈ Q
| ⊢  rel_mng_2(r; rho; A.ds; <>; de; e; s; x'; ·; tr)
| | by Using [`a',a;`s',s] (BackThruLemma `wp2_rel_correctness`)
|
| |    THEN Auto
| THEN EasyHypThen Auto
|
| |    ...
| |
| |\
| | 1. A : ioa{i:l}()
| | 2. de : sig()
| | 3. tc_ioa(A;de)
| | 4. ¬ioa_mentions_trace(A)
| | 5. Q : Fmla
| | 6. rho : Decl
| | 7. e : {[[de]] rho}
| | 8. a : [[A]] rho de e.action
| | 9. tr : trace_env([[A.da]] rho)
| | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | 11. single_valued_decls(A.ds)
| | 12. s : [[A]] rho de e.state
| | 13. x' : [[A]] rho de e.state
| | 14. tc_pred(Q;A.ds;<>;de)
| | 15. closed_pred(Q)
| | 16. covers_pred(A;Q)
| | 17. [[A]] rho de e.trans(s,a,x')
| | 18. [[wp2(A;kind(a);Q)]] rho A.ds ... de e s value(a) tr
| | 19. r : rel()
| | 20. r ∈ Q
| | ⊢  covers_rel(A;r)
| | | by Unfold `covers_rel` 0
| |
| | |    THEN AllHyps (\h. Unfold `covers_pred` h
```

```
| |
| | |                  THEN ParallelOp h)
| | THEN ParallelOp (-1)
| | |
| | .....antecedent .....
| | 1. A : ioa{i:l}()
| | 2. de : sig()
| | 3. tc_ioa(A;de)
| | 4. ¬ioa_mentions_trace(A)
| | 5. Q : Fmla
| | 6. rho : Decl
| | 7. e : {[[de]] rho}
| | 8. a : [[A]] rho de e.action
| | 9. tr : trace_env([[A.da]] rho)
| | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | 11. single_valued_decls(A.ds)
| | 12. s : [[A]] rho de e.state
| | 13. x' : [[A]] rho de e.state
| | 14. tc_pred(Q;A.ds;<>;de)
| | 15. closed_pred(Q)
| | 16. ∀x:Label. pred_mentions(Q;x) ⇒ covers_var(A;x)
| | 17. [[A]] rho de e.trans(s,a,x')
| | 18. [[wp2(A;kind(a);Q)]] rho A.ds ... de e s value(a) tr
| | 19. r : rel()
| | 20. r ∈ Q
| | 21. x : Label
| | 22. rel_mentions(r;x)
| | ⊢  pred_mentions(Q;x)
| | | by Unfold `pred_mentions` 0 THEN InstConcl [r] THEN Auto
| | |
| | .....subterm .....
| | 1. A : ioa{i:l}()
| | 2. de : sig()
| | 3. tc_ioa(A;de)
| | 4. ¬ioa_mentions_trace(A)
| | 5. Q : Fmla
| | 6. rho : Decl
| | 7. e : {[[de]] rho}
| | 8. a : [[A]] rho de e.action
| | 9. tr : trace_env([[A.da]] rho)
| | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | 11. single_valued_decls(A.ds)
| | 12. s : [[A]] rho de e.state
| | 13. x' : [[A]] rho de e.state
| | 14. tc_pred(Q;A.ds;<>;de)
| | 15. closed_pred(Q)
| | 16. ∀x:Label. pred_mentions(Q;x) ⇒ covers_var(A;x)
| | 17. [[A]] rho de e.trans(s,a,x')
| | 18. [[wp2(A;kind(a);Q)]] rho A.ds ... de e s value(a) tr
| | 19. r : rel()
| | 20. r ∈ Q
| | 21. x : Label
| | 22. rel_mentions(r;x)
| | 23. rel()
| | ⊢  Q ∈ Collection(rel())  by Fold `pred` 0 THEN Auto
```

```
| |
| .\
| . 1. A : ioa{i:l}()
| . 2. de : sig()
| . 3. tc_ioa(A;de)
| . 4. ¬ioa_mentions_trace(A)
| . 5. Q : Fmla
| . 6. rho : Decl
| . 7. e : {[[de]] rho}
| . 8. a : [[A]] rho de e.action
| . 9. tr : trace_env([[A.da]] rho)
| . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| . 11. single_valued_decls(A.ds)
| . 12. s : [[A]] rho de e.state
| . 13. x' : [[A]] rho de e.state
| . 14. tc_pred(Q;A.ds;<>;de)
| . 15. closed_pred(Q)
| . 16. covers_pred(A;Q)
| . 17. [[A]] rho de e.trans(s,a,x')
| . 18. [[wp2(A;kind(a);Q)]] rho A.ds ... de e s value(a) tr
| . 19. r : rel()
| . 20. r ∈ Q
| . ⊢  [[wp2_rel(A;kind(a);r)]] rho A.ds ... de e s value(a) tr
| . | by RepeatFor 2 (ParallelOp (-3)) THEN ParallelOp (-1)
| . |
| . .....antecedent .....
| . 1. A : ioa{i:l}()
| . 2. de : sig()
| . 3. tc_ioa(A;de)
| . 4. ¬ioa_mentions_trace(A)
| . 5. Q : Fmla
| . 6. rho : Decl
| . 7. e : {[[de]] rho}
| . 8. a : [[A]] rho de e.action
| . 9. tr : trace_env([[A.da]] rho)
| . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| . 11. single_valued_decls(A.ds)
| . 12. s : [[A]] rho de e.state
| . 13. x' : [[A]] rho de e.state
| . 14. tc_pred(Q;A.ds;<>;de)
| . 15. closed_pred(Q)
| . 16. covers_pred(A;Q)
| . 17. [[A]] rho de e.trans(s,a,x')
| . 18. ∀r:rel().
| .     r ∈ wp2(A;kind(a);Q)
| .     ⇒
| .     [[r]] rho A.ds dec_lookup(A.da;kind(a)) de e s value(a) tr
| . 19. r : rel()
| . 20. r ∈ Q
| . 21. r@0 : rel()
| . 22. r@0 ∈ wp2_rel(A;kind(a);r)
| . ⊢  r@0 ∈ wp2(A;kind(a);Q)
| .   by Unfold `wp2` 0 THEN RW ColMemberC 0
| .
| .      THEN Fold `wp2_rel` 0 THEN InstConcl [r] THEN Auto
```

