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1 aclfoundation Theory

Built: 19 January 2017

Parent Theories: indexedLists, patternMatches

1.1 Datatypes

```
Form =
  TT
| FF
| prop 'aavar
| notf (('aavar, 'apn, 'il, 'sl) Form)
| (andf) (('aavar, 'apn, 'il, 'sl) Form)
      (('aavar, 'apn, 'il, 'sl) Form)
| (orf) (('aavar, 'apn, 'il, 'sl) Form)
      (('aavar, 'apn, 'il, 'sl) Form)
| (impf) (('aavar, 'apn, 'il, 'sl) Form)
      (('aavar, 'apn, 'il, 'sl) Form)
| (eqf) (('aavar, 'apn, 'il, 'sl) Form)
      (('aavar, 'apn, 'il, 'sl) Form)
| (says) ('apn Princ) (('aavar, 'apn, 'il, 'sl) Form)
| (speaks_for) ('apn Princ) ('apn Princ)
| (controls) ('apn Princ) (('aavar, 'apn, 'il, 'sl) Form)
| reps ('apn Princ) ('apn Princ)
      (('aavar, 'apn, 'il, 'sl) Form)
| (domi) (('apn, 'il) IntLevel) (('apn, 'il) IntLevel)
| (eqi) (('apn, 'il) IntLevel) (('apn, 'il) IntLevel)
| (doms) (('apn, 'sl) SecLevel) (('apn, 'sl) SecLevel)
| (eqs) (('apn, 'sl) SecLevel) (('apn, 'sl) SecLevel)
| (eqn) num num
| (lte) num num
| (lt) num num
```

```
Kripke =
  KS ('aavar -> 'aaworld -> bool)
      ('apn -> 'aaworld -> 'aaworld -> bool) ('apn -> 'il)
      ('apn -> 'sl)
```

```
Princ =
  Name 'apn
| (meet) ('apn Princ) ('apn Princ)
| (quoting) ('apn Princ) ('apn Princ) ;
```

```
IntLevel = iLab 'il | il 'apn ;
```

```
SecLevel = sLab 'sl | sl 'apn
```

1.2 Definitions

[imapKS_def]

$$\vdash \forall \text{Intp } Jfn \text{ ilmap } slmap. \\ \text{imapKS } (KS \text{ Intp } Jfn \text{ ilmap } slmap) = \text{ilmap}$$

[intpKS_def]

$$\vdash \forall \text{Intp } Jfn \text{ ilmap } slmap. \\ \text{intpKS } (KS \text{ Intp } Jfn \text{ ilmap } slmap) = \text{Intp}$$

[jKS_def]

$$\vdash \forall \text{Intp } Jfn \text{ ilmap } slmap. \text{jKS } (KS \text{ Intp } Jfn \text{ ilmap } slmap) = Jfn$$

[O1_def]

$$\vdash O1 = PO \text{ one_weakorder}$$

[one_weakorder_def]

$$\vdash \forall x \ y. \text{one_weakorder } x \ y \iff T$$

[po_TY_DEF]

$$\vdash \exists rep. \text{TYPE_DEFINITION WeakOrder } rep$$

[po_tybij]

$$\vdash (\forall a. PO \text{ (repPO } a) = a) \wedge \\ \forall r. \text{WeakOrder } r \iff (\text{repPO } (PO \ r) = r)$$

[prod_PO_def]

$$\vdash \forall PO_1 \ PO_2. \\ \text{prod_PO } PO_1 \ PO_2 = PO \text{ (RPROD } (\text{repPO } PO_1) \ (\text{repPO } PO_2))$$

[smapKS_def]

$$\vdash \forall \text{Intp } Jfn \text{ ilmap } slmap. \\ \text{smapKS } (KS \text{ Intp } Jfn \text{ ilmap } slmap) = slmap$$

[Subset_PO_def]

$$\vdash \text{Subset_PO} = PO \ (\subseteq)$$

1.3 Theorems

[abs_po11]

$$\vdash \forall r \ r'. \\ \text{WeakOrder } r \Rightarrow \text{WeakOrder } r' \Rightarrow ((PO \ r = PO \ r') \iff (r = r'))$$

[absPO_fn_onto]

$$\vdash \forall a. \exists r. (a = PO \ r) \wedge \text{WeakOrder } r$$

[antisym_prod_antisym]

$\vdash \forall r \ s.$
 $\text{antisymmetric } r \wedge \text{antisymmetric } s \Rightarrow$
 $\text{antisymmetric } (\text{RPROD } r \ s)$

[EQ_WeakOrder]

$\vdash \text{WeakOrder } (=)$

[KS_bij]

$\vdash \forall M. M = \text{KS } (\text{intpKS } M) (\text{jKS } M) (\text{imapKS } M) (\text{smapKS } M)$

[one_weakorder_WO]

$\vdash \text{WeakOrder one_weakorder}$

[onto_po]

$\vdash \forall r. \text{WeakOrder } r \iff \exists a. r = \text{repPO } a$

[po_bij]

$\vdash (\forall a. \text{PO } (\text{repPO } a) = a) \wedge$
 $\forall r. \text{WeakOrder } r \iff (\text{repPO } (\text{PO } r) = r)$

[PO_repPO]

$\vdash \forall a. \text{PO } (\text{repPO } a) = a$

[refl_prod_refl]

$\vdash \forall r \ s. \text{reflexive } r \wedge \text{reflexive } s \Rightarrow \text{reflexive } (\text{RPROD } r \ s)$

[repPO_iPO_partial_order]

$\vdash (\forall x. \text{repPO } iPO \ x \ x) \wedge$
 $(\forall x \ y. \text{repPO } iPO \ x \ y \wedge \text{repPO } iPO \ y \ x \Rightarrow (x = y)) \wedge$
 $\forall x \ y \ z. \text{repPO } iPO \ x \ y \wedge \text{repPO } iPO \ y \ z \Rightarrow \text{repPO } iPO \ x \ z$

