

Components, Objects, and Contracts

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Contracts & e-contracts

“A **contract** is a binding agreement between two or more persons that is enforceable by law.” [Webster online]

Contracts & e-contracts

This deed of **Agreement** is made between:

1. **[name]**, from now on referred to as **Provider** and
2. the **Client**.

INTRODUCTION

3. The **Provider** is **obliged** to provide the **Internet Services** as stipulated in this **Agreement**.

4. DEFINITIONS

- a) **Internet traffic** may be measured by both **Client** and **Provider** by means of Equipment and may take the two values **high** and **normal**.

OPERATIVE PART

1. The **Client** shall not supply false information to the Client Relations Department of the **Provider**.
2. Whenever the Internet Traffic is **high** then the **Client** **must pay** *[price]* immediately, or the **Client** must notify the **Provider** by sending an e-mail specifying that he will pay later.
3. If the **Client** delays the payment as stipulated in 2, after notification he must immediately lower the Internet traffic to the **normal** level, and pay later twice ($2 * [price]$).
4. **If** the **Client** does **not** lower the Internet traffic immediately, **then** the **Client** will have to pay $3 * [price]$.
5. The **Client** shall, as soon as the Internet Service becomes operative, submit within seven (7) days the Personal Data Form from his account on the **Provider's** web page to the Client Relations Department of the **Provider**.

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Definition

A contract is a document which engages several parties in a transaction and stipulates their **obligations**, **rights**, and **prohibitions**, as well as **penalties** in case of contract violations.

Goal

- develop a notion of **component** model
- interface description by **deontic contracts**
- formal model for **e-contracts**
- formal semantics
- executable
- using **Creol** language

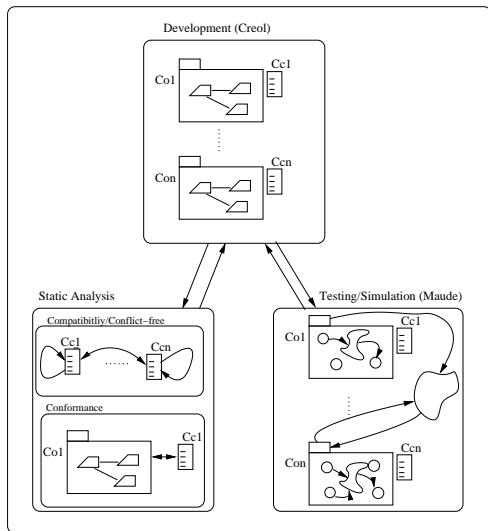
Creol: a concurrent object model

- executable oo modelling language **concurrent** objects
- formal semantics in **rewriting logics** /Maude
- strongly **typed**
- method invocations: synchronous or **asynchronous**
- recently: concurrent objects by (first-class) futures
- **dynamic reprogramming** : class definitions may *evolve at runtime*

Interfaces as types

- Object variables (pointers) are **typed by interfaces** (other variables are typed by data types)
- *Mutual dependency*: An interface may require a **cointerface**
 - Explicit keyword *caller*
 - Supports callbacks to the caller through the cointerface
 - Protocol-like behaviour
- Supports *strong typing*: no “method not understood” errors
- All object interaction is *controlled* by interfaces
 - *No explicit hiding* needed at the class level
 - Interfaces provide aspect-oriented specifications
 - A class may implement a number of interfaces

Contracts as behavioral interfaces



Contract specification language \mathcal{CL}

- formal specification language
- expressive enough to capture natural language contracts
 - contrary-to-duty (CTD)
 - contrary-to-permission (CTP)
- avoid certain paradoxes from deontic logic

A glimpse of \mathcal{CL}

$$\begin{aligned}
 \text{Contract} & := \mathcal{D} ; \mathcal{C} \\
 \mathcal{C} & := \phi \mid \mathcal{C}_O \mid \mathcal{C}_P \mid \mathcal{C}_F \mid \mathcal{C} \wedge \mathcal{C} \mid [\alpha]\mathcal{C} \mid \langle \alpha \rangle \mathcal{C} \mid \mathcal{C} \mathcal{U} \mathcal{C} \mid \bigcirc \mathcal{C} \mid \square \mathcal{C} \\
 \mathcal{C}_O & := \mathbf{O}(\alpha) \mid \mathcal{C}_O \oplus \mathcal{C}_O \\
 \mathcal{C}_P & := \mathbf{P}(\alpha) \mid \mathcal{C}_P \oplus \mathcal{C}_P \\
 \mathcal{C}_F & := \mathbf{F}(\delta) \mid \mathcal{C}_F \vee [\alpha]\mathcal{C}_F
 \end{aligned}$$

- formal modal logic, combining aspects of
 - temporal,
 - deontic (O, P, F), and
 - dynamic logics
- formal semantics by translation into μ -calculus C_μ variant
- model checking using nuSMV
- sophisticated action algebra

Conclusion & future work

- using Maude-engine for monitoring contracts
 - conformance checking
 - contracts-as-types
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- **FLACOS'07** – First Workshop on Formal Languages and Analysis of Contract-Oriented Software (in conjunction with NWPT'07): <http://www.ifi.uio.no/flacos07/>

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