Decidability Problems for Actor Systems

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Actors?

Yes Actors, like in

- Erlang
- Scala
- Rebeca

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and like in HATS

HATS stands for

Highly Adaptable and Trustworthy Software using Formal Models

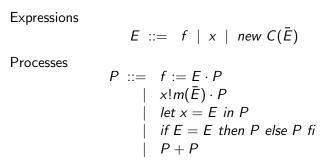
an Integrated Project supported by the 7th Framework Programme of the EC within the FET (Future and Emerging Technologies) scheme.

Main objective:

Executable modeling language based on concurrent objects

See http://www.hats-project.eu/

A Nominal Actor-based Language



Class definitions

$$C = (m_1(\bar{x}_1) = P_1, \ldots, m_n(\bar{x}_n) = P_n)$$

Programs

$$P \mid C_1, \ldots, C_n$$

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Semantics

Configuration = set of Actor states (*Process*, *QueueofMessages*) Message = $m(\bar{V})$

Asynchronous communication like in *communicating finite state machines* (Turing complete).

Unbounded in

- number of Actors
- size of queues
- number of (local) variables

But no explicit input

Main Decidability Result

Finite number of actors with no field updates

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Proof idea well-structured transitions systems

WSTS

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quasi-ordering reflective and transitive relation
well-quasi-ordering quasi-ordering (X, \leq)
                 such that, for every infinite sequence x_1, x_2, x_3, \cdots,
                 there exist i < j with x_i \leq x_i.
WSTS
                 (\mathcal{S}, \rightarrow, \prec)
                 where \prec is a well-quasi-ordering relation on S such
                 that
                 \leq is upward compatible with \rightarrow:
                 for every s_1 \leq s'_1 such that s_1 \rightarrow s_2, there exists
                 s'_1 \rightarrow^* s'_2 such that s_2 \preceq s'_2.
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Ordering Configurations of Actors

- Processes identified up to renaming
- Queues ordered by subsequence relation up to renaming:

$$m_1(\bar{E}_1)\ldots m_k(\bar{E}_k) \leq n_1(\bar{U}_1)\ldots n_h(\bar{U}_h)$$

if

$$\exists i_1 < i_2 < \cdots < i_k \le h \forall j \in 1..k. \ m_j = n_{i_j} \land \bar{E}_j \simeq \bar{U}_{i_j}$$

Unbounded stateless actors (no fields) are decidable.

Proof idea

Termination preserving abstraction from actors identities.

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Turing Completeness

- Finite number of actors with field updates
- Infinite number of actors without field updates

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Proof idea:

simulation of register machines

Future Work

Futures!

(Termination detection for active objects. Frank S. de Boer, Immo Grabe, Martin Steffen. J. Log. Algebr. Program, 2012)

Release points (coopreative scheduling)