[repPO_01]

$\vdash \text{repPO } 01 = \text{one_weakorder}$

[repPO_prod_PO]

$\vdash \forall po_1 \ po_2.$
 $\text{repPO } (\text{prod_PO } po_1 \ po_2) = \text{RPROD } (\text{repPO } po_1) (\text{repPO } po_2)$

[repPO_Subset_PO]

$\vdash \text{repPO } \text{Subset_PO} = (\subseteq)$

[RPROD_THM]

$\vdash \forall r \ s \ a \ b.$
 $\text{RPROD } r \ s \ a \ b \iff r \ (\text{FST } a) \ (\text{FST } b) \wedge s \ (\text{SND } a) \ (\text{SND } b)$

[SUBSET_WO]

$\vdash \text{WeakOrder } (\subseteq)$

[trans_prod_trans]

$\vdash \forall r s. \text{transitive } r \wedge \text{transitive } s \Rightarrow \text{transitive } (\text{RPROD } r s)$

[WeakOrder_Exists]

$\vdash \exists R. \text{WeakOrder } R$

[WO_prod_WO]

$\vdash \forall r s. \text{WeakOrder } r \wedge \text{WeakOrder } s \Rightarrow \text{WeakOrder } (\text{RPROD } r s)$

[WO_repPO]

$\vdash \forall r. \text{WeakOrder } r \iff (\text{repPO } (\text{PO } r) = r)$

2 aclsemanatics Theory

Built: 19 January 2017

Parent Theories: aclfoundation

2.1 Definitions

[Efn_def]

$\vdash (\forall Oi Os M. \text{Efn } Oi Os M \text{ TT} = \mathcal{U}(:'v)) \wedge$
 $(\forall Oi Os M. \text{Efn } Oi Os M \text{ FF} = \{\}) \wedge$
 $(\forall Oi Os M p. \text{Efn } Oi Os M (\text{prop } p) = \text{intpKS } M p) \wedge$
 $(\forall Oi Os M f.$
 $\quad \text{Efn } Oi Os M (\text{notf } f) = \mathcal{U}(:'v) \text{ DIFF Efn } Oi Os M f) \wedge$
 $(\forall Oi Os M f_1 f_2.$
 $\quad \text{Efn } Oi Os M (f_1 \text{ andf } f_2) =$
 $\quad \text{Efn } Oi Os M f_1 \cap \text{Efn } Oi Os M f_2) \wedge$
 $(\forall Oi Os M f_1 f_2.$
 $\quad \text{Efn } Oi Os M (f_1 \text{ orf } f_2) =$
 $\quad \text{Efn } Oi Os M f_1 \cup \text{Efn } Oi Os M f_2) \wedge$
 $(\forall Oi Os M f_1 f_2.$
 $\quad \text{Efn } Oi Os M (f_1 \text{ impf } f_2) =$
 $\quad \mathcal{U}(:'v) \text{ DIFF Efn } Oi Os M f_1 \cup \text{Efn } Oi Os M f_2) \wedge$
 $(\forall Oi Os M f_1 f_2.$
 $\quad \text{Efn } Oi Os M (f_1 \text{ eqf } f_2) =$
 $\quad (\mathcal{U}(:'v) \text{ DIFF Efn } Oi Os M f_1 \cup \text{Efn } Oi Os M f_2) \cap$
 $\quad (\mathcal{U}(:'v) \text{ DIFF Efn } Oi Os M f_2 \cup \text{Efn } Oi Os M f_1)) \wedge$
 $(\forall Oi Os M P f.$
 $\quad \text{Efn } Oi Os M (P \text{ says } f) =$
 $\quad \{w \mid \text{Jext } (\text{jKS } M) P w \subseteq \text{Efn } Oi Os M f\}) \wedge$
 $(\forall Oi Os M P Q.$
 $\quad \text{Efn } Oi Os M (P \text{ speaks_for } Q) =$

```

if Jext (jKS M) Q RSUBSET Jext (jKS M) P then  $\mathcal{U}(:,v)$ 
else  $\{\}$   $\wedge$ 
 $(\forall Oi Os M P f.$ 
  Efn Oi Os M (P controls f) =
   $\mathcal{U}(:,v)$  DIFF  $\{w \mid \text{Jext (jKS M) } P \ w \subseteq \text{Efn Oi Os M } f\} \cup$ 
  Efn Oi Os M f)  $\wedge$ 
 $(\forall Oi Os M P Q f.$ 
  Efn Oi Os M (reps P Q f) =
   $\mathcal{U}(:,v)$  DIFF
   $\{w \mid \text{Jext (jKS M) (P quoting Q) } w \subseteq \text{Efn Oi Os M } f\} \cup$ 
   $\{w \mid \text{Jext (jKS M) } Q \ w \subseteq \text{Efn Oi Os M } f\}) \wedge$ 
 $(\forall Oi Os M intl_1 intl_2.$ 
  Efn Oi Os M (intl1 domi intl2) =
  if repP0 Oi (Lifn M intl2) (Lifn M intl1) then  $\mathcal{U}(:,v)$ 
  else  $\{\}$   $\wedge$ 
 $(\forall Oi Os M intl_2 intl_1.$ 
  Efn Oi Os M (intl2 eqi intl1) =
  (if repP0 Oi (Lifn M intl2) (Lifn M intl1) then  $\mathcal{U}(:,v)$ 
  else  $\{\}$ )  $\cap$ 
  (if repP0 Oi (Lifn M intl1) (Lifn M intl2) then  $\mathcal{U}(:,v)$ 
  else  $\{\}$ )  $\wedge$ 
 $(\forall Oi Os M secl_1 secl_2.$ 
  Efn Oi Os M (secl1 doms secl2) =
  if repP0 Os (Lsfm M secl2) (Lsfm M secl1) then  $\mathcal{U}(:,v)$ 
  else  $\{\}$   $\wedge$ 
 $(\forall Oi Os M secl_2 secl_1.$ 
  Efn Oi Os M (secl2 eqs secl1) =
  (if repP0 Os (Lsfm M secl2) (Lsfm M secl1) then  $\mathcal{U}(:,v)$ 
  else  $\{\}$ )  $\cap$ 
  (if repP0 Os (Lsfm M secl1) (Lsfm M secl2) then  $\mathcal{U}(:,v)$ 
  else  $\{\}$ )  $\wedge$ 
 $(\forall Oi Os M numExp_1 numExp_2.$ 
  Efn Oi Os M (numExp1 eqn numExp2) =
  if numExp1 = numExp2 then  $\mathcal{U}(:,v)$  else  $\{\}$   $\wedge$ 
 $(\forall Oi Os M numExp_1 numExp_2.$ 
  Efn Oi Os M (numExp1 lte numExp2) =
  if numExp1 ≤ numExp2 then  $\mathcal{U}(:,v)$  else  $\{\}$   $\wedge$ 
 $\forall Oi Os M numExp_1 numExp_2.$ 
  Efn Oi Os M (numExp1 lt numExp2) =
  if numExp1 < numExp2 then  $\mathcal{U}(:,v)$  else  $\{\}$ 

