Contents

1 aclfoundation Theory

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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]

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

[intpKS_def]

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

[jKS_def]

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

[O1_def]

$\vdash \texttt{O1} = \texttt{PO one\_weakorder}$

[one_weakorder_def]

$\vdash \forall x\ y.\ \texttt{one\_weakorder}\ x\ y \iff \texttt{T}$

[po_TY_DEF]

$\vdash \exists \mathit{rep}.\ \texttt{TYPE\_DEFINITION WeakOrder}\ \mathit{rep}$

[po_tybij]

$\vdash (\forall a.\ \texttt{PO}\ (\texttt{repPO}\ a) = a) \land$
$\quad \forall r.\ \texttt{WeakOrder}\ r \iff (\texttt{repPO}\ (\texttt{PO}\ r) = r)$

[prod_PO_def]

$\vdash \forall PO_1\ PO_2.$
$\quad \texttt{prod\_PO}\ PO_1\ PO_2 = \texttt{PO}\ (\texttt{RPROD}\ (\texttt{repPO}\ PO_1)\ (\texttt{repPO}\ PO_2))$

[smapKS_def]

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

[Subset_PO_def]

$\vdash \texttt{Subset\_PO} = \texttt{PO}\ (\subseteq)$

1.3 Theorems

[abs_po11]

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

[absPO_fn_onto]

$\vdash \forall a.\ \exists r.\ (a = \texttt{PO}\ r) \land \texttt{WeakOrder}\ r$

[antisym_prod_antisym]

$\vdash \forall r\ s.$
antisymmetric $r \land$ antisymmetric $s \Rightarrow$
antisymmetric (RPROD r s)

[EQ_WeakOrder]

$\vdash$ WeakOrder (=)

[KS_bij]

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

[one_weakorder_WO]

$\vdash$ WeakOrder one_weakorder

[onto_po]

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

[po_bij]

$\vdash$ ($\forall a.$ PO (repPO a) = a) $\land$
$\forall r.$ WeakOrder $r \iff$ (repPO (PO r) = r)

[PO_repPO]

$\vdash \forall a.$ PO (repPO a) = a

[refl_prod_refl]

$\vdash \forall r\ s.$ reflexive $r \land$ reflexive $s \Rightarrow$ reflexive (RPROD r s)

[repPO_iPO_partial_order]

$\vdash$ ($\forall x.$ repPO iPO x x) $\land$
($\forall x\ y.$ repPO iPO x y $\land$ repPO iPO y $x \Rightarrow$ (x = y)) $\land$
$\forall x\ y\ z.$ repPO iPO x y $\land$ repPO iPO y $z \Rightarrow$ repPO iPO x z

[repPO_O1]

$\vdash$ repPO O1 = one_weakorder

[repPO_prod_PO]

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

[repPO_Subset_PO]

$\vdash$ repPO Subset_PO = ($\subseteq$)

[RPROD_THM]

$\vdash \forall r\ s\ a\ b.$
RPROD r s a $b \iff r$ (FST a) (FST b) $\land$ s (SND a) (SND b)

[SUBSET_WO]

$\vdash$ WeakOrder ($\subseteq$)

[trans_prod_trans]

$\vdash \forall r\ s.$ transitive $r \land$ transitive $s \Rightarrow$ transitive (RPROD r s)

[WeakOrder_Exists]

$\vdash \exists R.$ WeakOrder R

[WO_prod_WO]

$\vdash \forall r\ s.$ WeakOrder $r \land$ WeakOrder $s \Rightarrow$ WeakOrder (RPROD r s)

[WO_repPO]

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

2 aclsemantics Theory

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Parent Theories: aclfoundation