```
| .
| .      THEN Fold `pred` 0 THEN Auto
|
|\
| 1. A : ioa{i:l}()
| 2. de : sig()
| 3. tc_ioa(A;de)
| 4. ¬ioa_mentions_trace(A)
| 5. Q : Fmla
| 6. rho : Decl
| 7. e : {[[de]] rho}
| 8. a : [[A]] rho de e.action
| 9. tr : trace_env([[A.da]] rho)
| 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| 11. single_valued_decls(A.ds)
| 12. s : [[A]] rho de e.state
| 13. x' : [[A]] rho de e.state
| 14. tc_pred(Q;A.ds;<>;de)
| 15. closed_pred(Q)
| 16. covers_pred(A;Q)
| 17. [[A]] rho de e.trans(s,a,x')
| ⊢  value(a) ∈ [[dec_lookup(A.da;kind(a))]] rho
|   by AllHyps (\h. Unfold `ioa_mng` h THEN Reduce h)
| THEN Easy
|
|\
| 1. A : ioa{i:l}()
| 2. de : sig()
| 3. tc_ioa(A;de)
| 4. ¬ioa_mentions_trace(A)
| 5. Q : Fmla
| 6. rho : Decl
| 7. e : {[[de]] rho}
| 8. a : [[A]] rho de e.action
| 9. tr : trace_env([[A.da]] rho)
| 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| 11. single_valued_decls(A.ds)
| 12. s : [[A]] rho de e.state
| 13. x' : [[A]] rho de e.state
| 14. tc_pred(Q;A.ds;<>;de)
| 15. closed_pred(Q)
| 16. covers_pred(A;Q)
| 17. [[A]] rho de e.trans(s,a,x')
| ⊢  trace_consistent_pred(rho;A.da;tr.proj;wp2(A;kind(a);Q))
| | by Assert ∀r:rel().
| |    r ∈ Q
| |    ⇒
| |    trace_consistent_pred(rho;A.da;tr.proj;wp2_rel(A;kind(a);r))
| |
| |\
| | .....assertion .....
| | 1. A : ioa{i:l}()
| | 2. de : sig()
| | 3. tc_ioa(A;de)
| | 4. ¬ioa_mentions_trace(A)
```

```
| | 5. Q : Fmla
| | 6. rho : Decl
| | 7. e : {[[de]] rho}
| | 8. a : [[A]] rho de e.action
| | 9. tr : trace_env([[A.da]] rho)
| | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | 11. single_valued_decls(A.ds)
| | 12. s : [[A]] rho de e.state
| | 13. x' : [[A]] rho de e.state
| | 14. tc_pred(Q;A.ds;<>;de)
| | 15. closed_pred(Q)
| | 16. covers_pred(A;Q)
| | 17. [[A]] rho de e.trans(s,a,x')
| | ⊢  ∀r:rel().
| | |  r ∈ Q
| | |  ⇒
| | |  trace_consistent_pred(rho;A.da;tr.proj;wp2_rel(A;kind(a);r))
| | | by Auto
| | |
| | |\
| | | 1. A : ioa{i:l}()
| | | 2. de : sig()
| | | 3. tc_ioa(A;de)
| | | 4. ¬ioa_mentions_trace(A)
| | | 5. Q : Fmla
| | | 6. rho : Decl
| | | 7. e : {[[de]] rho}
| | | 8. a : [[A]] rho de e.action
| | | 9. tr : trace_env([[A.da]] rho)
| | | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | | 11. single_valued_decls(A.ds)
| | | 12. s : [[A]] rho de e.state
| | | 13. x' : [[A]] rho de e.state
| | | 14. tc_pred(Q;A.ds;<>;de)
| | | 15. closed_pred(Q)
| | | 16. covers_pred(A;Q)
| | | 17. [[A]] rho de e.trans(s,a,x')
| | | 18. r : rel()
| | | 19. r ∈ Q
| | | ⊢  trace_consistent_pred(rho;A.da;tr.proj;wp2_rel(A;kind(a);r))
| | | | by AssertBY tc(r;A.ds;<>;de) & closed_rel(r)
| | |
| | | |     (Auto THEN EasyHypThen Auto)
| | | |
| | | 1. A : ioa{i:l}()
| | | 2. de : sig()
| | | 3. tc_ioa(A;de)
| | | 4. ¬ioa_mentions_trace(A)
| | | 5. Q : Fmla
| | | 6. rho : Decl
| | | 7. e : {[[de]] rho}
| | | 8. a : [[A]] rho de e.action
| | | 9. tr : trace_env([[A.da]] rho)
| | | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | | 11. single_valued_decls(A.ds)
```

