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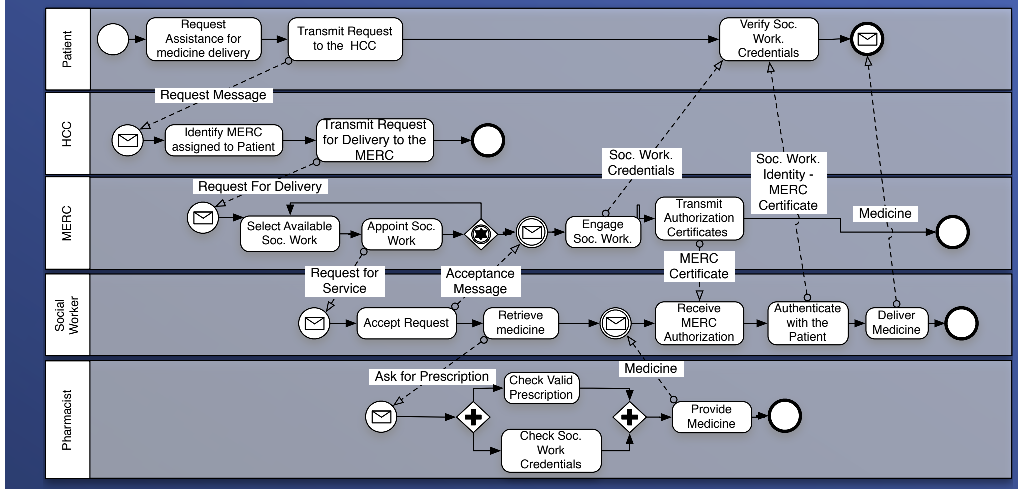
Concurrency Theory for Secure and Trustworthy Process-aware/Service Oriented Computing

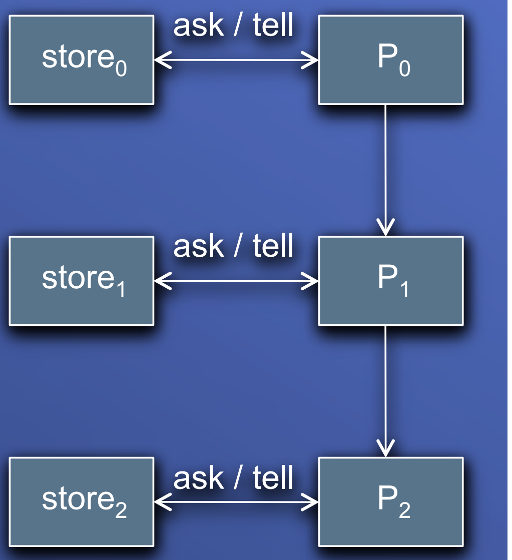
The study of concurrent systems is often carried out with the aid of **process calculi**. These are expressive formalisms centered on the notion of interaction. Systems are understood as interacting complex processes composed of smaller ones following a compositional approach. One branch of process calculi has been devoted to declarative models of computation, where the information is **partially defined**.

We are interested in the foundations of Process-aware/Service Oriented computing models using declarative models based on process calculi. The ultimate goal of research in the foundations of Process-aware and Service Oriented Computing is to provide means to describe and reason about the way different parts of a composite system can interact within each other, not only by sharing their information, but by composing new services in a **correct, reliable and secure** way, fulfilling the interests of the business partners involved. The results are so far encouraging although most remains to be done.


Patient
HCC
MERC
Social Worker
Pharmacist
Request Assistance for medicine delivery
Transmit Request to the HCC
Verify Soc. Work. Credentials
Request Message
Identify MERC assigned to Patient
Transmit Request for Delivery to the MERC
Soc. Work. Credentials
Soc. Work. Identity - MERC Certificate
Request For Delivery
Select Available Soc. Work
Appoint Soc. Work
Engage Soc. Work.
Transmit Authorization Certificates
Medicine
MERC Certificate
Request for Service
Acceptance Message
Accept Request
Retrieve medicine
Receive MERC Authorization
Authenticate with the Patient
Deliver Medicine
Ask for Prescription
Check Valid Prescription
Medicine
Check Soc. Work Credentials
Provide Medicine

A declarative approach for Service Modelling alleviates current used methodologies:

- The natural use of (concurrent) **processes** to model services.
- The notion of **time** to express the evolution of **dynamic** service architectures.
- The notion of **constraint** as a way of modeling **incomplete information**.
- The correspondence with a process semantics and an underlying logic allow us to **specify desirable properties** of service compositions.



Our project aims at advancing both the theory and tools of declarative process calculi for analyzing and programming Process and Service Oriented information systems, and Distributed Workflow Management Systems in particular.

Novelty

To our best knowledge, there is no work on Process-aware computing/Service Computing that takes advantage of the reasoning techniques of declarative process calculi.

Expected outcome

To advance the concurrency theory to deal with new challenging concepts from Mobility in Process Modeling and to produce a specification language and tools to reason about process-aware models.

Current Research

utcc is an extension of the tcc calculus combining a general model of synchronization with a notion of **reactive computation**. Systems are expressed in terms of agents that *tell* and *ask* constraints in a persistent store, as well as temporal operators to describe the evolution of the system in time. Moreover, while in tcc an ask is blocked if there is not enough information to entail the constraint from the store, utcc inspires its synchronization mechanism on the notion of *parametric asks* that can be instantiated several times if there are possible substitutions over free variables that entails a given constraint.

We are exploring the introduction of type systems to **restrict** the use of the abstraction operator to allow only secure communications (i.e.: a private value should not be abstractable to an attacker). This extension equips utcc with the necessary primitives for modeling mobility (in the sense of π-calculus) and (to the best of our knowledge) presents the first work towards type systems in the context of concurrent constraint programming. A natural extension of this work is the exploration of the calculus in the context of declarative business processes, using it as a formal testbed for linear temporal logic formalizations of business process activities.

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