2.1 Definitions

[Efn_def]

```
⊢ (∀Oi Os M. Efn Oi Os M TT = 𝒰(:'v)) ∧
  (∀Oi Os M. Efn Oi Os M FF = {}) ∧
  (∀Oi Os M p. Efn Oi Os M (prop p) = intpKS M p) ∧
  (∀Oi Os M f.
     Efn Oi Os M (notf f) = 𝒰(:'v) DIFF Efn Oi Os M f) ∧
  (∀Oi Os M f1 f2.
     Efn Oi Os M (f1 andf f2) =
     Efn Oi Os M f1 ∩ Efn Oi Os M f2) ∧
  (∀Oi Os M f1 f2.
     Efn Oi Os M (f1 orf f2) =
     Efn Oi Os M f1 ∪ Efn Oi Os M f2) ∧
  (∀Oi Os M f1 f2.
     Efn Oi Os M (f1 impf f2) =
     𝒰(:'v) DIFF Efn Oi Os M f1 ∪ Efn Oi Os M f2) ∧
  (∀Oi Os M f1 f2.
     Efn Oi Os M (f1 eqf f2) =
     (𝒰(:'v) DIFF Efn Oi Os M f1 ∪ Efn Oi Os M f2) ∩
     (𝒰(:'v) DIFF Efn Oi Os M f2 ∪ Efn Oi Os M f1)) ∧
  (∀Oi Os M P f.
     Efn Oi Os M (P says f) =
     {w | Jext (jKS M) P w ⊆ Efn Oi Os M f}) ∧
  (∀Oi Os M P Q.
     Efn Oi Os M (P speaks_for Q) =
```

```
    if Jext (jKS M) Q RSUBSET Jext (jKS M) P then 𝒰(:'v)
    else {}) ∧
  (∀ Oi Os M P f.
    Efn Oi Os M (P controls f) =
    𝒰(:'v) DIFF {w | Jext (jKS M) P w ⊆ Efn Oi Os M f} ∪
    Efn Oi Os M f) ∧
  (∀ Oi Os M P Q f.
    Efn Oi Os M (reps P Q f) =
    𝒰(:'v) DIFF
    {w | Jext (jKS M) (P quoting Q) w ⊆ Efn Oi Os M f} ∪
    {w | Jext (jKS M) Q w ⊆ Efn Oi Os M f}) ∧
  (∀ Oi Os M intl₁ intl₂.
    Efn Oi Os M (intl₁ domi intl₂) =
    if repPO Oi (Lifn M intl₂) (Lifn M intl₁) then 𝒰(:'v)
    else {}) ∧
  (∀ Oi Os M intl₂ intl₁.
    Efn Oi Os M (intl₂ eqi intl₁) =
    (if repPO Oi (Lifn M intl₂) (Lifn M intl₁) then 𝒰(:'v)
     else {}) ∩
    if repPO Oi (Lifn M intl₁) (Lifn M intl₂) then 𝒰(:'v)
    else {}) ∧
  (∀ Oi Os M secl₁ secl₂.
    Efn Oi Os M (secl₁ doms secl₂) =
    if repPO Os (Lsfn M secl₂) (Lsfn M secl₁) then 𝒰(:'v)
    else {}) ∧
  (∀ Oi Os M secl₂ secl₁.
    Efn Oi Os M (secl₂ eqs secl₁) =
    (if repPO Os (Lsfn M secl₂) (Lsfn M secl₁) then 𝒰(:'v)
     else {}) ∩
    if repPO Os (Lsfn M secl₁) (Lsfn M secl₂) then 𝒰(:'v)
    else {}) ∧
  (∀ Oi Os M numExp₁ numExp₂.
    Efn Oi Os M (numExp₁ eqn numExp₂) =
    if numExp₁ = numExp₂ then 𝒰(:'v) else {}) ∧
  (∀ Oi Os M numExp₁ numExp₂.
    Efn Oi Os M (numExp₁ lte numExp₂) =
    if numExp₁ ≤ numExp₂ then 𝒰(:'v) else {}) ∧
  ∀ Oi Os M numExp₁ numExp₂.
   Efn Oi Os M (numExp₁ lt numExp₂) =
   if numExp₁ < numExp₂ then 𝒰(:'v) else {}
```