```
| | | 12. s : [[A]] rho de e.state
| | | 13. x' : [[A]] rho de e.state
| | | 14. tc_pred(Q;A.ds;<>;de)
| | | 15. closed_pred(Q)
| | | 16. covers_pred(A;Q)
| | | 17. [[A]] rho de e.trans(s,a,x')
| | | 18. r : rel()
| | | 19. r ∈ Q
| | | 20. tc(r;A.ds;<>;de) & closed_rel(r)
| | | ⊢  trace_consistent_pred(rho;A.da;tr.proj;wp2_rel(A;kind(a);r))
| | | | by D (-1) THEN
| | | Unfold `trace_consistent_pred` 0 THEN
| | |
| | | |    Unfolds ``col_all wp2_rel`` 0 THEN Auto
| | |
| | | |    THEN  Try (Fold `pred` 0 THEN Auto)
| | | |
| | | 1. A : ioa{i:l}()
| | | 2. de : sig()
| | | 3. tc_ioa(A;de)
| | | 4. ¬ioa_mentions_trace(A)
| | | 5. Q : Fmla
| | | 6. rho : Decl
| | | 7. e : {[[de]] rho}
| | | 8. a : [[A]] rho de e.action
| | | 9. tr : trace_env([[A.da]] rho)
| | | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | | 11. single_valued_decls(A.ds)
| | | 12. s : [[A]] rho de e.state
| | | 13. x' : [[A]] rho de e.state
| | | 14. tc_pred(Q;A.ds;<>;de)
| | | 15. closed_pred(Q)
| | | 16. covers_pred(A;Q)
| | | 17. [[A]] rho de e.trans(s,a,x')
| | | 18. r : rel()
| | | 19. r ∈ Q
| | | 20. tc(r;A.ds;<>;de)
| | | 21. closed_rel(r)
| | | 22. r@0 : rel()
| | | 23. r@0 ∈ col_subst2(λx.
| | | |   smts_eff(action_effect(kind(a);A.eff;A.frame);x);r)
| | | ⊢  trace_consistent_rel(rho;A.da;tr.proj;r@0)
| | | | by RWO "member_col_subst2" (-1)
| | | THENA Auto
| | |
| | | |    THEN ExRepD THEN HypSubstSq (-1) 0
| | |
| | | |    THEN BackThruLemma `trace_consistent_rel_subst2` THEN Auto
| | | |
| | | |\
| | | | 1. A : ioa{i:l}()
| | | | 2. de : sig()
| | | | 3. tc_ioa(A;de)
| | | | 4. ¬ioa_mentions_trace(A)
| | | | 5. Q : Fmla
```

```
| | | | 6. rho : Decl
| | | | 7. e : {[[de]] rho}
| | | | 8. a : [[A]] rho de e.action
| | | | 9. tr : trace_env([[A.da]] rho)
| | | | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | | | 11. single_valued_decls(A.ds)
| | | | 12. s : [[A]] rho de e.state
| | | | 13. x' : [[A]] rho de e.state
| | | | 14. tc_pred(Q;A.ds;<>;de)
| | | | 15. closed_pred(Q)
| | | | 16. covers_pred(A;Q)
| | | | 17. [[A]] rho de e.trans(s,a,x')
| | | | 18. r : rel()
| | | | 19. r ∈ Q
| | | | 20. tc(r;A.ds;<>;de)
| | | | 21. closed_rel(r)
| | | | 22. r@0 : rel()
| | | | 23. as : (Label×Term) List
| | | | 24. 1of(unzip(as)) = rel_primed_vars(r)
| | | | 25. ∀i:ℕ.
| | | |     i<||as||
| | | |     ⇒
| | | |     2of(as[i]) ∈ ...
| | | |                  (1of(as[i]))
| | | | 26. r@0 = rel_subst2(as;r)
| | | | ⊢  trace_consistent_rel(rho;A.da;tr.proj;r)
| | | |   by EasyHypThen Auto
| | | |
| | | .\
| | | . 1. A : ioa{i:l}()
| | | . 2. de : sig()
| | | . 3. tc_ioa(A;de)
| | | . 4. ¬ioa_mentions_trace(A)
| | | . 5. Q : Fmla
| | | . 6. rho : Decl
| | | . 7. e : {[[de]] rho}
| | | . 8. a : [[A]] rho de e.action
| | | . 9. tr : trace_env([[A.da]] rho)
| | | . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | | . 11. single_valued_decls(A.ds)
| | | . 12. s : [[A]] rho de e.state
| | | . 13. x' : [[A]] rho de e.state
| | | . 14. tc_pred(Q;A.ds;<>;de)
| | | . 15. closed_pred(Q)
| | | . 16. covers_pred(A;Q)
| | | . 17. [[A]] rho de e.trans(s,a,x')
| | | . 18. r : rel()
| | | . 19. r ∈ Q
| | | . 20. tc(r;A.ds;<>;de)
| | | . 21. closed_rel(r)
| | | . 22. r@0 : rel()
| | | . 23. as : (Label×Term) List
| | | . 24. 1of(unzip(as)) = rel_primed_vars(r)
| | | . 25. ∀i:ℕ.
| | | .     i<||as||
```