```

[Jext_def]

```

 $\vdash (\forall J s. \text{Jext } J (\text{Name } s) = J s) \wedge$ 
 $(\forall J P_1 P_2.$ 
   $\text{Jext } J (P_1 \text{ meet } P_2) = \text{Jext } J P_1 \text{ RUNION } \text{Jext } J P_2) \wedge$ 
 $\forall J P_1 P_2. \text{Jext } J (P_1 \text{ quoting } P_2) = \text{Jext } J P_2 \ 0 \ \text{Jext } J P_1$ 

```

[Lifn_def]

```

 $\vdash (\forall M l. \text{Lifn } M (\text{iLab } l) = l) \wedge$ 
 $\forall M \text{ name}. \text{Lifn } M (\text{il name}) = \text{imapKS } M \text{ name}$ 

```

[Lsfn_def]

$$\vdash (\forall M \ l. \text{Lsfn } M \ (\text{sLab } l) = l) \wedge \\ \forall M \ name. \text{Lsfn } M \ (\text{sl } name) = \text{smapKS } M \ name$$

2.2 Theorems

[andf_def]

$$\vdash \forall Oi \ Os \ M \ f_1 \ f_2. \\ \text{Efn } Oi \ Os \ M \ (f_1 \text{ andf } f_2) = \text{Efn } Oi \ Os \ M \ f_1 \cap \text{Efn } Oi \ Os \ M \ f_2$$

[controls_def]

$$\vdash \forall Oi \ Os \ M \ P \ f. \\ \text{Efn } Oi \ Os \ M \ (P \text{ controls } f) = \\ \mathcal{U}(:, 'v) \text{ DIFF } \{w \mid \text{Jext } (\text{jKS } M) \ P \ w \subseteq \text{Efn } Oi \ Os \ M \ f\} \cup \\ \text{Efn } Oi \ Os \ M \ f$$

[controls_says]

$$\vdash \forall M \ P \ f. \\ \text{Efn } Oi \ Os \ M \ (P \text{ controls } f) = \text{Efn } Oi \ Os \ M \ (P \text{ says } f \text{ impf } f)$$

[domi_def]

$$\vdash \forall Oi \ Os \ M \ intl_1 \ intl_2. \\ \text{Efn } Oi \ Os \ M \ (intl_1 \text{ domi } intl_2) = \\ \text{if repP0 } Oi \ (\text{Lifn } M \ intl_2) \ (\text{Lifn } M \ intl_1) \text{ then } \mathcal{U}(:, 'v) \\ \text{else } \{\}$$

[doms_def]

$$\vdash \forall Oi \ Os \ M \ secl_1 \ secl_2. \\ \text{Efn } Oi \ Os \ M \ (secl_1 \text{ doms } secl_2) = \\ \text{if repP0 } Os \ (\text{Lsfn } M \ secl_2) \ (\text{Lsfn } M \ secl_1) \text{ then } \mathcal{U}(:, 'v) \\ \text{else } \{\}$$

[eqf_def]

$$\vdash \forall Oi \ Os \ M \ f_1 \ f_2. \\ \text{Efn } Oi \ Os \ M \ (f_1 \text{ eqf } f_2) = \\ (\mathcal{U}(:, 'v) \text{ DIFF } \text{Efn } Oi \ Os \ M \ f_1 \cup \text{Efn } Oi \ Os \ M \ f_2) \cap \\ (\mathcal{U}(:, 'v) \text{ DIFF } \text{Efn } Oi \ Os \ M \ f_2 \cup \text{Efn } Oi \ Os \ M \ f_1)$$

[eqf_impf]

$$\vdash \forall M \ f_1 \ f_2. \\ \text{Efn } Oi \ Os \ M \ (f_1 \text{ eqf } f_2) = \\ \text{Efn } Oi \ Os \ M \ ((f_1 \text{ impf } f_2) \text{ andf } (f_2 \text{ impf } f_1))$$