[Jext_def]

```
 ⊢ (∀ J s. Jext J (Name s) = J s) ∧
   (∀ J P₁ P₂.
     Jext J (P₁ meet P₂) = Jext J P₁ RUNION Jext J P₂) ∧
   ∀ J P₁ P₂. Jext J (P₁ quoting P₂) = Jext J P₂ O Jext J P₁
```

[Lifn_def]

```
 ⊢ (∀ M l. Lifn M (iLab l) = l) ∧
   ∀ M name. Lifn M (il name) = imapKS M name
```

[Lsfn_def]

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

2.2 Theorems

[andf_def]

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

[controls_def]

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

[controls_says]

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

[domi_def]

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

[doms_def]

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

[eqf_def]

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

[eqf_impf]

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

[eqi_def]

$\vdash \forall Oi\ Os\ M\ intl_2\ intl_1.$
$\quad$ Efn Oi Os M ($intl_2$ eqi $intl_1$) =
$\quad$ (**if** repPO Oi (Lifn M $intl_2$) (Lifn M $intl_1$) **then** $\mathcal{U}$(:'v)
$\quad$ **else** $\{\}$) $\cap$
$\quad$ **if** repPO Oi (Lifn M $intl_1$) (Lifn M $intl_2$) **then** $\mathcal{U}$(:'v)
$\quad$ **else** $\{\}$

[eqi_domi]

$\vdash \forall M\ intL_1\ intL_2.$
$\quad$ Efn Oi Os M ($intL_1$ eqi $intL_2$) =
$\quad$ Efn Oi Os M ($intL_2$ domi $intL_1$ andf $intL_1$ domi $intL_2$)

[eqn_def]

$\vdash \forall Oi\ Os\ M\ numExp_1\ numExp_2.$
$\quad$ Efn Oi Os M ($numExp_1$ eqn $numExp_2$) =
$\quad$ **if** $numExp_1 = numExp_2$ **then** $\mathcal{U}$(:'v) **else** $\{\}$

[eqs_def]

$\vdash \forall Oi\ Os\ M\ secl_2\ secl_1.$
$\quad$ Efn Oi Os M ($secl_2$ eqs $secl_1$) =
$\quad$ (**if** repPO Os (Lsfn M $secl_2$) (Lsfn M $secl_1$) **then** $\mathcal{U}$(:'v)
$\quad$ **else** $\{\}$) $\cap$
$\quad$ **if** repPO Os (Lsfn M $secl_1$) (Lsfn M $secl_2$) **then** $\mathcal{U}$(:'v)
$\quad$ **else** $\{\}$

[eqs_doms]

$\vdash \forall M\ secL_1\ secL_2.$
$\quad$ Efn Oi Os M ($secL_1$ eqs $secL_2$) =
$\quad$ Efn Oi Os M ($secL_2$ doms $secL_1$ andf $secL_1$ doms $secL_2$)

[FF_def]

$\vdash \forall Oi\ Os\ M.$ Efn Oi Os M FF = $\{\}$

[impf_def]

$\vdash \forall Oi\ Os\ M\ f_1\ f_2.$
$\quad$ Efn Oi Os M (f_1 impf f_2) =
$\quad$ $\mathcal{U}$(:'v) DIFF Efn Oi Os M f_1 $\cup$ Efn Oi Os M f_2

[lt_def]

$\vdash \forall Oi\ Os\ M\ numExp_1\ numExp_2.$
$\quad$ Efn Oi Os M ($numExp_1$ lt $numExp_2$) =
$\quad$ **if** $numExp_1 < numExp_2$ **then** $\mathcal{U}$(:'v) **else** $\{\}$

[lte_def]

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

[meet_def]

$\vdash \forall J\ P_1\ P_2.$ `Jext` J `(`P_1 `meet` P_2`) = Jext` $J\ P_1$ `RUNION Jext` $J\ P_2$

[name_def]

$\vdash \forall J\ s.$ `Jext` J `(Name` s`) =` $J\ s$

[notf_def]