```
| | | .     ⇒
| | | .     2of(as[i]) ∈ ...
| | | .                 (1of(as[i]))
| | | . 26. r@0 = rel_subst2(as;r)
| | | . ⊢  ¬subst_mentions_trace(as)
| | | .   by Reduce (-2)
| | | .
| | | .      ...
| | |
| | .\
| | . .....subterm .....
| | . 1. A : ioa{i:l}()
| | . 2. de : sig()
| | . 3. tc_ioa(A;de)
| | . 4. ¬ioa_mentions_trace(A)
| | . 5. Q : Fmla
| | . 6. rho : Decl
| | . 7. e : {[[de]] rho}
| | . 8. a : [[A]] rho de e.action
| | . 9. tr : trace_env([[A.da]] rho)
| | . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| | . 11. single_valued_decls(A.ds)
| | . 12. s : [[A]] rho de e.state
| | . 13. x' : [[A]] rho de e.state
| | . 14. tc_pred(Q;A.ds;<>;de)
| | . 15. closed_pred(Q)
| | . 16. covers_pred(A;Q)
| | . 17. [[A]] rho de e.trans(s,a,x')
| | . 18. rel()
| | . ⊢  Q ∈ Collection(rel())  by Fold `pred` 0 THEN Auto
| |
| .\
| . 1. A : ioa{i:l}()
| . 2. de : sig()
| . 3. tc_ioa(A;de)
| . 4. ¬ioa_mentions_trace(A)
| . 5. Q : Fmla
| . 6. rho : Decl
| . 7. e : {[[de]] rho}
| . 8. a : [[A]] rho de e.action
| . 9. tr : trace_env([[A.da]] rho)
| . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| . 11. single_valued_decls(A.ds)
| . 12. s : [[A]] rho de e.state
| . 13. x' : [[A]] rho de e.state
| . 14. tc_pred(Q;A.ds;<>;de)
| . 15. closed_pred(Q)
| . 16. covers_pred(A;Q)
| . 17. [[A]] rho de e.trans(s,a,x')
| . 18. ∀r:rel().
| . |   r ∈ Q
| . |   ⇒
| . |   trace_consistent_pred(rho;A.da;tr.proj;wp2_rel(A;kind(a);r))
| . ⊢  trace_consistent_pred(rho;A.da;tr.proj;wp2(A;kind(a);Q))
| . | by ...
```

```
| . |
| . |\
| . | 1. A : ioa{i:l}()
| . | 2. de : sig()
| . | 3. tc_ioa(A;de)
| . | 4. ¬ioa_mentions_trace(A)
| . | 5. Q : Fmla
| . | 6. rho : Decl
| . | 7. e : {[[de]] rho}
| . | 8. a : [[A]] rho de e.action
| . | 9. tr : trace_env([[A.da]] rho)
| . | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| . | 11. single_valued_decls(A.ds)
| . | 12. s : [[A]] rho de e.state
| . | 13. x' : [[A]] rho de e.state
| . | 14. tc_pred(Q;A.ds;<>;de)
| . | 15. closed_pred(Q)
| . | 16. covers_pred(A;Q)
| . | 17. [[A]] rho de e.trans(s,a,x')
| . | 18. ∀r:rel().
| . | |   r ∈ Q
| . | |   ⇒
| . | |   trace_consistent_pred(rho;A.da;tr.proj;wp2_rel(A;kind(a);r))
| . | 19. r : rel()
| . | 20. r ∈ wp2(A;kind(a);Q)
| . | ⊢  trace_consistent_rel(rho;A.da;tr.proj;r)
| . | | by ...
| . | |
| . | 1. A : ioa{i:l}()
| . | 2. de : sig()
| . | 3. tc_ioa(A;de)
| . | 4. ¬ioa_mentions_trace(A)
| . | 5. Q : Fmla
| . | 6. rho : Decl
| . | 7. e : {[[de]] rho}
| . | 8. a : [[A]] rho de e.action
| . | 9. tr : trace_env([[A.da]] rho)
| . | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| . | 11. single_valued_decls(A.ds)
| . | 12. s : [[A]] rho de e.state
| . | 13. x' : [[A]] rho de e.state
| . | 14. tc_pred(Q;A.ds;<>;de)
| . | 15. closed_pred(Q)
| . | 16. covers_pred(A;Q)
| . | 17. [[A]] rho de e.trans(s,a,x')
| . | 18. ∀r:rel().
| . | |   r ∈ Q
| . | |   ⇒
| . | |   trace_consistent_pred(rho;A.da;tr.proj;wp2_rel(A;kind(a);r))
| . | 19. r : rel()
| . | 20. r@0 : rel()
| . | 21. r@0 ∈ Q
| . | 22. r ∈ wp2_rel(A;kind(a);r@0)
| . | ⊢  trace_consistent_rel(rho;A.da;tr.proj;r)
| . | | by InstWithVar (-3) (-5) THENA Auto
```