[eqi_def]

$$\begin{aligned} &\vdash \forall Oi \ Os \ M \ intl_2 \ intl_1. \\ &\quad \text{Efn } Oi \ Os \ M \ (intl_2 \text{ eqi } intl_1) = \\ &\quad (\text{if repP0 } Oi \ (\text{Lifn } M \ intl_2) \ (\text{Lifn } M \ intl_1) \text{ then } \mathcal{U}(:'v) \\ &\quad \text{else } \{\}) \cap \\ &\quad \text{if repP0 } Oi \ (\text{Lifn } M \ intl_1) \ (\text{Lifn } M \ intl_2) \text{ then } \mathcal{U}(:'v) \\ &\quad \text{else } \{\} \end{aligned}$$
[eqi_domi]

$$\begin{aligned} &\vdash \forall M \ intL_1 \ intL_2. \\ &\quad \text{Efn } Oi \ Os \ M \ (intL_1 \text{ eqi } intL_2) = \\ &\quad \text{Efn } Oi \ Os \ M \ (intL_2 \text{ domi } intL_1 \text{ andf } intL_1 \text{ domi } intL_2) \end{aligned}$$
[eqn_def]

$$\begin{aligned} &\vdash \forall Oi \ Os \ M \ numExp_1 \ numExp_2. \\ &\quad \text{Efn } Oi \ Os \ M \ (numExp_1 \text{ eqn } numExp_2) = \\ &\quad \text{if } numExp_1 = numExp_2 \text{ then } \mathcal{U}(:'v) \text{ else } \{\} \end{aligned}$$
[eqs_def]

$$\begin{aligned} &\vdash \forall Oi \ Os \ M \ secl_2 \ secl_1. \\ &\quad \text{Efn } Oi \ Os \ M \ (secl_2 \text{ eqs } secl_1) = \\ &\quad (\text{if repP0 } Os \ (\text{Lsfm } M \ secl_2) \ (\text{Lsfm } M \ secl_1) \text{ then } \mathcal{U}(:'v) \\ &\quad \text{else } \{\}) \cap \\ &\quad \text{if repP0 } Os \ (\text{Lsfm } M \ secl_1) \ (\text{Lsfm } M \ secl_2) \text{ then } \mathcal{U}(:'v) \\ &\quad \text{else } \{\} \end{aligned}$$
[eqs_doms]

$$\begin{aligned} &\vdash \forall M \ secL_1 \ secL_2. \\ &\quad \text{Efn } Oi \ Os \ M \ (secL_1 \text{ eqs } secL_2) = \\ &\quad \text{Efn } Oi \ Os \ M \ (secL_2 \text{ doms } secL_1 \text{ andf } secL_1 \text{ doms } secL_2) \end{aligned}$$
[FF_def]

$$\vdash \forall Oi \ Os \ M. \text{Efn } Oi \ Os \ M \text{ FF} = \{\}$$
[impf_def]

$$\begin{aligned} &\vdash \forall Oi \ Os \ M \ f_1 \ f_2. \\ &\quad \text{Efn } Oi \ Os \ M \ (f_1 \text{ impf } f_2) = \\ &\quad \mathcal{U}(:'v) \text{ DIFF Efn } Oi \ Os \ M \ f_1 \cup \text{Efn } Oi \ Os \ M \ f_2 \end{aligned}$$
[lt_def]

$$\begin{aligned} &\vdash \forall Oi \ Os \ M \ numExp_1 \ numExp_2. \\ &\quad \text{Efn } Oi \ Os \ M \ (numExp_1 \text{ lt } numExp_2) = \\ &\quad \text{if } numExp_1 < numExp_2 \text{ then } \mathcal{U}(:'v) \text{ else } \{\} \end{aligned}$$
[lte_def]

$$\begin{aligned} &\vdash \forall Oi \ Os \ M \ numExp_1 \ numExp_2. \\ &\quad \text{Efn } Oi \ Os \ M \ (numExp_1 \text{ lte } numExp_2) = \\ &\quad \text{if } numExp_1 \leq numExp_2 \text{ then } \mathcal{U}(:'v) \text{ else } \{\} \end{aligned}$$

[meet_def]

$$\vdash \forall J P_1 P_2. \text{Jext } J (P_1 \text{ meet } P_2) = \text{Jext } J P_1 \text{ RUNION } \text{Jext } J P_2$$

[name_def]

$$\vdash \forall J s. \text{Jext } J (\text{Name } s) = J s$$

[notf_def]

$$\vdash \forall Oi Os M f. \text{Efn } Oi Os M (\text{notf } f) = \mathcal{U}(:'v) \text{ DIFF } \text{Efn } Oi Os M f$$

[orf_def]

$$\vdash \forall Oi Os M f_1 f_2. \\ \text{Efn } Oi Os M (f_1 \text{ orf } f_2) = \text{Efn } Oi Os M f_1 \cup \text{Efn } Oi Os M f_2$$

[prop_def]

$$\vdash \forall Oi Os M p. \text{Efn } Oi Os M (\text{prop } p) = \text{intpKS } M p$$

[quoting_def]

$$\vdash \forall J P_1 P_2. \text{Jext } J (P_1 \text{ quoting } P_2) = \text{Jext } J P_2 \text{ } 0 \text{ Jext } J P_1$$

[reps_def]

$$\vdash \forall Oi Os M P Q f. \\ \text{Efn } Oi Os M (\text{reps } P Q f) = \\ \mathcal{U}(:'v) \text{ DIFF} \\ \{w \mid \text{Jext } (\text{jKS } M) (P \text{ quoting } Q) w \subseteq \text{Efn } Oi Os M f\} \cup \\ \{w \mid \text{Jext } (\text{jKS } M) Q w \subseteq \text{Efn } Oi Os M f\}$$

[says_def]

$$\vdash \forall Oi Os M P f. \\ \text{Efn } Oi Os M (P \text{ says } f) = \\ \{w \mid \text{Jext } (\text{jKS } M) P w \subseteq \text{Efn } Oi Os M f\}$$