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

[orf_def]

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

[prop_def]

$\vdash \forall Oi\ Os\ M\ p.$ `Efn` $Oi\ Os\ M$ `(prop` p`) = intpKS` $M\ p$

[quoting_def]

$\vdash \forall J\ P_1\ P_2.$ `Jext` J `(`P_1 `quoting` P_2`) = Jext` $J\ P_2$ `O Jext` $J\ P_1$

[reps_def]

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

[says_def]

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

[speaks_for_def]

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

[TT_def]

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

3 aclrules Theory

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Parent Theories: aclsemantics

3.1 Definitions

[sat_def]

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

3.2 Theorems

[And_Says]

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

[And_Says_Eq]

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

[and_says_lemma]

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

[Controls_Eq]

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

[DIFF_UNIV_SUBSET]

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

[domi_antisymmetric]

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

[domi_reflexive]

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

[domi_transitive]

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

[doms_antisymmetric]

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

[doms_reflexive]

$\vdash \forall M\ Oi\ Os\ l.\ (M,Oi,Os)\ \texttt{sat}\ l\ \texttt{doms}\ l$

[doms_transitive]

$\vdash \forall M\ Oi\ Os\ l_1\ l_2\ l_3.$
$\quad (M,Oi,Os)\ \texttt{sat}\ l_1\ \texttt{doms}\ l_2 \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ l_2\ \texttt{doms}\ l_3 \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ l_1\ \texttt{doms}\ l_3$

[eqf_and_impf]

$\vdash \forall M\ Oi\ Os\ f_1\ f_2.$
$\quad (M,Oi,Os)\ \texttt{sat}\ f_1\ \texttt{eqf}\ f_2 \iff$
$\quad (M,Oi,Os)\ \texttt{sat}\ (f_1\ \texttt{impf}\ f_2)\ \texttt{andf}\ (f_2\ \texttt{impf}\ f_1)$

[eqf_andf1]

$\vdash \forall M\ Oi\ Os\ f\ f'\ g.$
$\quad (M,Oi,Os)\ \texttt{sat}\ f\ \texttt{eqf}\ f' \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ f\ \texttt{andf}\ g \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ f'\ \texttt{andf}\ g$

[eqf_andf2]

$\vdash \forall M\ Oi\ Os\ f\ f'\ g.$
$\quad (M,Oi,Os)\ \texttt{sat}\ f\ \texttt{eqf}\ f' \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ g\ \texttt{andf}\ f \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ g\ \texttt{andf}\ f'$

[eqf_controls]

$\vdash \forall M\ Oi\ Os\ P\ f\ f'.$
$\quad (M,Oi,Os)\ \texttt{sat}\ f\ \texttt{eqf}\ f' \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ P\ \texttt{controls}\ f \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ P\ \texttt{controls}\ f'$

[eqf_eq]

$\vdash (\texttt{Efn}\ Oi\ Os\ M\ (f_1\ \texttt{eqf}\ f_2) = \mathcal{U}(\texttt{:'b})) \iff$
$\quad (\texttt{Efn}\ Oi\ Os\ M\ f_1 = \texttt{Efn}\ Oi\ Os\ M\ f_2)$

[eqf_eqf1]

$\vdash \forall M\ Oi\ Os\ f\ f'\ g.$
$\quad (M,Oi,Os)\ \texttt{sat}\ f\ \texttt{eqf}\ f' \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ f\ \texttt{eqf}\ g \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ f'\ \texttt{eqf}\ g$

[eqf_eqf2]

$\vdash \forall M\ Oi\ Os\ f\ f'\ g.$
$\quad (M,Oi,Os)\ \texttt{sat}\ f\ \texttt{eqf}\ f' \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ g\ \texttt{eqf}\ f \Rightarrow$
$\quad (M,Oi,Os)\ \texttt{sat}\ g\ \texttt{eqf}\ f'$

[eqf_impf1]

