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Manual for Using the UMC Model of the Finance Case Study

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Date of preparation: March 12, 2010 Revision: final Dissemination level: PU

Contract start date: September 1, 2005 Duration: 48 months Project coordinator: Martin Wirsing (LMU) Partners: LMU, UNITN, ULEICES, UWARSAW, DTU, PISA, DSIUF, UNIBO, ISTI, FFCUL, UEDIN, ATX, TILab, FAST, BUTE, S&N, LSS-Imperial, LSS-UCL, MIP, ATXT, CIR

Integrated Project funded by the European Community under the "Information Society Technologies" Programme (2002—2006)



Executive Summary

We show how to use a UMC model of the credit request scenario of SENSORIA's Finance case study, described in detail in [1], and verify properties formulated in the service-oriented temporal logic SocL.

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1 UMC

UMC [2, 3] is an on-the-fly model checker (its current prototype can be experimented via a web interface [5], which also includes a user guide [4]). UMC allows the efficient verification of SocL formulae over a set of communicating UML state machines. SocL [3] is an event- and state-based, branching-time, efficiently verifiable, parametric temporal logic that was specifically designed to capture peculiar aspects of services. UMC's web interface is depicted in Fig. 1.



Figure 1: UMC web interface.

1.1 Selecting a UMC model

By selecting "Model Definition ... " in the Commands Menu on the left, one obtains Fig. 2.



Figure 2: Selecting a model.

Subsequently clicking "Select one of the examples \dots " brings one to Fig. 3 (it might be necessary to use the scrollbar to select the UMC model 0-0-CreditPortal.umc).



Figure 3: Selecting an example model.

Clicking "Open Selected Example" leads to Fig. 4: the UMC model of the Credit Portal scenario of the Finance case study.

| UMC v3.6w | Class CreditRequest is Signals: abortProcess_return(callid); reply from PortalService acceptOffer_return(callid); reply from CreditManagementService approvalResult(callid,result;Token); reply from RotalService cancel(callid,ustomerData); seeive from PortalService cancel(callid,ustomerData); seeive from PortalService cancel(callid,ustomerData); seeive from PortalService checkUser_return(callid,result;Token); reply from CustomerManagementS clearData_return(callid,result;Data); send&receive from PortalService createMeWCreditRequest(callid,creditData); send&receive from Portal enterBalanceData_return(callid,result); reply from PortalService generateDeCline_return(callid,result); reply from PortalService generateDeCline_return(callid,result); reply from CreditManagementS getustomerdata_return(callid, result); reply from CreditManagementS initCreditData_return(callid, send&receive from PortalService initCreditData_return(callid, result); reply from CreditManagementS initCreditData_return(callid, send&receive from PortalService initCreditData_return(callid, reply from CreditManagementS updateSlanecReating_return(callid, reply from BotalService updateSecurityRating_return(callid); reply from SecurityService removeData_return(callid); reply from SecurityService removeData_return(callid); reply from CreditManagementService | ٥ | |
|-----------|--|---|---|
| | tau; Vars: Priority: int := 10; RANDOMOUEUE; | | × |

Figure 4: UMC model of Credit Portal.

Using the scrollbar on the right, one can inspect this UMC code.

1.2 Experimenting with a UMC model

To start experimenting the UMC model, one must select "Load Current Model" in the Commands Menu on the left, resulting in Fig. 5. This figure shows the model's classes and active objects, as well as its current (initial) configuration.

| UMC v3.6w | The System Classes are: Codiffequest Codiffequest |
|-----------|--|
| | UCIL . |
| | Check Explain The the Formula Result |

Figure 5: A loaded UMC model.

The latter can be inspected further by clicking "(show details \dots)", which results in Fig. 6 (using the scrollbar on the right details of variables, active states, event queues and possible evolutions of all active objects can be consulted).



Figure 6: A model's details.

Another possibility provided in Fig. 5 is to perform an evolution step by clicking on "C1 --> C2", which results in Fig. 7 (which can be 'repeated' in the obvious way to perform more evolution steps).

| UMC v3.6w | The System Classes are: Casdifikeness: CredifikanagementNersis (CustomsrManagementNersis) (CustomsrManagementService TheCalculatorService TheBalanceService BalanceService TheSecurityService:SecurityService TheCating TheCrediftManagementService TheBalanceService:BalanceService BalanceService TheSecurityService:SecurityService TheCating TheCrediftManagementService TheBalanceService:BalanceService BalanceService TheSecurityService:SecurityService TheCating TheCrediftManagementService TheBalanceService:BalanceService:BalanceService:Cating CrediftManagementService:Security |
|-----------|--|
| | UCTL true Check Explain The the Formula Result |

Figure 7: An evolution step.

Yet another possibility provided in Fig. 5 is to create a minimized abstract evolution graph of the model by clicking on "Minimize (FullTrace)".