[speaks_for_def]

$$\vdash \forall Oi Os M P Q. \\ \text{Efn } Oi Os M (P \text{ speaks_for } Q) = \\ \text{if } \text{Jext } (\text{jKS } M) Q \text{ RSUBSET } \text{Jext } (\text{jKS } M) P \text{ then } \mathcal{U}(:'v) \\ \text{else } \{\}$$

[TT_def]

$$\vdash \forall Oi Os M. \text{Efn } Oi Os M \text{ TT} = \mathcal{U}(:'v)$$

3 aclrules Theory

Built: 19 January 2017

Parent Theories: aclsemantics

3.1 Definitions

[sat_def]

$$\vdash \forall M \ Oi \ Os \ f. (M, Oi, Os) \text{ sat } f \iff (\text{Efn } Oi \ Os \ M \ f = \mathcal{U}(:'\text{world}))$$

3.2 Theorems

[And_Says]

$$\vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ (M, Oi, Os) \text{ sat } P \text{ meet } Q \text{ says } f \text{ eqf } P \text{ says } f \text{ andf } Q \text{ says } f$$

[And_Says_Eq]

$$\vdash (M, Oi, Os) \text{ sat } P \text{ meet } Q \text{ says } f \iff \\ (M, Oi, Os) \text{ sat } P \text{ says } f \text{ andf } Q \text{ says } f$$

[and_says_lemma]

$$\vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ (M, Oi, Os) \text{ sat } P \text{ meet } Q \text{ says } f \text{ impf } P \text{ says } f \text{ andf } Q \text{ says } f$$

[Controls_Eq]

$$\vdash \forall M \ Oi \ Os \ P \ f. \\ (M, Oi, Os) \text{ sat } P \text{ controls } f \iff (M, Oi, Os) \text{ sat } P \text{ says } f \text{ impf } f$$

[DIFF_UNIV_SUBSET]

$$\vdash (\mathcal{U}(:'\text{a}) \text{ DIFF } s \cup t = \mathcal{U}(:'\text{a})) \iff s \subseteq t$$

[domi_antisymmetric]

$$\vdash \forall M \ Oi \ Os \ l_1 \ l_2. \\ (M, Oi, Os) \text{ sat } l_1 \text{ domi } l_2 \Rightarrow \\ (M, Oi, Os) \text{ sat } l_2 \text{ domi } l_1 \Rightarrow \\ (M, Oi, Os) \text{ sat } l_1 \text{ eqi } l_2$$

[domi_reflexive]

$$\vdash \forall M \ Oi \ Os \ l. (M, Oi, Os) \text{ sat } l \text{ domi } l$$

[domi_transitive]

$$\vdash \forall M \ Oi \ Os \ l_1 \ l_2 \ l_3. \\ (M, Oi, Os) \text{ sat } l_1 \text{ domi } l_2 \Rightarrow \\ (M, Oi, Os) \text{ sat } l_2 \text{ domi } l_3 \Rightarrow \\ (M, Oi, Os) \text{ sat } l_1 \text{ domi } l_3$$

[doms_antisymmetric]

$$\vdash \forall M \ Oi \ Os \ l_1 \ l_2. \\ (M, Oi, Os) \text{ sat } l_1 \text{ doms } l_2 \Rightarrow \\ (M, Oi, Os) \text{ sat } l_2 \text{ doms } l_1 \Rightarrow \\ (M, Oi, Os) \text{ sat } l_1 \text{ eqs } l_2$$

[doms_reflexive]

$$\vdash \forall M \ Oi \ Os \ l. (M, Oi, Os) \text{ sat } l \text{ doms } l$$
[doms_transitive]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ l_1 \ l_2 \ l_3. \\ (M, Oi, Os) \text{ sat } l_1 \text{ doms } l_2 \Rightarrow \\ (M, Oi, Os) \text{ sat } l_2 \text{ doms } l_3 \Rightarrow \\ (M, Oi, Os) \text{ sat } l_1 \text{ doms } l_3 \end{aligned}$$
[eqf_and_impf]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ f_1 \ f_2. \\ (M, Oi, Os) \text{ sat } f_1 \text{ eqf } f_2 \iff \\ (M, Oi, Os) \text{ sat } (f_1 \text{ impf } f_2) \text{ andf } (f_2 \text{ impf } f_1) \end{aligned}$$
[eqf_andf1]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ f \ f' \ g. \\ (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ (M, Oi, Os) \text{ sat } f \text{ andf } g \Rightarrow \\ (M, Oi, Os) \text{ sat } f' \text{ andf } g \end{aligned}$$
[eqf_andf2]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ f \ f' \ g. \\ (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ (M, Oi, Os) \text{ sat } g \text{ andf } f \Rightarrow \\ (M, Oi, Os) \text{ sat } g \text{ andf } f' \end{aligned}$$
[eqf_controls]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ P \ f \ f'. \\ (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ (M, Oi, Os) \text{ sat } P \text{ controls } f \Rightarrow \\ (M, Oi, Os) \text{ sat } P \text{ controls } f' \end{aligned}$$
[eqf_eq]

$$\begin{aligned} \vdash (\text{Efn } Oi \ Os \ M \ (f_1 \text{ eqf } f_2) = \mathcal{U}(:'b)) \iff \\ (\text{Efn } Oi \ Os \ M \ f_1 = \text{Efn } Oi \ Os \ M \ f_2) \end{aligned}$$
[eqf_eqf1]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ f \ f' \ g. \\ (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ (M, Oi, Os) \text{ sat } f \text{ eqf } g \Rightarrow \\ (M, Oi, Os) \text{ sat } f' \text{ eqf } g \end{aligned}$$
[eqf_eqf2]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ f \ f' \ g. \\ (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ (M, Oi, Os) \text{ sat } g \text{ eqf } f \Rightarrow \\ (M, Oi, Os) \text{ sat } g \text{ eqf } f' \end{aligned}$$