$\vdash \forall M\ Oi\ Os\ f\ f'\ g.$
$\quad$ `(`M`,`Oi`,`Os`) sat` f `eqf` $f' \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat` f `impf` $g \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat` f' `impf` g

[eqf_impf2]

$\vdash \forall M\ Oi\ Os\ f\ f'\ g.$
$\quad$ `(`M`,`Oi`,`Os`) sat` f `eqf` $f' \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat` g `impf` $f \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat` g `impf` f'

[eqf_notf]

$\vdash \forall M\ Oi\ Os\ f\ f'.$
$\quad$ `(`M`,`Oi`,`Os`) sat` f `eqf` $f' \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat notf` $f \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat notf` f'

[eqf_orf1]

$\vdash \forall M\ Oi\ Os\ f\ f'\ g.$
$\quad$ `(`M`,`Oi`,`Os`) sat` f `eqf` $f' \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat` f `orf` $g \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat` f' `orf` g

[eqf_orf2]

$\vdash \forall M\ Oi\ Os\ f\ f'\ g.$
$\quad$ `(`M`,`Oi`,`Os`) sat` f `eqf` $f' \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat` g `orf` $f \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat` g `orf` f'

[eqf_reps]

$\vdash \forall M\ Oi\ Os\ P\ Q\ f\ f'.$
$\quad$ `(`M`,`Oi`,`Os`) sat` f `eqf` $f' \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat reps` $P\ Q\ f \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat reps` $P\ Q\ f'$

[eqf_sat]

$\vdash \forall M\ Oi\ Os\ f_1\ f_2.$
$\quad$ `(`M`,`Oi`,`Os`) sat` f_1 `eqf` $f_2 \Rightarrow$
$\quad$ `((`M`,`Oi`,`Os`) sat` $f_1 \iff$ `(`M`,`Oi`,`Os`) sat` f_2`)`

[eqf_says]

$\vdash \forall M\ Oi\ Os\ P\ f\ f'.$
$\quad$ `(`M`,`Oi`,`Os`) sat` f `eqf` $f' \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat` P `says` $f \Rightarrow$
$\quad$ `(`M`,`Oi`,`Os`) sat` P `says` f'

[eqi_Eq]

$\vdash \forall M\ Oi\ Os\ l_1\ l_2.$
 (M,Oi,Os) sat l_1 eqi $l_2 \iff$
 (M,Oi,Os) sat l_2 domi l_1 andf l_1 domi l_2

[eqs_Eq]

$\vdash \forall M\ Oi\ Os\ l_1\ l_2.$
 (M,Oi,Os) sat l_1 eqs $l_2 \iff$
 (M,Oi,Os) sat l_2 doms l_1 andf l_1 doms l_2

[Idemp_Speaks_For]

$\vdash \forall M\ Oi\ Os\ P.\ (M,Oi,Os)$ sat P speaks_for P

[Image_cmp]

$\vdash \forall R_1\ R_2\ R_3\ u.\ (R_1$ O $R_2)\ u \subseteq R_3 \iff R_2\ u \subseteq \{y \mid R_1\ y \subseteq R_3\}$

[Image_SUBSET]

$\vdash \forall R_1\ R_2.\ R_2$ RSUBSET $R_1 \Rightarrow \forall w.\ R_2\ w \subseteq R_1\ w$

[Image_UNION]

$\vdash \forall R_1\ R_2\ w.\ (R_1$ RUNION $R_2)\ w = R_1\ w \cup R_2\ w$

[INTER_EQ_UNIV]

$\vdash (s \cap t = \mathcal{U}(:'a)) \iff (s = \mathcal{U}(:'a)) \land (t = \mathcal{U}(:'a))$

[Modus_Ponens]

$\vdash \forall M\ Oi\ Os\ f_1\ f_2.$
 (M,Oi,Os) sat $f_1 \Rightarrow$
 (M,Oi,Os) sat f_1 impf $f_2 \Rightarrow$
 (M,Oi,Os) sat f_2

