Some Help for the Project

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FMSEC Project Help, v.1

Guarded Formulas

All property formulas in Tamarin must be guarded.

Definition (Guarded formula)

A formula φ is guarded if all its quantified subformulas are of the forms:

$$\forall \overline{x}.\ F(\overline{z})@i \Rightarrow \psi \quad \exists \overline{x}.\ F(\overline{z})@i \wedge \psi \quad \text{(and special cases: } (\forall|\exists)\overline{x}.\ F(\overline{z})@i)$$

where F is a fact and $\overline{x}$ and $\overline{z}$ are vectors of variables such that $\overline{x} \subseteq \overline{z} \cup \{i\}$, i.e., all bound variables appear in the fact formula $F(\overline{z})@i$.

Example

Not guarded:

$$\exists Id\ i.\ Create(A, Id, 'I')@i \vee Create(B, Id, 'R')@i$$

Guarded equivalents:

$$(\exists Id\ i.\ Create(A, Id, 'I')@i \wedge T) \vee (\exists Id\ i.\ Create(B, Id, 'R')@i \wedge T)$$
$$(\exists Id\ i.\ Create(A, Id, 'I')@i) \vee (\exists Id\ i.\ Create(B, Id, 'R')@i)$$

Claim and Honesty Facts

Example (Honesty Facts in Security Properties)

Secrecy:

$$\forall A\ M\ i.\ Secret(A, M)@i \Rightarrow (\neg(\exists j.K(M)@j) \vee (\exists X\ j.\ Rev(X)@j \wedge Honest(X)@i))$$

Non-injective agreement:

$$\forall A\ B\ M\ i.\ Commit(A, B, \langle `I`, `R`, M\rangle)@i \Rightarrow ((\exists j.\ Running(B, A, \langle `I`, `R`, M\rangle)@j) \vee (\exists X\ j.\ Rev(X)@j \wedge Honest(X)@i))$$

- The honesty facts $Honest(X)$ label the same rule ($@i$) as the main claim fact (e.g., *Secret*, *Commit*).
- The properties hold (i.e., secrecy of M resp. existence of a *Running* fact) unless an agent that is expected to be honest is compromised in the trace.

Roles and Agents in Agreement

Example (Non-injective agreement of initiator with responder)

$$\forall A\ B\ M\ i.\ \mathit{Commit}(A, B, \langle \text{`}I\text{`}, \text{`}R\text{`}, M\rangle)@i$$
$$\Rightarrow ((\exists j.\ \mathit{Running}(B, A, \langle \text{`}I\text{`}, \text{`}R\text{`}, M\rangle)@j)$$
$$\vee(\exists X\ j.\ \mathit{Rev}(X)@j \wedge \mathit{Honest}(X)@i))$$

- Order of `}I\text{` and `}R\text{` fixed, meaning that the agent (A) in the initiator role agrees with the agent (B) in the responder role (on M).
- Order of agents A and B instantiating the initiator and responder roles is swapped.
- Idea is that the first agent name is the one "executing" the claim.

Executability Lemmas

- Executability lemmas are so-called existential properties.
- These show the existence of some protocol trace satisfying the formula ...
- ... instead of the usual case where all traces must satisfy the formula.

Example (Executabilty in Tamarin)

Insert the keyword **exists-trace** between the lemma name and the formula.

lemma executablility: **exists-trace**
"...(formula φ)..."

"There exists a trace that reaches the end of the protocol (expressed by φ)."

Syntax Issues: Type Annotations

- You must mark index variables with a hash (#) in quantifications.
- This is not done on our slides to avoid notational clutter.

Example (Secrecy)

$$\forall A\ M\ \#i.\ Secret(A, M)@i \Rightarrow (\neg(\exists \#j.K(M)@j) \vee (\exists X\ \#j.\ Rev(X)@j \wedge Honest(X)@i))$$

In rewrite rules:

- You must mark all occurrences of a fresh name with a tilde (e.g., $\tilde{}k$) or no occurrence. A similar remark holds for agent names (e.g., $\$A$)
- A variable that occurs only on the right-hand side of a rule must be marked public, i.e., carry a $ annotation (e.g. $Fr(sk) \rightarrow !Ltk(\$A, sk)$).
- Generally, you should not annotate elements of messages received in *In* facts with types as this would reduce the scope of the analysis.