Sessions, contracts and compliance

Achievements during the Betty project

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Session types and contracts are two formalisms used to study client/server protocols. In between these two formalisms lie *session contracts* (originally called "session behaviours" in [1]), interpreting session types into contracts of a certain shape.

Compliance and sub-behaviour. The purpose of interpreting session types into contracts is to refine and simplify the behavioural semantics of session types, building on the concepts of *compliance* and *sub-behaviour* from the theory of web contracts. In [3] we have introduced three relations on a suitable class of contracts with higher-order input/output. Such relations, depending on each other, represent the idea of sub-behaviour from the point of view of a client, a server or a peer, respectively. We have obtained a formal system for the three subtyping relations for session types that takes into account the role played by a user of a channel during an interaction, so extending Gay and Hole subtyping theory; for such a system we have established soundness and completeness results of the interpretation.

The notion of compliance, although simple and elegant, is often too restrictive in practical contexts. In [2] we have considered the possibility of skipping outputs from the server side, that in a synchronous setting would be blocking. The more complex notion of compliance, however remains tractable: indeed most of the relevant properties, like existence of a minimal compliant sub-contract and decidability of compliance, are preserved.

Reversible and retractable contracts. The undoing of previous choices are common in client-server interaction, motivating an investigation of compliance in a system where some form of reversible interaction is permitted. In [6] (full version of [5]), after adding checkpoints to the syntax of session contracts, we have formalized the operational semantics via an LTS, and defined a natural notion of checkpoint compliance. We have obtained a co-inductive characterization of such compliance relation, and an axiomatic presentation that is proved to be sound and complete.

The undoing of previous interactions can be also useful in case of failure of synchronization. If the interaction fails, the past agreements are good candidates as points where to roll back, in order to try a different interaction path. We have proposed in [7] a variant of contracts with synchronous rollbacks to agreement points in case of synchronization failure, dubbed *retractable contracts*.

Orchestrators. Orchestrators have been introduced in the literature to obtain a broader class of compliant communicating processes by means of a mediator. In [9] (full version of [8]) we have investigated the notion of orchestrated compliance when orchestrators have unbounded buffering capabilities and nonetheless guarantee that any message from the client will be eventually delivered by the orchestrator to the server, while preventing the server from sending messages which are kept indefinitely inside the orchestrator.

Orchestrators are nicely related with retractable contracts. In [4] we have shown that a client is retractable-compliant with a server if and only if there exists a winning strategy for a particular player in a game-theoretic model of contracts. Such a player can be looked at as a mediator, driving the choices in the retractable points. We have proved that winning strategies

for the mediator player correspond to orchestrators in a system of orchestrated client/server sessions, and vice versa.

References

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