[Mono_speaks_for]

$\vdash \forall M\ Oi\ Os\ P\ P'\ Q\ Q'.$
 (M,Oi,Os) sat P speaks_for $P' \Rightarrow$
 (M,Oi,Os) sat Q speaks_for $Q' \Rightarrow$
 (M,Oi,Os) sat P quoting Q speaks_for P' quoting Q'

[MP_Says]

$\vdash \forall M\ Oi\ Os\ P\ f_1\ f_2.$
 (M,Oi,Os) sat
 P says $(f_1$ impf $f_2)$ impf P says f_1 impf P says f_2

[Quoting]

$\vdash \forall M\ Oi\ Os\ P\ Q\ f.$
 (M,Oi,Os) sat P quoting Q says f eqf P says Q says f

[Quoting_Eq]

$\vdash \forall M\ Oi\ Os\ P\ Q\ f.$
$\quad (M,Oi,Os)$ sat P quoting Q says f $\iff$
$\quad (M,Oi,Os)$ sat P says Q says f

[reps_def_lemma]

$\vdash \forall M\ Oi\ Os\ P\ Q\ f.$
$\quad$ Efn Oi Os M (reps P Q f) =
$\quad$ Efn Oi Os M (P quoting Q says f impf Q says f)

[Reps_Eq]

$\vdash \forall M\ Oi\ Os\ P\ Q\ f.$
$\quad (M,Oi,Os)$ sat reps P Q f $\iff$
$\quad (M,Oi,Os)$ sat P quoting Q says f impf Q says f

[sat_allworld]

$\vdash \forall M\ f.\ (M,Oi,Os)$ sat f $\iff$ $\forall w.\ w \in$ Efn Oi Os M f

[sat_andf_eq_and_sat]

$\vdash (M,Oi,Os)$ sat f_1 andf f_2 $\iff$
$\quad (M,Oi,Os)$ sat f_1 $\land$ (M,Oi,Os) sat f_2

[sat_TT]

$\vdash (M,Oi,Os)$ sat TT

[Says]

$\vdash \forall M\ Oi\ Os\ P\ f.\ (M,Oi,Os)$ sat f $\Rightarrow$ (M,Oi,Os) sat P says f

[says_and_lemma]

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

[Speaks_For]

$\vdash \forall M\ Oi\ Os\ P\ Q\ f.$
$\quad (M,Oi,Os)$ sat P speaks_for Q impf P says f impf Q says f

[speaks_for_SUBSET]

$\vdash \forall R_3\ R_2\ R_1.$
$\quad R_2$ 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]

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

[Trans_Speaks_For]
$\vdash \forall M\ Oi\ Os\ P\ Q\ R.$
$\quad$ (M,Oi,Os) sat P speaks_for $Q \Rightarrow$
$\quad$ (M,Oi,Os) sat Q speaks_for $R \Rightarrow$
$\quad$ (M,Oi,Os) sat P speaks_for R

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

[world_and]
$\vdash \forall M\ Oi\ Os\ f_1\ f_2\ w.$
$\quad$ $w \in$ Efn $Oi\ Os\ M\ (f_1$ andf $f_2) \iff$
$\quad$ $w \in$ Efn $Oi\ Os\ M\ f_1 \land w \in$ Efn $Oi\ Os\ M\ f_2$

[world_eq]
$\vdash \forall M\ Oi\ Os\ f_1\ f_2\ w.$
$\quad$ $w \in$ Efn $Oi\ Os\ M\ (f_1$ eqf $f_2) \iff$
$\quad$ $(w \in$ Efn $Oi\ Os\ M\ f_1 \iff w \in$ Efn $Oi\ Os\ M\ f_2)$