```
| . | |
| . | 1. A : ioa{i:l}()
| . | 2. de : sig()
| . | 3. tc_ioa(A;de)
| . | 4. ¬ioa_mentions_trace(A)
| . | 5. Q : Fmla
| . | 6. rho : Decl
| . | 7. e : {[[de]] rho}
| . | 8. a : [[A]] rho de e.action
| . | 9. tr : trace_env([[A.da]] rho)
| . | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| . | 11. single_valued_decls(A.ds)
| . | 12. s : [[A]] rho de e.state
| . | 13. x' : [[A]] rho de e.state
| . | 14. tc_pred(Q;A.ds;<>;de)
| . | 15. closed_pred(Q)
| . | 16. covers_pred(A;Q)
| . | 17. [[A]] rho de e.trans(s,a,x')
| . | 18. ∀r:rel().
| . |     r ∈ Q
| . |     ⇒
| . |     trace_consistent_pred(rho;A.da;tr.proj;wp2_rel(A;kind(a);r))
| . | 19. r : rel()
| . | 20. r@0 : rel()
| . | 21. r@0 ∈ Q
| . | 22. r ∈ wp2_rel(A;kind(a);r@0)
| . | 23. trace_consistent_pred(rho;A.da;tr.proj;wp2_rel(A;...;r@0))
| . | ⊢ trace_consistent_rel(rho;A.da;tr.proj;r)
| . |   by ...
| . | BackThruHyp (-1) THEN Auto
| . |
| . .\
| . . .....subterm .....
| . . 1. A : ioa{i:l}()
| . . 2. de : sig()
| . . 3. tc_ioa(A;de)
| . . 4. ¬ioa_mentions_trace(A)
| . . 5. Q : Fmla
| . . 6. rho : Decl
| . . 7. e : {[[de]] rho}
| . . 8. a : [[A]] rho de e.action
| . . 9. tr : trace_env([[A.da]] rho)
| . . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
| . . 11. single_valued_decls(A.ds)
| . . 12. s : [[A]] rho de e.state
| . . 13. x' : [[A]] rho de e.state
| . . 14. tc_pred(Q;A.ds;<>;de)
| . . 15. closed_pred(Q)
| . . 16. covers_pred(A;Q)
| . . 17. [[A]] rho de e.trans(s,a,x')
| . . 18. ∀r:rel().
| . .     r ∈ Q
| . .     ⇒
| . .     trace_consistent_pred(rho;A.da;tr.proj;wp2_rel(A;kind(a);r))
| . . 19. rel()
```

```
| . . ⊢  wp2(A;kind(a);Q) ∈ Collection(rel())
| . .   by Fold ‘pred‘ 0 THEN Auto
|
.\
. 1. A : ioa{i:l}()
. 2. de : sig()
. 3. tc_ioa(A;de)
. 4. ¬ioa_mentions_trace(A)
. 5. Q : Fmla
. 6. rho : Decl
. 7. e : {[[de]] rho}
. 8. a : [[A]] rho de e.action
. 9. tr : trace_env([[A.da]] rho)
. 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. 11. single_valued_decls(A.ds)
. 12. s : [[A]] rho de e.state
. 13. x’ : [[A]] rho de e.state
. 14. tc_pred(Q;A.ds;<>;de)
. 15. closed_pred(Q)
. 16. covers_pred(A;Q)
. 17. [[A]] rho de e.trans(s,a,x’)
. ⊢  tc_pred(wp2(A;kind(a);Q);A.ds;dec_lookup(A.da;kind(a));de)
. | by Assert ∀r:rel().
. |    r ∈ Q
. |    ⇒
. |    tc_pred(wp2_rel(A;kind(a);r);A.ds;dec_lookup(A.da;kind(a));de)
. |
. |\
. | .....assertion .....
. | 1. A : ioa{i:l}()
. | 2. de : sig()
. | 3. tc_ioa(A;de)
. | 4. ¬ioa_mentions_trace(A)
. | 5. Q : Fmla
. | 6. rho : Decl
. | 7. e : {[[de]] rho}
. | 8. a : [[A]] rho de e.action
. | 9. tr : trace_env([[A.da]] rho)
. | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. | 11. single_valued_decls(A.ds)
. | 12. s : [[A]] rho de e.state
. | 13. x’ : [[A]] rho de e.state
. | 14. tc_pred(Q;A.ds;<>;de)
. | 15. closed_pred(Q)
. | 16. covers_pred(A;Q)
. | 17. [[A]] rho de e.trans(s,a,x’)
. | ⊢  ∀r:rel().
. | |  r ∈ Q
. | |  ⇒
. | |  tc_pred(wp2_rel(A;kind(a);r);A.ds;dec_lookup(A.da;kind(a));de)
. | | by Auto
. | |
. | |\
. | | 1. A : ioa{i:l}()
. | | 2. de : sig()
```

