Towards a Formal Language for Privacy Options

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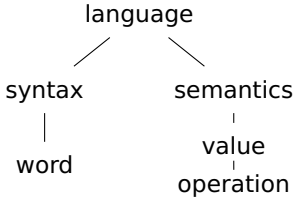
Outline



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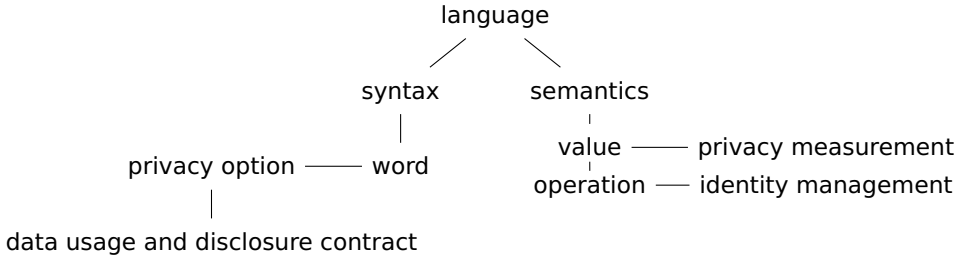

language
syntax
semantics
privacy option
word
value
privacy measurement
operation
identity management
data usage and disclosure contract

Design Idea

$\underbrace{\text{predicate}\ \underbrace{c_1}_{\texttt{Contract}}}_{\texttt{Contract}}$ } simple extension of (basic) contracts

$\underbrace{c_1\ \text{`predicate'}\ c_2}_{\texttt{Contract}}$ } combination of contracts

Design Idea

$\underbrace{\text{predicate}\ \underbrace{c_1}_{\texttt{Contract}}}_{\texttt{Contract}}$ } simple extension of (basic) contracts

e. g., postponing of contract execution

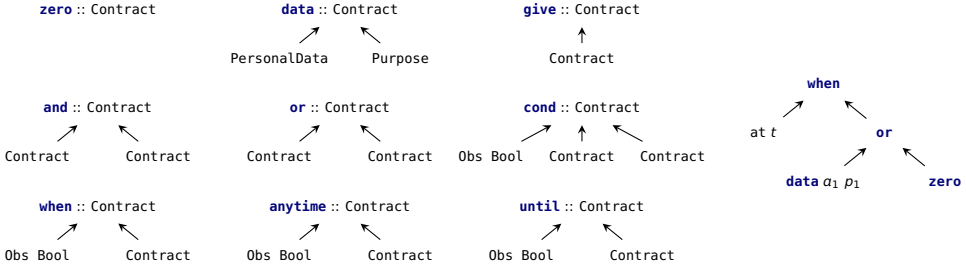
$\underbrace{c_1\ \text{`predicate'}\ c_2}_{\texttt{Contract}}$ } combination of contracts

e. g., Boolean operators

Examples

$c_1 = \texttt{zero}$	... no rights, no obligations
$c_2 = \texttt{data}\ a_1\ p_1$	... receive data and use it immediately
$c_3 = \texttt{give}\ c_2$	... send data which is used immediately
$c_4 = c_1\ \text{`}\texttt{or}\text{'}\ c_2$	... receive and use the data or do nothing
$c_5 = \texttt{when}\ (\text{at}\ t)\ c_4$	... postpone c_4 to time t

Syntax


zero :: Contract
data :: Contract
PersonalData
Purpose
give :: Contract
Contract
and :: Contract
Contract
Contract
or :: Contract
Contract
Contract
cond :: Contract
Obs Bool
Contract
Contract
when :: Contract
Obs Bool
Contract
anytime :: Contract
Obs Bool
Contract
until :: Contract
Obs Bool
Contract
when
at t
or
data a_1 p_1
zero

$$\mathcal{ACTION} = \texttt{Date} \to \mathcal{IO}\ \texttt{Contract}$$
$$\mathcal{O}_{\mathcal{E}}[\![\cdot]\!] : \texttt{Contract} \to \mathcal{ACTION}$$

$$\mathcal{O}_{\mathcal{E}}[\![\texttt{zero}]\!] = \text{return}(\texttt{zero})$$
$$\mathcal{O}_{\mathcal{E}}[\![\texttt{data}\ a\ p]\!] = \text{use}(a, p)$$
$$\mathcal{O}_{\mathcal{E}}[\![\texttt{give}\ c]\!] = \text{send}(c)$$
$$\mathcal{O}_{\mathcal{E}}[\![c_1\ \texttt{`and`}\ c_2]\!] = \mathcal{O}_{\mathcal{E}}[\![c_1]\!] \parallel \mathcal{O}_{\mathcal{E}}[\![c_2]\!]$$
$$\mathcal{O}_{\mathcal{E}}[\![c_1\ \texttt{`or`}\ c_2]\!] = \text{greedy}_{\mathcal{E}}(\mathcal{O}_{\mathcal{E}}[\![c_2]\!], \mathcal{O}_{\mathcal{E}}[\![c_1]\!])$$
$$\mathcal{O}_{\mathcal{E}}[\![\texttt{cond}\ o\ c_1\ c_2]\!] = \text{if}(\mathcal{V}[\![o]\!], \mathcal{O}_{\mathcal{E}}[\![c_1]\!], \mathcal{O}_{\mathcal{E}}[\![c_2]\!])$$
$$\mathcal{O}_{\mathcal{E}}[\![\texttt{when}\ o\ c]\!] = \text{when}'_{\mathcal{E}}(\mathcal{V}[\![o]\!], \mathcal{O}_{\mathcal{E}}[\![c]\!])$$
$$\mathcal{O}_{\mathcal{E}}[\![\texttt{anytime}\ o\ c]\!] = \text{stopping}'_{\mathcal{E}}(\mathcal{V}[\![o]\!], \mathcal{O}_{\mathcal{E}}[\![c]\!])$$
$$\mathcal{O}_{\mathcal{E}}[\![\texttt{until}\ o\ c]\!] = \text{absorb}'_{\mathcal{E}}(\mathcal{V}[\![o]\!], \mathcal{O}_{\mathcal{E}}[\![c]\!])$$

Comparison with PPL Sticky Policies

Motivation

- language with similar design goals: PPL Sticky Policies.
- POL $\not\subseteq$ PPL and POL $\not\supseteq$ PPL, thus no easy comparison.
- way out: POL$^-$ $\subseteq$ POL with POL$^-$ $\subseteq$ PPL.

Q: how to define POL$^-$?

- when and `anytime` *not* part of POL$^-$.
- points of time the *only* conditions of `until` and `cond`.
- new PPL action: ‘immediate usage’.

Language Extensions

- add new language primitives (experts only).
  - experts only.
  - risk for redundancy.
  - readjustment of semantics.
- combinators for common contract patterns (common user).
  - common user.
  - application of existing language primitives.
  - no readjustment of semantics.
  - ex def: `twice` $f\ c = (f\ c)$ `‘and‘` $(f\ c)$.
  - ex app: `until` (at t) `‘twice‘` c_1

Results & Summary

- def: language for describing privacy options (syntax, semantics).
- word in that language can be interpreted as:
  - (numeric) value – privacy measurement.
  - sequence of i/o action – identity management.
- comparision to existing languages (PPL).
- discussion: extending the language.

Q & A

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Recommended reading. Berthold, S., Böhme, R.: Valuating privacy with option pricing theory. In: Workshop on the Economics of Information Security (WEIS), University College London, UK (2009).