[eqf_impf1]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f \ f' \ g. \\ &\quad (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } f \text{ impf } g \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } f' \text{ impf } g \end{aligned}$$
[eqf_impf2]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f \ f' \ g. \\ &\quad (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } g \text{ impf } f \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } g \text{ impf } f' \end{aligned}$$
[eqf_notf]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f \ f'. \\ &\quad (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat notf } f \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat notf } f' \end{aligned}$$
[eqf_orf1]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f \ f' \ g. \\ &\quad (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } f \text{ orf } g \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } f' \text{ orf } g \end{aligned}$$
[eqf_orf2]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f \ f' \ g. \\ &\quad (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } g \text{ orf } f \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } g \text{ orf } f' \end{aligned}$$
[eqf_reps]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ Q \ f \ f'. \\ &\quad (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat reps } P \ Q \ f \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat reps } P \ Q \ f' \end{aligned}$$
[eqf_sat]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f_1 \ f_2. \\ &\quad (M, Oi, Os) \text{ sat } f_1 \text{ eqf } f_2 \Rightarrow \\ &\quad ((M, Oi, Os) \text{ sat } f_1 \iff (M, Oi, Os) \text{ sat } f_2) \end{aligned}$$
[eqf_says]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ f \ f'. \\ &\quad (M, Oi, Os) \text{ sat } f \text{ eqf } f' \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } P \text{ says } f \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } P \text{ says } f' \end{aligned}$$

[eqi_Eq]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ l_1 \ l_2. \\ &\quad (M, Oi, Os) \text{ sat } l_1 \text{ eqi } l_2 \iff \\ &\quad (M, Oi, Os) \text{ sat } l_2 \text{ domi } l_1 \text{ andf } l_1 \text{ domi } l_2 \end{aligned}$$
[eqs_Eq]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ l_1 \ l_2. \\ &\quad (M, Oi, Os) \text{ sat } l_1 \text{ eqs } l_2 \iff \\ &\quad (M, Oi, Os) \text{ sat } l_2 \text{ doms } l_1 \text{ andf } l_1 \text{ doms } l_2 \end{aligned}$$
[Idemp_Speaks_For]

$$\vdash \forall M \ Oi \ Os \ P. (M, Oi, Os) \text{ sat } P \text{ speaks_for } P$$
[Image_cmp]

$$\vdash \forall R_1 \ R_2 \ R_3 \ u. (R_1 \ 0 \ R_2) \ u \subseteq R_3 \iff R_2 \ u \subseteq \{y \mid R_1 \ y \subseteq R_3\}$$
[Image_SUBSET]

$$\vdash \forall R_1 \ R_2. R_2 \text{ RSUBSET } R_1 \Rightarrow \forall w. R_2 \ w \subseteq R_1 \ w$$
[Image_UNION]

$$\vdash \forall R_1 \ R_2 \ w. (R_1 \text{ RUNION } R_2) \ w = R_1 \ w \cup R_2 \ w$$
[INTER_EQ_UNIV]

$$\vdash (s \cap t = \mathcal{U}(:'a)) \iff (s = \mathcal{U}(:'a)) \wedge (t = \mathcal{U}(:'a))$$
[Modus_Ponens]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f_1 \ f_2. \\ &\quad (M, Oi, Os) \text{ sat } f_1 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } f_1 \text{ impf } f_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } f_2 \end{aligned}$$
[Mono_speaks_for]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ P' \ Q \ Q'. \\ &\quad (M, Oi, Os) \text{ sat } P \text{ speaks_for } P' \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } Q \text{ speaks_for } Q' \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } P \text{ quoting } Q \text{ speaks_for } P' \text{ quoting } Q' \end{aligned}$$
[MP_Says]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ f_1 \ f_2. \\ &\quad (M, Oi, Os) \text{ sat } \\ &\quad P \text{ says } (f_1 \text{ impf } f_2) \text{ impf } P \text{ says } f_1 \text{ impf } P \text{ says } f_2 \end{aligned}$$
[Quoting]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ &\quad (M, Oi, Os) \text{ sat } P \text{ quoting } Q \text{ says } f \text{ eqf } P \text{ says } Q \text{ says } f \end{aligned}$$

[Quoting_Eq]

$$\vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ (M, Oi, Os) \text{ sat } P \text{ quoting } Q \text{ says } f \iff \\ (M, Oi, Os) \text{ sat } P \text{ says } Q \text{ says } f$$
[reps_def_lemma]

$$\vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ \text{Efn } Oi \ Os \ M \ (\text{reps } P \ Q \ f) = \\ \text{Efn } Oi \ Os \ M \ (P \text{ quoting } Q \text{ says } f \text{ impf } Q \text{ says } f)$$
[Reps_Eq]

$$\vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ (M, Oi, Os) \text{ sat reps } P \ Q \ f \iff \\ (M, Oi, Os) \text{ sat } P \text{ quoting } Q \text{ says } f \text{ impf } Q \text{ says } f$$
[sat_allworld]

$$\vdash \forall M \ f. (M, Oi, Os) \text{ sat } f \iff \forall w. w \in \text{Efn } Oi \ Os \ M \ f$$
[sat_andf_eq_and_sat]

$$\vdash (M, Oi, Os) \text{ sat } f_1 \text{ andf } f_2 \iff \\ (M, Oi, Os) \text{ sat } f_1 \wedge (M, Oi, Os) \text{ sat } f_2$$
[sat_TT]

$$\vdash (M, Oi, Os) \text{ sat TT}$$
[Says]