```
. | | 3. tc_ioa(A;de)
. | | 4. ¬ioa_mentions_trace(A)
. | | 5. Q : Fmla
. | | 6. rho : Decl
. | | 7. e : {[[de]] rho}
. | | 8. a : [[A]] rho de e.action
. | | 9. tr : trace_env([[A.da]] rho)
. | | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. | | 11. single_valued_decls(A.ds)
. | | 12. s : [[A]] rho de e.state
. | | 13. x' : [[A]] rho de e.state
. | | 14. tc_pred(Q;A.ds;<>;de)
. | | 15. closed_pred(Q)
. | | 16. covers_pred(A;Q)
. | | 17. [[A]] rho de e.trans(s,a,x')
. | | 18. r : rel()
. | | 19. r ∈ Q
. | | ⊢  tc_pred(wp2_rel(A;kind(a);r);A.ds;dec_lookup(A.da;...);de)
. | | | by InstLemma `tc_wp2` [A;r;de;kind(a)] THENA Auto
. | | |
. | | |\
. | | | .....antecedent .....
. | | | 1. A : ioa{i:l}()
. | | | 2. de : sig()
. | | | 3. tc_ioa(A;de)
. | | | 4. ¬ioa_mentions_trace(A)
. | | | 5. Q : Fmla
. | | | 6. rho : Decl
. | | | 7. e : {[[de]] rho}
. | | | 8. a : [[A]] rho de e.action
. | | | 9. tr : trace_env([[A.da]] rho)
. | | | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. | | | 11. single_valued_decls(A.ds)
. | | | 12. s : [[A]] rho de e.state
. | | | 13. x' : [[A]] rho de e.state
. | | | 14. tc_pred(Q;A.ds;<>;de)
. | | | 15. closed_pred(Q)
. | | | 16. covers_pred(A;Q)
. | | | 17. [[A]] rho de e.trans(s,a,x')
. | | | 18. r : rel()
. | | | 19. r ∈ Q
. | | | ⊢  tc_pred(r;A.ds;dec_lookup(A.da;kind(a));de)
. | | | | by ...
. | | | | THEN Subst r@0 ∼ r 0  THEN Auto
. | | | |
. | | | 1. A : ioa{i:l}()
. | | | 2. de : sig()
. | | | 3. tc_ioa(A;de)
. | | | 4. ¬ioa_mentions_trace(A)
. | | | 5. Q : Fmla
. | | | 6. rho : Decl
. | | | 7. e : {[[de]] rho}
. | | | 8. a : [[A]] rho de e.action
. | | | 9. tr : trace_env([[A.da]] rho)
. | | | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
```

```
. | | | 11. single_valued_decls(A.ds)
. | | | 12. s : [[A]] rho de e.state
. | | | 13. x' : [[A]] rho de e.state
. | | | 14. tc_pred(Q;A.ds;<>;de)
. | | | 15. closed_pred(Q)
. | | | 16. covers_pred(A;Q)
. | | | 17. [[A]] rho de e.trans(s,a,x')
. | | | 18. r : rel()
. | | | 19. r ∈ Q
. | | | 20. r@0 : rel()
. | | | 21. r@0 = r
. | | | ⊢  tc(r;A.ds;dec_lookup(A.da;kind(a));de)
. | | | | by Assert tc(r;A.ds;<>;de) & closed_rel(r)
. | | | |
. | | | |\
. | | | | .....assertion .....
. | | | | 1. A : ioa{i:l}()
. | | | | 2. de : sig()
. | | | | 3. tc_ioa(A;de)
. | | | | 4. ¬ioa_mentions_trace(A)
. | | | | 5. Q : Fmla
. | | | | 6. rho : Decl
. | | | | 7. e : {[[de]] rho}
. | | | | 8. a : [[A]] rho de e.action
. | | | | 9. tr : trace_env([[A.da]] rho)
. | | | | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. | | | | 11. single_valued_decls(A.ds)
. | | | | 12. s : [[A]] rho de e.state
. | | | | 13. x' : [[A]] rho de e.state
. | | | | 14. tc_pred(Q;A.ds;<>;de)
. | | | | 15. closed_pred(Q)
. | | | | 16. covers_pred(A;Q)
. | | | | 17. [[A]] rho de e.trans(s,a,x')
. | | | | 18. r : rel()
. | | | | 19. r ∈ Q
. | | | | 20. r@0 : rel()
. | | | | 21. r@0 = r
. | | | | ⊢  tc(r;A.ds;<>;de) & closed_rel(r)
. | | | |   by Auto THEN EasyHypThen Auto
. | | | |
. | | | .\
. | | | . 1. A : ioa{i:l}()
. | | | . 2. de : sig()
. | | | . 3. tc_ioa(A;de)
. | | | . 4. ¬ioa_mentions_trace(A)
. | | | . 5. Q : Fmla
. | | | . 6. rho : Decl
. | | | . 7. e : {[[de]] rho}
. | | | . 8. a : [[A]] rho de e.action
. | | | . 9. tr : trace_env([[A.da]] rho)
. | | | . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. | | | . 11. single_valued_decls(A.ds)
. | | | . 12. s : [[A]] rho de e.state
. | | | . 13. x' : [[A]] rho de e.state
. | | | . 14. tc_pred(Q;A.ds;<>;de)
```