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

[world_F]
$\vdash \forall M\ Oi\ Os\ w.\ w \notin$ Efn $Oi\ Os\ M$ FF

[world_imp]
$\vdash \forall M\ Oi\ Os\ f_1\ f_2\ w.$
$\quad$ $w \in$ Efn $Oi\ Os\ M\ (f_1$ impf $f_2) \iff$
$\quad$ $w \in$ Efn $Oi\ Os\ M\ f_1 \Rightarrow w \in$ Efn $Oi\ Os\ M\ f_2$

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

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

[world_not]
$\vdash \forall M\ Oi\ Os\ f\ w.\ w \in$ Efn $Oi\ Os\ M$ (notf f) $\iff w \notin$ Efn $Oi\ Os\ M\ f$

[world_or]
$\vdash \forall M\ f_1\ f_2\ w.$
$\quad$ $w \in$ Efn $Oi\ Os\ M\ (f_1$ orf $f_2) \iff$
$\quad$ $w \in$ Efn $Oi\ Os\ M\ f_1 \lor w \in$ Efn $Oi\ Os\ M\ f_2$

[world_says]
$\vdash \forall M\ Oi\ Os\ P\ f\ w.$
$\quad$ $w \in$ Efn $Oi\ Os\ M\ (P$ says $f) \iff$
$\quad$ $\forall v.\ v \in$ Jext (jKS M) $P\ w \Rightarrow v \in$ Efn $Oi\ Os\ M\ f$

[world_T]
$\vdash \forall M\ Oi\ Os\ w.\ w \in$ Efn $Oi\ Os\ M$ TT

4 aclDrules Theory

Built: 19 January 2017

Parent Theories: aclrules

4.1 Theorems

[Conjunction]

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

[Controls]

$$\vdash \forall M\ Oi\ Os\ P\ f.\ (M,Oi,Os)\ \texttt{sat}\ P\ \texttt{says}\ f \Rightarrow (M,Oi,Os)\ \texttt{sat}\ P\ \texttt{controls}\ f \Rightarrow (M,Oi,Os)\ \texttt{sat}\ f$$

[Derived_Controls]

$$\vdash \forall M\ Oi\ Os\ P\ Q\ f.\ (M,Oi,Os)\ \texttt{sat}\ P\ \texttt{speaks\_for}\ Q \Rightarrow (M,Oi,Os)\ \texttt{sat}\ Q\ \texttt{controls}\ f \Rightarrow (M,Oi,Os)\ \texttt{sat}\ P\ \texttt{controls}\ f$$

[Derived_Speaks_For]

$$\vdash \forall M\ Oi\ Os\ P\ Q\ f.\ (M,Oi,Os)\ \texttt{sat}\ P\ \texttt{speaks\_for}\ Q \Rightarrow (M,Oi,Os)\ \texttt{sat}\ P\ \texttt{says}\ f \Rightarrow (M,Oi,Os)\ \texttt{sat}\ Q\ \texttt{says}\ f$$

[Disjunction1]

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

[Disjunction2]

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

[Disjunctive_Syllogism]

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

[Double_Negation]

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

[eqn_eqn]

$\vdash$ (M, Oi, Os) sat c_1 eqn n_1 $\Rightarrow$
(M, Oi, Os) sat c_2 eqn n_2 $\Rightarrow$
(M, Oi, Os) sat n_1 eqn n_2 $\Rightarrow$
(M, Oi, Os) sat c_1 eqn c_2

[eqn_lt]

$\vdash$ (M, Oi, Os) sat c_1 eqn n_1 $\Rightarrow$
(M, Oi, Os) sat c_2 eqn n_2 $\Rightarrow$
(M, Oi, Os) sat n_1 lt n_2 $\Rightarrow$
(M, Oi, Os) sat c_1 lt c_2

[eqn_lte]

$\vdash$ (M, Oi, Os) sat c_1 eqn n_1 $\Rightarrow$
(M, Oi, Os) sat c_2 eqn n_2 $\Rightarrow$
(M, Oi, Os) sat n_1 lte n_2 $\Rightarrow$
(M, Oi, Os) sat c_1 lte c_2

[Hypothetical_Syllogism]