$$\vdash \forall M \ Oi \ Os \ P \ f. (M, Oi, Os) \text{ sat } f \Rightarrow (M, Oi, Os) \text{ sat } P \text{ says } f$$
[says_and_lemma]

$$\vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ (M, Oi, Os) \text{ sat } P \text{ says } f \text{ andf } Q \text{ says } f \text{ impf } P \text{ meet } Q \text{ says } f$$
[Speaks_For]

$$\vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ (M, Oi, Os) \text{ sat } P \text{ speaks_for } Q \text{ impf } P \text{ says } f \text{ impf } Q \text{ says } f$$
[speaks_for_SUBSET]

$$\vdash \forall R_3 \ R_2 \ R_1. \\ R_2 \text{ RSUBSET } R_1 \Rightarrow \forall w. \{w \mid R_1 \ w \subseteq R_3\} \subseteq \{w \mid R_2 \ w \subseteq R_3\}$$
[SUBSET_Image_SUBSET]

$$\vdash \forall R_1 \ R_2 \ R_3. \\ (\forall w_1. R_2 \ w_1 \subseteq R_1 \ w_1) \Rightarrow \\ \forall w. \{w \mid R_1 \ w \subseteq R_3\} \subseteq \{w \mid R_2 \ w \subseteq R_3\}$$

[Trans_Speaks_For]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ Q \ R. \\ &\quad (M, Oi, Os) \text{ sat } P \text{ speaks_for } Q \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } Q \text{ speaks_for } R \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } P \text{ speaks_for } R \end{aligned}$$
[UNIV_DIFF_SUBSET]

$$\vdash \forall R_1 \ R_2. \ R_1 \subseteq R_2 \Rightarrow (\mathcal{U}(:'a) \text{ DIFF } R_1 \cup R_2 = \mathcal{U}(:'a))$$
[world_and]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f_1 \ f_2 \ w. \\ &\quad w \in \text{Efn } Oi \ Os \ M \ (f_1 \text{ andf } f_2) \iff \\ &\quad w \in \text{Efn } Oi \ Os \ M \ f_1 \wedge w \in \text{Efn } Oi \ Os \ M \ f_2 \end{aligned}$$
[world_eq]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f_1 \ f_2 \ w. \\ &\quad w \in \text{Efn } Oi \ Os \ M \ (f_1 \text{ eqf } f_2) \iff \\ &\quad (w \in \text{Efn } Oi \ Os \ M \ f_1 \iff w \in \text{Efn } Oi \ Os \ M \ f_2) \end{aligned}$$
[world_eqn]

$$\vdash \forall M \ Oi \ Os \ n_1 \ n_2 \ w. \ w \in \text{Efn } Oi \ Os \ m \ (n_1 \text{ eqn } n_2) \iff (n_1 = n_2)$$
[world_F]

$$\vdash \forall M \ Oi \ Os \ w. \ w \notin \text{Efn } Oi \ Os \ M \text{ FF}$$
[world_imp]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f_1 \ f_2 \ w. \\ &\quad w \in \text{Efn } Oi \ Os \ M \ (f_1 \text{ impf } f_2) \iff \\ &\quad w \in \text{Efn } Oi \ Os \ M \ f_1 \Rightarrow w \in \text{Efn } Oi \ Os \ M \ f_2 \end{aligned}$$
[world_lt]

$$\vdash \forall M \ Oi \ Os \ n_1 \ n_2 \ w. \ w \in \text{Efn } Oi \ Os \ m \ (n_1 \text{ lt } n_2) \iff n_1 < n_2$$
[world_lte]

$$\vdash \forall M \ Oi \ Os \ n_1 \ n_2 \ w. \ w \in \text{Efn } Oi \ Os \ m \ (n_1 \text{ lte } n_2) \iff n_1 \leq n_2$$
[world_not]

$$\vdash \forall M \ Oi \ Os \ f \ w. \ w \in \text{Efn } Oi \ Os \ M \ (\text{notf } f) \iff w \notin \text{Efn } Oi \ Os \ M \ f$$
[world_or]

$$\begin{aligned} &\vdash \forall M \ f_1 \ f_2 \ w. \\ &\quad w \in \text{Efn } Oi \ Os \ M \ (f_1 \text{ orf } f_2) \iff \\ &\quad w \in \text{Efn } Oi \ Os \ M \ f_1 \vee w \in \text{Efn } Oi \ Os \ M \ f_2 \end{aligned}$$
[world_says]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ f \ w. \\ &\quad w \in \text{Efn } Oi \ Os \ M \ (P \text{ says } f) \iff \\ &\quad \forall v. v \in \text{Jext } (\text{jKS } M) \ P \ w \Rightarrow v \in \text{Efn } Oi \ Os \ M \ f \end{aligned}$$
[world_T]

$$\vdash \forall M \ Oi \ Os \ w. \ w \in \text{Efn } Oi \ Os \ M \text{ TT}$$

4 aclDrules Theory

Built: 19 January 2017

Parent Theories: acldrules

4.1 Theorems

[Conjunction]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ f_1 \ f_2. \\ (M, Oi, Os) \text{ sat } f_1 \Rightarrow \\ (M, Oi, Os) \text{ sat } f_2 \Rightarrow \\ (M, Oi, Os) \text{ sat } f_1 \text{ andf } f_2 \end{aligned}$$

[Controls]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ P \ f. \\ (M, Oi, Os) \text{ sat } P \text{ says } f \Rightarrow \\ (M, Oi, Os) \text{ sat } P \text{ controls } f \Rightarrow \\ (M, Oi, Os) \text{ sat } f \end{aligned}$$

[Derived_Controls]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ (M, Oi, Os) \text{ sat } P \text{ speaks_for } Q \Rightarrow \\ (M, Oi, Os) \text{ sat } Q \text{ controls } f \Rightarrow \\ (M, Oi, Os) \text{ sat } P \text{ controls } f \end{aligned}$$