```
. | | | . 15. closed_pred(Q)
. | | | . 16. covers_pred(A;Q)
. | | | . 17. [[A]] rho de e.trans(s,a,x')
. | | | . 18. r : rel()
. | | | . 19. r ∈ Q
. | | | . 20. r@0 : rel()
. | | | . 21. r@0 = r
. | | | . 22. tc(r;A.ds;<>;de) & closed_rel(r)
. | | | . ⊢  tc(r;A.ds;dec_lookup(A.da;kind(a));de)
. | | | .   by D (-1) THEN BackChain 1
. | | |
. | | .\
. | | . 1. A : ioa{i:l}()
. | | . 2. de : sig()
. | | . 3. tc_ioa(A;de)
. | | . 4. ¬ioa_mentions_trace(A)
. | | . 5. Q : Fmla
. | | . 6. rho : Decl
. | | . 7. e : {[[de]] rho}
. | | . 8. a : [[A]] rho de e.action
. | | . 9. tr : trace_env([[A.da]] rho)
. | | . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. | | . 11. single_valued_decls(A.ds)
. | | . 12. s : [[A]] rho de e.state
. | | . 13. x' : [[A]] rho de e.state
. | | . 14. tc_pred(Q;A.ds;<>;de)
. | | . 15. closed_pred(Q)
. | | . 16. covers_pred(A;Q)
. | | . 17. [[A]] rho de e.trans(s,a,x')
. | | . 18. r : rel()
. | | . 19. r ∈ Q
. | | . 20. tc_pred(wp2(A;kind(a);r);A.ds;dec_lookup(A.da;kind(a));de)
. | | . ⊢  tc_pred(wp2_rel(A;kind(a);r);A.ds;dec_lookup(A.da;...);de)
. | | . | by ...
. | | .
. | | . |    ...
. | | . | THEN BackThruSomeHyp THEN Auto
. | | . |
. | | . 1. A : ioa{i:l}()
. | | . 2. de : sig()
. | | . 3. tc_ioa(A;de)
. | | . 4. ¬ioa_mentions_trace(A)
. | | . 5. Q : Fmla
. | | . 6. rho : Decl
. | | . 7. e : {[[de]] rho}
. | | . 8. a : [[A]] rho de e.action
. | | . 9. tr : trace_env([[A.da]] rho)
. | | . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. | | . 11. single_valued_decls(A.ds)
. | | . 12. s : [[A]] rho de e.state
. | | . 13. x' : [[A]] rho de e.state
. | | . 14. ∀r:rel(). r ∈ Q ⇒ tc(r;A.ds;<>;de)
. | | . 15. closed_pred(Q)
. | | . 16. covers_pred(A;Q)
. | | . 17. [[A]] rho de e.trans(s,a,x')
```

```
. | | . 18. r : rel()
. | | . 19. r ∈ Q
. | | . 20. ∀r@0:rel().
. | | .     (∃r@1:rel(). r@1 = r & r@0 ∈ wp2_rel(A;kind(a);r@1))
. | | .     ⇒
. | | .     tc(r@0;A.ds;dec_lookup(A.da;kind(a));de)
. | | . 21. r@0 : rel()
. | | . 22. r@0 ∈ wp2_rel(A;kind(a);r)
. | | . ⊢  ∃r@1:rel(). r@1 = r & r@0 ∈ wp2_rel(A;kind(a);r@1)
. | | .   by InstConcl [r
. | | .      ] THEN Auto THEN Try (Fold ‘pred‘ 0 THEN Auto)
. | |
. | .\
. | . .....subterm .....
. | . 1. A : ioa{i:l}()
. | . 2. de : sig()
. | . 3. tc_ioa(A;de)
. | . 4. ¬ioa_mentions_trace(A)
. | . 5. Q : Fmla
. | . 6. rho : Decl
. | . 7. e : {[[de]] rho}
. | . 8. a : [[A]] rho de e.action
. | . 9. tr : trace_env([[A.da]] rho)
. | . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. | . 11. single_valued_decls(A.ds)
. | . 12. s : [[A]] rho de e.state
. | . 13. x’ : [[A]] rho de e.state
. | . 14. tc_pred(Q;A.ds;<>;de)
. | . 15. closed_pred(Q)
. | . 16. covers_pred(A;Q)
. | . 17. [[A]] rho de e.trans(s,a,x’)
. | . 18. rel()
. | . ⊢  Q ∈ Collection(rel())  by Fold ‘pred‘ 0 THEN Auto
. |
. .\
. . 1. A : ioa{i:l}()
. . 2. de : sig()
. . 3. tc_ioa(A;de)
. . 4. ¬ioa_mentions_trace(A)
. . 5. Q : Fmla
. . 6. rho : Decl
. . 7. e : {[[de]] rho}
. . 8. a : [[A]] rho de e.action
. . 9. tr : trace_env([[A.da]] rho)
. . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. . 11. single_valued_decls(A.ds)
. . 12. s : [[A]] rho de e.state
. . 13. x’ : [[A]] rho de e.state
. . 14. tc_pred(Q;A.ds;<>;de)
. . 15. closed_pred(Q)
. . 16. covers_pred(A;Q)
. . 17. [[A]] rho de e.trans(s,a,x’)
. . 18. ∀r:rel().
. . |   r ∈ Q
. . |   ⇒
```