2 Verification with UMC

By means of two examples, we show how to use UMC to verify SocL formulae over the model of the previous section (described in detail in [1]). More example properties that we have verified, inspired by the Patterns of service properties listed in [3], can be found in [1]. As a first example, let us verify that the CreditRequest service is *available*. To this aim, it suffices to verify the SocL formula

AF (accepting_requests(initialize)),

which means that in every state the CreditRequest service may eventually accept (the initialization of) a credit request. This is done by inserting this formula in the field labelled UCTL (of which SocL is a specialized version) on the lower side, which by default contains the formula true, and subsequently pushing the button "Check The Formula" on the lower right side. This results in Fig. 8, i.e. the above formula is TRUE. Note that a UMC model needs to be loaded before verifying properties, so the UCTL field only appears from Fig. 5 onward.

2.1 Interpreting a Counterexample

As a second example, we now repeat the above operations for the SocL formula

```
AF (accepting_requests(cancel)),
```

which results in Fig. 9, i.e. this formula is FALSE.

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| UMC v3.6w | The Formula: |
|----------------------|---|
| | AF accepting_requests(initialize) |
| - | is TRUE |
| Contraction of the | (states generated= 11, computations fragments generated= 23) |
| | |
| Commands Menu | |
| Edit Current Model | |
| Explore the Model | |
| | |
| | |
| | |
| Minimize (FullTrace) | |
| Welcome | |
| Quit | |
| | |
| | |
| | |
| | |
| | UCTL |
| | AF (accepting_requests(initialize)) Check Explain The the Formula Event |
| | |

Figure 8: Result (true) of a verification.

| | | _ |
|----------------------|---|---|
| UMC v3.6w | The Formula: | |
| | AF accepting_requests(cancel) | |
| | is FALSE | |
| CONSIGNATION OF | (state anomaly 61 computations for much accorded 118) | |
| | (states generated = 61, computations fragments generated = 118) | |
| | | |
| Commands Menu | | |
| New Model | | |
| Edit Current Model | | |
| Explore the Model | | |
| | | |
| | | |
| Minimize (FullTrace) | | |
| Welcome | | |
| Quit | | |
| ******** | | |
| 0 | | |
| | | |
| O | | |
| | | |
| | | |
| | | |
| | UCTL 4F (accepting requests(concel)) | |
| | (deepeng_equests(dates)) Check [Explain] The the | |
| | Formula Result | |
| | | |

Figure 9: Result (false) of a verification.

Pushing the button "Explain the Result" on the lower right side of Fig. 9 results in Fig. 10, displaying the counterexample produced by UMC. The node names are hyperlinks which, when followed, allow one to observe all details of that configuration. Furthermore, while abstract transition labels are always fully displayed on the right-hand side of the transitions, their corresponding underlying ground events (which are useful for understanding what exactly is happening in the ground model's evolutions) are shown as dynamic tooltips that appear when the cursor is moved over the "/*...*/" regions. Note that the explanation returned by UMC has the form of a (partial) proof, in the sense that not only the *witnessing* model fragment but also the subformulae holding in the various substates, are put in evidence; moreover, only what are considered the *useful* parts of the explanation are shown.

| UMC v3.6w | | |
|--|--|---|
| | The formula: | |
| | AF accepting_requests(cancel) | |
| | is FOUND_FALSE in State C1 | |
| Notice Charles | | |
| Contraction of the local division of the | This happens because | |
| | <u>C1</u> > C2{start(CreditRequest)} /* */ | |
| | <u>C2</u> > C3 /* */ | |
| | <u>C3</u> -> C4 /* */ | |
| Commands Menu | <u>C4</u> -> C5 /* */ | |
| New Model | <u>C5</u> -> C6{receive(TheClient,initialize)} /* */ | |
| Edit Current Medel | <u>C6</u> > C8{send(ThePortal, initialize), receive(ThePortal, initialize)} /* */ | |
| Edit Cuffeitt Model | C8 -> C9{start(Initialize)} /* */ | |
| Explore the Model | <u>C9</u> > C10 /* */ | |
| | $C10 \rightarrow C11 \{ send(TheCredit,initialize) \} /* */$ | |
| | CII> CI2{receive(TheCredit,checkUser)}/* */ | |
| | <u>C12</u> > C14{send(TheCustomerManagement,checkUser), receive(TheCustomerManagement,checkUser_return)} /* */ | |
| | C14> C55{send(1neCredit,checkUser_return)} /* */ | |
| Minimize (FullTrace) | $C55 \rightarrow C56$ [receive(1 net) reduction initialize_return) $1/2 \dots 2/2$ | |
| Welcome | $(53 - 5)$ (send) The Originatize_return), received interorial initialize_return) /**/ | |
| Ouit | $\Box J \rightarrow \Box A$ (send) (The Chern, initialize Teurin) / $A = A$ | |
| | $\Box = - \sum_{i=1}^{i} (i) (i) (i) (i) (i) (i) (i) (i) (i) (i)$ | |
| -##################################### | and the formula: | |
| | accentine volume. | |
| | is FOUND FALSE in State C61 | |
| 1200 | | |
| A Strategy | | |
| | | |
| | | |
| | | |
| | | |
| | | - |
| | UCTL | |
| | AF (accepting_requests(cancel)) Check Explain | |
| | The the | |
| | Formula Result | |
| | | |
| | | |

Figure 10: Counterexample of a formula.

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