[Derived_Speaks_For]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ (M, Oi, Os) \text{ sat } P \text{ speaks_for } Q \Rightarrow \\ (M, Oi, Os) \text{ sat } P \text{ says } f \Rightarrow \\ (M, Oi, Os) \text{ sat } Q \text{ says } f \end{aligned}$$

[Disjunction1]

$$\vdash \forall M \ Oi \ Os \ f_1 \ f_2. (M, Oi, Os) \text{ sat } f_1 \Rightarrow (M, Oi, Os) \text{ sat } f_1 \text{ orf } f_2$$

[Disjunction2]

$$\vdash \forall M \ Oi \ Os \ f_1 \ f_2. (M, Oi, Os) \text{ sat } f_2 \Rightarrow (M, Oi, Os) \text{ sat } f_1 \text{ orf } f_2$$

[Disjunctive_Syllogism]

$$\begin{aligned} \vdash \forall M \ Oi \ Os \ f_1 \ f_2. \\ (M, Oi, Os) \text{ sat } f_1 \text{ orf } f_2 \Rightarrow \\ (M, Oi, Os) \text{ sat notf } f_1 \Rightarrow \\ (M, Oi, Os) \text{ sat } f_2 \end{aligned}$$

[Double_Negation]

$$\vdash \forall M \ Oi \ Os \ f. (M, Oi, Os) \text{ sat notf (notf } f) \Rightarrow (M, Oi, Os) \text{ sat } f$$

[eqn_eqn]

$$\begin{aligned} &\vdash (M, Oi, Os) \text{ sat } c_1 \text{ eqn } n_1 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } c_2 \text{ eqn } n_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } n_1 \text{ eqn } n_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } c_1 \text{ eqn } c_2 \end{aligned}$$
[eqn_lt]

$$\begin{aligned} &\vdash (M, Oi, Os) \text{ sat } c_1 \text{ eqn } n_1 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } c_2 \text{ eqn } n_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } n_1 \text{ lt } n_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } c_1 \text{ lt } c_2 \end{aligned}$$
[eqn_lte]

$$\begin{aligned} &\vdash (M, Oi, Os) \text{ sat } c_1 \text{ eqn } n_1 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } c_2 \text{ eqn } n_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } n_1 \text{ lte } n_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } c_1 \text{ lte } c_2 \end{aligned}$$
[Hypothetical_Syllogism]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f_1 \ f_2 \ f_3. \\ &\quad (M, Oi, Os) \text{ sat } f_1 \text{ impf } f_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } f_2 \text{ impf } f_3 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } f_1 \text{ impf } f_3 \end{aligned}$$
[il_domi]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ Q \ l_1 \ l_2. \\ &\quad (M, Oi, Os) \text{ sat il } P \text{ eqi } l_1 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat il } Q \text{ eqi } l_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } l_2 \text{ domi } l_1 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat il } Q \text{ domi il } P \end{aligned}$$
[INTER_EQ_UNIV]

$$\vdash \forall s_1 \ s_2. (s_1 \cap s_2 = \mathcal{U}(:'a)) \iff (s_1 = \mathcal{U}(:'a)) \wedge (s_2 = \mathcal{U}(:'a))$$
[Modus_Tollens]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ f_1 \ f_2. \\ &\quad (M, Oi, Os) \text{ sat } f_1 \text{ impf } f_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat notf } f_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat notf } f_1 \end{aligned}$$
[Rep_Controls_Eq]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ A \ B \ f. \\ &\quad (M, Oi, Os) \text{ sat reps } A \ B \ f \iff \\ &\quad (M, Oi, Os) \text{ sat } A \text{ controls } B \text{ says } f \end{aligned}$$

[Rep_Says]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ &\quad (M, Oi, Os) \text{ sat } \text{reps } P \ Q \ f \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } P \text{ quoting } Q \text{ says } f \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } Q \text{ says } f \end{aligned}$$
[Reps]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ Q \ f. \\ &\quad (M, Oi, Os) \text{ sat } \text{reps } P \ Q \ f \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } P \text{ quoting } Q \text{ says } f \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } Q \text{ controls } f \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } f \end{aligned}$$
[Says_Simplification1]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ f_1 \ f_2. \\ &\quad (M, Oi, Os) \text{ sat } P \text{ says } (f_1 \text{ andf } f_2) \Rightarrow (M, Oi, Os) \text{ sat } P \text{ says } f_1 \end{aligned}$$
[Says_Simplification2]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ f_1 \ f_2. \\ &\quad (M, Oi, Os) \text{ sat } P \text{ says } (f_1 \text{ andf } f_2) \Rightarrow (M, Oi, Os) \text{ sat } P \text{ says } f_2 \end{aligned}$$
[Simplification1]

$$\vdash \forall M \ Oi \ Os \ f_1 \ f_2. (M, Oi, Os) \text{ sat } f_1 \text{ andf } f_2 \Rightarrow (M, Oi, Os) \text{ sat } f_1$$
[Simplification2]

$$\vdash \forall M \ Oi \ Os \ f_1 \ f_2. (M, Oi, Os) \text{ sat } f_1 \text{ andf } f_2 \Rightarrow (M, Oi, Os) \text{ sat } f_2$$
[sl_doms]

$$\begin{aligned} &\vdash \forall M \ Oi \ Os \ P \ Q \ l_1 \ l_2. \\ &\quad (M, Oi, Os) \text{ sat } \text{sl } P \text{ eqs } l_1 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } \text{sl } Q \text{ eqs } l_2 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } l_2 \text{ doms } l_1 \Rightarrow \\ &\quad (M, Oi, Os) \text{ sat } \text{sl } Q \text{ doms } \text{sl } P \end{aligned}$$

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