```
. . |   tc_pred(wp2_rel(A;kind(a);r);A.ds;dec_lookup(A.da;kind(a));de)
. . ⊢  tc_pred(wp2(A;kind(a);Q);A.ds;dec_lookup(A.da;kind(a));de)
. . | by Unfold `tc_pred` 0 THEN Auto
. . |
. . |\
. . | 1. A : ioa{i:l}()
. . | 2. de : sig()
. . | 3. tc_ioa(A;de)
. . | 4. ¬ioa_mentions_trace(A)
. . | 5. Q : Fmla
. . | 6. rho : Decl
. . | 7. e : {[[de]] rho}
. . | 8. a : [[A]] rho de e.action
. . | 9. tr : trace_env([[A.da]] rho)
. . | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. . | 11. single_valued_decls(A.ds)
. . | 12. s : [[A]] rho de e.state
. . | 13. x' : [[A]] rho de e.state
. . | 14. tc_pred(Q;A.ds;<>;de)
. . | 15. closed_pred(Q)
. . | 16. covers_pred(A;Q)
. . | 17. [[A]] rho de e.trans(s,a,x')
. . | 18. ∀r:rel().
. . | |   r ∈ Q
. . | |   ⇒
. . | |   tc_pred(wp2_rel(A;kind(a);r);A.ds;dec_lookup(A.da;...);de)
. . | 19. r : rel()
. . | 20. r ∈ wp2(A;kind(a);Q)
. . | ⊢  tc(r;A.ds;dec_lookup(A.da;kind(a));de)
. . | | by Unfold `wp2` (-1)
. . |
. . | |    ...
. . | |
. . | 1. A : ioa{i:l}()
. . | 2. de : sig()
. . | 3. tc_ioa(A;de)
. . | 4. ¬ioa_mentions_trace(A)
. . | 5. Q : Fmla
. . | 6. rho : Decl
. . | 7. e : {[[de]] rho}
. . | 8. a : [[A]] rho de e.action
. . | 9. tr : trace_env([[A.da]] rho)
. . | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. . | 11. single_valued_decls(A.ds)
. . | 12. s : [[A]] rho de e.state
. . | 13. x' : [[A]] rho de e.state
. . | 14. tc_pred(Q;A.ds;<>;de)
. . | 15. closed_pred(Q)
. . | 16. covers_pred(A;Q)
. . | 17. [[A]] rho de e.trans(s,a,x')
. . | 18. ∀r:rel().
. . | |   r ∈ Q
. . | |   ⇒
. . | |   tc_pred(wp2_rel(A;kind(a);r);A.ds;dec_lookup(A.da;...);de)
. . | 19. r : rel()
```

```
. . | 20. r@0 : rel()
. . | 21. r@0 ∈ Q
. . | 22. r ∈ wp2_rel(A;kind(a);r@0)
. . | ⊢  tc(r;A.ds;dec_lookup(A.da;kind(a));de)
. . | | by InstWithVar (-3) (-5) THENA Auto
. . | |
. . | 1. A : ioa{i:l}()
. . | 2. de : sig()
. . | 3. tc_ioa(A;de)
. . | 4. ¬ioa_mentions_trace(A)
. . | 5. Q : Fmla
. . | 6. rho : Decl
. . | 7. e : {[[de]] rho}
. . | 8. a : [[A]] rho de e.action
. . | 9. tr : trace_env([[A.da]] rho)
. . | 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. . | 11. single_valued_decls(A.ds)
. . | 12. s : [[A]] rho de e.state
. . | 13. x' : [[A]] rho de e.state
. . | 14. tc_pred(Q;A.ds;<>;de)
. . | 15. closed_pred(Q)
. . | 16. covers_pred(A;Q)
. . | 17. [[A]] rho de e.trans(s,a,x')
. . | 18. ∀r:rel().
. . |     r ∈ Q
. . |     ⇒
. . |     tc_pred(wp2_rel(A;kind(a);r);A.ds;dec_lookup(A.da;...);de)
. . | 19. r : rel()
. . | 20. r@0 : rel()
. . | 21. r@0 ∈ Q
. . | 22. r ∈ wp2_rel(A;kind(a);r@0)
. . | 23. tc_pred(wp2_rel(A;kind(a);r@0);A.ds;dec_lookup(A.da;...);de)
. . | ⊢  tc(r;A.ds;dec_lookup(A.da;kind(a));de)  by EasyHypThen Auto
. . |
. . .\
. . . .....subterm .....
. . . 1. A : ioa{i:l}()
. . . 2. de : sig()
. . . 3. tc_ioa(A;de)
. . . 4. ¬ioa_mentions_trace(A)
. . . 5. Q : Fmla
. . . 6. rho : Decl
. . . 7. e : {[[de]] rho}
. . . 8. a : [[A]] rho de e.action
. . . 9. tr : trace_env([[A.da]] rho)
. . . 10. trace_consistent_pred(rho;A.da;tr.proj;Q)
. . . 11. single_valued_decls(A.ds)
. . . 12. s : [[A]] rho de e.state
. . . 13. x' : [[A]] rho de e.state
. . . 14. tc_pred(Q;A.ds;<>;de)
. . . 15. closed_pred(Q)
. . . 16. covers_pred(A;Q)
. . . 17. [[A]] rho de e.trans(s,a,x')
. . . 18. ∀r:rel().
. . .     r ∈ Q
```

```
. . .      ⇒
. . .      tc_pred(wp2_rel(A;kind(a);r);A.ds;dec_lookup(A.da;...);de)
. . . 19. rel()
. . . ⊢  wp2(A;kind(a);Q) ∈ Collection(rel())
. . .    by Fold ‘pred‘ 0 THEN Auto
END
```