$\vdash$ $\forall M\ Oi\ Os\ f_1\ f_2\ f_3$.
(M, Oi, Os) sat f_1 impf f_2 $\Rightarrow$
(M, Oi, Os) sat f_2 impf f_3 $\Rightarrow$
(M, Oi, Os) sat f_1 impf f_3

[il_domi]

$\vdash$ $\forall M\ Oi\ Os\ P\ Q\ l_1\ l_2$.
(M, Oi, Os) sat il P eqi l_1 $\Rightarrow$
(M, Oi, Os) sat il Q eqi l_2 $\Rightarrow$
(M, Oi, Os) sat l_2 domi l_1 $\Rightarrow$
(M, Oi, Os) sat il Q domi il P

[INTER_EQ_UNIV]

$\vdash$ $\forall s_1\ s_2.\ (s_1 \cap s_2 = \mathcal{U}(:\text{'a})) \iff (s_1 = \mathcal{U}(:\text{'a})) \land (s_2 = \mathcal{U}(:\text{'a}))$

[Modus_Tollens]

$\vdash$ $\forall M\ Oi\ Os\ f_1\ f_2$.
(M, Oi, Os) sat f_1 impf f_2 $\Rightarrow$
(M, Oi, Os) sat notf f_2 $\Rightarrow$
(M, Oi, Os) sat notf f_1

[Rep_Controls_Eq]

$\vdash$ $\forall M\ Oi\ Os\ A\ B\ f$.
(M, Oi, Os) sat reps A B f $\iff$
(M, Oi, Os) sat A controls B says f

[Rep_Says]

$\vdash \forall M\ Oi\ Os\ P\ Q\ f.$
$\quad (M,Oi,Os)$ `sat` `reps` $P\ Q\ f \Rightarrow$
$\quad (M,Oi,Os)$ `sat` P `quoting` Q `says` $f \Rightarrow$
$\quad (M,Oi,Os)$ `sat` Q `says` f

[Reps]

$\vdash \forall M\ Oi\ Os\ P\ Q\ f.$
$\quad (M,Oi,Os)$ `sat` `reps` $P\ Q\ f \Rightarrow$
$\quad (M,Oi,Os)$ `sat` P `quoting` Q `says` $f \Rightarrow$
$\quad (M,Oi,Os)$ `sat` Q `controls` $f \Rightarrow$
$\quad (M,Oi,Os)$ `sat` f

[Says_Simplification1]

$\vdash \forall M\ Oi\ Os\ P\ f_1\ f_2.$
$\quad (M,Oi,Os)$ `sat` P `says` (f_1 `andf` f_2) $\Rightarrow (M,Oi,Os)$ `sat` P `says` f_1

[Says_Simplification2]

$\vdash \forall M\ Oi\ Os\ P\ f_1\ f_2.$
$\quad (M,Oi,Os)$ `sat` P `says` (f_1 `andf` f_2) $\Rightarrow (M,Oi,Os)$ `sat` P `says` f_2

[Simplification1]

$\vdash \forall M\ Oi\ Os\ f_1\ f_2.\ (M,Oi,Os)$ `sat` f_1 `andf` $f_2 \Rightarrow (M,Oi,Os)$ `sat` f_1

[Simplification2]

$\vdash \forall M\ Oi\ Os\ f_1\ f_2.\ (M,Oi,Os)$ `sat` f_1 `andf` $f_2 \Rightarrow (M,Oi,Os)$ `sat` f_2

[sl_doms]

$\vdash \forall M\ Oi\ Os\ P\ Q\ l_1\ l_2.$
$\quad (M,Oi,Os)$ `sat` `sl` P `eqs` $l_1 \Rightarrow$
$\quad (M,Oi,Os)$ `sat` `sl` Q `eqs` $l_2 \Rightarrow$
$\quad (M,Oi,Os)$ `sat` l_2 `doms` $l_1 \Rightarrow$
$\quad (M,Oi,Os)$ `sat` `sl` Q `doms` `sl` P

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